# ALUMINUM INGOT MARKET 1959-1968

Thesis for the Degree of D. B. A.

MICHIGAN STATE UNIVERSITY

Emil Albert

1971

This is to certify that the

thesis entitled

ALUMINUM INGOT MARKET

1959-1968

presented by

EMIL ALBERT

has been accepted towards fulfillment
of the requirements for

D.B.A. degree in PRODUCTION

John H Hoagland
Major professor

Date April 30, 1971

O-7639

got

Cau

to

men

rel

the

ing

cau

shi

lev

ing

sal

con

ba

ABSTRACT

ALUMINUM INGOT MARKET
1959 - 1968

By

Emil Albert

The study examined fluctuations in the aluminum ingot market in the United States during the period 1959-1968. Causes of the fluctuations were identified, and the extent to which they effected purchasing, inventories, and shipments were analyzed. The study also provided information relative to the physical and economic characteristics of the market.

Direction for the study was provided by the following hypotheses. Hypothesis I: During the period 1959-1968, causes of fluctuations in aluminum ingot inventories and shipments were the result of other than changes in the level of demand for ingot. Hypothesis II: The aluminum ingot producers follow policies which lead to inverse stock-sale ratios of aluminum ingot at the producing firms.

Empirical data and historical evidence, used in conjunction with an aluminum industry model, provided a basis for the study.

deli

alum

mati

ship

was

mark

ment

tuat

thre

term

exhi

atic

betw

add

on

and

wer

The model developed the relations between total deliveries, shipments, production, and inventories in the aluminum ingot market. The empirical data provided information required to perform trend analyses of total deliveries, shipments, production, and inventories. Historical evidence was used to identify causes for the fluctuations in the market.

Results of the study indicated that the market segments were subjected to extensive fluctuations. These fluctuations resulted from year-end institutional factors, threats of interruptions in supply from labor contract terminations and wars, and price increases. Production exhibited a stable linear growth with only minor fluctuations. Inventories acted as a dependent variable link between deliveries and shipments, and production. Two additional elements which were discovered to have effects on the aluminum ingot market were the government stockpile and net of imports and exports.

Based on the results of the study, the hypotheses were accepted and the following conclusions were formulated.

1. Specific conditions in the aluminum ingot market cause extensive short range

fluctuations in the levels of deliveries and shipments of aluminum ingot. These conditions are identified above as year end inventory taxes, increased December shipments, threats of strikes and wars, and price increases.

2. The conditions causing short range fluctuations in the level of aluminum ingot deliveries and shipments are predictable, under various degrees of certainty. The lack of certainty results from the timing, magnitude and duration of the conditions identified above.
3. Aluminum ingot purchasers react to the uncertainty of conditions by overbuying material to hedge against threatened supply interruptions.
4. The most extensive fluctuations in the level of deliveries and shipments of aluminum ingot are those resulting from industry labor contract terminations.
5. Aluminum ingot inventories tend to follow an inverse stock-sales ratio. The inverse ratio results from deliberate policies of producers and users of aluminum ingot.

Emil Albert

6. A form of hedging used by aluminum ingot purchasers is to increase the level of imports of aluminum ingot during periods of threatened supply interruptions.

7. Labor contract negotiations have an adverse economic effect on both domestic aluminum ingot producers and the labor employed by domestic producers.

# ALUMINUM INGOT MARKET

# 1959-1968

By

Emil Albert

A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

DOCTOR OF BUSINESS ADMINISTRATION

Department of Management

1971

670325

many

the

off

and

of

fin

gui

to

Pro

ass

the

muc

co

al

## ACKNOWLEDGMENTS

This study would not have been possible without the many individuals who were so considerate in assisting during the course of the research. The information and guidance offered by the various members of the aluminum producing and using industry is greatly appreciated.

Professor John H. Hoagland, who served as Chairman of the dissertation committee and assisted in locating financial help, deserves a special thanks. His continued guidance provided the needed assistance to bring the study to a conclusion. Sincere appreciation is also extended to Professors John W. Bonge and Frank H. Mossman for their assistance and suggestions.

Financial support offered as a doctoral grant by the National Association of Purchasing Management provided much needed assistance in carrying out the research. The continued interest and assistance of this organization is also appreciated.

LIST

LIST

LIST

Chap

I

TABLE OF CONTENTS

Chapter | Page

Chap

Chap

VI

V

Chap

BIBL

APPE

LIST OF TABLES

| Table | | Page |
|---|---|---|
| 13 | Gross Deliveries and Shipments of Aluminum Ingot for Selected Months Affected by Price Changes, 1959-1968. . . . | 116 |
| 14 | Correlation of Expected and Actual Changes in Deliveries and Shipments of Aluminum Ingot for Selected Months Affected by Price Changes, 1959-1968. . . . | 119 |
| 15 | Summary of Absolute and Incremental Aluminum Ingot Capacity Changes, 1959-1968 . . . . . . . . . . . . . . . . . . | 127 |
| 16 | Fluctuations in the Level of Average Daily Aluminum Ingot Production Occurring in the Period 1959-1968 . . . . . . | 131 |
| 17 | Comparison of Average Daily Shipment Fluctuations and Inventory Changes Resulting From Aluminum Industry Labor Contract Negotiations . . . . . . . . . | 140 |
| 18 | Estimated Additional Primary Aluminum Imports Occurring During Labor Contract Negotiations . . . . . . . . . . . . | 144 |

## LIST OF FIGURES

App

LIST OF APPENDICES

the

per

fie

tor

Nec

co

of

th

by

ir

th

pl

th

v

# CHAPTER I

# INTRODUCTION AND HYPOTHESES

## Introduction

This study is undertaken to examine fluctuations in the aluminum ingot market in the United States during the period 1959-1968. Causes of the fluctuations will be identified and the extent to which they effect purchasing, inventories, and shipments will be analyzed.

### Need for the Study

One justification for this study rests with the contributions it can make toward confirmation or refutation of current business and economic theories, as reviewed in the following section. This contribution will be approached by developing the operating characteristics of the aluminum ingot market during the period 1959-1968 and then comparing these characteristics with existing theories. In this empirical approach, differences, if any, between actual and theoretical conditions, should provide insights into the validity of applying the theories to a specific market.

a be

buy

stu

stu

pur

sim

eff

rei

st

ta

pr

ca

s

a
S

I
E
I

A further justification for the study is to provide a better understanding of the aluminum ingot market for the buyers and sellers who participate in the market.

Currently, there is only a limited number of similar studies. One is the work of Rodney L. Boyes, who made a study of the timing and magnitude of fluctuations of steel purchases and inventories.[1] Another study of a somewhat similar nature was the work of Ruth Mack, who directed her efforts more toward consumer commodities.[2] Additional references are discussed in the following section.

## Review of Previous Literature

In order to provide background material for the study, an investigation of previous literature was undertaken. This investigation, while not exhaustive, does provide a background of previous major writings and indicates the change in emphasis through the years.

The findings varied from both an historical and subjective standpoint. Early studies were generally

---

[1]Rodney L. Boyes, "Fluctuations in Steel Purchases and Inventories 1953-1963", Unpublished DBA Thesis (Michigan State University, East Lansing, 1964).

[2]Ruth (Prince) Mack, Information, Expectations, and Inventory Fluctuations (New York: National Bureau of Economic Research; distributed by Columbia University Press, 1967).

di

a

th

Mc

er

fl

ca

ar

su

ch

I

t

c

n

F

f

(

I
(

directed toward consideration of inventories, in total, as a factor in business conditions. These general inventory theories were later modified to consider stock-sales ratios. More recent theories consider further aspects of the general area of inventories. This includes the elements of fluctuations, expectations, unfilled orders, backlogs, and capacity.

The results of the review of previous literature are summarized below. In this, the material is divided by subject matter. Within the subject matter it is reviewed chronologically.

Inventories - General

The consensus of writers seems to be that inventories have an important and aggravating effect on short cycle fluctuations in business activity, although there is no complete agreement as to the precise role.

Pre 1959 - In his early work John Maynard Keynes attributed fluctuations in inventories to miscalculations on the part of manufacturers.[3] The theories expressed in this classic

[3] John Maynard Keynes, The General Theory of Employment, Interest and Money (New York: Harcourt, Brace and Company), 1936, p. 332.

co

dur

tic

Abr

cha

Pos

re

Th

su

In

Fo

th

c

(
1

S
S

economic writing were the basis of many business decisions during the recession, war, and recovery years.

One conflict of ideas that developed was in relation to the timing of the inventory changes. Moses Abramovitz concluded that, with respect to timing, inventory changes would lag changes in output.[4]

Post 1959 - Revised theories were also developed with regard to the effect of inventories and inventory changes. This aggravating effect of inventory changes has been the subject of extensive research by Professor John H. Hoagland. In 1960, he stated the following:

> Large, violent fluctuations in inventories continue to occur. During the past twelve years the annual variations were greater in magnitude and volatility for the GNP category "changes in non-farm business inventories" than any other category, with the exception of federal expenditures.[5]

Following this, Thomas M. Stanback, Jr., developed the idea that inventory fluctuations were a leading indicator when considering elements of unfilled orders, availability of

---

[4] Moses Abramovitz, Inventories and Business Cycles (New York: National Bureau of Economic Research, Inc., 1950), p. 317.

[5] John H. Hoagland, Purchasing and Inventory Forecasting (A paper read before the Business and Economic Section of the American Statistical Association, Stanford University, August, 1960).

mat

hav

act

rep

And

in

re

us

ge

in

op

ar
Jo
Pr

Co

(

materials, and prices.[6]

Businessmen similarly realized that inventories have an aggravating effect on the level of business activity. Typical comments appeared in the Kaiser annual reports where the following comments were made:

> . . . customers' inventories were at reduced levels at year end; there is therefore reason to believe that even a modest improvement in the nation's metal-working industries during 1961 will result in increased aluminum shipments.[7]

And further, when commenting on lower prices and shipments in 1967: ". . . included a decline in aluminum shipments reflecting reduced demand . . . and inventory reduction by users of aluminum."[8]

This brief summary of theories, relating to the general aspect of inventories, serves to illustrate that inventories exist to provide insurance against interrupted operations and to protect against possible shortages of

---

[6]Thomas M. Stanback Jr., Inventory Fluctuations and Economic Stabilization. Annual Report Prepared for the Joint Economic Committee (Washington: U. S. Government Printing Office, 1961), p. 3.

[7]"Annual Report," Kaiser Aluminum and Chemical Corp. (Oakland: 1960).

[8]"Annual Report," Kaiser Industries Corp. (Oakland: 1967).

ma

St

ru

pa

ca

in

an

kn

th

he

sa

re

Un

th

ha

Pr

m

pa

Pr
1

materials.[9]

Stock-Sales Ratio

In addition to serving as protection against interruptions of supply, inventories also exist to meet anticipated future market demands. The amount of inventory carried to meet future market demand is reflected, at least in part, by a comparison of the amount of inventory on hand and the level of current sales. This comparison is widely known as a stock-sales ratio. The theory, in effect, says that if a businessman found a change in the level of sales, he would react by changing the level of inventories in the same direction.

A controversy, as illustrated below, has developed regarding the validity of this stock-sales ratio theory. Unfortunately, empirical data have failed to substantiate theories relating to the stock-sales ratio, rather they have served to point out discrepancies in the theory.

Pre 1959. Recognition of discrepancies has existed for a number of years, and attempts were made to explain them, in part, by reasoning such as that voiced by Abramovitz when

---

[9] J. H. Westing and I. V. Fine, Industrial Purchasing, 3rd edi. (New York: John Wiley & Sons, Inc., 1961), p. 263.

he

ca

pa

Cl

ne

ca

P

t

s

h

s

he wrote:

> It is also true that because inventories typically lag behind production and sales at cyclical turning points, an inverse movement in the stock-sales ratio is bound to occur over at least part of the cycle.[10]

Abramovitz in his studies, postulated that typically stock-sales ratios decline when production is expanding and vice versa.

Just prior to the time period of this study, Clarence L. Barber, in his study of inventories and business cycles, arrived at a different conclusion as to the cause of fluctuations in the stock-sales ratio. He stated:

> . . . Since major firms have adopted better methods of controlling inventories during recent decades, it seems likely that the inverse movement of the stock-sales ratio may be the result, in part at least, of deliberate policy.[11]

Post 1959. Dr. John H. Hoagland recognized for some time that businessmen do not attempt to maintain a constant stock-sales ratio. In 1960, he stated . . . "Moreover, it has been assumed frequently that a constant inventory to sales ratio is the target. This is not true in many times

---

[10]Abramovitz, *op. cit.*, pp. 144-45.

[11]Clarence L. Barber, *Inventories and the Business Cycle with Special Reference to Canada* (Toronto: The University of Toronto Press, 1958), p. 4.

of

rec

fa

bus

sa

mo

ex

co

In

t

s

b

t

a

of threatened shortages or excesses."[12] Finally, in her recent book, Ruth Mack concluded that statistical studies failed to show a stock-sales relation which indicated that businessmen were concerned with holding a constant stock-sales ratio. Rather, she reasoned that other factors were more significant in determining levels of stocks than the expected volume of sales.[13] Her conclusion was:

> . . . that a very substantial amount of the fluctuation in material stocks on hand and on order . . . appears to be influenced by variables other than changes in sales.[14]

The maintenance of a constant stock-sales ratio continues to be a controversial area.

<u>Inventory-Price Speculation</u>

The controversy regarding stock-sales ratios raises the question; given that fluctuations do occur in the stock-sales ratio and that businessmen may cause the fluctuations by deliberate policy; what would cause businessmen to change their inventory policy?

A possible reason why businessmen may take deliberate action to change inventory levels and hence, change the

---

[12] Hoagland, *op. cit.*

[13] Mack, *op. cit.*, p. 3.

[14] *Ibid.*, p. 9.

stock

a com

Pre I

inver

tory

the

by pr

impo

Engl

erat

effe

writ

spec

whic

make

Act

Ind

Inc

stock-sales ratio, is to speculate on the price changes of a commodity.

Pre 1959. As far back as the 1940's, Albert Hart considered inventory speculation. He observed that the level of inventory speculation becomes a function of the extent to which the increased cost of carrying the inventory can be offset by profits earned on the inventory during inflation.[15] An important consideration was also pointed out by Nathaniel Engle et. al. They brought out the use of internally generated funds to finance inventories in the short run.[16]

Barber also recognized the existence and possible effect of speculation. Barber states that, "Numerous writers have argued that, in periods of rising prices, speculative accumulations of stocks are likely to occur which will temporarily reinforce the price rise and may make a subsequent recession inevitable."[17] and,

> Finally, business firms may use their inventories as a method of earning speculative profits.

---

[15]Albert Gailord Hart, Money, Debt, and Economic Activity (New York: Prentice-Hall, 1948), p. 244.

[16]Nathaniel Howard Engle, et. al., Aluminum, An Industrial Marketing Appraisal (Chicago: Richard D. Irwin, Inc., 1945), p. 125.

[17]Barber, op. cit., p. 7.

Pos

to

cat

th

pr

ma

th

E

r

t

> When prices are expected to rise, business firms will have an incentive to build up their inventories in order to liquidate them at a profit .... How important this policy may be in causing an accumulation or liquidation of inventories cannot easily be determined.[18]

Post 1959. That inventory-price speculation exists appears to be acknowledged, although not always recommended, as indicated by Westing and Fine.[19]

Of a more recent nature is the study of Mack. In this study she reiterates that, "Expectations that materials prices will rise could be another reason for extending material ownership,"[20] but at the same time she cautioned that:

> Extension of stock on hand and on order predicated on an expected rise in prices occurs at increasing costs and this causes priced-timed ownership in any form to have ceiling levels.[21]

Expectations of Supply Interruptions

Just as inventory-price speculation has become recognized as a reason why businessmen may make adjustments to stock-sales ratios, the area of expectations of supply

---

[18] Ibid., p. 5.

[19] Westing and Fine, op. cit., p. 265.

[20] Mack, op. cit., p. 10.

[21] Ibid., p. 14.

int

Pre

pro

wri

sta

rup

cos

ra

Po

in

in

interruptions also has been recognized as a possible cause.

Pre 1959. One of the earlier authors who recognized the problem concerning short range expectations was Hart; writing in 1948 about union organizing in the 1930's, he stated: "Threatening users of commodities both with interruptions of supply through strikes and with higher labor costs, this organizing drive helped to motivate a very rapid increase of business inventories in 1936-1937."[22]

Post 1959. Hoagland, in 1960, also recognized that changes in expectations were a prime factor in causing changes in inventory levels. He wrote:

> . . . Vendor performance (a measure of lead-time) . . . influences inventory accumulations and liquidations. If slower vendor performance is expected or experienced, inventory safety targets are raised and purchase inventories are increased. . . . If vendor performance is faster, or is expected to be faster, the resulting tendency is to cause liquidation. . . . If sources of supply are to be shut off, purchasers, to keep production from being shut down, must either accumulate purchase inventories ahead of time, seek alternate sources of supply, or both.[23]

Patrick J. Robinson and Charles W. Faris indicated a recognition of the effect of expectations when they wrote,

---

[22]Hart, op. cit., p. 323.

[23]Hoagland, op. cit.

"Th

ima

sho

pi

He

pr

bi

ne

ne

La

re

"The threat of material or parts shortages, whether real or imagined, will have an impact on purchasing. Fears of shortages typically lead to forward buying and stockpiling."[24] George W. Aljian reinforced these conclusions. He wrote: "If the commodity under consideration is being produced by an industry fraught with frequent labor instability, then close attention to labor contracts and awareness of the possibility of interrupted work schedules are necessary in order to make sound forward buying decisions."[25] Lastly, Howard L. Timms expressed a similar conclusion relative to raw materials purchases. He stated:

> Work in process and raw material . . . normally are a function of end item production and bear a rather constant relationship to end item inventories expressed as a ratio. With this ratio applied to end item inventory level, the level of total inventory may be aggregated in dollars for the beginning and end of the coming fiscal year. An exception to this process would be raw material inventories. These are subject to shifts reflecting top management policy on price hedging or hedging against supply breakdowns. For instance, expectations of a strike next year at a supplier's plant would be hedged by shifting upward the ratio of the affected raw material to total needs as "exploded" from

---

[24] Patrick J. Robinson and Charles W. Faris, Industrial Buying and Creative Marketing (Boston: Allyn and Bacon, Inc., 1967), p. 120.

[25] George W. Aljian, ed., Purchasing Handbook (New York: McGraw-Hill Book Company, Inc., 1966), pp. 12-8.

to

whi

pro

tat

buy

in

fu

an

Un

o

b

f

the sales forecast.[26]

These writings indicate that there is an awareness to possible interruptions of the supply of a raw material which necessitate action, on the part of purchasers, to protect their operations from being shutdown. These expectations of problems led the writer to anticipate that overbuys and underbuys of material might occur. The possible increased purchasing activity leads to a need to consider further factors in procurement which are unfilled orders and backlogs at supplier plants.

Unfilled Orders and Backlogs

This review of previous literature only uncovered one early reference to the subject of unfilled orders and backlogs. This was made by Barber when he commented on the fact that the ease with which a firm can change inventories will depend on the time between orders and deliveries.[27]

Post 1959. Through the technique of "Monthly Change Indices" which were reported on by Hoagland in 1959,[28] the

---

[26]Howard L. Timms, The Production Function in Business, (Homewood: Richard D. Irwin, Inc., 1966), p. 475.

[27]Barber, op. cit., p. 6.

[28]John H. Hoagland, Monthly Change Indices and other New Measures of Business Fluctuations (Paper presented at the Business and Economical Statistical Section of the American Statistical Association: Washington D.C., December 29, 1959).

existe

and th

relati

mand l

orders

gener

Conve

effec

matic

order

recer

stat

inve

aver

cluc

ment

and

und

existence of wide fluctuations in levels of unfilled orders and the resulting effect on leadtime was illustrated. These relationships led Hoagland to conclude that increased demand led to increases in orders and backlogs (unfilled orders) which in turn led to increased leadtimes which generate increased orders and a continuation of the cycle. Conversely, decreases in demand would have the opposite effect. Moreover, business suffers from a lack of information relative to levels and rates of change of unfilled orders which further complicates the situation.[29] More recently, Mack also reached a similar conclusion when she stated, ". . . unfilled orders help to explain inventory investment."[30] "If delivery terms change, so will the average periods that orders are outstanding."[31] She concluded from specific studies ". . . that inventory investment is, roughly, equally influenced by unfilled orders and sales."[32]

It can be presumed that purchasing overbuys and underbuys act as a source of information by which a

---

[29]Hoagland, Purchasing and Inventory Forecasting.

[30]Mack, op. cit., p. 21.

[31]Ibid., p. 154.

[32]Ibid., p. 22.

manufa

busine

to est

levels

busine

Capaci

the s

study

of qu

the u

these

and r

of em

produ

rela

stat

plan

basi

phys

manufacturer may establish inventory levels and rates of business activity. At this point it does not appear possible to establish a specific degree to which varying purchasing levels, along with unfilled orders, affect inventories and business activity.

Capacity

The effect of the limitation of capacity has been the subject of numerous theoretical studies. One type of study that this has included is the quantitative approach of queuing theory. Another type of study has been through the use of models such as the work of Jay W. Forrester. In these cases the studies have been of a theoretical nature and not of an empirical nature. There appears to be a lack of empirical studies relative to the effect of capacity on production levels and inventories.

In her work, Mack was unable to locate any general relationship of the effect of capacity limitations. She stated ". . . the examination of the data available on plant capacity and its utilization fails to provide the basis for attributing the build-up of buying waves to physical capacity limitations."[33]

More specifically directed to the aluminum industry,

[33] Ibid., p. 11.

Engle

would

year

durin

Summa

effe

in F

gene

stoc

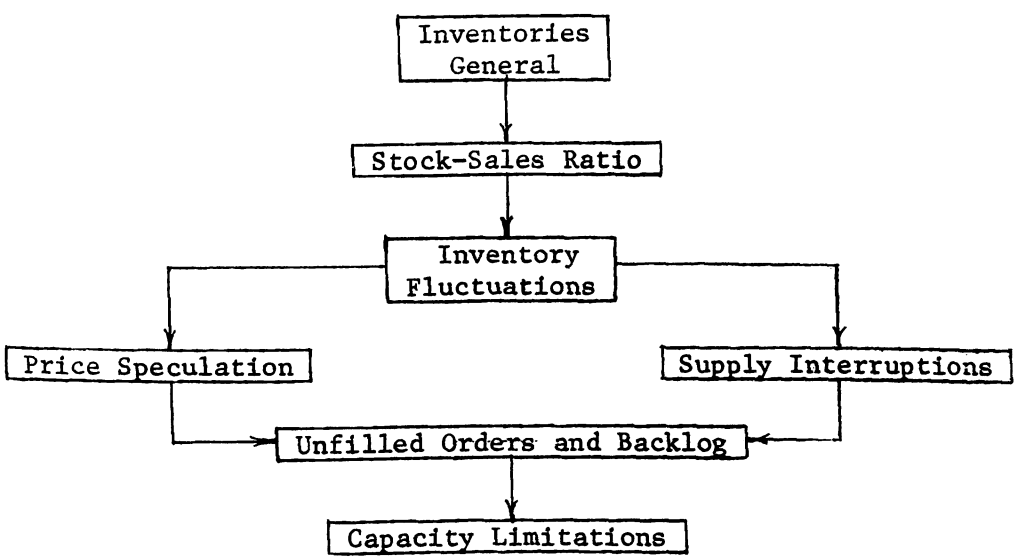
Engle suggests that there is the possibility that producers would produce for inventory during particular times of the year if power were unavailable at other particular times during the year.[34]

Summary

The development of ideas and theories regarding the effect of inventories on business conditions is summarized in Figure 1. This illustrates how early ideas regarding the general effect of inventories lead to consideration of the stock-sales ratio.

FIGURE 1

HISTORY OF THE DEVELOPMENT OF THEORIES OF PREVIOUS AUTHORS RELATIVE TO THE EFFECT OF INVENTORIES ON BUSINESS CONDITIONS




[34]Engle, *op. cit.*, p. 95.

sales

frequ

tions

to c

flec

inve

busi

mig

las

rat

ca

de

ch

th

i

a

t

In attempting to apply the idea of a constant stock-sales ratio, a number of writers discovered that fluctuations frequently occurred. At least two causes of these fluctuations were identified as price speculation and speculation to cover threatened supply interruptions.

Discovery of the area of speculation, which is reflected by purchasers in overbuys and underbuys, lead to an investigation of how unfilled orders and backlogs effect business conditions.

Lastly, consideration of how capacity limitations might effect business conditions has been studied. This last area has been approached mainly from a theoretical rather than an empirical nature.

## Hypotheses and Questions

The preceding review of previous literature indicates that there are variations in theories that have been developed to explain the causes of fluctuations in purchasing, inventories and shipments. This review also shows that in the last decade a substantial increase has occurred in the awareness of this area. Along with this increase in awareness has come a corresponding increase in the attempts to provide explanations for these fluctuations.

This study, with its objective to analyze the purch

ingot

ident

this

secu

in t

ide

lis

ing

tic

a c

wi

re

to

n

d

w

i

purchasing, inventory, and shipment segments of the aluminum ingot market, will attempt to add to existing knowledge by identifying causes of fluctuations in this same market. To this end, the following hypothesis is established.

> HYPOTHESIS I: During the period 1959-1968, causes of fluctuations in aluminum ingot inventories and shipments were the result of other than changes in the level of demand for ingot.

This hypothesis does not negate the importance of secular, seasonal and cyclical conditions which may exist in the aluminum ingot market. Rather, the objective is to identify conditions which occur in the market and to establish the significance of these conditions on the aluminum ingot market. Implied in the above hypothesis is the condition pointed out in the previous review of literature that a change in expectations of future availability of material will be reflected in purchasing activity which in turn will result in changes in order backlogs, shipments, and inventory levels.

A second area which also has been subjected to numerous studies and expansion of theories in the last decade is the question of stock-sales ratios. This study will also investigate this area in relation to the aluminum ingot market. To this end, the following hypothesis is estal

tion

mark

ing

cont

que

exa

k

l

t

established.

> HYPOTHESIS II: The aluminum ingot producers follow policies which lead to inverse stock-sales ratios of aluminum ingot at the producing firms.

The first hypothesis is concerned with identification and measurement of conditions in the aluminum ingot market. The second hypothesis is concerned with identifying specific actions of aluminum producers relative to the controversial area of stock-sales ratios.

In addition to evaluating these hypotheses, specific questions relative to the aluminum ingot market will be examined.

1. Do significant levels of correlation exist between the rate of supply of aluminum and the rate of consumption in automobile production?

2. Are imports or exports major factors in the domestic aluminum market?

3. What information is available concerning lead-times and backlogs in the aluminum market?

## Limitations of the Study

A series of restrictions were imposed in order to keep the study within manageable limits.

The first limitation involved the selection of 1959-1968 as the time period for the study. The reason that the study was not carried back to an earlier time per

the

alu

ket

1,

app

CON

Ye

19

19

19

19

19

period was because of the basic changes that occurred in the market prior to 1959.

The second limitation involved the selection of the aluminum ingot market portion of the overall aluminum market. From the standpoint of volume, as indicated in Table 1, this limitation restricts the study to the extent that approximately 70% of the ingot shipped during the period of

TABLE 1

COMPARISON OF INGOT SHIPMENTS TO TOTAL INDUSTRY SHIPMENTS, 1959-1968--Millions of pounds

| Year | Total Industry Shipments | Ingot Shipped to Independent Producers | Percent Ingot Shipped to Independent Producers |
|---|---|---|---|
| 1959 | 5,061.0 | 1,575.0 | 31.1 |
| 1960 | 4,732.5 | 1,608.6 | 34.0 |
| 1961 | 4,970.1 | 1,536.6 | 30.9 |
| 1962 | 5,772.5 | 1,858.6 | 32.2 |
| 1963 | 6,377.0 | 2,032.6 | 31.9 |
| 1964 | 7,171.3 | 2,228.6 | 31.1 |
| 1965 | 8,150.2 | 2,337.3 | 28.7 |
| 1966 | 9,031.6 | 2,340.1 | 25.9 |
| 1967 | 8,946.4 | 2,486.4 | 27.8 |
| 1968 | 10,087.1 | 2,784.8 | 27.6 |

Source: 1968 Aluminum Statistical Review, New York: The Aluminum Association, 1969, p. 17.

the
proc
pair
penc

the
era
to

Col
th
to

In
of
18

a
t
t

the study was shipped to captive operations of the ingot producers. However this limitation does not appear to impair the study because of the substantial number of independent producers in the market at this level.

The third limitation involved the restriction of the study to the domestic aluminum ingot market and consideration of imports and exports as modifications which occur to the domestic market.

## Organization of the Study

Chapter II entitled "Research Methodology and Collection of Data" reviews the sources of the data used in this study. In addition, estimates are included relative to the accuracy and credibility of the data.

Chapter III entitled "The History of the Aluminum Industry" summarizes the salient points in the development of the aluminum industry from its beginning in the early 1800's to the termination of the study (1968).

Chapter IV entitled "Structure of the Production and Consumption Segments of the Aluminum Industry" reviews the supply and demand elements of the industry from mining to final consumption.

Chapter V entitled "Current Aluminum Ingot Market Characteristics" combines the material of Chapters III and

IV i

Ship

mark

Inve

stoc

"Su

IV into specific assumptions for this study.

Chapter VI entitled "Aluminum Ingot Deliveries and Shipments: 1959-1968," is a trend analysis of the subject market.

Chapter VII entitled "Aluminum Ingot Production, Inventory and Import-Export Variables" sets out specific stock-sales ratio conditions and import-export effects.

Chapter VIII, the final chapter, is entitled "Summary and Conclusions."

dus

ill

mov

pro

inc

th

al

Fi

tu

b

a

c

m

# CHAPTER II

# RESEARCH METHODOLOGY AND COLLECTION OF DATA

## Introduction

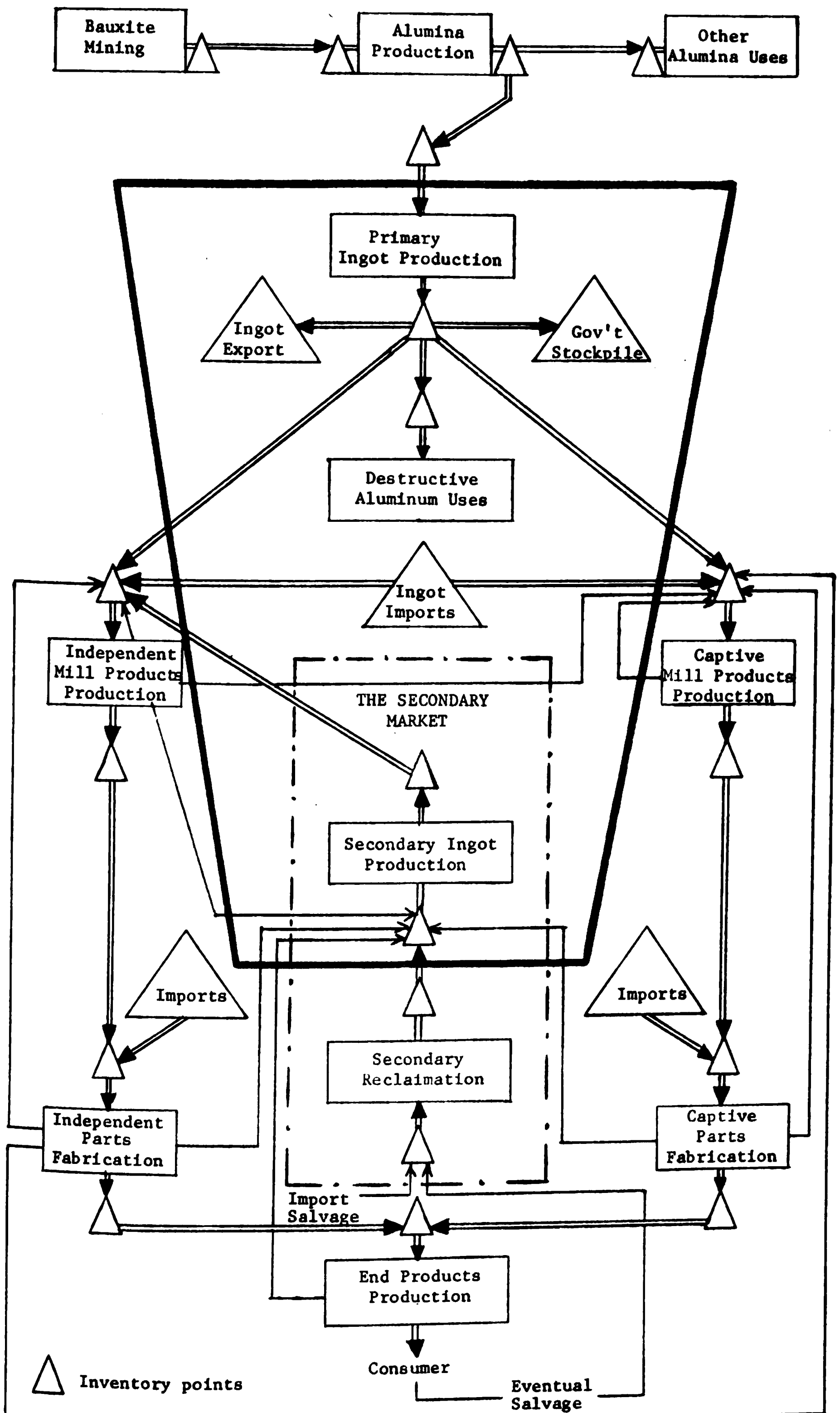
The flow of material in the over-all aluminum industry is depicted in the model in Figure 2. This model illustrates the various flows and stocks as the material moves from the mining operation, through the stages of the production segment, into the consumption segment. Also indicated in the model is the counter flow of material back through the salvage recovery stage. A history of how the aluminum industry developed into the physical flow model in Figure 2 is the subject of Chapter III. The current structure of the over-all model is described in Chapter IV.

A portion of the over-all model in Figure 2 has been extracted to form the area which will receive primary attention in this study. This portion, outlined in the central portion of Figure 2, is identified as the ingot market.

The research methodology of the study was selected

FIGURE 2

A PHYSICAL FLOW MODEL OF THE ALUMINUM PRODUCTION PROCUREMENT, INVENTORY, CONSUMPTION CYCLE



to p

flo

mat

rel

hyp

sel

mor

to provide an information flow coincident with the physical flow in the model. To meet this objective, specific information, as discussed below, was selected.

<u>Selection of Data Sources</u>

With the establishment of historical information relative to the aluminum industry and the formulation of hypotheses and questions, the research consisted of the selection of specific information sources to meet one or more of the following goals:

1. To establish the basic operating characteristics of the aluminum ingot producing industry.

2. To provide accurate and timely data to perform a time series analysis of aluminum ingot shipments.

3. To measure irregular conditions of a procurement, production, inventory, and shipment nature.

4. To provide a summary of possible historical causes of irregular conditions.

5. To provide a basis for establishing associations between the historical causes and the indicated conditions.

In addition to meeting one or more of the above criteria, it was necessary that the data also be available on a short time period basis so that long range data would not camouflage short range conditions. These guidelines led to the selection of sources to include: (1) monthly agg

(3)

dis

Mon

pro

and

alw

abo

st

mo

Bu

di

an

wi

ob

be

D
I

S
W

aggregate data, (2) a chronology of historical events, and (3) interviews and questionnaires. Each of these areas is discussed below.

Monthly Aggregate Data

The purpose of aggregate data in this study is to provide information relative to the magnitude of operations and fluctuations in the ingot producing segment of the aluminum industry as enumerated in goals 1, 2, and 3, cited above.

A majority of the aggregate data required for this study was taken from a single source. This source is a monthly publication of the U. S. Department of the Interior, Bureau of Mines, and is based on information submitted directly to the Bureau of Mines by the aluminum producers and others.[1] Data pertaining to stockpile deliveries and withdrawals are scanty, but those that were available were obtained from the Department of Commerce.[2] Lastly, as will be noted later and where required, additional data were

---

[1]"Metals Industry Survey Aluminum Monthly", (U. S. Dept. of Interior, Bureau of Mines, Washington, D. C.) Issued Monthly.

[2]U. S. Dept. of Commerce, Business and Defense Services Administration, Aluminum and Magnesium Division, Washington, D. C.

col

ver

ana

pro

cal

app

tra

Ch

ev

co

al

co

th

th

h

e

a

a

collected directly from industry sources.

Certain computational steps were necessary to convert the data into the proper units of measurement for analysis. The basic objectives of the computations were to properly reflect production and trading day factors. These calculations consisted of dividing monthly data by the appropriate number of days to convert data into tons per trading day or calendar day basis.

## Chronology of Significant Historical Events

The objective in collecting a record of historical events was to provide a source of information with which to compare fluctuations and conditions, which occurred in aluminum ingot production, inventories, and shipments. In collecting an historical record, the possibility existed that events would be prejudged, thereby creating a bias in the study results. In an attempt to prevent this from happening, data collection was sequenced so that first the events were recorded; second, the research was performed; and then the historical record was searched.

In searching published records, any event which appeared to have a direct or indirect relation to the aluminum industry was selected for inclusion. This resulted in an extensive chronological record based on information publ

Str

sel

dom

and

rel

mi

se

of

ma

I

f

t

r

published in Encyclopedia Britannica Yearbook, The Wall Street Journal, The American Metal Market, and other selected periodicals. Included in the chronology were domestic and international events of a political, business, and economical nature, along with technical events directly related to aluminum.

The complete chronological record became too voluminous to be made a part of the final research report. Consequently, only those events which ultimately proved to be of greatest significance are included in Appendix A, A Summary of Significant Historical Events, 1959-1968.

## Interviews and Questionnaires

Initial interviews were conducted to establish the feasibility of the study. These interviews with representatives of primary aluminum producers and trade associations representing various aspects of the aluminum industry consisted of preliminary evaluations of the subject matter of the study.[3]

Having established that the proposed study was in

[3]The aluminum ingot producing firms, who were contacted to participate in this study, are listed in Chapter III, Section, "The Current Structure of the Aluminum Ingot Producing Industry." All but one of the smaller of these firms participated in the study.

fact f
the co
supple
in an
ducing
from s
were
senta
cally
minim
from

tribu
tion,
has g
study

cal
was
will
pres
rent
for

fact feasible, further interviews were conducted throughout the course of the study to provide continuous guidance and supplemental information. The interviewees were selected in an attempt to gain substantial coverage of the ingot producing segment of the aluminum industry. Representatives from selected trade associations and governmental offices were also interviewed. The direct interviews, with a representative sample of domestic primary producers, were basically nondirected although an attempt was made to cover a minimum number of aspects. The interviews varied in length from approximately one to four hours.

Generally, the interviewees were willing to contribute their knowledge to assist in the study. In addition, they provided a wealth of information and data, which has greatly assisted in substantiating the results of this study.

Although the interviewees lacked accurate historical data concerning procurement and inventory levels, it was interesting to note that a substantial number were willing to accept the general theme of the hypotheses as presented. They also agreed that there was a need for current and accurate backlog, procurement, and inventory data for their use in business decisions.

Exl

tha

wei

sp

ti

st

me

Th

no

as

fo

me

el

s

t

i

b

r

l

v

A series of questions, as listed in Appendix B, Exhibit 1, served as a guideline for the direct interviews that were conducted. In those cases where the interviewees were not contacted directly, a letter was directed to a specific individual in those firms in which the same questions were asked. An additional part of the data gathering step included a telephone follow-up with those industry members who had not responded to the mail questionnaire. This step was taken so that the results of the study would not be biased by a failure to include all industry members as potential participants. This method of contact and follow-up resulted in the inclusion of all primary industry members, except one of the smaller ingot producers who elected not to participate in the study.

The information gathered in this portion of the study provided substantiating evidence to the parameters that were established concerning conditions existing in the industry during the period of the study, 1959-1968. The body of data collected is used in later chapters.

The aluminum ingot industry consists of only a small number of producers, and some members desired that they not be identified specifically. This resulted in situations where sources of information could not be specifically

identified. In order to protect the anonymity of the source, certain information has been identified only as an industry source.

## Collection of Data

Of basic importance to the study was a critical review of data collected to establish an estimated degree of accuracy. In the following subsections, the various elements of the data are discussed and estimated levels of accuracy are established.

### Monthly Production Capacity

Year end capacity figures indicating the available reduction capacity of primary producers are published by numerous sources including The Aluminum Association[4] and Minerals Yearbook.[5] In no case was monthly reduction capacity indicated. In addition to a lack of monthly reduction capacity data, a number of discrepancies were noted relative to year end capacity levels as published by various sources.[6] These discrepancies appeared to result

---

[4]The Aluminum Association, 420 Lexington Ave., New York 10017.

[5]Minerals Yearbook, (U. S. Dept. of the Interior Bureau of Mines, U. S. Government Printing Office, Washington, D. C., 1959 through 1968).

[6]Examples of specific discrepancies in data are cited in Appendix H.

from the fact that projected start up dates for new facilities were used rather than actual start up dates. Because of these shortcomings, a thorough search of the literature was undertaken to establish capacity figures based on the following criteria:

1. Existing primary capacity was included as long as it was in an operating plant and could be placed into operation during a normal start up cycle.

2. New capacity was included when substantiating evidence was located to indicate that the capacity was actually in operation.

Unfortunately, it was not possible to meet the second objective completely as all start up dates were not located in publications. In those cases where published information was not available, two alternatives were available to establish adjusted start up dates. These two alternatives included first of all an arbitrary selection of a start up at midyear of the year concerned, or second, direct contact with the producers to obtain start up information. In actuality, both alternatives were used. Industry sources were contacted and in numerous cases start up information was obtained to establish correct capacity information. This procedure provided information of all capacity increases of a major size. In those cases where the percent change in total capacity was of a minor size

to t

mary

mari

Prin

tai

men

mon

dom

6-1

wit

be

Sec

mo

ar

Mi

to

W.

size, an arbitrary selection of midyear was made. This led to the development of a month end production capacity summary. The overall results of this capacity study are summarized by plant, month, and year in Appendix C.

## Primary Production, Shipment, and Inventory Data

Monthly data relative to these three areas were obtained from monthly reports as published by the U. S. Department of Interior Bureau of Mines.[7] These data are based on monthly reports submitted to the Bureau of Mines by all domestic primary producers, on U. S. Government Form 6-1012-M. Because of the small number of producers along with complete industry coverage, these data are assumed to be accurate and are included here for reference in Appendix D.

## Secondary Production, Shipment, and Inventory Data

Data concerning these three areas are also published monthly by the Bureau of Mines.[8] The data, as published, are a combination of information obtained by the Bureau of Mines from two sources. First, data are submitted monthly to the Bureau of Mines by the ARSI.[9] This organization has

---

[7] Metals Industry Survey, Aluminum Monthly, op. cit.

[8] Ibid.

[9] Aluminum Smelters Research Institute, 20 North Wacker Drive, Chicago, Illinois.

as
ly
the
err
Bu
mi
ve
tw
li
d
n
t
c
s

as its membership, firms which account for approximately 70 per cent of the output of the secondary segment of the aluminum industry. The second source of data is Government Form 6-1114-MA, which is submitted directly to the Bureau of Mines by producers and users. This form is submitted monthly by invitation of the Bureau of Mines.

Secondary aluminum production, shipment, and inventory data suffers from probable inaccuracies in at least two areas. One problem area is that quite often only preliminary monthly data are published, and corrected final data are either not published until several months later or not published at all. The second problem area is the degree to which this segment of the industry is covered. Because of changing conditions in the market place, users are constantly shifting their demand between primary and secondary metal. When these shifts occur, the Bureau of Mines, in many instances, fails to request information from some of the users.[10] The net result of these problem areas is that these data must be adjudged inaccurate to an indeterminable degree. The data is included for reference in Appendix D.

---

[10]Interview Mr. McMahon, U. S. Dept. of the Interior, Bureau of Mines, Washington, D. C., January, 1970.

Import

mitted

Census

as to

due to

tion o

in App

Stockp

delive

prior

gated

finan

appro

durin

the s

As ye

by a

slig

offi

rela

Import and Export Data

Information relating to imports and exports is submitted to the Bureau of Mines by the U. S. Bureau of the Census. These data are considered substantially accurate as to quantities, but they do suffer somewhat as to timing due to lengthy periods between time of shipment and completion of all business transactions. The data are included in Appendix E.

Stockpile Data

An attempt to locate monthly data about stockpile deliveries and withdrawals was unsuccessful for the period prior to December, 1965, as government data had been relegated to the archives and resources were not adequate to finance a thorough search of these records.

Because of this limitation, it was necessary to approximate monthly data for deliveries to the stockpile during the period 1959 through 1963 and withdrawals from the stockpile for the period 1963 through November, 1965. As yearly data are available, this approximation was made by assuming a constant rate throughout a given year with slight adjustments so that year end inventories agree with official figures. The extent of this approximation is relatively minor for most of the years, as averages varied between

6920 to

deliver

pile co

operat

zation

produc

drawal

The ne

minor.

cent o

age wa

are i

are u

condi

cause

by co

---

Depa
Admi
D. C
sion
Wash

between a low of 2042 tons per month in 1963 to a high of 6920 tons per month in 1959. The greater portion of these deliveries was made by Harvey Aluminum to meet their stockpile contract commitments. Their reduction plant started operation in 1958, a time of relatively low capacity utilization, and consequently, a very limited market for a new producer. The balance of the data are actual monthly withdrawals as reported by General Services Administration.[11] The net effect of using monthly averages is relatively minor. In 1959, stockpile deliveries averaged under 5 per cent of monthly average production, while in 1963, the average was down to approximately 1 per cent. Stockpile data are included in Appendix E.

## Use of Data

Monthly data relative to deliveries and shipments are used in Chapter VI to determine what, if any, irregular conditions exist in the aluminum ingot market. Probable causes of these conditions are analyzed also in Chapter VI by comparing data with the Chronology of Significant

---

[11] Stockpile information obtained from the U. S. Department of Commerce, Business and Defense Services Administration, Aluminum and Magnesium Div., Washington, D. C., based on a report of the Stockpile Disposal Division, Metals Branch, General Services Administration, Washington, D. C.

Histori

and inv

flow of

product

Historical Events, 1959-1968. Export, import, production, and inventory data are used in Chapter VII to analyze the flow of aluminum ingot from all sources into the mill products stage.

the a

indus

Walla

to ex

vide

divi

beca

aler

Expe

(New

Ind

Ind
Pre

## CHAPTER III

# THE HISTORY OF THE ALUMINUM INDUSTRY

## Significant Historical Developments

The discovery of aluminum and the development of the aluminum industry is a classic study of a monopolistic industry. This has been well documented by Muller,[1] Wallace,[2] Peck[3] and others. In this study, the intent is to extract significant facts from that history which provide factors of importance to current industry conditions.

The history of the aluminum industry has been divided by the writer into five stages, each significant because of specific economic and business conditions prevalent at the time. These five stages are as follows: The Experimental and Discovery Stage, The Process Development

---

[1]Charlotte F. Muller, Light Metals Monopoly (New York: Columbia University Press, 1946).

[2]Donald H. Wallace, Market Control in the Aluminum Industry (Cambridge: Harvard University Press, 1937).

[3]Merton J. Peck, Competition in the Aluminum Industry, 1945-1958 (Cambridge: Harvard University Press, 1961).

Stage

final

The I

by s

the

incl

alum

Denm

ment

of a

alum

1854

alum

cou

pro

whe

cal

met

the

thi

Stage, The Monopoly Stage, The War Expansion Stage, and finally, The Diversification Stage.

## The Experimental and Discovery Stage

This period in the history of aluminum is dominated by scientists and inventors and their attempts to isolate the metal from its natural state. These early experimenters included Sir Humphrey Davy, who first produced an iron-aluminum alloy in 1809. Following Davy, H. C. Oerstadt of Denmark and Friedrich Wöhler of Germany conducted experiments in which they succeeded in producing minute quantities of aluminum in the laboratory.

The first commercially significant discovery of aluminum was made by Sainte-Claire Deville in France in 1854. His efforts led to the establishment of the chemical aluminum industry in France in 1855, and provided that country with an early lead as one of the major aluminum producing countries in the world.

Aluminum's high cost ($17.00 per pound in 1859) when produced by the chemical process in France, drastically limited its usage. Commercial exploitation of the metal awaited the discovery of an economic method to reduce the aluminum from its ore, bauxite. A method to accomplish this was discovered in February, 1886, by two men working indepe

Martin

same e

separa

covery

an imp

ore.

step w

econom

and Ba

use to

with s

for ra

<u>The P</u>

the f

1888.

and t

time

inter

two c

A.G.

independently, Paul L. T. Heroult in France and Charles Martin Hall in the United States. Both men developed the same electrolytic process by which the aluminum could be separated from aluminum oxide (alumina). A corollary discovery by Karl Joseph Bayer in 1888, in Germany, provided an improved process to extract alumina from the bauxite ore. This provided a raw material input to the reduction step which was chemically pure enough to be processed economically.

The significance of the discoveries of Hall, Heroult and Bayer is the fact that their discoveries are still in use today. This has provided the aluminum ingot industry with stability in the production process that is required for rapid growth.

## The Process Development Stage

Domestic exploitation of the Hall process began with the formation of the Pittsburgh Reduction Company (PRC) in 1888. This company was formed by an Alfred E. Hunt, Hall, and the banking interests of T. Mellon and Sons. At the time PRC was being formed in the United States, foreign interests of the Heroult patent were being considered by two companies, Pechiney in France and Aluminumindustrie A.G. (AIAG) in Switzerland.

Further c

undertaken by PRO

America (Alcoa) i

to consolidate mo

protection of the

addition to the l

by the Bradley p

with the Cowles

early competitor

during this peri

nical problems a

cess. Lastly, a

was provided by

ducing mill prod

producers would

efforts led to

sole aluminum p

In orde

fore final pate

Alcoa solidify

control of the

and electric p

purchasing exi

Further domestic developments in the industry were undertaken by PRC (changed to the Aluminum Company of America (Alcoa) in 1907). These developments allowed Alcoa to consolidate monopolistic control of production under the protection of the Hall patent which expired in 1906. In addition to the Hall patent, protection was provided Alcoa by the Bradley patent, which Alcoa acquired in a litigation with the Cowles Electric Smelting and Aluminum Company, an early competitor. Having the security of patent protection during this period, Alcoa was able to solve the many technical problems associated with the Hall electrolytic process. Lastly, an outlet for the metal was required. This was provided by Alcoa, who established a practice of producing mill products and end products whenever existing producers would not accept the challenge. These combined efforts led to the establishment of Alcoa as an integrated, sole aluminum producer in the United States.

In order to secure its position as a monopolist before final patent expiration in 1909, it was necessary that Alcoa solidify its production system by acquisition and control of the major factors of production, namely bauxite and electric power. Bauxite control was accomplished by purchasing existing producers in Georgia and the acquisition of 90 percent of A

control followed a

acquisition of a s

acquisition was fo

the St. Lawrence R

received and smal

was finally block

United States and

endeavor, Alcoa t

developed an exte

In additi

for production an

plant in East St.

as a highly integ

1909 recession, a

develop.

Internat

its Canadian sub

which was later

influence was ex

cartel formed in

---

4Muller

5Wallac

of 90 percent of Arkansas bauxite acreage by 1909.[4] Power control followed a similar pattern beginning with the acquisition of a site at Shawinigan Falls in Canada. This acquisition was followed by an attempt to control and dam the St. Lawrence River. Although state approval was received and small land parcels were acquired, this effort was finally blocked by joint action on the parts of the United States and Canadian governments. Failing in this endeavor, Alcoa turned to the Little Tennessee River and developed an extensive power system.[5]

In addition to gaining control of electric power for production and bauxite, Alcoa also erected an alumina plant in East St. Louis in 1902. This established Alcoa as a highly integrated firm when patents expired in the 1909 recession, an inopportune time for competition to develop.

International influence was exerted by Alcoa through its Canadian subsidiary, the Northern Aluminum Company, which was later changed to Aluminium Limited (Alcan). This influence was exerted by Alcan's membership in a world cartel formed in 1901 which included British, French, and

---

[4]Muller, op. cit., p. 40.

[5]Wallace, op. cit., pp. 25-26.

Swiss interests.

ment to control w

A complet

neither possible

nificant here is

influence over th

control of Alcan.

The Monopoly Sta

Between

was under the co

ly 50 per cent of

combined interes

as a separate Ca

by Alcoa through

industry is an e

Muller[7] and Wal

events pertinen

These events in

1. Alc
ric
Gui

---

[6]Mulle

[7]Ibid.

[8]Walla

Swiss interests. This cartel was an early official agreement to control world aluminum prices and production.[6]

A complete review of the world aluminum cartel is neither possible nor necessary at this point. What is significant here is that Alcoa was able to exert extensive influence over the world aluminum industry through its control of Alcan.

## The Monopoly Stage

Between 1909 and 1940 domestic aluminum production was under the control of Alcoa. Furthermore, approximately 50 per cent of the world production was controlled by the combined interests of Alcoa and Alcan which was established as a separate Canadian Corporation in 1928, but controlled by Alcoa through joint stock ownership. This period of the industry is an excellent monopolistic study documented by Muller[7] and Wallace.[8] From this history some significant events pertinent to current conditions have been extracted. These events include the following:

1. Alcoa's search for, and ultimate control of rich bauxite reserves in British and Dutch Guinea between 1912 and 1916. In acquiring

---

[6]Muller, <u>op. cit.</u>, pp. 103-04.

[7]*Ibid.*

[8]Wallace, *op. cit.*

these
the
Comp
star
Sout
cial
1915

2. The
1912
whic
year
infl
by A

3. The
by
own
Also
int
com

4. The
192
lis
alu
ind

5. The
192
alu
sol
du
194
by
th
Fa
pe

---

[9] Mulle

[10] Ibid

[11] Wall

these interests, Alcoa was able to overcome the competition of the Southern Aluminum Company, a French firm which attempted to start production in North Carolina. The Southern Aluminum Company failed for financial reasons and was purchased by Alcoa in 1915.

2. The extension of the world cartel in June, 1912,[9] and a further agreement in 1931, which extended cartel arrangements for 99 years.[10] In all of these, Alcoa exerted influence through the leading part played by Alcan.[11]

3. The control within Alcoa, which was exerted by the Mellon Bank of Pittsburgh because it owned approximately one third of the stock. Also, The Mellon Bank had other commercial interests by which it was able to discourage competition in aluminum.

4. The piston patent pool agreement of March 7, 1922, at which time Alcoa was able to establish herself as the primary supplier of aluminum used for pistons in the automotive industry.

5. The Alcoa-Dow Chemical Company agreement of 1927 in which Alcoa retained control over aluminum production and Dow emerged as the sole magnesium producer. This domestic production control was maintained by Dow until 1940. The marketing of magnesium was controlled by Dow, Alcoa and I. G. Farben. Dow marketed the magnesium direct while Alcoa and I. G. Farben marketed the magnesium through 50-per cent interest in each of the American

---

[9]Muller, op. cit., p. 105.

[10]Ibid., p. 35.

[11]Wallace, op. cit., p. 163.

Magn
Deve

Followin

prior to 1940,

This was achiev

tial competitio

(bauxite and po

development, an

taining high fi

against potenti

to provide suf

characteristic

occurring fact

Signs

began to appea

reduction capa

destroying the

defendent in a

which the fede

of monopolizin

---

[12] Mul

[13] Ibi

Magnesium Corporation and the Magnesium Development Corporation.[12]

Following the expiration of patents in 1909 and prior to 1940, Alcoa dominated world aluminum production. This was achieved through a policy of acquisition of potential competition, control of major factors of production (bauxite and power), aggressive marketing and product development, and finally, by restricting output and maintaining high firm prices. At the same time, as a deterrent against potential competition, over capacity was maintained to provide sufficient supply above existing demand. This characteristic of excess capacity has been a continually reoccurring factor in the aluminum industry.

Signs of change in world and domestic control first began to appear in 1933 as Germany started expansion of her reduction capacity in preparation for war, thereby largely destroying the 1931 cartel. Domestically, Alcoa was the defendent in a federal antitrust suit filed in 1937, in which the federal government contended that Alcoa was guilty of monopolizing the production of aluminum ingot.[13]

---

[12] Muller, _op. cit._, p. 194.

[13] _Ibid._, p. 11.

The War Expansio

World co

for additional a

Additions to thi

Reynolds Metals

construction on

Listerhill, Alab

1941, and was fo

Reynolds plant i

In 1941,

a need for a gre

war plane produc

plished through

and the construc

ration. These

ment money but

was operated by

production from

time production

Followi

plants became a

complicated by

the plants unti

The War Expansion Stage

World conditions in 1939 and 1940 signified the need for additional aluminum capacity in the United States. Additions to this capacity were started in 1940 when the Reynolds Metals Co., which was not part of Alcoa, began construction on its first aluminum reduction plant at Listerhill, Alabama. This plant began producing in May, 1941, and was followed shortly thereafter by a second Reynolds plant in Longview, Washington.

In 1941, the federal government finally recognized a need for a greatly expanded aluminum industry to meet war plane production schedules. This expansion was accomplished through private industry, namely Alcoa and Reynolds, and the construction of plants by the Defense Plant Corporation. These plants were constructed with federal government money but operated by private industry; all but one was operated by Alcoa. This expansion program increased production from 163,500 tons per year in 1939 to a peak war time production of 1,250,000 tons per year.

Following the war, disposal of the government owned plants became an item of major concern. The situation was complicated by the fact that Alcoa held leases to operate the plants until 1948. In addition, Alcoa held patents covering operati

further complica

was still pendir

the plants to Al

ultimate soluti

assembling of u

balance. In th

divided approxi

and Kaiser Alum

The gov

of reduction ca

government inte

to gain an unde

industry, it is

in the antitrus

original case

District Court

July 23, 1942;

was appealed b

of Appeals, si

[14]For

aluminum plant

Public Adminis

Harcourt Brace

covering operating methods in some of the plants. To further complicate the problem, the 1937 antitrust suit was still pending against Alcoa; consequently, disposal of the plants to Alcoa was considered to be illegal.[14] The ultimate solution to this complex situation was the disassembling of unprofitable plants and the disposal of the balance. In the late 1940's total domestic capacity was divided approximately as follows: Alcoa 50%, Reynolds 30%, and Kaiser Aluminum and Chemical Corporation, 20%.

The government program of construction and disposal of reduction capacity was only one of many incidents of government intervention in the aluminum industry. In order to gain an understanding of the structure of the aluminum industry, it is necessary to briefly review the major events in the antitrust suit started against Alcoa in 1937. The original case was decided by Judge Caffey of the Federal District Court for the Southern District of New York on July 23, 1942; Alcoa was absolved of all charges. The case was appealed by the Justice Department; and the U. S. Court of Appeals, sitting in lieu of the Supreme Court, found

---

[14]For a comprehensive coverage of the disposal of aluminum plants following World War II, see Harold Stein, Public Administration and Policy Development (New York: Harcourt Brace & Co., 1952), pp. 315-360.

Alcoa guilty of

and recommended

written by Judge

tion of Alcoa o

position of the

pleted. The U.

on April 23, 19

but allowing th

tute further pr

ingot market if

given the right

cient competiti

Further

1950, when Judg

longer monopol

conditions, di

Knox stipulate

of Alcoa and A

other.[15] Fina

bringing to an

Furthe

---

15Char
(New York: Ri

Alcoa guilty of monopolizing the ingot market as of 1940 and recommended dissolution of Alcoa. In the opinion written by Judge Learned Hand, a ruling relative to dissolution of Alcoa on the monopoly count was forbidden until disposition of the government owned aluminum plants was completed. The U. S. District Court entered the final judgment on April 23, 1946, without requiring dissolution of Alcoa but allowing the U. S. Attorney General the right to institute further proceedings on the grounds of monopolizing the ingot market if an indicated need arose. Alcoa was also given the right to petition the court for relief if sufficient competition developed.

Further consideration in the case came on June 2, 1950, when Judge Knox filed his opinion that Alcoa no longer monopolized the ingot market, and under the existing conditions, dissolution was not necessary. However, Judge Knox stipulated in his decision that major stockholders of Alcoa and Alcan must divest their interest in one or the other.[15] Final litigation came about in June, 1957, thus bringing to an end a case begun in 1937.

Further government intervention came about with the

---

[15]Charles C. Carr, Alcoa, An American Enterprise (New York: Rinehart & Company, Inc., 1952), pp. 217-236.

establishment o

purpose of this

material in cas

was to serve as

duced business

arrangement whe

were allowed to

encouragement t

The fou

occurred in the

Mobilization in

existing produc

in the programs

two main featu

1. An
ca

2. Re
ne
so

This entire pr

of 446,217, an

tively. The f

---

[16]Phil
Profile of an
p. 27.

establishment of the aluminum stockpile program. The avowed purpose of this program was to provide a supply of critical material in case of a national emergency. In addition, it was to serve as a source of demand during periods of reduced business activity. This was accomplished by an arrangement wherein new entrants to the aluminum industry were allowed to sell metal to the federal government as an encouragement to enter business.[16]

The fourth major incident of government intervention occurred in the fall of 1950 when the Office of Defense Mobilization initiated a series of expansion programs. All existing producers and some potential entrants participated in the programs designed to increase ingot capacity. The two main features of the program were the following:

1. An accelerated five year amortization certificate covering 85% of the cost of the facilities.
2. Requirement of the government to purchase from new plants all ingot output which could not be sold commercially.

This entire program consisted of three rounds of increments of 446,217, and 214 thousand tons of annual capacity respectively. The first two rounds were completed, but nothing

---

[16]Philip Farin & Gary G. Reibsamen, Aluminum--Profile of an Industry (New York: McGraw-Hill Inc., 1969), p. 27.

of the last rour

sion program was

In addi

capacity that w

there are at le

to inventory po

aluminum indust

tinued threat c

industry operat

and into the fc

threat has beer

both domestical

and possible o

been the devel

By developing

effect, a brok

buy metal when

demand exceede

economic tool

supply, and pr

program was d

---

[17]Pec

of the last round was under construction when this expansion program was closed in September, 1955.[17]

In addition to the tremendously large increase in capacity that was built during this stage of the industry, there are at least two other factors which are significant to inventory policies and procurement practices in the aluminum industry. The first of these factors is the continued threat of antitrust action which has hung over the industry operation, particularly Alcoa, during this stage and into the following stage. The effect of this apparent threat has been to throttle possible competitive action both domestically and internationally on the part of Alcoa and possible other industry members. The second factor has been the development of the government stockpile program. By developing the stockpile, the government has become, in effect, a broker in aluminum; it has been in a position to buy metal when the demand was down and to sell metal when demand exceeded supply. This stockpile became an effective economic tool for use in combating fluctuations in demand, supply, and price. This effective use of the stockpiling program was demonstrated in 1965; an event which will be

---

[17]Peck, op. cit., pp. 148-150.

discussed later

The Expansion a

The sel

current stage o

no clearly defi

posed to what l

date is predica

1. Ca
th

2. Al
de
la

3. An
Ju
ac
wh
in
in
ti
lo

Establ

current stage

ing point for

[18]Joh
Harry A. Youn
1965: Its Ef
(Unpublished
of Business,

discussed later.[18]

## The Expansion and Diversification Stage

The selection of 1959 as the starting point of the current stage of the aluminum industry is arbitrary in that no clearly defined incident occurred at that time, as opposed to what happened in 1940. However, selection of this date is predicated on the following facts:

1. Capacity expansion brought about largely through government programs had been completed.

2. Although some shipments were made after 1958, deliveries to the government stockpile were largely completed by this time.

3. Antitrust action against Alcoa was ended in June, 1957. In this decision, the court accepted the Alcoa-Alcan divesture plan in which major stockholders gave up their holdings in one or the other firm. Also, the industry was adjudged sufficiently competitive so that dissolution of Alcoa was no longer considered necessary.

Establishment of 1959 as the starting point of the current stage of the aluminum industry provides the starting point for this study to be detailed in later chapters.

---

[18] John A. Haas, Avner M. Porat, Andre H. K. Tan, Harry A. Young, "The Aluminum Price Crisis of November 1965: Its Effect on Business-Government Relations," (Unpublished Report), (Pittsburgh, Pa.: Graduate School of Business, University of Pittsburgh), n.d.

A

At the

ing primary me

discussion bri

ownership of t

of December 31

Aluminum Compa

Alcoa

eight primary

| Location |
| --- |
| Alcoa, Tenness |
| Badin, No. Car |
| Evansville, In |
| Massena, New Y |
| Point Comfort, |
| Rockdale, Texa |
| Vancouver, Was |
| Wenatchee, Was |

Anaconda Alumi

Anaco

conda Company

1955 with the

facility at C

## The Current Structure of the Aluminum Ingot Producing Industry

At the end of 1968, there were eight firms producing primary metal within the United States. The following discussion briefly summarizes the capacity, location and ownership of these producers. The capacity reported is as of December 31, 1968.

### Aluminum Company of America

Alcoa is a publicly held firm and has the following eight primary producing sites:

| Location | Capacity | | Date Production Started |
|---|---|---|---|
| Alcoa, Tennessee | 125,000 | Tons/year | Prior to 1959 |
| Badin, No. Carolina | 100,000 | " | " |
| Evansville, Indiana | 175,000 | " | July, 1960 |
| Massena, New York | 127,000 | " | Prior to 1959 |
| Point Comfort, Texas | 175,000 | " | " |
| Rockdale, Texas | 220,000 | " | " |
| Vancouver, Washington | 100,000 | " | " |
| Wenatchee, Washington | 175,000 | " | " |

### Anaconda Aluminum Company

Anaconda is a wholly owned subsidiary of the Anaconda Company. The firm entered the aluminum business in 1955 with the construction of a 175,000 tons per year facility at Columbia Falls, Montana.

The Consolidat

Conalc

Aluminum Limit

with a 140,000

Tennessee.

Harvey Aluminu

Harvey

tion facility

in 1958. The

Intalco Alumin

Intalc

dale, Washingt

per year in 1

three other c

Ameri
Howme
Pechi

Intalco does

all productio

Kaiser Alumin

Kaise

subsidiary of

## The Consolidated Aluminum Corporation

Conalco is a wholly owned subsidiary of Swiss Aluminum Limited. Primary production was started in 1963 with a 140,000 ton per year facility at New Johnsonville, Tennessee.

## Harvey Aluminum, Incorporated

Harvey is a public corporation with a single reduction facility at The Dalles, Oregon which started production in 1958. The capacity is 91,000 tons per year.

## Intalco Aluminum Corporation

Intalco started a single reduction facility in Ferndale, Washington with a reduction capacity of 228,000 tons per year in 1966. Intalco is a cooperative venture of three other corporations:

| | Ownership |
|---|---|
| American Metal Climax | 50% |
| Howmet Corporation | 25% |
| Pechiney Enterprises (France) | 25% |

Intalco does not sell metal on the open market, but ships all production to the three owners.

## Kaiser Aluminum and Chemical Corporation

Kaiser is a publicly held corporation formed as a subsidiary of Kaiser Industries. Initial production was started in faci

War II. Since

as follows:

Location

Chalmette, Lou
Mead, Washingt
Ravenswood, We
Tacoma, Washin

Ormet Corporat

Ormet

owned by Olin

by Revere Copp

tons per year

facility at Ha

Reynolds Metal

Reyno

reduction of a

Current reduct

locations:

started in facilities built by the government during World War II. Since then reduction capacity has been developed as follows:

| Location | Capacity | Date Production Started |
|---|---|---|
| Chalmette, Louisiana | 257,000 Tons/year | Prior to 1959 |
| Mead, Washington | 213,000 " | " |
| Ravenswood, West Virginia | 159,000 " | " |
| Tacoma, Washington | 61,000 " | " |

Ormet Corporation

Ormet is an affiliate, 50 per cent of which is owned by Olin Mathieson Chemical Corporation and 50 per cent by Revere Copper & Brass. Production capacity of 240,000 tons per year started in 1958, and is consolidated in one facility at Hannibal, Ohio.

Reynolds Metals Company

Reynolds was the first firm to start domestic reduction of aluminum outside of the Alcoa organization. Current reduction is carried on at the following seven locations:

Location

Arkadelphia, A
Corpus Christi
Jones Mills, A
Longview, Wash
Massena, New Y
Sheffield, Ala
Troutdale, Ore

As pre
above are base
capacity at th
these figures
facility start
ization progra
ductive capaci
capacity on a

The ov
includes the
fabricators,
scrap for use
have become a
the total vol
quality of pr
proximates th

| Location | Capacity | Date Production Started |
|---|---|---|
| Arkadelphia, Arkansas | 63,000 Tons/year | Prior to 1959 |
| Corpus Christi, Texas | 111,000 " | " |
| Jones Mills, Arkansas | 122,000 " | " |
| Longview, Washington | 150,000 " | " |
| Massena, New York | 128,000 " | July, 1959 |
| Sheffield, Alabama | 221,000 " | Prior to 1959 |
| Troutdale, Oregon | 100,000 " | " |

As previously noted, the capacity figures listed above are based on available information and are the rated capacity at the end of 1968. In practically all cases, these figures exceed the potential capacity at the time the facility started in production since enlargement and modernization programs are constantly being undertaken. (The productive capacity per facility and total domestic industry capacity on a monthly basis is summarized in Appendix C.)

## Secondary Producers

The overall organization of the secondary producers includes the large secondary smelters and the non-integrated fabricators, in addition to dealers and brokers who gather scrap for use by the secondary producers. These producers have become a much greater factor in the overall industry as the total volume of scrap has grown. Furthermore, the quality of product of the secondary producers closely approximates the quality of product of the primary producers, thereby making

mary metal.

The re

to enlarge cap

easy to enter

producers and

tions where it

lish accurate

As a general o

shortage of ca

supply.[19]

The ch

industry previ

whereby forei

in the U. S.

come about th

panies; Alcan

type of forei

pand as long

balance and c

---

[19]Far

thereby making secondary metal a close substitute for primary metal.

The relatively low investment cost and the ability to enlarge capacity inexpensively makes it comparatively easy to enter production. This fact of a large number of producers and numerous small operations establishes conditions where it is beyond the scope of this study to establish accurate capacity figures for the secondary industry. As a general observation, it does not appear that any shortage of capacity has or will effect this source of supply.[19]

## Foreign Sources

The changing structure of the international aluminum industry previously discussed, has developed the trend whereby foreign producers are becoming a greater influence in the U. S. domestic market. Part of this influence has come about through an expansion of imports by old line companies; Alcan being the one of greatest importance. This type of foreign influence will undoubtedly continue to expand as long as the foreign sources have a net supply balance and can import metal into the United States at a

[19] Farin, *op. cit.*, p. 34-47.

profit. A prim
again Alcan, wh
metal it produc
by foreign prod
cussed in detai
element has bee
consisting of t
ducers to the e
and transportat

This sc
with metal prod
Conalco, Intal
these firms ar
physical stand

profit. A prime example of a firm in this category is again Alcan, which exports approximately 75 per cent of the metal it produces. The volume and effects of metal supplied by foreign producers to the domestic market will be discussed in detail later. The net effect of this international element has been to open up a substantial source of material consisting of the excess capacity of numerous foreign producers to the extent that is allowed under present economic and transportation barriers.

This source of foreign supply should not be confused with metal produced domestically by foreign firms such as Conalco, Intalco, and others being contemplated. Although these firms are the result of foreign investments, from a physical standpoint, they are considered domestic producers.

STRUCT

I

dustry wi

two secti

segment.

ated to p

the alumi

T

aluminum

serve to

productio

the form

ations re

ber of ma

S

degrees o

productio

CHAPTER IV

# STRUCTURE OF THE PRODUCTION AND CONSUMPTION SEGMENTS OF THE ALUMINUM INDUSTRY

## Introduction

In this chapter, the structure of the aluminum industry will be reviewed. This review will be divided into two sections, the production segment and the consumption segment. Within these two segments, details will be enumerated to provide an introduction to the current structure of the aluminum industry.

The objectives in providing this review of the aluminum industry are twofold. First, the discussion should serve to illustrate the complexity that exists in both the production and consumption segments. This complexity is in the form of a relatively large number of production operations required to produce usable products and diverse number of market areas where the metal is used.

Second, the discussion should also illustrate the degrees of stability that prevail in the industry. From the production standpoint, a high degree of stability exists in the basic

usable pr

cessing

used to

butes of

ment are

num in t

later se

general

the proc

steps.

reviewe

process

Product

be subd

those s

pure al

parts f

and fi

the basic processing by which the ore is transformed into usable products. At the same time these stable, basic processing techniques are highly versatile in that they can be used to produce a variety of end products. These attributes of stability and versatility of the production segment are compatible with the diverse applications of aluminum in the consumption segment as will be illustrated in a later section in this chapter.

## The Production Segment

The basic purpose of this section is to provide a general understanding of the production steps through which the product flows and the degree of difficulty of those steps. In addition, the industry cost structure will be reviewed, locational factors analyzed, and the limiting processing operation will be defined.

### Production Stages

The production segment of the aluminum industry can be subdivided into five areas. These areas include: first, those steps required to mine, refine, and reduce the ore to pure aluminum; second, the mill products stage; third, the parts fabrication stage; fourth, the end products stage; and fifth, the salvage recovery stage.

N

third mos

can be fo

varying s

gibbsite

domestic

aluminum

portant

tropical

of the l

process.

the ore

then was

for the

is the f

quate do

in the S

current

domestic

producti

sents a

Mining. Aluminum, in its natural state, is the third most abundant element in the world. Its ore, bauxite, can be found in various parts of the world in deposits of varying sizes and quality. Currently, only two ores, gibbsite and boehmite, are rich enough to warrant processing domestically. These two ores yield 16 to 25 per cent of pure aluminum and in addition are of low silica content, an important factor in the processing of the ore.

Most ores are found at, or near, the surface in tropical and subtropical areas; consequently, mining is one of the lesser important steps in the over-all production process. The mining process consists merely of removing the ore with power equipment, crushing it into uniform size, then washing and drying it. At this point the ore is ready for the next processing operation.

A basic problem of the domestic aluminum industry is the fact that the United States does not have an adequate domestic reserve of bauxite. Original discoveries in the Southeastern United States have been depleted and current reserves in Arkansas are limited. This means that domestic producers must be dependent on imports to maintain production. This factor is of importance because it presents a cost problem, a continuity of supply problem, and finally, a n

Cur

bauxite fro

Australia,

are under t

are integra

tries into

their requi

purchase ag

include Ana

<u>Alu</u>

bauxite is

operations

ties in th

cess (deve

which the

to produce

and driers

step requi

one-quarte

eighth pou

alumina.[1]

---

[1]P
of an Indu

finally, a national defense problem.

Currently, the various domestic producers receive bauxite from Surinam, Dominican Republic, Jamaica, Guinea, Australia, Guyana, and Haiti. In some cases these sources are under the direct control of the primary producers who are integrated back to the mines. Some of the newer entries into the primary aluminum stage currently procure their requirements from the older prime producers under purchase agreements. The producers, who purchase bauxite, include Anaconda, Conalco, Intalco, and Ormet.

Alumina Refining. The second step in refining the bauxite is a series of chemical, mechanical, and thermal operations designed to separate the alumina from the impurities in the bauxite. This is accomplished by the Bayer Process (developed by Karl Joseph Bayer in Germany in 1888) in which the bauxite, coal, fuel oil, soda, and lime are used to produce the alumina through a series of tanks, filters, and driers. The mixture of ingredients in this production step requires four pounds of bauxite, one-half pound coal, one-quarter pound fuel oil, one-half pound soda, and one-eighth pound lime all combined to produce two pounds of alumina.[1]

---

[1]Philip Farin & Gary G. Reibsamen, Aluminum-Profile of an Industry, (New York: McGraw-Hill Inc., 1969), p. 20.

As in

is operated as

ducers. As o

United States

by Kaiser, an

sumed in the

this situatio

established c

foreign sourc

structed, in S

Jamaica.[2]

Reduc

in use today

process disc

alumina, six-

pound cryoli

six to eight

pound of alu

The

lined tank i

cryolite bat

---

[2] Ibi

[3] Ibi

As in bauxite production, most alumina production is operated as a captive step by the primary aluminum producers. As of 1968, there were eight alumina plants in the United States; three owned by Alcoa, two by Reynolds, two by Kaiser, and one by Ormet. Most alumina currently consumed in the United States is produced domestically, but this situation is changing as alumina operations are being established closer to the bauxite sources. Currently, foreign sources for alumina are operating, or are being constructed, in Surinam, Virgin Islands, Australia, and Jamaica.[2]

Reduction. As previously noted, the basic process in use today to produce pure aluminum is the Hall-Heroult process discovered in 1886. In this process two pounds alumina, six-tenth pound baked carbon, three-hundredth pound cryolite, four-hundredth pound aluminum fluoride, and six to eight Kwh of electricity are combined to produce one pound of aluminum.[3]

The reduction process is accomplished in a carbon lined tank into which the alumina is dissolved in the cryolite bath by the heat generated in the electrolysis.

---

[2] Ibid., p. 25.

[3] Ibid., p. 20.

The carbo

DC curren

Periodica

cast into

M

in the re

for use i

forms inc

ingot, fo

insulated

in this f

can be fu

Table 2 i

producers

T

are signi

cators, a

with a fe

metal. T

the cycle

and gener

I

fabricati

The carbon is used in the form of anodes and is consumed as DC current is applied to separate the aluminum and oxygen. Periodically, the aluminum is then tapped from the tank and cast into ingot.

Mill Products. After the pure aluminum is produced in the reduction stage, it is cast into a variety of forms for use in either captive or independent operations. These forms include unalloyed ingot, extrusion billet, rolling ingot, forging ingot, casting ingot, hot metal (shipped in insulated ladles), and, finally, shot and notch bar. Once in this form, the metal is in a mechanical state where it can be further processed into various mill products. Table 2 indicates the input-output, and the number of 1968 producers of various types of mill products.

Two factors in this stage of the production cycle are significant. First, there are approximately 3300 fabricators, and second, this is an intermediate stage, which, with a few minor exceptions, only changes the form of the metal. These factors create additional inventory points in the cycle, add to the volume of material to be transported, and generate a large volume of salvage to be reprocessed.

Parts Fabrication and End Products Manufacture. The fabrication of parts and manufacture of end products are not

| Product Ou |
| --- |
| From Reduc |
| Stage |
| Unalloyed |
| Extrusion |
| Rolling In |
| Forging In |
| Casting In |
| Hot Metal |
| Shot & No |

a

Dept. of

istration

b

by the fa

product a

more than

more than

c

plants or

contract

is includ

homogeneo

by captiv

TABLE 2

ALUMINUM MILL PRODUCTS PRODUCERS, 1968

| Product Output From Reduction Stage | Input to: | Mill Product Output | Number[a] Producers 1968 |
|---|---|---|---|
| Unalloyed Ingot | Independent Extruders w/cast houses | Extrusions | -- |
| Extrusion Ingot | Extruders | Extrusions | 177 |
| Rolling Ingot | Sheet & Rod Mills | Wire, sheet plate, foil | 100[b] |
| Forging Ingot | Forge Shops | Forgings | 52 |
| Casting Ingot | Foundries | Castings | 2771 |
| Hot Metal | Auto Foundries C | Castings | --[c] |
| Shot & Notch Bar | Steel Mills | None | -- |

[a]Source: "Directory of Aluminum Suppliers," (U.S. Dept. of Commerce, Business and Defense Service Administration, Washington, D.C. Internal Report, Revised 1970).

[b]This is an estimated figure which is complicated by the fact that numerous plants produce more than one product at one location. BDSA census counts producers in more than one category if production facilities exist in more than one category within one plant.

[c]Hot metal is shipped direct from the reduction plants or salvage plants to automotive foundries on a contract basis. The number of foundries in this category is included in the 2771 above.

homogeneous areas. In some instances parts are fabricated by captive operations of the primary metal producers, in some cases

as captive

two stages

put-output

consumer.

material to

Sec

tive uses,

existence i

oxide form

constantly

metal is ge

or is no lo

returned to

industries.

development

The

aluminum in

in 1968.[4]

is producin

also is hig

---

[4] U.
Minerals Ye
Printing Of

some cases as independent parts fabricators, and sometimes as captive operations of the end product producers. These two stages of the overall processing cycle act then as input-output stages between the mill product stages and the consumer. In addition, they serve as a source of raw material to the salvage stage.

Secondary Processing. Other than in its destructive uses, once aluminum has been reduced, it continues in existence in its metallic form and does not return to an oxide form as does iron. Thus, the supply of aluminum is constantly expanding rather than being reduced, for as the metal is generated as salvage from processing operations or is no longer of value in its durable good state, it is returned to a usable form in either secondary or remelt industries. This source of metal has been the basis of development and growth of this secondary industry.

The secondary industry's effect on the supply of aluminum ingot is substantial; 580,692 tons were processed in 1968.[4] At the same time that the secondary industry is producing and adding to the overall metal supply, it also is highly dependent on the primary industry as a major

---

[4]U. S. Department of the Interior, Bureau of Mines, Minerals Yearbook-1968, (Washington: U. S. Government Printing Office), 1969.

source of

dustry is

new scrap

as high a

fabricati

to be rep

to the cy

metal in

in each s

ally, the

industry

various s

salvage g

P

1

1

1

1

1

Source:

source of supply, as much scrap used in the secondary industry is generated as dross in reduction operations and as new scrap from fabricating operations. It is estimated that as high as 25 per cent of the amount of metal used in some fabricating operations returns to the cycle as new scrap to be reprocessed. This percentage is constantly returned to the cycle. This means that the per cent of secondary metal in the system is becoming a greater inventory factor in each succeeding year as indicated in Table 3. Additionally, the level of production activity in the secondary industry is closely related to levels of activity in the various stages of the primary industry due to the rate of salvage generation.

TABLE 3

ACTUAL AND PROJECTED SUPPLY OF SCRAP ALUMINUM AVAILABLE FOR PROCESSING BY THE SECONDARY INDUSTRY

| Period | Amount tons |
|---|---|
| 1950-54 | 1,657,000 |
| 1955-59 | 2,163,000 |
| 1960-64 | 2,852,000 |
| 1965-69 | 3,981,000 |
| 1970-74 | 5,740,000 |

Source: Aluminum Smelters Research Institute, 20 No. Wacker Dr., Chicago, Ill.

Industry Co

The

cost indust

ties, sourc

eralizatior

gorically c

small founc

ment, but f

product is

In

industry, i

cost struct

cost struct

mation proj

ments made

producers.

Tab

the metal r

from ore to

the reducti

follows:

Industry Cost Structure

The aluminum industry can be classed as a high fixed cost industry due to the large investment required in facilities, sources of supply, and power. However, this is a generalization, and all processing steps should not be categorically classified. As an example, a fabricating shop or small foundry can be started for a relatively small investment, but from an overall nature, the greater volume of product is processed in high fixed cost facilities.

In order to project the total economic effect of the industry, it is necessary to develop an estimated average cost structure in the industry. The following theoretical cost structure is developed from previously published information projected to current market conditions, plus adjustments made due to proprietary information received from producers.

Table 4 illustrates the changing cost structure as the metal moves through the various stages of production from ore to a marketable good used by the consumer. At the reduction stages major cost factors per ton are as follows:

| Item |
| --- |
| Bauxi |
| del |
| Min |
| Proc |
| Tra |
| Alumi |
| Bau |
| Soda |
| Ind |
| Labo |
| Depr |
| Ove |
| Frei |
| Alumi |
| Alum |
| Carl |
| Batl |
| All |
| Labo |
| Elec |
| Over |
| Depr |
| Frei |
| Mill p |
| Alum |
| 1. |
| Othe |
| Labo |
| Depr |
| Over |
| Frei |

TABLE 4

ESTIMATED AVERAGE COST AND PRICE OF ALUMINUM PRODUCTS ON A PER TON BASIS

| Item | Unit Cost Per Ton | Total Cost Per Ton | Delivered Price Per Ton |
|---|---|---|---|
| Bauxite - delivered to North America | | | |
| Mining cost | 2.00 | | |
| Processing | nil | | |
| Transportation | 5.00[a] | 7.00 | 7.00[b] |
| Alumina | | | |
| Bauxite 7.00/ton x 2 ton | 14.00 | | |
| Soda, fuel, other materials | 11.00 | | |
| Indirect materials | 2.50 | | |
| Labor (direct & indirect) | 5.75 | | |
| Depreciation | 14.50 | | |
| Overhead | 1.00 | | |
| Freight | 3.00 | 51.75 | 51.75[b] |
| Aluminum | | | |
| Alumina 51.75/ton x 2 ton | 103.50 | | |
| Carbon & pitch | 26.00 | | |
| Bath materials | 12.00 | | |
| All other materials | 20.00 | | |
| Labor | 60.00 | | |
| Electrical energy | 60.00 | | |
| Overhead | 17.50 | | |
| Depreciation | 75.00 | | |
| Freight | 20.00 | 394.00 | 520.00 |
| Mill Products | | | |
| Aluminum 520.00/ton x 1.1 ton[c] | 572.00 | | |
| Other materials | 10.00 | | |
| Labor | 80.00 | | |
| Depreciation | 40.00 | | |
| Overhead | 40.00 | | |
| Freight | 25.00 | 757.00 | 1000.00[d] |

| Item |
| --- |
| Fabric |
| Mil |
| x |
| Othe |
| Labo |
| Depr |
| Over |
| Frei |
| End Pr |
| Fabr |
| x |
| Othe |
| Labo |
| Depr |
| Over |
| Frei |

Source

$2.00

proces

weight
.35/#
items.

TABLE 4--Continued

| Item | Unit Cost Per Ton | Total Cost Per Ton | Delivered Price Per Ton |
|---|---|---|---|
| Fabricated Parts | | | |
| Mill product 1000.00/ton x 1.25 ton | 1250.00 | | |
| Other materials | 10.00 | | |
| Labor | 250.00 | | |
| Depreciation | 30.00 | | |
| Overhead | 60.00 | | |
| Freight | 40.00 | 1640.00 | 2000.00[e] |
| End Product | | | |
| Fabricated part 2000.00/ton x 1 ton | 2000.00 | | |
| Other materials | nil | | |
| Labor | 150.00 | | |
| Depreciation | 30.00 | | |
| Overhead | 60.00 | | |
| Freight | 40.00 | 2280.00 | 2500.00[e] |

Source: Philip Farin and Gary G. Reibsamen, Aluminum-Profile of an Industry (New York: McGraw-Hill, Inc., 1969), p. 148-156.

[a]Transportation costs can vary between less than $2.00 to approximately $9.00 per ton depending on distance.

[b]Difference between cost and price unavailable.

[c]Estimated 10% average salvage regeneration in this processing step.

[d]A composite estimate of various mill products weighted, by annual sales. Prices range from a low of .35/# for extrusions, .50/# for sheet to .90/# for specialty items.

[e]Estimated composite.

By c

lead

ture

This

fact

redu

with

cont

low

trum

ther

with

the

| | Cost/ton | Per cent |
|---|---|---|
| Materials | 71.50 | 13.8 |
| Labor | 67.75 | 13.0 |
| Power | 60.00 | 11.5 |
| Depreciation | 89.50 | 17.2 |
| Freight | 28.00 | 5.4 |
| Other, incl. overhead | 77.25 | 14.9 |
| Profit (all stages) | 126.00 | 24.2 |
| Total | $520.00 | 100.0 |

By comparison, a composite breakdown per ton of all factors leading up to the end product indicates how the cost structure has changed.

| | Cost/ton | Per cent |
|---|---|---|
| Materials | 121.00 | 5.3 |
| Labor | 593.00 | 26.0 |
| Power | 82.50 | 3.6 |
| Depreciation | 227.00 | 10.0 |
| Freight | 149.00 | 6.5 |
| Other, incl. overhead | 270.00 | 11.8 |
| Profit (all stages) | 837.50 | 36.8 |
| Total | $2280.00 | 100.0 |

This indicates the relative importance of the various cost factors at the different levels of production. At the reduction stage, fixed costs of power and depreciation, along with captive sources of bauxite, indicate a need to maintain continued production to absorb costs and thereby maintain a low per unit cost. At the end product stage of the spectrum, labor and other variable costs become dominant, thereby suggesting adjusted levels of production in line with end product demand. Operation of different levels of the industry according to these different principles resul

stage

nique

value

based

illus

make

tion

profi

opera

Locat

mary

num i

This

porta

electr

basic

duce

per y

results in widely fluctuating inventory levels between the stages which thereby suggests differing procurement techniques between the levels.

The reader is cautioned to bear in mind that the values imputed in Table 4 are in many cases composites based on factors noted. They have been presented to illustrate the approximate comparative costs that go to make up total costs, and in this sense they provide a relation between fixed costs, variable costs, and estimated profits rather than a specific cost structure of a specific operation.

## Locational Factors and Transportation Considerations

With one exception, transportation costs are a primary factor in determining facility locations in the aluminum industry. The one exception is the reduction stage. This exception is not because of a lack of a need for transportation, but because the need for vast amounts of cheap electrical power takes precedence.

Table 5 is a compilation of the estimated volume of basic materials which must be transported in order to produce end products of aluminum.

This estimated volume of more than 45 million tons per year indicates the importance of locating succeeding

E

Source:

producti

Currentl

new alu

sources,

million

energy r

materia

Once the

made by

TABLE 5

ESTIMATED VOLUME OF BASIC MATERIALS TRANSPORTED FOR THE ALUMINUM INDUSTRY - 1967

| Material | Volume - Tons |
|---|---|
| Bauxite | 13,080,000 |
| Coal | 1,635,000 |
| Fuel Oil | 817,500 |
| Soda | 1,635,000 |
| Lime | 408,750 |
| Alumina | 6,540,000 |
| Bath Materials | 2,180,000 |
| Ingot | 3,270,000 |
| Imports | 450,000 |
| Secondary production | 893,000 |
| Mill Products | 5,552,700 |
| Parts | 4,441,000 |
| End Products | 4,441,000 |
| Total | 45,342,950 |

Source: Values computed from cited inputs in text.

production stages as near as possible to preceding stages. Currently, the industry practice appears to be to locate new alumina facilities at, or near, the foreign bauxite sources, thereby, eliminating the need to ship the 13 million tons of bauxite to this country. Because of the energy requirement, shipment of the alumina and bath materials to an available power source is a necessity. Once the aluminum is produced, locational decisions are made by a relative weighting of transportation costs between prod

to a

Dete

indu

tion

trol

cens

the

star

the

the

tion

an

tion

for

pha

the

bal

tio

usu

are

producing sites, markets, and secondary recovery operations to arrive at the lowest total transportation cost.

Determination of the Controlling Production Operation

Discussions were initiated during interviews with industry representatives to establish acceptance or rejection of the assumption that the reduction phase is the controlling phase of the production process. The general concensus was that the reduction operation of production was the major controlling phase, although extenuating circumstances existed in numerous cases. Locational factors and the critical input of power were obvious elements to justify the selection of the reduction phase as the critical production phase. Additionally, the large output per potline as an increment of total output further justifies the selection, as does the cost structure, which generates the need for continual operation of the production facility.

There are specific instances when the reduction phase would not be classified as the most critical phase in the production cycle. Such instances would include imbalances in fabrication capacity, shortages of transportation facilities, or other short range problems which usually can be corrected in a shorter time than problem areas in the reduction phase.

plet

inte

acce

the

(See

*Mat
and

The

tion

lish

stag

alum

effe

ment

and

Alu

Although extenuating circumstances exist, and complete acceptance of the assumption was not obtained in the interviews, a majority of the people interviewed expressed acceptance of the assumption that the reduction phase is the most critical phase in the overall production cycle. (See Appendix B, Exhibit 2)

## Structure of the Consumption Segment*

*Material in this section is based on information in Farin[5] and published information on the Aluminum Association.[6]

### The Major Markets

The end uses of a product and the level of production of those end uses is the determining factor in establishing production levels throughout the intermediate stages of the industry. An understanding of end uses of aluminum by major markets then is imperative so that the effect of changes in these markets can be used as an adjustment factor when making decisions relating to procurement and inventories.

For statistical and analytical purposes, the markets

---

[5] Farin, *op. cit.*, pp. 78-99.

[6] Market segmentation is established by the Aluminum Association, 420 Lexington Ave., New York City.

for a
These
each
The e
from
categ
econo
secon
produ
life
the a
duct
while
tive.

buil
buil
the
star
of c
clos

for aluminum have been divided into eight categories. These categories are not completely homogeneous in that each category is composed of a variety of end products. The existing homogeneity of the categories seems to stem from two areas. First, from an economic standpoint, the categories relate closely to sections of our national economy and, thereby, provide a basis for comparison. The second area of homogeneity is in the life cycle of the end product. Because of the durability of aluminum, the total life of the end product is controlled by factors other than the aluminum itself. Consequently, the period between production and salvage varies widely between each category, while within each category life cycle variations are relatively small.

A brief description of the eight markets follows:

1. Building and Construction

This category includes metal used in all types of building construction and ranging from high rise commercial buildings to conventional homes and mobile homes. Use of the metal in this market is closely related to housing starts and programmed commercial construction. The level of consumption and its changes can be predicted rather closely when based on anticipated construction.

sum

pro

mar

tio

in

are

cia

gra

in

di

wi

re

co

in

th

is

ke

2. Transportation

Approximately one-half of the total aluminum consumed by the transportation market is used in automobile production. Predictions of usage in this portion of the market can be associated with levels of automobile production. The other half of this category includes metal used in commercial vehicles and marine and railroad applications; areas which are subject to fluctuations since they are associated with government programs and capital equipment programs.

3. Electrical

The major portion of metal used in this category is in cable and transmission towers required for electrical distribution. Its use in this area is in close competition with copper. Predictions of metal usage in this category require considerations of both projected construction and competitive pricing of copper.

4. Containers and Packaging

This category is currently in a very dynamic stage in that new uses are being developed. One in particular is the beverage can. In addition, the life cycle in this usage is very short. These combined factors establish this market as an area which can subject the total market to short range c

5.

with l

air co

ances,

change

consum

6.

and la

cation

could

tial c

desali

7.

ply of

use.

will b

8.

range changes in over-all demand levels as the market expands.

5. Consumer Durables

Use of metal in this market is directly associated with levels of consumer spending for durable items such as air conditioners, cooking utensils, furniture, boats, appliances, sporting goods, etc. Predictions of short range changes in this market can be related to expected changes in consumer discretionary income.

6. Machinery and Equipment

The use of aluminum in this area is relatively stable and large changes in the future will result from new applications. Currently, there are two areas in which aluminum could establish a strong market and thereby cause a substantial change in overall aluminum demand. These two areas are desalination and cryogenics, the science of low temperatures.

7. Export

The export market is associated with the overall supply of metal, including imports, rather than as an end product use. Consequently, the net affects of imports and exports will be discussed later in this study as a supply factor.

8. Other

The "Other" category is established by the Aluminum

Ass

app

to

lev

pol

Cur

bre

bas

Bu
Tr
El
Co
Co
Ma
Ex
Ot

So

Association consists primarily of defense uses. In defense applications the level of demand and life cycle are subject to relatively wide fluctuations. Predictions of changes in level of demand are subject to domestic and international political activity.

## Current and Projected Market Shares

Table 6 illustrates the current and predicted breakdown of the domestic aluminum market on a percentage basis.

TABLE 6

CURRENT AND PROJECTED ALUMINUM
MARKET SHARE BY CATEGORY

| Market | Actual 1967 | | Projected 1972 | |
|---|---|---|---|---|
| | Mil lbs. | Per cent | Mil lbs. | Per cent |
| Building and Construction | 1915 | 21.4 | 2600 | 20.3 |
| Transportation | 1866 | 20.8 | 3000 | 23.5 |
| Electrical | 1249 | 13.9 | 1850 | 14.4 |
| Containers and Packaging | 866 | 9.7 | 1600 | 12.5 |
| Consumer Durables | 844 | 9.4 | 1100 | 8.6 |
| Machinery and Equipment | 625 | 7.0 | 950 | 7.4 |
| Export | 657 | 7.3 | 700 | 5.5 |
| Other | 940 | 10.5 | 1000 | 7.8 |
| Total | 8962 | 100.0 | 12,800 | 100.0 |

Source: Farin, *op. cit.*, p. 83.

This su

trates

importa

in mak

This summary of aluminum markets and projected growth illustrates the need to consider overall market levels but, more importantly, changes in market levels as modifying factors in making purchasing and inventory decisions.

alu

tor

con

cus

ing

for

mat

ing

ar

th

ti

te

op

# CHAPTER V

# CURRENT ALUMINUM INGOT MARKET CHARACTERISTICS

## Introduction

In the two preceding chapters, the history of the aluminum industry was reviewed. In addition to the historical review, current production and general consumption conditions were discussed. This preceding review and discussion establishes a framework for construction of aluminum ingot market characteristics from which assumptions can be formulated. This chapter uses the general industry information of the preceding chapters as a basis to develop ingot market characteristics.

## Market Characteristics

The characteristics of the aluminum ingot market are subdivided into four parts. The first characteristic that is discussed is price, which is a reflection of competition and profit in the ingot market. The second characteristic deals with physical elements, which determine operating conditions in the production segment of the market.

The

the

the

titi

Each

<u>Pric</u>

many

of

con

Thi

on

att

lev

sal

als

the

by

sta

use

of

The third characteristic deals with inventories, which are the linkage between the production and market segments of the industry. The fourth characteristic deals with competition that the domestic market faces from world production. Each of these four areas are discussed below.

Price Characteristics

The homogeneity of aluminum produced by primary manufacturers and the highly comparable quality of product of the secondary industry and foreign sources establishes a condition of very high cross elasticity between producers. This condition has led to uniform pricing generally based on a formula of cost plus profit with consideration for attainment of a desired rate of return on investment. The level of the price is determined by its possible effect on sales and the possibility of government intervention. It also acts as a deterrent to the entry by new producers into the aluminum ingot market.

In addition to price uniformity, an attempt is made by the industry to maintain price stability. This price stability encourages the use of aluminum as it provides the user with a high degree of certainty in long range planning of products, markets, and facilities.

Based on these industry conditions, the following charac

Physic

operat

effect

alumi

which

ancy,

appro

tensi

facil

equip

const

Indus
by Jo

Indus
1961)
alum

characteristics are established:

1. Overall demand is not responsive to short term changes in price.[1]

2. The level of customer loyalty is relatively low.[2]

Physical Characteristics

Physical considerations relate to the plant and operating characteristics of the reduction phase, and the effects of these characteristics on the structure of the aluminum industry.

The development of additional reduction capacity which was an approximate twenty to thirty year life expectancy, characteristically requires a gestation period of approximately three years.[3] Factors which necessitate extensive time periods to construct and operate reduction facilities are power, transportation, financing, and capital equipment. This long leadtime required, coupled with the constantly increasing demand for metal, leads to an effect

---

[1]Sterling Brubaker, Trends in World Aluminum Industry (Baltimore: Published for resources for the future by John Hopkins Press, 1967), p. 63.

[2]Merton J. Peck, Competition in the Aluminum Industry, 1945-1958. (Cambridge: Harvard University Press, 1961), pp. 35-36. For a complete analysis of pricing of aluminum ingot, the reader is referred to Peck Chapter IV.

[3]Ibid., p. 144.

as ill

this e

up co

that

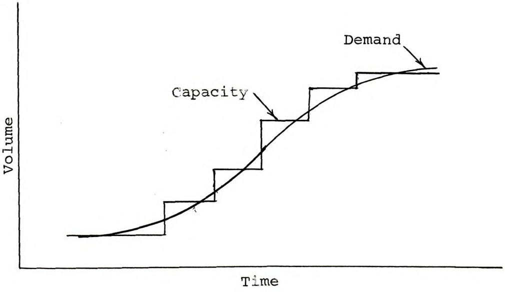
cost

as illustrated in Figure 3. The following consequences of this effect result:

1. The incremental size of new reduction capacity leads to excess supply when the new capacity goes into operation. (A potline capacity varies but is in the range of 40,000 to 50,000 tons per year.)

FIGURE 3

COMPARISON OF REDUCTION CAPACITY AND DEMAND CHANGES OVER TIME




2. Erroneous decisions as to timing of additional capacity serves to aggravate supply-demand inequities.

Once additional capacity has been constructed, start up costs become a significant consideration. Peck estimates that restarting a potline requires one to two months at a cost of $1000,000 per potline.[4] Currently, the cost would

[4] Ibid., p. 85.

be l

fig

niq

lin

Nia

rat

are

ati

sta

use

the

tro

the

the

hig

ass

wit

and

pre

rec

wi

be higher, although the establishment of a specific dollar figure has not been attempted due to new designs and techniques. Today the industry uses two general types of potlines (reduction techniques). One is called a prebake or Niagara, wherein the carbon electrodes are prepared separately and are installed in the line when the old electrodes are used up. This type of line has somewhat higher operating costs but is relatively simplier to shutdown and restart. The second type of potline, called a Soderburg, uses carbon electrodes that are made up and baked right in the line. In this type of line, shutdown to change electrodes is not necessary, therefore savings in downtime and the prebaking of electrodes reduces operating costs, but at the same time shutdown and start up costs are substantially higher.

The preceding explanation would lead to the obvious assumption, which has been substantiated in discussions with industry representatives, that other things being equal, and given a choice, a producer would normally shutdown a prebake line rather than a Soderburg line.

An additional physical factor is the relation of reduction capacity to mill products fabricating capacity within an integrated firm. A producer would normally have

ex
ca
at
am
ti
pe
mu
pl
se
pr
al
ca
re
ca
ca
me
sh

am
fi
ti
pe
the

excess mill products fabricating capacity over reduction capacity in order to meet the total demand for metal, while at the same time having flexibility to produce varying amounts of mill products. It would also suggest that in times of excess demand, prime producers who supply to independent fabricators as well as their own captive operations must either allocate metal to the two areas or provide supplementary basic metals from the stockpile, imports and secondary sources. In either case, whether the primary producer supplements his supply of metal or whether he allocates his captive supply, he must maintain some physical mill products fabricating capacity in excess of his reduction capacity. This excess capacity over reduction capacity provides a method whereby the total ingot output can be used. If this were not the case, a producer's one method of using up excess ingot inventory would be by shutting down reduction capacity.

Two problems exist in attempting to arrive at the amount of this excess capacity that is in existence. The first problem is that some of this capacity exists as captive capacity of the primary producers and some as independent production. The task of measuring capacity at all the physical locations becomes an insurmountable project bey

typ

dem

pro

a v

How

thr

usa

phy

tha

it

The

poi

the

sic

dem

fut

of

beyond the scope of this study.

The second problem is the correlation of a specific type of mill products fabricating capacity with end product demand. As long as the metal remains in a basic form as produced at the reduction plant it can be used to produce a variety of mill products and practically all end products. However, the same is not true after it has been processed through the mill products stage. After this step, its usage in a variety of end products is limited due to physical form.

The result of this analysis leads to the observation that although excess capacity exists in a physical sense, it may not be of a usable nature in a production sense.[5] The possible effects of problems of excess capacity are pointed out by Merton J. Peck when he says, "Even though the excess capacity may be in large part a temporary recession phenomenon, the existence of closer balance between demand and supply seems likely to alter substantially the future pattern of market behavior."[6]

The foregoing summary leads to the establishment of the following characteristics:

---

[5] Ibid., pp. 93-94.

[6] Ibid., p. 165.

Invent

of the

tion r

period

and du

will e

are re

contin

ence e

These

inflat

tion s

rather

tories

G. W.
Contro

1. The aluminum industry is faced with a continuous problem of imbalance between supply and demand.

2. The cost structure of the reduction stage leads to a tendency to maintain constant output levels at the reduction stage.

Inventory Characteristics

The physical characteristics of the reduction stage of the industry leads to operations at a constant production rate. This results in a condition where, during periods of business expansion, inventories will contract and during periods of business contraction, inventories will expand. Also, two additional conditions exist which are relevant. One is the fact that the industry faces a continual growth in demand. Secondly, a substantial difference exists between the marginal cost and price of aluminum. These factors combined with the prospect of a continual inflation trend and easy storability suggests that production should be maintained and inventories accumulated, rather than production shut down in period of excess supply.[7]

Counteracting the tendency to accumulate inventories is the cost required to carry them.[8] Two of the

---

[7] *Ibid.*, p. 88.

[8] For an analysis of inventory carrying costs see: G. W. Plossl and O. W. Wight, *Production and Inventory Control* (New Jersey: Prentice-Hall, Inc., 1967), pp. 52-56.

majo

inve

stor

natu

not

redu

only

inve

rela

assu

capa

per

$3 m

duce

the

down

the

abil

that

no a

capa

major elements in these carrying costs are interest on investment and storage costs. In the case of aluminum, storage costs are of lesser importance due to aluminum's nature. It does not deteriorate readily in weather, it is not subject to obsolescence, nor does it decompose. In its reduced state, it can be stored outside; consequently, its only storage requirement is security. On the other hand, investment and interest on investment are major elements relative to aluminum inventories. As an illustration, assume that a new facility comes on stream with an annual capacity of 100,000 tons. At an estimated cost of $394.00 per ton,[9] a producer could accumulate an inventory of over $3 million in just thirty days.

Based on the foregoing, it is assumed that a producer would continue to produce and store inventory up to the point where carrying costs are counterbalanced by shutdown and restart costs. The higher the cost of capital, the lower the inventory accumulation. In addition, availability of capital becomes a further limiting factor in that complete exhaustion of available capital leaves a firm no alternative but to close down sufficient reduction capacity to discontinue further inventory accumulation.

---

[9]See Table 4 for method used to compute cost.

stricti

aluminu

a curre

duo or

of an c

tion wi

lishing

practic

firm, a

excess

conditi

Profil
pp. 10

World Production Characteristics

World market conditions and individual country restrictions have a detrimental affect on the free flow of aluminum between countries. These restrictions have led to a current practice of replacing cartel organizations with a duo or tri consortium. These consortium usually consists of an old line United States and/or European firm in conjunction with a domestic firm in the second country, thus establishing an outlet for the external firm. Although this practice leads to assurance of a market for a specific firm, at the same time it tends to develop a condition of excess world capacity.[10]

These world conditions lead to the establishment of conditions as follows:

1. A position as a net exporter is an indication of an oversupply condition.
2. Producers try to pre-empt local markets thus creating a general condition of oversupply and the need for producers to establish world wide production facilities.

---

[10] Phillip Farin and Gary G. Reibsamen, Aluminum Profile of an Industry, (New York: McGraw-Hill, Inc., 1969), pp. 106-113.

alumi

produ
alumi
deli
is t
all

phys
produ
rath

accu
of f

easi

## Study Assumptions

The preceding discussion of characteristics of the aluminum ingot market leads to the following assumptions:

Assumption I. Given the conditions of a homogeneous product and equal price, a purchaser's selection of an aluminum ingot source of supply is a function of quality, delivery, and service. The signification of this assumption is that, from a price standpoint, all markets are open to all sellers.

Assumption II. The high fixed cost structure and physical operating characteristics of the aluminum ingot production segment encourages operation on a constant rather than a variable basis.

Assumption III. Aluminum ingot producers will accumulate inventories to the extent cost and availability of funds allow.

Assumption IV. Domestic aluminum markets are easily penetrated by foreign producers.

AL

ditions

1959 th

series

seasona

of all

cyclica

will be

tice to

deliver

the pro

ingot,

primary

Product

process

# CHAPTER VI

# ALUMINUM INGOT DELIVERIES AND SHIPMENTS: 1959-1968

The purpose of this chapter is to analyze the conditions which existed in the aluminum ingot market from 1959 through 1968. The analysis will be based on a time series with a specific objective of identifying secular, seasonal, and cyclical patterns and irregular conditions.

In conducting the analysis, definitions will first of all be established. Second, secular, seasonal, and cyclical trends will be analyzed. Third, other conditions will be identified and evaluated.

## Definitions of Delivery and Shipment Data

Within the aluminum industry, it is a common practice to speak of deliveries. The industry defines these deliveries as shipments from the final stage controlled by the producers. These deliveries include metal from the ingot, mill products and parts fabrication stages of the primary producers. (See Chapter IV Section entitled, "The Production Segment"). In most cases, this metal is processed through additional stages of the production segme

to th

Total

deliv

ingot

secon

ports

prima

subtr

inte

Shipm

the

ducer

both

expo

Comp

rela

meas

segment by independent fabricators before it is delivered to the ultimate user.

Total Deliveries

Total deliveries are a summation of all metal deliveries to the mill products stage from all sources of ingot. These data are calculated by adding primary and secondary ingot shipments, primary and secondary ingot imports and finally stockpile withdrawals. From this total, primary and secondary exports and stockpile deliveries are subtracted.

In this report, the term deliveries will be used interchangeably to mean the same as total deliveries.

Shipments

In the following analysis, shipments are denoted as the total amount of metal shipped by domestic primary producers from the reduction stage. This metal is shipped to both captive and independent operations. It also includes exports and stockpile deliveries.

Comparison of Shipments and Total Deliveries

The two measures defined above differ because they relate to two phases of the aluminum industry. The first measure, shipments, is a quantitative indication of the

amoun
the d
deliv
the a
stage
from
an ir

comes
acti
tion
the
montl
in A

vari
vary
to e
mont
have
Trad
days

amount of metal produced and shipped by the ingot stage of the domestic aluminum industry. The second measure, total deliveries, is also a quantitative measure. It indicates the amount of metal used in the subsequent mill products stage. The shipment measure can be considered as an output from one stage while total deliveries can be considered as an input to the next stage.

Another difference that exists between these two comes about because shipments are an indication of domestic activity only, while total deliveries take into consideration the net additions to supply from imports and exports, the government stockpile and scrap regeneration. The monthly data of both measures are included for reference in Appendix F.

## Variations of Monthly Patterns

Recognition is given to the problem of monthly variations in deliveries and shipments resulting from a varying number of trading days in each month. In order to eliminate the effect of varying trading days in each month, the data, covering both deliveries and shipments, have been established on a tons per trading day basis. Trading days are computed by subtracting Saturdays, Sundays, and holidays from the total number of days in each mont

mont

range

tions

of ac

diffe

on a

ously

adju

seri

cove

the

dust

to l

prog

agai

---

the
alum
cont

month.[1] This step results in data which reflect month to month short range fluctuations without camouflaging long range trends. In addition, recognition is given to variations which might come about because of the differing basis of activity in the shipment and production areas. This difference is the result of operating shipping facilities on a trading day basis while production is operated continuously 24 hours per day every day in the month. Trading day adjustments are the only adjustments made to the data.

## Analysis of Delivery and Shipment Patterns

The basis of the following discussion is a time series analysis of aluminum ingot deliveries and shipments covering the period 1959 through 1968.

To reiterate, 1959 was selected as the beginning of the current stage in the development of the aluminum industry because of basic changes which occurred just prior to 1959 in the areas of government sponsored expansion programs, the stockpile program and antitrust action against Alcoa.

---

[1]Holidays is to be excluded were established by the writer based on work day information available from the aluminum industry. This holiday allowance covers labor contract obligations.

Ana

and

was

in

clu

mad

occ

pos

tha

196

men

4.[2]

pat

196

dai

plo

of

day

ref

Analysis of Long Range Trends

In an initial plotting of average daily deliveries and shipments, a definite change in the trend in mid 1960 was clearly evident. In order to adjust from this change in trend, delivery and shipment data prior to 1960 was excluded from the trend calculations. This adjustment was made on the assumption that a definite change in the market occurred. The cause of this change is not verified, but it possibly is the result of the changes, enumerated above, that occurred just prior to 1959 in conjunction with the 1960-1961 business decline.

The calculated trend lines of deliveries and shipment using the least squares method are plotted in Figure 4.[2] These trend lines clearly illustrate the linear growth pattern that has occurred in the aluminum ingot market from 1960 through 1968.

In addition to the trend lines, monthly average daily total deliveries and shipments of aluminum ingot are plotted in Figure 4. These provide a visual presentation of total delivery and shipment data, adjusted for trading day variations but including secular, seasonal, cyclical,

---

[2]Calculations of trend lines are included for reference in Appendix G.

and

men

fro

sev

The

is

bee

slo

fer

of

inc

Qua

to

bas

the

des

by
Alc
cus
tis
196

and irregular patterns.

Figure 4 shows that both total deliveries and shipments have increased in a linear pattern during the period from mid 1960 through 1968. In addition, the existence of several short range fluctuations are clearly indicated. The nature of these fluctuations are discussed below.

An additional factor is apparent in Figure 4. This is the fact that total deliveries and shipments have not been increasing the same as indicated by the different slopes of the two trend lines. The reasons for these differing slopes are assumed to be caused by a greater amount of secondary metal, larger stockpile withdrawals, and an increased level of imports over exports.

Quarterly Fluctuations

It is a common practice within the aluminum industry to speak of traditional seasonal deliveries on a quarterly basis with the second quarter being the highest, followed by the first quarter, fourth quarter and third quarter in descending order.[3] In the following analysis of total

---

[3]The existence of the seasonal pattern was suggested by Dr. Stanley Malcuit in an interview December 29, 1968, at Alcoa, Pittsburgh, Pa. Also, the Aluminum Association discusses the existence of seasonal patterns. "Aluminum Statistical Review 1968." (New York, The Aluminum Association, 1969), p. 46.

FIGURE 4

AVERAGE DAILY DELIVERIES AND SHIPMENTS OF ALUMINUM INGOT PER TRADING DAY COMPARED TO A LINEAR TREND, 1959-1968

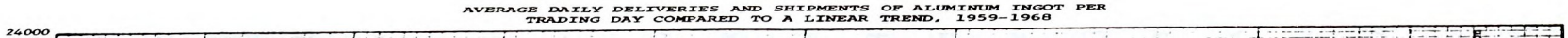
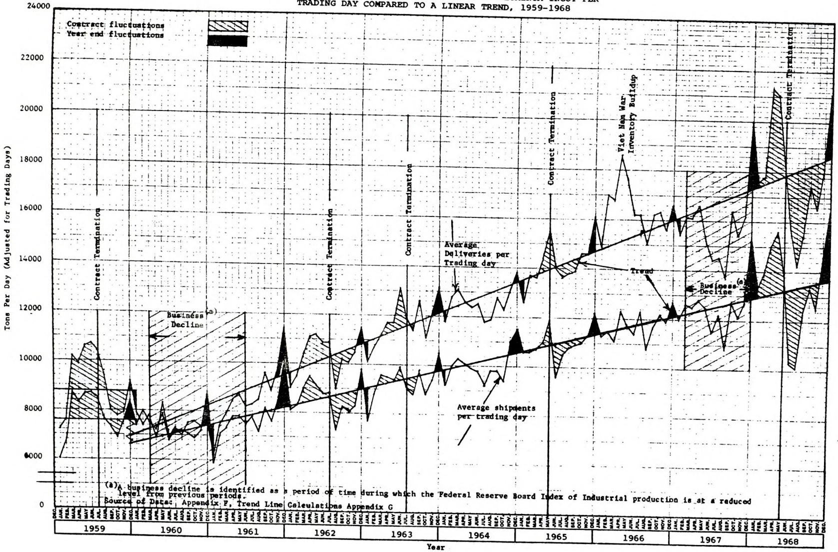


FIGURE 4

AVERAGE DAILY DELIVERIES AND SHIPMENTS OF ALUMINUM INGOT PER TRADING DAY COMPARED TO A LINEAR TREND, 1959-1968




(a) A business decline is identified as a period of time during which the Federal Reserve Board Index of Industrial production is at a reduced level from previous periods.

Source of Data: Appendix F, Trend Line Calculations Appendix G delive

a dete

quarte

terly

dustry

factor

measur

the la

produc

any se

would

referr

not pr

a peri

tion a

ming

delive

Using

from

and ba

would

deliveries and shipments, attention will be directed toward a determination of whether or not a pattern does exist on a quarterly and/or monthly basis.

In analyzing ingot total delivery and shipment quarterly patterns and comparing them with the suggested industry quarterly pattern it is necessary to consider the factor of leadtime. Ingot deliveries and shipments are a measure of the amount of metal available for processing in the later mill products and parts fabrication stages of the production cycle. Because of leadtime between the stages, any seasonal patterns in ingot shipments that might exist would very likely not coincide with seasonal patterns as referred to by the aluminum industry. However, this does not preclude the possibility of similar patterns, offset by a period of time equal to the leadtime between ingot production and the shipment of mill and fabricated products.

Using total deliveries as identified above and summing by quarters, Table 7 has been prepared showing the delivery pattern for each of the ten years of this study. Using the suggested industry delivery pattern of a sequence from the highest quarter to the lowest quarter of 2-1-4-3, and barring the occurrence of short range fluctuations, we would expect to find this sequence (2-1-4-3) in a majority of the

this se

of the

with th

quarter

| Year |
|---|
| 1959 |
| 1960 |
| 1961 |
| 1962 |
| 1963 |
| 1964 |
| 1965 |
| 1966 |
| 1967 |
| 1968 |

been p

produc

occurr

inate.

of the years under study. It is interesting to note that this sequence does not occur in the entire ten year period of the study, although the second quarter does coincide with the industry suggested pattern, as the dominate highest quarter.

TABLE 7

AVERAGE DAILY TOTAL DELIVERIES OF ALUMINUM FROM THE INGOT STAGE RANKED BY QUARTERS, 1959-1968 ADJUSTED FOR TREND

| Year | Highest Quarter | Second Highest Quarter | Third Highest Quarter | Lowest Quarter |
|---|---|---|---|---|
| 1959 | 2 | 3 | 1 | 4 |
| 1960 | 1 | 2 | 3 | 4 |
| 1961 | 4 | 2 | 3 | 1 |
| 1962 | 2 | 3 | 1 | 4 |
| 1963 | 2 | 4 | 3 | 1 |
| 1964 | 2 | 1 | 3 | 4 |
| 1965 | 2 | 4 | 3 | 1 |
| 1966 | 2 | 4 | 3 | 1 |
| 1967 | 4 | 1 | 2 | 3 |
| 1968 | 1 | 2 | 4 | 3 |

Following the same pattern as above, Table 8 has been prepared showing shipments of metal from the primary producers only. Here, we do not find the industry pattern occurring either.

In neither case does a sequential pattern predominate. From a total delivery standpoint a specific sequence does no

From a

more t

AVE

| Year |
| --- |
| 1959 |
| 1960 |
| 1961 |
| 1962 |
| 1963 |
| 1964 |
| 1965 |
| 1966 |
| 1967 |
| 1968 |

Table

shipme

consis

delive

concer

On the

does not occur more than three times in the ten year period. From a primary metal shipment standpoint no sequence occurs more than twice.

TABLE 8

AVERAGE DAILY SHIPMENTS OF ALUMINUM INGOT FROM PRIMARY DOMESTIC PRODUCERS RANKED BY QUARTERS, 1959-1968 ADJUSTED FOR TREND

| Year | Highest Quarter | Second Highest Quarter | Third Highest Quarter | Lowest Quarter |
|---|---|---|---|---|
| 1959 | 2 | 3 | 4 | 1 |
| 1960 | 1 | 2 | 3 | 4 |
| 1961 | 4 | 2 | 1 | 3 |
| 1962 | 2 | 1 | 3 | 4 |
| 1963 | 2 | 4 | 1 | 3 |
| 1964 | 2 | 4 | 3 | 1 |
| 1965 | 4 | 2 | 1 | 3 |
| 1966 | 4 | 2 | 3 | 1 |
| 1967 | 4 | 1 | 2 | 3 |
| 1968 | 1 | 4 | 2 | 3 |

A further evaluation of shipments is included in Table 9 where the high and low average daily deliveries and shipments on a monthly basis are tabulated. No month is consistently high as a month where the highest average daily deliveries occur. As far as average daily shipments are concerned, December is the predominantly high month. On the opposite end of the spectrum, no month is predominant

| Year |
| --- |
| 1959 |
| 1960 |
| 1961 |
| 1962 |
| 1963 |
| 1964 |
| 1965 |
| 1966 |
| 1967 |
| 1968 |

as t

trad

pari

hig

of

cas

cid

as

thi

thu

the

TABLE 9

TABULATION OF HIGH AND LOW MONTHS OF AVERAGE DAILY DELIVERIES AND SHIPMENT, 1959-1968 ADJUSTED FOR TREND

| Year | Total Deliveries, Tons/Trading Day | | Primary Shipments Tons/Trading Day | |
|---|---|---|---|---|
| | High Month | Low Month | High Month | Low Month |
| 1959 | June | January | May | January |
| 1960 | March | July | February | July |
| 1961 | December | January | December | January |
| 1962 | May | August | December | August |
| 1963 | June | January | December | January |
| 1964 | March | July | December | July |
| 1965 | December | June | May | June |
| 1966 | April | August | April | August |
| 1967 | December | August | December | August |
| 1968 | March | July | December | July |

as the month with the lowest deliveries or shipments per trading day.

One further analytical step that was made was a comparison of the high and low months with their respective high and low quarters. Of the twenty possible comparisons of high month and high quarter, in twelve out of twenty cases the month of highest deliveries or shipments coincided with the highest quarter. Less correlation occurred as far as the low month and low quarter are concerned. In this case only seven out of a possible twenty coincided, thus indicating a substantial degree of variability in the level of monthly activity.

seque

lacki

cate

a ran

above

occur

By ob

there

in De

Janua

is ta

in ex

ties

dete

indi

foll

This analysis fails to establish the existence of a sequential quarterly pattern of ingot shipments. Although lacking evidence of a sequential pattern, these data indicate a pattern dominated by the second quarter, followed by a random distribution of the remaining three quarters.

Year End Fluctuations. In the previous discussion above it was noted that peak deliveries and shipments occurred with the greatest degree of regularity in December. By observing this phenomenon in Figure 4, it is clear that there is a definite pattern of high deliveries and shipments in December followed by a corresponding drop in activity in January. The extent of this change in the level of activity is tabulated in Table 10 and indicates average fluctuations in excess of 11 per cent over the two month period.

Reference to the existence of these year end activities was included in the industry survey in an attempt to determine a causal relationship. The results of the survey indicated that this condition existed basically for the following reasons:[4]

1. Numerous states have year end inventory taxes. Tax on any material in transit at year end out of these states can be avoided by having

---

[4] Industry Survey, See Appendix B, Exhibit 2.

| Year |
| --- |
| 1959-60 |
| 1960-61 |
| 1961-62 |
| 1962-63 |
| 1963-64 |
| 1964-65 |
| 1965-66 |
| 1966-67 |
| 1967-68 |
| 1968- |
| Ave |

does p
but at
to the
worklo
would
ties,
tion i

TABLE 10

A COMPARISON OF PER CENT CHANGE IN AVERAGE DAILY DELIVERY AND SHIPMENT ACTIVITY IN DECEMBER AND JANUARY, 1959-1968

| Year | Total Average Daily Deliveries | | Average Domestic Primary Shipments | |
|---|---|---|---|---|
| | % Dec. over November | % Jan. under December | % Dec. over November | % Jan. under December |
| 1959-60 | 15.3 | 14.3 | 9.0 | 10.6 |
| 1960-61 | 1.9 | 14.1 | 7.1 | 20.5 |
| 1961-62 | 16.5 | 21.2 | 17.8 | 20.1 |
| 1962-63 | 9.9 | 12.0 | 17.2 | 21.7 |
| 1963-64 | 13.5 | 14.1 | 17.8 | 17.2 |
| 1964-65 | 4.8 | 8.3 | 5.1 | 8.0 |
| 1965-66 | 10.2 | 3.0 | 7.1 | 3.8 |
| 1966-67 | 6.9 | 3.4 | 6.7 | 1.8 |
| 1967-68 | 23.4 | 12.1 | 20.8 | 14.3 |
| 1968- | 16.8 | -- | 12.7 | -- |
| Average | 11.9% | 11.4% | 12.1% | 13.1% |

material in transit before the year end.[5]

2. The producers, in order to present an improved condition of sales for a given year, increase activity in December to raise the total sales volume for the current year. This, in effect, robs shipments from January of each succeeding year.[6]

---

[5]This cause has not been verified in the study. It does provide a logical cause for the year end fluctuation, but at the same time raises additional questions relative to the ability of the industry to handle the additional workload. Also, a short range fluctuation of this magnitude would create a substantial demand on transportation facilities, which could be beyond the capability of the transportation industry to handle in the short time period available.

[6]*Ibid.*

Contract

I

visual in

which occ

1963, 196

a peak sc

followed

Finally,

fourth qu

A

the seaso

and varia

than the

the resu

these ex

the alum

tories t

interrup

from lab

Fluctuat

The stru

industry

dure wit

Contract Termination Effects

In addition to the year end seasonal pattern, visual inspection of Figure 4 indicates a wave pattern which occurs with some regularity in the years 1959, 1962, 1963, 1964, 1965, 1967, and 1968. This pattern illustrates a peak sometime in the first or second quarter of the year followed by a rapid drop in deliveries and shipments. Finally, a return to a normal level occurs in the third or fourth quarter.

Although these cycles have a gross relationship to the seasonal pattern that the industry projects, the extent and variability of these cycles appears to be far greater than the fluctuations that would be expected if they were the result of a change in demand.

A factor which appears to be the probable cause of these extensive fluctuations is a threat to the supply of the aluminum which would necessitate a build up of inventories to protect users. A major form of threatened supply interruption is possible production shutdowns resulting from labor contract terminations.

Fluctuations Caused by Labor Contract Negotiations. The structure of labor contract negotiations in the aluminum industry is basically an industry wide negotiating procedure with two major unions. These two unions are the

United

CIO, ar

affilia

concurr

cent pl

carriec

produc

indust

were b

teams,

produc

alumin

is app

occur

relati

labor

exists

supply

tions

metal.

follow

United Steelworkers of America (USA),affiliated with the CIO, and the Aluminum Workers International Union (AWU), affiliated with the AFL.

Actual contract negotiations were usually carried on concurrently between the industry and both unions in adjacent physical locations. These concurrent negotiations were carried out by teams of negotiators representing the producing firms involved, with Alcoa generally acting as industry spokesman. While the industry-wide negotiations were being carried out between industry and union negotiating teams, local negotiations were carried on between individual production facilities and local union representatives.

The termination dates of labor contracts with the aluminum industry are plotted on Figure 4. From this, it is apparent that a pattern of short range fluctuations does occur preceding and following these termination dates. In relating these fluctuations to historical data relative to labor contract negotiations, a high degree of relationship exists between these threats to the interruption of the supply of aluminum and the resulting short range fluctuations in the average daily deliveries and shipments of metal. A detailed analysis of each threatened interruption follows:

No
du
th
or
ex
th
wh
or
Ju

ru
te
mo
ac

Ne
Th
US
ye
ma
ti
ar
re
th
re
ac
a

no
n
t
c
th
t

a
p
d
t
l

1. 1959--Contract expiration date was July 31. No agreement was apparent between the aluminum producers and unions as the termination date approached; thus the threatened interruption continued. Finally, on July 28, an agreement was reached, extending the existing contract until November 1 or 30 days after the current steel contract negotiations were completed, whichever occurred first. Final agreement was reached on December 19, when a three year contract expiring on July 31, 1962 was approved.

The net effect of this threatened supply interruption was a period of above normal shipments extending from March through July. These above normal months were followed by a period of below normal activity from August through October.

2. 1962--Contract expiration date was July 31. Negotiations were begun with the Unions on May 15. These negotiations proceeded successfully with the USA and an agreement was reached on June 29 on a two year contract. This agreement was completed approximately one month ahead of the termination date. Negotiations with the AWU were less successful and negotiations were suspended on June 1. These talks were resumed on July 8, but no settlement was reached by the July 31 termination date. On that date plants represented by the AWU were closed by strike. Final agreement was reached a few days later on August 2, after which the struck plants were immediately reopened.

The effect of the 1962 negotiations caused above normal shipment activity starting in March and below normal conditions existing until November. In addition, these contracts of 1962 carried an important clause allowing reopening of the contract in 1963, thus establishing another threatened interruption to the metal supply in the following year.

3. 1963--The reopening date for contract negotiations was July 31. Informal talks began between the producers and the Unions early in 1963. These informal discussions continued until July 31, at which time the two year contract of 1962 was extended until July 1, 1965.

na
po
ac
ab
Ma
Ju

In
Wo
te
le
ti
at
on
on
af

al
ac
ac

In
ll
pi
re
to
fo
be

th
ye
be
pe
12

Wage Cl
Bullet
Office

Although these discussions were not of a formal nature, the threat of a strike did exist during a portion of the time, thus necessitating hedging action on the part of aluminum users. Specifically, above normal shipment activity was apparent from March through June and below normal activity in July and August.

4. 1965--Contract expiration date was June 1. In April, the steel industry and the United Steel Workers agreed to postpone their steel contract termination date from May 1 to September 1. This led to a unique situation in that, for the first time, aluminum negotiations preceded steel negotiations. Actual negotiations in aluminum were opened on April 29 with the AWU. Agreements were reached on May 31 with the USA and on June 1 with the AWU, after a brief walkout by members of the AWU.

This threatened interruption to the supply of aluminum in 1965 resulted in above normal shipment activity during April and May and below normal activity from June through August.[7]

5. 1968--Contract expiration date was June 1. Initial labor contract negotiations began on April 11 amid reports of strike hedge buying and stockpiling. Failure to reach agreement with the AWU resulted in the shutdown of approximately 800,000 tons of capacity on June 1. This strike continued for approximately two months with final settlement being reached in August.

The 1968 labor contract negotiations resulted in the most extensive shipment fluctuations in the ten year period of the study. Pre-strike hedge buying began in February and continued through May with a peak being reached in April when it was approximately 12 per cent above the February level. Following the

---

[7]U. S. Dept. of Labor, Bureau of Labor Statistics, Wage Chronology, Aluminum Company of America, 1939-1968. Bulletin #1559, Washington: U. S. Government Printing Office, 1967.

c
s
s
e
r
t
i
t

labor

this s

the ex

year i

delive

the ye

tween

tions

by ant

strike

occasi

Becaus

on the

built

shutdo

---

pany c

contract termination, average daily deliveries and shipments dropped below normal, partly due to the strike shutdown in June and July and partly due to excess inventories. Deliveries, and shipments did not return to a normal level until November; thus the labor contract negotiations of 1968 resulted in abnormal delivery and shipment levels over a total period of nine months.[8]

In summary, in each of the five occurrences of a labor contract termination during the ten year period of this study, the same pattern developed. Table 11 summarizes the extent of these fluctuations. On an average, in any year in which a labor contract was negotiated, abnormal delivery and shipment activity occurs during 7.6 months of the year. The range of this abnormal activity varied between five and nine months.

The preceding discussion applies only to fluctuations in deliveries and shipments, which are brought about by anticipated production shutdowns resulting from threatened strikes. In addition to anticipated strike shutdowns, occasional unanticipated or "wildcat" strikes do occur. Because they are unexpected, no hedging action is possible on the part of users, hence no pre-strike inventories are built up. The effects of these unanticipated production shutdowns are quite different from anticipated production

---

[8]Interview Dr. Stanley Malcuit, The Aluminum Company of America, Pittsburgh.

F

| Year |
| --- |
| 1959 |
| 1962 |
| 1963 |
| 1965 |
| 1968 |
| Averag |

shutdo

Chapte

Price

labor

occur

appea

relat

TABLE 11

FLUCTUATIONS IN AVERAGE DAILY DELIVERIES CAUSED BY LABOR CONTRACT NEGOTIATIONS IN THE DOMESTIC ALUMINUM INDUSTRY FOR SELECTED YEARS, 1959-1968

| Year | Months of Above Normal Activity Preceding Termination | Average Fluctuations of Average Daily Deliveries Per Month in Tons Per Day | Months Below Normal Activity Following Settlement | Average Fluctuations of Average Daily Deliveries Per Month in Tons Per Day |
|---|---|---|---|---|
| 1959 | 5 | 1625 | 3 | 808 |
| 1962 | 5 | 655 | 4 | 769 |
| 1963 | 4 | 550 | 2 | 400 |
| 1965 | 2 | 1325 | 3 | 400 |
| 1968 | 4 | 1825 | 6 | 2179 |
| Average | 4.0 | 1196 | 3.6 | 911 |

shutdowns. They will be reviewed in detail later in Chapter VII.

## Price Change Fluctuations

Beyond the extensive fluctuations resulting from labor contract negotiations and the seasonal fluctuations occurring at year end, additional fluctuations occur which appear to have a relationship to price increases. This relationship seems to follow a pattern of increased

deliverie
price inc
This resu
used up b
level. T
this phen
producers
for a spe
announcem
operates
announced
date new
Second, a
longer be
shipments
ment of t

T
ten year
attempted
shows the
effective
which had

O

deliveries and shipments prior to the effective date of a price increase followed by a period of depressed activity. This results in increased inventories, which then must be used up before deliveries and shipments return to a normal level. This section will be directed toward an analysis of this phenomenon. When prices are increased by the aluminum producers, it is a common practice to allow price protection for a specified period of time following the date of announcement of the increase. Mechanically, the procedure operates in the following manner. First, an increase is announced and an effective date is established; after this date new orders will no longer be accepted at the old price. Second, a date is established after which shipments will no longer be made at the old price. This effective date on shipments is normally thirty days after the date of announcement of the increase.

There were twelve price changes announced during the ten year span of this study. The details of these twelve attempted price changes are summarized in Table 12, which shows the date of announcement, the amount of change, the effective dates of orders, and additionally, the firm(s) which had the initial responsibility for the price change.

Of the twelve attempted price changes, two were

TABLE 12

A SUMMARY OF ATTEMPTED ALUMINUM INGOT PRICE CHANGES,

TABLE 12

A SUMMARY OF ATTEMPTED ALUMINUM INGOT PRICE CHANGES, 1959-1868

| Date of Announcement | Amount of Price Change Per Pound | Effective Date of Price Change | Producer Change |
|---|---|---|---|
| 16 Dec. 1959 | + .013 | 18 Dec. 1959 | Initiated by Alcan |
| 22 Sept. 1961 | - .020 | 25 Sept. 1961 | Initiated by Alcan |
| 2 Dec. 1962 | - .015 | 3 Dec. 1962 | Initiated by Kaiser |
| 23 Sept. 1963 | + .005 | 2 Oct. 1963 | Initiated by Reynolds |
| 5 Dec. 1963 | + .010 | -- | Initiated by Kaiser Aborted by Alcoa |
| 16 Jan. 1964 | + .010 | -- | Initiated by Reynolds Aborted by Alcoa |
| 4 March 1964 | + .005 | 5 Mar. 1964 | Initiated by Alcoa |
| 4 June 1964 | + .005 | 15 June 1964 | Initiated by Ormet |
| 16 Nov. 1964 | + .005 | 19 Nov. 1964 | Initiated by Alcoa |
| 29 Oct. 1965 | + .005 | -- | Initiated by Ormet Aborted by Gov't. |
| 12 Jan. 1967 | + .010 | 18 Jan. 1967 | Initiated by Ormet Reduced to .005 by Alcoa |
| 31 May 1968 | + .010 | 3 June 1968 | Initiated by Alcoa |

Source: Dr. Stanley Malcuit, Aluminum Company of America, Pittsburgh, Pa.

decreas

analysi

have ar

any hec

Two of

1964, w

announc

1965, w

the ann

industr

not ger

ever, t

results

in havi

stockpi

orderly

tons by

mum yea

to be w

---

the alu

decreases and, consequently, they are excluded from the analysis. The price decreases are excluded because they have an immediate effectivity, therefore buyers do not take any hedging action. In addition, three were unsuccessful. Two of these failures, December 5, 1963, and January 16, 1964, were the result of Alcoa's failure to support the announced increases. The third failure on October 29, 1965, was the result of government intervention to prevent the announced increase.

The details of the activity on the parts of the industry and government which led to the 1965 failure are not germane to this study and are not detailed here; however, the net results of the action are of concern.[9] These results were twofold. First, the government was successful in having the announced increase rescinded. Second, the stockpile reduction program was established.

The program that was established called for an orderly reduction of the stockpile to a level of 450,000 tons by 1981. This reduction was based on minimum and maximum yearly allocations (subject to carry-overs) which had to be withdrawn by each of the participants as follows:

---

[9]For a detailed study of the 1965 price crisis in the aluminum industry see Hass, Porat, Tan & Young, op. cit.

Maximum

allocati

Intalco

the stoc

a contra

Althoug

changes

entire

reducti

in the

Table 1

see Far

| Participant | Minimum Yearly Allocation |
| --- | --- |
| Alcan | 10,000 tons |
| Alcoa | 29,400 " |
| Harvey | 2,700 " |
| Kaiser | 20,100 " |
| Ormet | 5,700 " |
| Reynolds | 22,400 |
| Total | 90,300 tons |

Maximum allocations were established at twice the minimum allocations.

The program did not include Anaconda, Conalco or Intalco as they were not original participants in building the stockpile; consequently, they elected not to enter into a contract to participate in the withdrawal program. Although not of primary concern to the effects of price changes on the level of shipments, the results of this entire action was the establishment of an orderly stockpile reduction program with its eventual elimination as a factor in the production, inventory, shipment cycle.[10]

The remaining seven price changes as shown in Table 12 were increases wherein possible effects from the

---

[10]For additional details of the stockpile program see Farin, *op. cit.*, p. 27.

price

vide

parti

not t

secon

prote

from

tice

for a

that

Exhib

prote

the s

year

direc

creas

and s

of th

to fo

deliv

tion.

price protection policy might be expected. In order to provide data for evaluating the effect of price changes, all participants in the industry survey were asked whether or not they did, in fact, provide price protection; and secondly, they were asked the length of time of the price protection. The results of the survey, based on information from six respondents, indicated that they followed the practice of allowing a period of price protection on shipments for a period of approximately thirty days after the date that the price change is announced. (See Appendix B - Exhibit 2).

Based on confirmation by the industry that price protection does exist, the following analysis will cover the seven successful price increases effected in the ten year period covered in this study. This analysis will be directed toward a determination of whether or not price increases do cause short range fluctuations in deliveries and shipments in the months immediately following the date of the price increases.

Theoretically, the fluctuations should be expected to follow a pattern of an increase in the level of deliveries and shipments during the period of price protection. Following this period of increased activity, it would be

activity

change f

data exi

changes

the mont

effect o

announce

in the

actual

occurre

levels

total

increa

would be reasonable to expect to find a period of depressed activity during which time excess inventories would be used.

A problem that exists in analyzing these price change fluctuations is the fact that delivery and shipment data exists only on a calendar month basis, while price changes are announced at times other than the first day of the month. This condition then has a potential varying effect on monthly activity depending on the timing of the announcement within the month. This condition is resolved in the following analysis by three assumptions:

1. If the price change announcement is made in the first days of the month, that same month will be primarily effected by the price change with only a minimal effect in the following month.

2. If the announcement is made in the middle portion of the month, both the current month and following month should indicate increased activity.

3. If the announcement is made in the latter part of the month, the following month will be primarily effected.

Based on the above assumptions, Table 13 indicates actual levels of delivery and shipment activity which occurred when a price increase became effective. These levels are stated in gross tonnage per month to illustrate total volume movements which subsequently result in inventory increases or reductions. The change from the indicated

TABLE 13

GROSS DELIVERIES AND SHIPMENTS OF ALUMINUM INGOT FOR SELECTED MONTHS AFFECTED BY PRICE CHANGES, 1959-1968

TABLE 13

GROSS DELIVERIES AND SHIPMENTS OF ALUMINUM INGOT FOR SELECTED MONTHS AFFECTED BY PRICE CHANGES, 1959-1968

| Date of Price Change | Affected Month | Total Deliveries Tons/Month | Per Cent Change in Deliveries From Reference Month | | Total Shipments Tons/Month | Per Cent Change in Shipments From Reference Month | |
|---|---|---|---|---|---|---|---|
| | | | % | Ref.Mo. | | % | Ref.Mo. |
| Dec. 16, 1959 | Nov. '59 | 159,852 | - | - | 152,024 | - | - |
| | Dec. '59 | 202,463 | +26.7 | Nov. | 184,123 | +21.1 | Nov. |
| | Jan. '60 | 157,855 | - 1.3 | Nov. | 148,129 | - 2.6 | Nov. |
| | Feb. '60 | 155,695 | - 2.6 | Jan. | 167,215 | +12.9 | Jan. |
| Sept. 23, 1963 | Aug. '63 | 250,427 | - | - | 194,268 | - | - |
| | Sept.'63 | 255,058 | + 1.8 | Aug. | 202,001 | + 4.0 | Aug. |
| | Nov. '63 | 243,005 | - 4.7 | Sept. | 187,355 | - 7.2 | Sept. |
| Mar. 4, 1964 | Feb. '64 | 255,717 | - | - | 200,400 | - | - |
| | Mar. '64 | 274,539 | + 7.4 | Feb. | 216,079 | + 7.8 | Feb. |
| | Apr. '64 | 277,999 | + 8.7 | Feb. | 220,922 | +10.2 | Feb. |
| | May '64 | 261,218 | - 6.0 | Apr. | 208,462 | - 5.6 | Apr. |
| June 4, 1964 | May '64 | 261,218 | - | - | 208,462 | - | - |
| | June '64 | 272,903 | + 4.5 | May | 216,281 | + 3.8 | May |
| | July '64 | 271,025 | + 3.8 | May | 211,069 | + 1.3 | May |
| | Aug. '64 | 250,081 | - 7.7 | July | 204,947 | - 2.9 | July |
| Nov. 16, 1964 | Oct. '64 | 269,541 | - | - | 206,945 | - | - |
| | Nov. '64 | 262,863 | - 2.5 | Oct. | 219,242 | + 5.9 | Oct. |
| | Dec. '64 | 289,459 | + 7.4 | Oct. | 242,129 | +17.0 | Oct. |
| | Jan. '65 | 252,759 | -12.7 | Dec. | 212,139 | -12.4 | Dec. |
| Jan. 12, 1967 | Dec. '66 | 332,437 | - | - | 254,056 | - | - |
| | Jan. '67 | 337,388 | + 1.5 | Dec. | 263,487 | + 3.7 | Dec. |
| | Feb. '67 | 322,782 | - 3.0 | Dec. | 251,056 | - 1.2 | Dec. |
| | Mar. '67 | 353,553 | + 9.5 | Feb. | 273,681 | + 9.0 | Feb. |
| May 31, 1968 | May '68 | 402,112 | - | - | 305,080 | - | - |
| | June '68 | 313,618 | -22.0 | May | 206,571 | -32.3 | May |
| | July '68 | 311,591 | - .6 | June | 221,089 | + 7.0 | June |

referen
In each
column
month i
be a mo
followi

does em
changes
June 4,
pattern
followi
in the
activit
case,
in the
case t
rather
respec

not fo
correl
occurr

reference month is also included as a measure of magnitude. In each case, the first month shown in the "Affected Month" column opposite the "Date of Price Change" is the reference month in each series of months. This month is assumed to be a month of normal activity to which changes in the following months can be compared.

In viewing each price change individually a pattern does emerge in the selected changes. In three of the price changes, those of September 23, 1963, March 4, 1964, and June 4, 1964, deliveries and shipments follow the predicted pattern. In each of the three cases, the first two months following the reference month show a higher activity than in the reference month while in the third succeeding month activity drops to a level substantially lower. In a fourth case, that of November 16, 1964, a single variation occurred in the pattern of total deliveries in November. In this case the deliveries were lower than the reference month rather than higher, as would be expected. In all other respects this price change also followed the pattern.

The remaining three price changes in the series did not follow the prescribed pattern. Reviewing this lack of correlation in the light of extenuating circumstances occurring at the same time, it is assumed that this

deviatio
1959, ar
of the
The lack
of May
down in

Indicat
of deli
Secondl
each of
ments.
tween t
of char
correla
correla

fifteen
deliver
the ca
that w
sidere
situat

deviation from the pattern concerning the December 16, 1959, and January 12, 1967, price changes was the result of the year end seasonal activity previously discussed. The lack of correlation in the remaining price change, that of May 31, 1968, was the obvious result of the strike shutdown in progress in the aluminum industry at the time.

The overall pattern is summarized in Table 14. Indicated in the table is the expected direction of change of deliveries and shipments in each of the affected months. Secondly, the actual direction of change is indicated for each of the affected months for both deliveries and shipments. In the last section of the table, comparison between the expected direction of change and actual direction of change is indicated by a positive sign (+) to indicate correlation and a negative sign (-) to indicate non-correlation.

The total correlation in the seven price changes is fifteen of twenty months or 75 per cent in the case of deliveries and fourteen of twenty months or 70 per cent in the case of shipments. When only the four price changes that were unaffected by extenuating circumstances are considered, almost complete correlation is evident. In this situation only one month of a total of twenty-four monthly

TABLE 14

CORRELATION OF EXPECTED AND ACTUAL CHANGES IN DELIVERIES AND SHIPMENTS OF ALUMINUM INGOT FOR SELECTED MONTHS AFFECTED BY PRICE CHANGES, 1959-1968

TABLE 14

CORRELATION OF EXPECTED AND ACTUAL CHANGES IN DELIVERIES AND SHIPMENTS OF ALUMINUM INGOT FOR SELECTED MONTHS AFFECTED BY PRICE CHANGES, 1959-1968

| Date of Price Change | Unaffected Month | Affected Month | Expected Direction of Change Over Unaffected Months | Expected Direction of Change Over Previous Month | Actual Direction | | Correlation | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Deliveries | Shipments | Deliveries | Shipments |
| Dec. 16, 1959 | Nov. '59 | Dec. '59 | + | | + | + | + | + |
| | | Jan. '60 | + | | - | - | - | - |
| | | Feb. '60 | | - | - | + | + | - |
| Sept. 23, 1963 | Aug. '63 | Sept. '63 | + | | + | + | + | + |
| | | Oct. '63 | + | | + | + | + | + |
| | | Nov. '63 | | - | - | - | + | + |
| Mar. 4, 1964 | Feb. '64 | Mar. '64 | + | | + | + | + | + |
| | | Apr. '64 | + | | + | + | + | + |
| | | May '64 | | - | - | - | + | + |
| June 4, 1964 | May '64 | June '64 | + | | + | + | + | + |
| | | July '64 | + | | + | + | + | + |
| | | Aug. '64 | | - | - | - | + | + |
| Nov. 16, 1964 | Oct. '64 | Nov. '64 | + | | - | + | - | + |
| | | Dec. '64 | + | | + | + | + | + |
| | | Jan. '65 | | - | - | - | + | + |
| Jan. 12, 1967 | Dec. '66 | Jan. '67 | + | | + | + | + | + |
| | | Feb. '67 | + | | - | - | - | - |
| | | Mar. '67 | | - | + | + | - | - |
| May 31, 1968 | May '68 | June '68 | + | | - | - | - | - |
| | | July '68 | | - | - | + | + | - |

correla

this an

each ti

tory cy

mately

substa

cycle i

to whic

time pe

if a pe

comple

cides

price

end ac

weaker

this c

acts a

ditior

correlations failed to follow the predicated pattern.

The Effects of Price Change Policy. The results of this analysis provides sufficient evidence to assume that each time the aluminum industry increases prices, an inventory cycle is generated. This cycle extends for approximately 60 days. During the first 30 days, shipments are substantially above consumption. The second half of the cycle is less well defined because it depends on the extent to which users hedge on price, but it does consist of a time period during which shipments are below demand.

This pattern occurs each time a price change is made if a period of price protection is allowed. At times the complete process is not evident if the price change coincides with other conditions which might overshadow the price change effect. In these situations, such as year end activity or strikes, the price change effect is the weaker and it is dominated by the other condition. When this occurs, the net result is that the price change effect acts as a modifying factor on the stronger prevailing condition.

War Thr

of wars

and shi
1960 th
major c
factor
and sa
ducers

tinual
have b
price
alumin
on the
These
tation
the ex
buying

War Threat Inventory Fluctuations

The apparent effects, resulting from wars and threats of wars, are discussed in Chapter VII.

## Summary

The trend in the level of aluminum ingot deliveries and shipments has followed a linear growth pattern from 1960 through 1968. This trend did not indicate that any major cyclical patterns occurred. At least one seasonal factor has been identified which is a year end inventory and sales adjustment program followed by the primary producers.

Of greater importance are the conditions that continually occur in the aluminum ingot market of which two have been identified as labor contract negotiations and price changes. The importance of these conditions on the aluminum ingot market is in that they place varying demands on the production and distribution system in the short run. These varying demands are the result of changes in expectations on the part of aluminum users who compensate for the expectation changes by first overbuying and then underbuying.

of th

sion

to wh

stock-

quest

far a

stant

is th

tion

inven

will

discu

This

suppo

CHAPTER VII

# ALUMINUM INGOT PRODUCTION, INVENTORY, AND IMPORT-EXPORT VARIABLES

## Introduction

In the Chapter I subsection, "Stock-Sales Ratios", of the section, "Review of Previous Literature", a discussion was presented indicating conflicting theories relative to whether or not businessmen attempt to maintain a constant stock-sales ratio. Further, HYPOTHESIS II specifically questions the validity of a constant stock-sales ratio as far as the aluminum ingot market is concerned.

An investigation into the applicability of the constant stock-sales ratio theory to the aluminum ingot market is the primary objective of this chapter. This investigation will be carried out by developing the production and inventory segments of the over-all model. These segments will be combined with the shipment and delivery segment discussed in Chapter VI, into an aluminum ingot model. This model will be examined to determine if it can logically support the constant stock-sales ratio theory.

I

of the co

ingot mar

evaluate

ingot mar

T

tories, a

A MODEL

Productio

In this

then in

economi

of ship

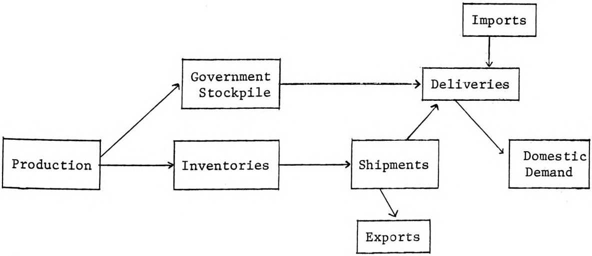
In addition to an investigation of the applicability of the constant stock-sales ratio theory to the aluminum ingot market, a second objective of this chapter will be to evaluate the effects of imports and exports on the same ingot market.

## The Aluminum Ingot Market Model

The basic relationship between production, inventories, and shipments is illustrated in Figure 5:

FIGURE 5

A MODEL OF THE PRODUCTION-INVENTORIES-SHIPMENT RELATIONSHIP




In this model, if demand and leadtime are deterministic, then inventory's primary role is to allow production in economic lot quantities at a rate different than the rate of shipments. If an assumption is made so that the rate of produ

rate of

of shipm

probabil

uncoupli

cycle.

duction

viding f

ments, a

the rate

the vari

range f

ments w

that th

of pred

ments t

basis.

ingot a

the mod

tuating

of production is variable over an infinite range, then the rate of production can be matched perfectly with the rate of shipments and the need for inventories is eliminated.

As these deterministic conditions are replaced by probabilistic conditions, inventories take on a role as an uncoupling device between the stages of the production cycle. This role includes the functions of allowing production and procurement in economic lot quantities, providing for variances between anticipated and actual shipments, allowing for anticipated and random fluctuations in the rate of production, and finally as a means to separate the various stages of the production process.

In the preceding chapter, the levels and short range fluctuations in the levels of aluminum ingot shipments were analyzed. In that analysis it was determined that the ingot shipments were influenced by a number of predictable factors which caused the level of shipments to vary over a wide range on a month to month basis. Due to these conditions, shipments of aluminum ingot are established as a widely fluctuating variable in the model.

The production alternatives brought on by a fluctuating shipment pattern are two. First, the fluctuating shipment

to match

case whe

cannot b

the stag

relative

phase o

tion th

than a

the alu

and ing

terns.

analysi

1959-19

Ingot p

aluminu

tion of

This in

shipments can be matched by an adjustable production system to match the shipments. The second alternative, in the case where the condition of an adjustable production system cannot be met, is the use of an inventory buffer between the stages of the system.

## Production

The conditions that were established in Chapter V relative to the operating characteristics of the reduction phase of the aluminum production cycle led to the assumption that production would tend toward a fixed rate, rather than a highly variable rate. If this situation prevails in the aluminum ingot production phase, then ingot production and ingot shipments are operated on widely divergent patterns. The following discussion will be directed toward an analysis of aluminum ingot production during the period of 1959-1968 to ascertain what production conditions prevailed.

### Ingot Production Capacity

In order to establish the potential output of aluminum ingot, a first step in the analysis is a determination of available domestic capacity on a monthly basis. This ingot capacity is summarized in Appendix C.

During the period of time of the study, total yearl

1959,

incre

addi

sult

tons

chan

1967

76,0

at F

incr

as a

the

ver

age

ity

64.

tiv

Uti

of

un

yearly capacity increased from 2,225,500 tons in January, 1959, to 3,654,000 tons in December, 1968. This capacity increase was accomplished in a total of 38 incremental additions, ranging in size from 3,000 tons per year resulting from minor production improvements, up to 158,000 tons per year resulting from major plant additions and changes. This latter increase was recorded in January, 1967. It resulted from one major capacity addition of 76,000 tons at Intalco and several capacity improvements at Reynolds.

On an incremental basis, as shown in Table 15, the increases were of a relatively small size when considered as a per cent of the then existing capacity. The range of the capacity increases, on a percentage basis, was from a very minimal 0.1 per cent up to 5.4 per cent with the average 1.3 per cent. This indicates that although total capacity growth over the entire ten year period was a substantial 64.3 per cent, available capacity was increased in relatively small increments over a linear growth pattern.

## Utilization of Aluminum Ingot Capacity

With the exception of war years, the earlier history of aluminum ingot production indicates that capacity was under utilized. Previous to World War II, this excess

| Month Recor Chan |
| --- |
| 1959 |
| 1960 |
| 1961 |
| 1962 |
| 1963 |
| 1964 |
| 1965 |
| 1966 |
| 1967 |
| 1968 |

TABLE 15

SUMMARY OF ABSOLUTE AND INCREMENTAL ALUMINUM INGOT CAPACITY CHANGES, 1959-1968

| Month of Recorded Change | | Absolute Change In Capacity In 1000's Tons Per Year | Incremental Change In Per Cent |
|---|---|---|---|
| 1959 | June | 36 | 1.6 |
| | July | 33 | 1.4 |
| 1960 | March | 53 | 2.3 |
| | July | 46 | 2.0 |
| 1961 | March | 15 | .6 |
| 1962 | May | 34 | 1.4 |
| 1963 | January | 5 | .2 |
| | September | 20 | .8 |
| 1964 | March | 9 | .4 |
| | April | 15 | .6 |
| | July | 19 | .8 |
| | October | 5 | .2 |
| | December | 41 | 1.6 |
| 1965 | January | (-8) | (.3) |
| | February | 60 | 2.4 |
| | March | 26.5 | 1.0 |
| | April | 30 | 1.2 |
| | June | 105 | 3.9 |
| | August | 35 | 1.3 |
| 1966 | May | 49 | 1.7 |
| | June | 76 | 2.7 |
| | July | 13 | .4 |
| 1967 | January | 158 | 5.4 |
| | March | 50 | 1.6 |
| | July | 11 | .3 |
| | August | 10 | .3 |
| | September | 60 | 1.9 |
| | October | 46 | 1.4 |
| | November | 10 | .3 |
| | December | 10 | .3 |
| 1968 | January | 8 | .2 |
| | February | 20 | .6 |
| | March | 34 | 1.0 |
| | July | 3 | .1 |
| | September | 75 | 2.2 |
| | October | 20 | .6 |
| | November | 76 | 2.2 |
| | December | 120 | 3.4 |

capacity

First,

mands o

vided a

active

ity to

II and

capacit

capacit

governn

provide

alumin

five y

capaci

reache

declin

availa

reachi

steadi

change

capacity was developed by Alcoa for a twofold purpose. First, it provided a ready source of metal to meet the demands of a constantly expanding market, and second, it provided a deterrent to new entrants into the industry.

Beginning in 1940, the Federal Government was active in encouraging and financing ingot production capacity to meet the needs of the economy during both World War II and the Korean War. During this period, utilization of capacity fluctuated extensively. At times of peak demand, capacity was fully utilized, while at other times, the government resorted to the artificial stockpile market to provide an increased level of capacity utilization for the aluminum producers.

Change in Capacity Utilization. During the first five years encompassed by this study, under utilization of capacity continued as a problem. This under utilization reached a low point in April, 1961, during the business decline. At that time, approximately 27 per cent of the available domestic ingot capacity was shutdown. After reaching this low point, capacity utilization increased steadily (see Figure 6).

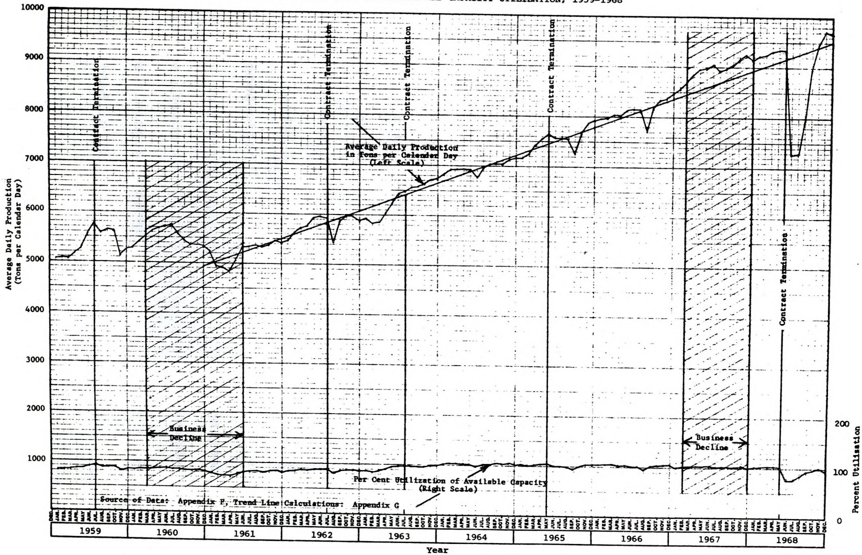
The pattern of utilization underwent a substantial change beginning in 1964. Starting in early 1964 and

FIGURE 6

DOMESTIC ALUMINUM INGOT PRODUCTION AND CAPACITY UTILIZATION, 1959-1968

FIGURE 6

DOMESTIC ALUMINUM INGOT PRODUCTION AND CAPACITY UTILIZATION, 1959-1968



continu

sional

utilize

Fluctu

a line

patter

discus

fluctu

tinuin

stable

short

tion,

those

per m

of ac

to id

where

limit

are s

continuing through 1968, with the exception of some occasional deviations to be discussed later, capacity was utilized at or above its rated level.

Fluctuations in Production

A comparison of actual average daily production with a linear regression line in Figure 6 shows a change in the pattern in 1961 similar to the shipment pattern previously discussed. Prior to 1961, the actual production pattern fluctuated to a greater extent. Starting in 1961 and continuing through 1968, production followed a relatively stable linear growth pattern with the exception of some short range fluctuations.

In order to identify these fluctuations in production, a basis was provided by the arbitrary selection of those periods where the change in average daily production per month exceeded 3 per cent from the then existing level of actual production. Based on this criteria, it was possible to identify only seven periods in the entire ten years wherein the change in the rate of production exceeded this limit. The timing and apparent causes of these fluctuations are summarized in Table 16.

FLU

Peri

1959

1961

1962

1963

1965

1966

1968

any
thi
mas
red
the
men

Pro

195

se

bu

TABLE 16

FLUCTUATIONS IN THE LEVEL OF AVERAGE DAILY ALUMINUM INGOT PRODUCTION OCCURRING IN THE PERIOD 1959-1968

| Period | | Apparent Reason For Production Fluctuation |
|---|---|---|
| 1959 | June--November | Build up prior to and shut-down following labor contract negotiations. |
| 1961 | March--June | Business decline. |
| 1962 | August--September | Industry strike. |
| 1963 | April--June | Build up prior to labor contract negotiations. |
| 1965 | September--November | Unidentified[a] |
| 1966 | August--September | Wildcat strike at Ormet. |
| 1968 | June--October | Industry strike. |

[a]A search of available publications failed to reveal any specific cause for a reduced level of production during this period. Probable causes include wildcat strikes or the massive power blackout that occurred November 9, 1965. Also reduced production levels could have been associated with the stockpile disposal program negotiated with the government.

Production Activity during Business Declines

Two business declines occurred during the period 1959-1968. Figure 7 shows that, based on the Federal Reserve Board's Index of Industrial Production, the first business downturn started in the second quarter of 1960

FIGURE 7

DOMESTIC ALUMINUM INGOT PRODUCTION, INVENTORIES, AND FRB INDEX OF INDUSTRIAL PRODUCTION, 1959-1968

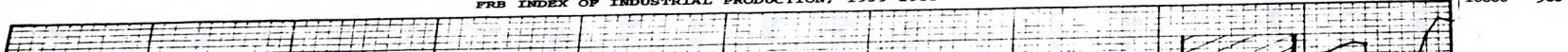
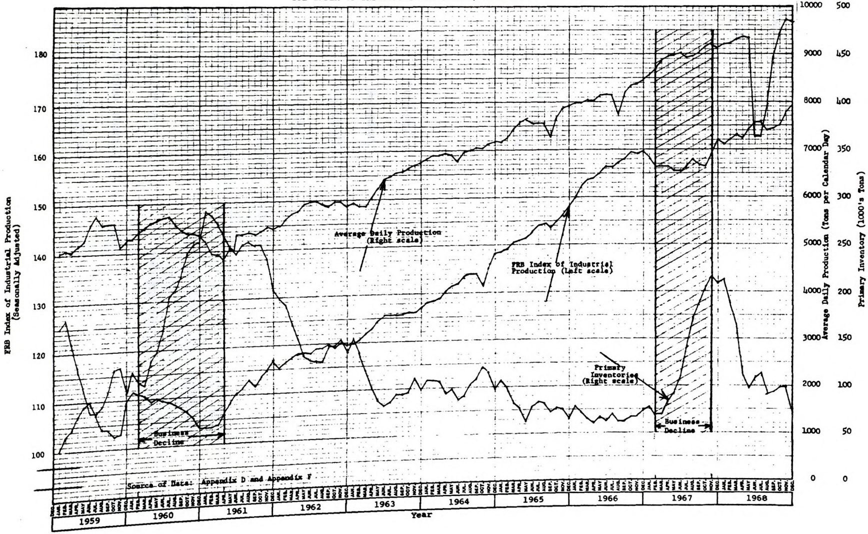


FIGURE 7

DOMESTIC ALUMINUM INGOT PRODUCTION, INVENTORIES, AND FRB INDEX OF INDUSTRIAL PRODUCTION, 1959-1968



and contin

second dec

quarter of

ingot acti

between th

19

immediatel

producers

came on s

continued

the decli

to the ge

duction i

Starting

decreased

trend of

April, 1

a long r

aluminum

general

months o

Index of

level wh

and continued through the second quarter of 1961. The second decline of much less magnitude, began in the first quarter of 1967 with recovery by the end of 1967. Aluminum ingot activity, summarized below, differed substantially between the two declines.

<u>1960-1961 Business Decline</u>. During the period immediately preceding the 1960-61 decline, aluminum ingot producers increased the level of production as new capacity came on stream. This increase in average daily production continued until July, 1960, so that in the early months of the decline aluminum ingot production actually ran counter to the general trend of industrial production as ingot production increased and industrial production decreased. Starting in August, 1960, average daily production was decreased as potlines were shut down, thus matching the trend of the FRB index. This decrease continued until April, 1961, at which time average daily production started a long range upward trend. From a macro standpoint, aluminum ingot production had differing relations to the general trend of industrial production. In the early months of the decline, aluminum tended to hold the FRB Index of Industrial Production at a higher than expected level while in the later stage of the decline, and during

the recove

trend of i

D

approxima

290,000 t

exceed de

depressin

1963 as i

capacity

point of

capacity

to norma

moderate

FRB Inde

November

producti

maintain

producti

producti

were add

Table 1

the recovery, aluminum activity reinforced the general trend of industrial production.

During the decline inventories were increased from approximately 115,000 tons in March, 1960, to a peak of 290,000 tons in January, 1961, as production continued to exceed demand. After recovery, these inventories had a depressing effect on aluminum ingot production until mid 1963 as illustrated in Figure 7. During this entire period, capacity utilization ran below 90 per cent, reaching a low point of 73 per cent in April, 1961, as producers held capacity out of production pending a reduction of inventory to normal levels.

1967 Business Decline. The decline of 1967 was a moderate downturn as illustrated by the gradual dip in the FRB Index of Industrial Production between February and November. The significant aspect, as far as aluminum ingot production is concerned, is the fact that the producers maintained the upward trend in the level of average daily production during the entire period rather than reduce production. Actually, incremental increases in capacity were added in eight different months during 1967. (See Table 15).

As in the earlier decline, the effect of reduced demand

approx

Novemb

materi

declin

the te

period

increa

stanti

of pro

with s

carryi

combin

depend

of dep

crease

adjust

levels

elemen

at the

demand was reflected in an increase in inventories from approximately 120,000 tons in April to 215,000 tons in November. In the long run, this inventory buildup provided material to meet demand during the strike of 1968.

Summary of Business Declines. Action during the declines, on the part of aluminum ingot producers, confirms the tendency to continue production operations during periods of reduced demand while inventories are allowed to increase to substantially high levels. These patterns substantiate the previous assumptions relative to the practice of producers maintaining production while demand catches up with supply or where inventories reach a level so high that carrying costs prohibit further increases. These factors combine to establish an inventory cycle of variable length depending on the level of business activity. During periods of depressed demand, inventories increase and as demand increases, inventories decrease. Production levels are not adjusted until inventories exceed excessively high or low levels.

## Inventories

Physical inventories in the model consist of two elements. These two elements are: one, inventories on hand at the various reduction plants, and two, metal inventories in th

vento

Appa

plan

rate

inve

smal

quer

Seco

exis

ing.

able

unde

it a

data

abi

yea

tha

in

The

the

in the government stockpile. Data relative to actual inventories are included in Appendix D.

Apparent Accuracy of Inventory Data

Inventory data, relating to ingot at producer's plants and the stockpile, is assumed to be relatively accurate. Reasons for assuming a high level of accuracy in the inventory data are based first on the fact that only a small number of primary producers are involved, consequently, complete monthly reporting is easily achieved. Second, the product is homogeneous hence no apparent problem exists in defining inventory to be included in the reporting. Third, government stockpile data, although not available on a monthly basis for the entire study period, is under close governmental control and inspection, consequently, it also appears to be accurate except as noted.

Inaccuracies existing in the government stockpile data for the months prior to 1965 result from the unavailability of monthly data from government sources, although year end data exists. This problem was resolved by assuming that stockpile deliveries and withdrawals were accomplished in equal monthly increments throughout the entire year. The effect of monthly averaging of stockpile changes over the entire year is less than 5 per cent of total shipments for an

does

levels

Invent

shipme

betwe

tuati

produ

these

the s

produ

creas

decre

trate

vent

and s

rate

this

and

inve

for any month of the study. The effect of the assumption does not cause any change in the over-all trend of inventory levels.

Inventories as a Dependent Variable

Given that fluctuations occur in deliveries and shipments; inventories, in performing an uncoupling function between production and shipments, are subject to the fluctuations in these independent variables.

At least five fluctuating conditions relating to production and shipments could prevail. Under three of these conditions, the net effect on inventories would be the same. These are: one, constant and equal rates of production and shipments; two, production and shipments increasing at equal rates; three, production and shipments decreasing at equal rates. These three conditions are illustrated in Figure 8. This indicates the dependence of inventories on the difference between the rates of production and shipments.

The fourth condition to be considered is where the rate of shipments exceeds the rate of production. Under this condition, the level of inventories will be decreased and the ratio between inventories and shipments will vary inversely. This condition is also illustrated in Figure 8.

The fi

situati

ments a

invers

The ac

pared

AN I

Rate

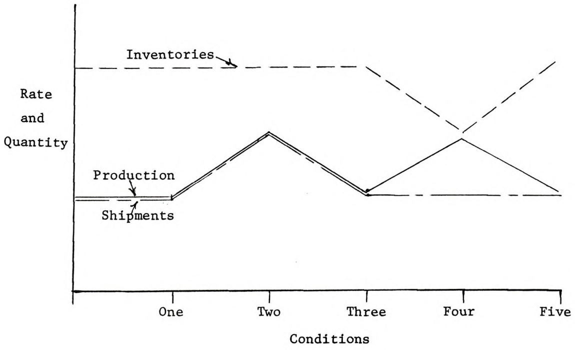
and

Quantity

The fifth condition is the inverse of the fourth. In this situation, the rate of production exceeds the rate of shipments and inventories will be increasing. Here again an inverse ratio would exist between inventories and shipments. The actual conditions existing in the ingot market are compared below with the preceding theoretical conditions.

FIGURE 8

AN ILLUSTRATION OF THE EFFECT OF PRODUCTION AND SHIPMENT LEVELS ON INVENTORIES IN THE ALUMINUM INGOT MODEL



Year

nega

char

is

The

inv

shi

day

onl

in

red

the

the

Alu

tua

tor

mer

bot

In

the

Year End Institutional Fluctuations

The expected counter cyclical pattern of a large negative inventory change in December followed by a positive change in January brought about by year end shipment activity is clearly evident in every year of the study except 1966. The reasons that 1966 does not show a pattern of year end inventory fluctuations are: first, although average daily shipments were increased, due to a lessor number of trading days (20), gross shipments of 254,056 tons in December were only slightly higher than gross shipments of 250,008 tons in November; second, stockpile withdrawals were drastically reduced from previous months as the producers had fulfilled their commitments under the 1965 stockpile plan earlier in the year.

Aluminum Industry Strike Hedge Fluctuations

A close relation is evident between shipment fluctuations caused by strike hedging and corresponding inventory change fluctuations as summarized in Table 17.

In the five pre-termination situations, either shipments were increased and production remained constant or both the rate of production and shipments were increased. In both cases, the increase in rate of shipments exceeded the increase in the rate of production so that inventories

| Year of Negot iatio |
|---|
| 1959 |
| 1962 |
| 1963 |
| 1965 |
| 1968 |

decre

oppos

peak

dates

indic

TABLE 17

COMPARISON OF AVERAGE DAILY SHIPMENT FLUCTUATIONS AND INVENTORY CHANGES RESULTING FROM ALUMINUM INDUSTRY LABOR CONTRACT NEGOTIATIONS

| Year of Negotiation | Labor Contract Pre-Termination Patterns | | | | | Labor Contract Post-Termination Patterns | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Production and Shipment Change | | | Inventory Change | | Production and Shipment Change | | | Inventory Change | |
| | Shipment | Production | Months | Direction | Months | Shipment | Production | Months | Direction | Months |
| 1959 | + | + | 4 | - | 5 | - | 0 | 4 | + | 4 |
| 1962 | + | 0 | 5 | - | 5 | - | 0 | 4 | + | 5 |
| 1963 | + | + | 4 | - | 5 | - | 0 | 4 | + | 5 |
| 1965 | + | + | 3 | - | 4 | 0 | 0 | 3 | + | 2 |
| 1968 | + | 0 | 5 | - | 4 | - | - | 3 | + | 2 |

decreased. In the five post-termination situations, the opposite conditions prevailed so that inventories increased.

## Imports and Exports

An aspect of this analysis is the relation between peak levels of net imports and labor contract termination dates that have been disclosed. This relation is clearly indicated in Figure 9, where total imports are plotted on

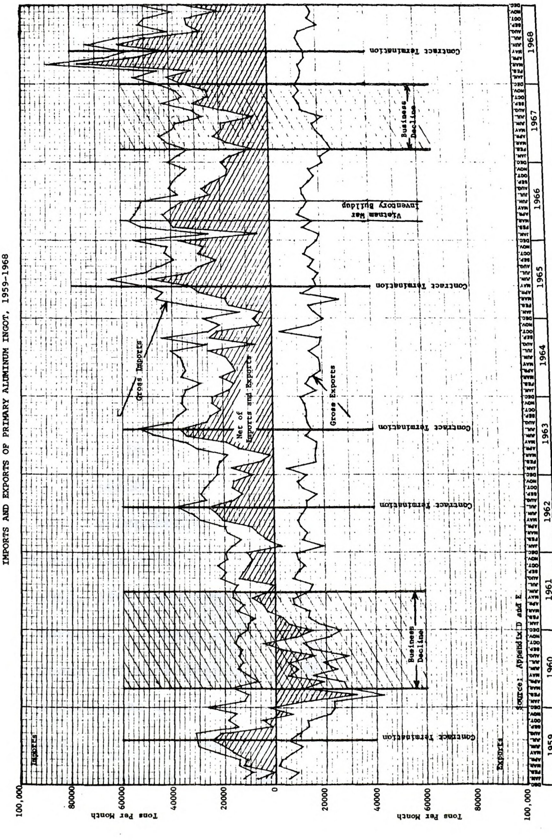
FIGURE 9

IMPORTS AND EXPORTS OF PRIMARY ALUMINUM INGOT, 1959-1968

100,000

FIGURE 9

IMPORTS AND EXPORTS OF PRIMARY ALUMINUM INGOT, 1959-1968



the t

on th

net o

noted

Febru

Unite

do oc

are a

of th

level

time.

in 19

tinue

a per

playe

1962,

tract

These

is in

produ

the top on an ascending scale and total exports are plotted on the bottom portion of an inverted scale. The resulting net of imports and exports are also plotted. As can be noted, except for the period from November, 1959, to February, 1961, and the single month of January, 1962, the United States has been a net importer of primary aluminum.

A review of exports shows that, although fluctuations do occur, no recognized patterns of short range fluctuations are apparent or consistent. Over the entire ten year period of the study, only two extended periods occurred where the level of exports increased over an appreciable length of time. One of these periods was during the business decline in 1960-61. The other started in the fall of 1966 and continued until July, 1967. This likewise was partially during a period of reduced business activity.

Gross imports and net of imports over exports displayed a series of six peak periods. The peaks of 1959, 1962, 1963, 1965, and 1968 coincide with the labor contract termination dates of the domestic aluminum industry. These peaks indicate that a portion of the metal that is inventoried as a strike hedge is supplied by foreign producers.

No attempt has been made in this study to relate end pr

specif

hedge,

is sub

affect

by an

on le

ing t

estim

numbe

tiona

losse

hedgi

Altho

prov

suff

inte

<u>War</u>

not

for

of

War

end product demand with total metal supply to determine the specific amount of additional metal imported as a strike hedge, although it is apparent from Figure 9 that the amount is substantial. It is also apparent that these imports affect domestic production by reducing domestic shipments by an equivalent amount. As a rough approximation, based on levels of net imports immediately preceding and following the strike hedge period, these additional imports are estimated to be as indicated in Table 18. The approximate number of days of production lost to the estimated additional imports serve as an indication of the amount of losses incurred by domestic producers and labor because of hedging against the threat of an interruption of supply. Although admittedly only rough approximations, these figures provide evidence that both domestic industry and labor do suffer economic losses because of the threat of supply interruptions brought about through collective bargaining.

War Threat Inventory Hedge

The peak of net imports which occurred in 1966 does not relate to any labor contract negotiations. The reason for this high level of imports is attributed to the threat of a supply interruption or shortage due to the Vietnam War. In this case, users were faced with increased demands

E

| Year |
| --- |
| 1959 |
| 1962 |
| 1963 |
| 1965 |
| 1968 |

for

to

duc

res

re

in

ch

an

co

TABLE 18

ESTIMATED ADDITIONAL PRIMARY ALUMINUM IMPORTS OCCURRING DURING LABOR CONTRACT NEGOTIATIONS

| Year | Estimated Additional Tonnage of Net Imports | Approximate Days of Domestic Production Lost |
|---|---|---|
| 1959 | 50,000 | 9 |
| 1962 | 45,000 | 8 |
| 1963 | 42,000 | 7 |
| 1965 | 52,000 | 7 |
| 1968 | 109,000 | 11 |

for end products thereby necessitating increased purchases to fill work in process pipelines. Because domestic producers were operating close to full capacity levels, users resorted to foreign sources to fill this need.

## Summary

Results of this analysis indicate no reason for rejecting the original hypothesis regarding the aluminum ingot Production-Inventory-Shipment Model. The diverse characteristics of a widely fluctuating shipment pattern and a relatively stable production pattern establish the condition wherein the uncoupling characteristic of inventories is r

caus

clos

acti

actu

dire

als

inc

Usi

an

los

tot

mat

one

of

inv

ma

is required. Although other factors exist, the primary causes of fluctuations in both shipments and production are closely related to labor contract negotiations either in activity brought about in anticipation of a strike or in actual shutdown resulting from strikes.

In addition to the fluctuations that are caused directly by labor contract negotiations, detrimental effects also occur to both domestic industry and labor because of increased imports. This effect can be approximated for 1968. Using the estimated increase in imports of 109,000 tons, and an estimated labor content of $60.00[1] per ton, this is a loss in direct labor only of approximately $6,500,000. The total effect on domestic business is a reduction of approximately $56,680,000.[2]

Further, although insufficient evidence from only one incident precludes arriving at a conclusion, the threat of war also appears to be a condition which generates inventory and import fluctuations in the domestic ingot market.

---

[1]See Table 4 for cost and price data.

[2]Ibid.

pi

in

19

an

to

de

we

Fi

wh

19

th

Hy

in
oi

# CHAPTER VIII

# SUMMARY AND CONCLUSIONS

This study of the aluminum ingot market, as depicted in Figure 2, was undertaken to examine fluctuations in this market in the United States during the period 1959-1968. Specific causes of the fluctuations were identified and the extent to which they effected purchasing, inventories, and shipments were analyzed.

## Conclusions

The study was approached by analyzing monthly total deliveries, shipments, production, and inventory data that were applicable to the flow of aluminum ingot as shown in Figure 2. This analysis identified and evaluated conditions which effected the domestic ingot market during the period 1959-1968. The results of the analysis, as applicable to the hypotheses and questions, are discussed below.

### Hypothesis I

The first hypothesis stated:

During the period 1959-1968, causes of fluctuations in aluminum ingot inventories and shipments were the result of other than changes in the level of demand for ingot.

Ch

19

in

19

co

me

The validity of this hypothesis (demonstrated in Chapter VI "Aluminum Ingot Deliveries and Shipments, 1959-1968") was in the form of a time series analysis of aluminum ingot total deliveries and shipments during the period 1959-1968. The time series analysis led to the identification of conditions which caused fluctuations in deliveries and shipments. The specific conditions that were identified were:

1. Year end institutional factors of inventory taxes and attempts to show improved sales records, which cause ingot producers to increase shipment activity in December of each year.

2. Threats of interruptions in the supply of ingot resulting from labor contract terminations.

3. Threats of interruptions in the supply of ingot resulting from wars and threats of wars.

4. Price increases.

The effect of these conditions on the aluminum ingot market is fluctuations in that market (see Figure 4). These fluctuations and their causes led to the formulation of conclusions as follows.

<u>Conclusion I - Specific conditions in the aluminum ingot market (as enumerated above) cause extensive short range fluctuations in the levels of deliveries and shipments of aluminum ingot</u>.

This conclusion is based on a trend analysis (Chapter VI) which clearly demonstrated the existence of fluctuations in total deliveries and shipments.

Ident
the r
threa
tract
speci
ation
speci
the r

caus
of o
This
and

in t

in t
poss

Identification of the causes of the fluctuations as being the result of institutional factors, price changes, and threats of supply interruptions resulting from labor contract terminations and wars was accomplished by associating specific historical events in Appendix A with the fluctuations. This association led to the identification of the specified conditions as having the most likely relation to the resultant fluctuations.[1]

Identification of the market fluctuations and their causes raised a question as to the degree of predictability of occurrence of a fluctuation following a specific cause. This element of uncertainty is the basis of Conclusion II and Conclusion III.

> <u>Conclusion II - The conditions causing short range fluctuations in the level of aluminum ingot deliveries and shipments are predictable, under various degrees of certainty</u>.

The predictability of the occurrence of conditions in the aluminum ingot market exists under varying degrees

---

[1]Establishment of the existence of fluctuations in the aluminum ingot market raises two questions for possible future consideration:

a) To what extent do the fluctuations in the aluminum ingot market effect over-all economic activity?

b) What relations, if any, exist between these fluctuations in the aluminum ingot market and similar conditions which might exist in other commodity markets?

of
ti
fi
co
pr
ou

co
Th
su

ca
a
r
r
f

of certainty. This certainty relates to three factors: timing, duration, and magnitude. Of the conditions identified, labor contract terminations and the year end seasonal condition can be accurately predicated as to timing. The predictability of the timing of price changes and the actual outbreak of wars is more uncertain.

The effect of price changes and year end seasonal conditions can be accurately predicated as to duration. The duration of the effect caused by wars and strikes are subject to a substantial degree of uncertainty.

Predictability, relative to magnitude, is in all cases, subject to moderate degrees of uncertainty. No attempt was made in this study to establish quantitative relations between the conditions and the magnitude of the resultant fluctuation. Consequently, magnitudes of the fluctuations have not been established explicitly.

Conclusion III - Aluminum ingot purchasers react to the uncertainty of conditions by overbuying material to hedge against threatened supply interruptions.

Discussions with members of the aluminum industry led to confirmation of this conclusion. The varying degrees of uncertainty pertaining to contract terminations, year end seasonal conditions, price changes, and prewar inventory buildups establish situations, wherein an aluminum ingot purchaser develops expectations as to the effect of these

co
de
ve

(
e
f
r
a
t
c
T
c
a

conditions on the future availability of material. The degree to which a purchaser reacts is indicated by the volume of overbuying that occurs.[2]

Supporting evidence (Chapter VI) and survey results (Appendix B) indicate that in reacting to a condition effecting the supply of a material, the purchaser is performing a hedging action against a threatened supply interruption or price increase. This hedge is an attempt to assure material to maintain a continuity of production in the purchasers' plant. This hedging action is the less costly of two alternatives that confront the purchaser. These alternatives are: one, the increase in costs associated with increased inventories; or two, losses associated with a shutdown of production facilities for lack of raw materials. The less expensive of these alternatives is the increased inventory levels. The only practical

---

[2]A possible measure of the extent to which a purchaser of aluminum ingot reacts to uncertainty might be a seasonally adjusted index, indicating the change in the level of new orders that are received by the aluminum ingot producers. At the time of this study, this information was not generally available from the aluminum industry.

In addition, when more than one reason for hedging occurs at one time, the question arises; do buyers compound their overbuys and thereby cause greater fluctuations, or is the degree of hedging determined by the event which is expected to be of the greatest significance?

alternative this leaves for the purchaser is to build a hedge inventory.

Conclusion IV - The most extensive fluctuations in the level of deliveries and shipments of aluminum ingot are those resulting from industry labor contract terminations.

Based on a combination of the observed number of occurrences, the magnitude of the fluctuations, and the duration of the fluctuations, the effect of labor contract terminations appear to be more extensive than any of the other identificable causes of fluctuations. (The extent of fluctuations caused by labor contract terminations is approximated in Table 11.

Hypothesis II

The second hypothesis stated:

The aluminum ingot producers follow policies which lead to inverse stock-sales ratios of aluminum ingot at the producing firms.

The validity of this hypothesis is based on evidence which showed that ingot deliveries and shipments fluctuated over a wide range (Chapter VI). At the same time, the aluminum ingot producers tended to maintain a stable level of production (Chapter VII). The consequence of a fluctuating level of deliveries and shipments, combined with a stable level of production, is fluctuating inventories. These fluctuations in inventories absorb the differences in

rates between shipments and production. The net result is that, as long as the producers do not change the level of production, inventories decrease as shipments increase and they increase as shipments decrease. This relation between deliveries and shipments, production, and inventories leads to inverse stock-sales ratios during at least part of the inventory cycle.

<u>Conclusion V - Aluminum ingot inventories tend to follow an inverse stock-sales ratio</u>.

This inverse ratio is substantiated by the intention of the aluminum ingot producers to use inventories as an uncoupling device between production and shipments. These results largely invalidate assumptions that aluminum ingot producers intend to operate with a constant stock-sales ratio.

## Analysis of Questions

In addition to the two hypotheses that were discussed in the preceding sections, three questions were raised in Chapter I. The results of the attempt to answer these questions, are discussed below.

<u>Question I - Do significant levels of correlation exist between the rate of shipments of aluminum ingot and the rate of consumption in automobile production?</u>

This question was approached in the form of a

correlation analysis. This analysis was performed using accepted procedures wherein correlations of coefficient and coefficients of determination were calculated between both aluminum ingot deliveries and shipments, and automobile production. These calculations, covering the period 1959-1968, were performed on a current basis, a 30 day lag basis, and a 60 day lag basis. The coefficients of determination ranged from a high of 30.7 per cent to a low of 2.4 per cent. In no cases did the coefficients show a high degree of correlation. Because the analysis failed to develop a significant level of correlation, the data have been excluded from the study.

Question 2 - Are imports or exports of aluminum ingot major factors in the domestic aluminum market?

This analysis illustrated that a relation existed between threats of supply interruptions brought on by labor contract terminations and wars and the level of imports (see Figure 9). These relations led to the formulation of the following conclusions.

Conclusion VI - A form of hedging used by aluminum ingot purchasers is to increase the level of imports of aluminum ingot during periods of threatened supply interruptions.

Aluminum ingot is a homogeneous product with a high degree of cross elasticity between producers. This high

degree of cross elasticity provides easy substitution of foreign material in the domestic market, which provides an additional source of supply during threatened interruptions of supply of domestic material. This leads to two separate reactions by the domestic purchaser. First, the purchaser obtains some of his pre-contract termination hedge inventory by purchasing from foreign sources prior to the threatened interruption (see Figure 9). This study indicates (Table 18) that a substantial amount of inventory hedge does come from these foreign sources. Second, the purchaser can also obtain material from foreign producers to sustain production during an actual supply interruption, if domestic inventories are insufficient.

Conclusion VII - Labor contract negotiations have an adverse economic effect on both domestic aluminum ingot producers and the labor employed by domestic producers.

In the collective bargaining process, direct economic losses can be identified and the amount of that loss can be approximated if a strike occurs and production ceases. In addition, there is a further loss to both the producer and to labor, regardless of whether or not a strike occurs. This loss results from the pre-contract termination inventory hedge that is supplied by foreign producers. This material, once it becomes a part of the purchaser's inventory,

will ultimately lead to underbuying of domestic metal after agreements are reached and labor contracts are settled.[3]

Question 3 - What information is available concerning lead times and backlogs in the aluminum industry?

A search of current literature failed to provide any usable information relating to aluminum delivery lead time and backlogs. The producers were questioned concerning the availability of information in this area. The results of the questionnaire (see Appendix B - Exhibit 2) substantiate previous assumptions that leadtime and backlog information is not available to the general public.

---

[3]This study establishes an approximation of the volume of aluminum ingot that is imported as a pre-contract termination inventory hedge. This approximation is reported in Table 18. It is suggested that in the future a more extensive analysis might be undertaken to establish more accurate data.

# BIBLIOGRAPHY

## SELECTED BIBLIOGRAPHY

### Books


Abramovitz, Moses. Inventories and Business Cycles. New York: National Bureau of Economic Research, Inc., 1950.

Aljian, George W. (ed.) Purchasing Handbook. New York: McGraw-Hill Book Company, Inc., 1966.

Barber, Clarence L. Inventories and the Business Cycle with Special Reference to Canada. Toronto: The University of Toronto Press, 1958.

Brubaker, Sterling. Trends in the World Aluminum Industry. Baltimore: The John Hopkins Press, 1967.

Carr, Charles C. ALCOA an American Enterprise. New York: Rinehart and Company, Inc., 1952.

Croxton, Frederick E. and Cowden, Dudley J. Applied General Statistics. 2d ed. Englewood Cliffs: Prentice-Hall, Inc., 1955.

Engle, Nathaniel Howard, et al. Aluminum, An Industrial Marketing Appraisal. Homewood: Richard D. Irwin Inc., 1945.

Eggert, Robert J., et al. Inventory Fluctuations, Price Level Changes, and Economic Growth. Washington: Prepared for the Joint Economic Committee. U. S. Government Printing Office, 1962.

Farin, Philip and Reibsamen, Gary G. Aluminum: Profile of an Industry. New York: Metals Week, 1969.

Griffin, John Ignatius. Statistics: Methods and Applications. New York: Holt, Rinehart and Winston, 1962.

Hart, Albert Gailord. Money, Debt and Economic Activity. New York: Prentice-Hall, Inc., 1948.

Keynes, John Maynard. The General Theory of Employment Interest and Money. New York: Harcourt, Brace and Co., 1936.

Mack, Ruth (Prince). Information, Expectations, and Inventory Fluctuations. New York: National Bureau of Economic Research, Inc., 1967.

Muller, Charlotte F. Light Metals Monopoly. New York: Columbia University Press, 1946.

Peck, Merton J. Competition in the Aluminum Industry, 1945-1958. Cambridge: Harvard University Press, 1961.

Plossl, G. W. and Wight, O. W. Production and Inventory Control; Principles and Techniques. Englewood Cliffs: Prentice-Hall, Inc., 1967.

Robinson, Patrick J. and Faris, Charles W. Industrial Buying and Creative Marketing. Boston: Allyn and Bacon, Inc., 1967.

Stanback, Thomas M. Jr. Inventory Fluctuations and Economic Stabilization, Part 1. Prepared for the Joint Economic Committee, Washington: U. S. Government Printing Office, 1961.

Stein, Harold. (ed.) Public Administration and Policy Development, A Case Book. New York: Harcourt, Brace and Co., 1952.

Timms, Howard L. The Production Function in Business. Homewood: Richard D. Irwin, Inc., 1966.

Wallace, Donald H. Market Control in the Aluminum Industry. Cambridge: Harvard University Press, 1937.

Westing, J. H. and Fine, I. V. Industrial Purchasing. 2d ed. New York: John Wiley & Sons, Inc., 1961.

________. Britannica Book of the Year. Chicago: Encyclopedia Britannica, Inc., Yearly 1959 through 1968 inclusive.

________. Metal Statistics. Somerset: American Metal Market Co., Yearly 1959 through 1968 inclusive.

________. Minerals Yearbook. Washington: U. S. Government Printing Office, Yearly 1959 through 1968 inclusive.

________. Yearbook of the American Bureau of Metal Statistics, York: The Maple Press Co., 1966 and 1967.

## Reports and Documents

1968 Aluminum Statistical Review. New York: The Aluminum Association, 1969.

1967 Aluminum Statistical Review. New York: The Aluminum Association, 1968.

Haas, John A. et al. The Aluminum Price Crisis of November 1965: Its Effect on Business-Government Relations. Pittsburgh: University of Pittsburgh (An unpublished Report).

Annual Report-1967. Oakland: Kaiser Industries Corp., 1967.

Annual Report-1960. Oakland: Kaiser Aluminum and Chemical Corp., 1960.

Boyes, Rodney L. Fluctuations in Steel Purchases and Inventories, 1953-1963. Lansing: Michigan State University, 1964 (Unpublished Dissertation).

U. S. Congress, Joint Hearings Aluminum Plant Disposal. Washington: U. S. Government Printing Office, 1945.

U. S. Dept. of the Interior, Bureau of Mines. Mineral Industry Surveys, Aluminum Monthly. Washington: U. S. Government Printing Office, Monthly January 1959 through December 1968 inclusive.

U. S. Dept. of Labor, Bureau of Labor Statistics. Wage Chronology-Aluminum Company of America,1939-67, Bulletin #1559. Washington: U. S. Government Printing Office, 1967.

The Story of Aluminum. New York: The Aluminum Association, Undated.

U. S. Congress, Aluminum Industry Hearings before Subcommittee #3, Select Committee on Small Business. Washington: U. S. Government Printing Office, 1956.

## Other Sources

Hoagland, John H. "Monthly Change Indices and Other New Measures of Business Fluctuations." Paper read before the Business and Economic Statistical Section of the American Statistical Association, Washington D. C., December 29, 1959.

________. "Purchasing and Inventory Forecasting." Paper read before the Business and Economic Statistical Section of the American Statistical Association, Stanford University, August, 1960.

APPENDICES

## APPENDIX A

## <u>CHRONOLOGY OF SIGNIFICANT HISTORICAL EVENTS 1959-1968</u>

The events listed in this chronology were selected for inclusion based on their apparent relevance to aluminum ingot market conditions. The general historical series of events was derived from <u>Encyclopaedia Britannica Yearbook</u>. This general series was supplemented with specific events by information published in the <u>Wall Street Journal</u>, <u>The American Metal Market</u>, and other selected sources.

<u>1959</u>

| | |
|---|---|
| Jan. 1 | Castro makes power move in Cuba. |
| Apr. - | Steel and union propose one year wage and price freezes. |
| May 1 | Anaconda and Aluminum Workers sign contract, balance of industry in negotiations. |
| May 5 | USW and Steel start negotiations. |
| May 11 | Wildcat strikes occur in steel. |
| June 28 | USW and steel agree to 2 week truce. |
| June - | Aluminum production and shipments at record levels in anticipation of August strike. |
| July 13 | Steel mills start shutting down as negotiations collapse. |
| July 28 | Aluminum negotiators agree to extend current contracts to Nov. 1 or 30 days after steel settles. |
| July - | Aluminum production and shipments continue at record levels. |

1959 (Continued)

| | |
|---|---|
| Aug. – | Aluminum production and shipments drop extensively. |
| Sept. 6 | Mitchell threatens steel with Taft-Hartley. |
| Sept. 21 | Auto industry feels steel shortage. |
| Oct. 14 | GM begins layoffs. |
| Oct. 20 | Kaiser signs steel agreement. |
| Oct. - | Aluminum industry extends contract indefinitely. |
| Nov. 7 | Steel strike ends after 116 days after Supreme Court upholds Taft-Hartley. |
| Dec. 16 | Alcan announces aluminum price increase. |
| Dec. 19 | Aluminum industry reaches a three year contract agreement. |
| Dec. 31 | Steel industry discontinues negotiations. |
| Dec. - | Secondary aluminum stocks high because of lower auto production. |

1960

| | |
|---|---|
| Jan. 3 | Steel industry agrees to settlement. Kennedy announces candidacy for president. |
| Mar. 6 | Auto inventories high, work week reduced. |
| Mar. - | Alcoa and Reynolds open new reduction lines. |
| Apr. 29 | Stock market hits 17 month low. |
| May 6 | Khruschev reveals U-2 plane incident. |
| May - | Yates committee recommends Justice Department probe aluminum pricing. |
| June 26 | Early auto shutdown predicted. |
| Aug. 11 | Economy appears weak. |

<u>1960</u> (Continued)

Aug. 12 Ike indicates that economy is in good shape.

Sept. 22 Ike and Khruschev meet in New York.

Nov. 7 Kennedy elected.

Dec. 4 Auto market weak.

Dec. - Apparent consumption of aluminum in 1960 down 19%.

Dec. - U. S. ends year as net exporter of aluminum.

<u>1961</u>

Jan. 4 U. S.-Cuba break relations.

Jan. 6 Economists indicate recession will worsen.

Jan. 20 Kennedy inaugurated.

Feb. 16 Kennedy appoints committee to promote wage and price policies.

Feb. 21 Kennedy announces new anti-recession plans.

Mar. 1 Peace Corp established.

Mar. 17 FRB says downturn is halted.

Apr. 6 Auto sales pick up.

Apr. 10 Steel and aluminum demand increases.

Apr. 17 Personal income increases - "Bay of Pigs".

May 1 Economic activity increasing.

June 29 Auto industry negotiations start.

July 28 Kennedy's military buildup program approved.

Aug. 1 Congress approves call up of reserves.

Aug. 31 Russia resumes "A" tests.

1961 (Continued)

Aug. 31 Aluminum workers wage increase goes into effect.

Sept. 6 U. S. resumes "A" tests.

Sept. 12 GM local strikes spread.

Sept. 21 GM-UAW reach agreement. Alcan reduces aluminum price.

Oct. 31 Russia explodes super bomb.

Nov. 20 Economic statistics look good.

Nov. 24 Auto production up.

1962

Jan. 9 Chrysler lays off some workers.

Jan. - Aluminum production and shipments show upturn.

Feb. 26 Steel hedge buying light due to optimism for early settlement.

Mar. 2 Steel negotiations broken off.

Mar. 14 Steel negotiations resume.

Mar. 28 Steel settlement reached.

Apr. 11 Kennedy denounces steel industry for attempted price increases.

Apr. 13 Steel industry rescinds price increases.

May 15 Aluminum industry opens contract negotiations.

June 1 Aluminum and AWU suspend negotiations.

June 4 Widespread layoffs in steel industry.

June 29 Aluminum and USA agree on a 2 year contract.

July 8 Aluminum and AWU resume talks.

1962 (Continued)

| | |
|---|---|
| July 31 | AWU strikes aluminum industry. |
| Aug. 2 | Aluminum and AWU settle. |
| Aug. 27 | Kennedy confirms USSR is providing Cuba with supplies and technicians. |
| Sept. 4 | Kennedy warns USSR. |
| Oct. 22 | Cuban blockade begins. |
| Dec. 2 | Kaiser initiates aluminum price decrease. |

1963

| | |
|---|---|
| Jan. 11 | Auto production reported higher. |
| Jan. 21 | Steel hedge buying reported. |
| Jan. 24 | USSR build up reported in Cuba. |
| Feb. 6 | January auto sales reported up. |
| Mar. 6 | February auto sales reported up. |
| Apr. 4 | Nationwide rail strike averted. |
| Apr. 30 | Steel production up. |
| Apr. - | Aluminum and unions continue informal talks. |
| May - | USW fails to serve notice to reopen contracts. |
| June 20 | Steel - USW settle contract. |
| June 26 | Auto sales at record pace. |
| June - | Aluminum and unions fail to exercise reopener clause. |
| July 1 | Business continues to expand. |
| July 31 | Aluminum and unions agree to extend 1962 contract to June 1, 1965. |

<u>1963</u> (Continued)

| | |
|---|---|
| Aug. 2 | Auto sales up. |
| Sept. 4 | Auto production up. |
| Sept. 6 | Turmoil in South Viet Nam. |
| Sept. 18 | Economy continues strong. |
| Sept. 23 | Reynolds announces aluminum price increase. |
| Oct. - | Selected price increases made in steel - economy continues strong. |
| Nov. 1 | Overthrow in South Viet Nam. |
| Nov. 22 | Kennedy assassinated. |
| Dec. 5 | Kaiser increases aluminum prices, Alcoa aborts increase by failing to follow increase. |
| Dec. 27 | Auto sales continue to increase. |

<u>1964</u>

| | |
|---|---|
| Jan. 3 | USSR purchases wheat from U. S. |
| Jan. 9 | Riots against U. S. breakout in Panama. |
| Jan. 16 | Reynolds increases aluminum prices, Alcoa again aborts increase. |
| Mar. 4 | Alcoa increases aluminum prices. |
| Mar. 26 | McNamara increases aid to South Viet Nam. |
| Apr. 7 | U. S. indicts 8 steel firms for price fixing. |
| Apr. 8 | Unions strike railroads. |
| Apr. 9 | Johnson obtains 15 day postponement of rail strike. |
| Apr. 22 | Rail strike settled. |
| June 4 | Ormet initiates aluminum price increase. |

1964 (Continued)

July 7 China shoots down U-2.

July 15 Republicans select Goldwater.

Aug. 5 U. S. bombs North Viet Nam.

Aug. 24 Democrats select Johnson.

Sept. 9 Chrysler and UAW sign agreement.

Sept. 25 UAW strikes GM.

Oct. 16 Communist China explodes "A" Bomb.

Oct. 25 GM and UAW sign agreement.

Nov. 3 Johnson reelected president.

Nov. 16 Alcoa initiates aluminum price increase.

Nov. 19-25 Financial crisis in England.

Dec. 11 U. S. increases aid to South Viet Nam.

1965

Jan. 26 Military ousts South Viet Nam government.

Feb. 7 Railroads and non-operating Unions reach agreement.

Mar. 25 Civil rights rally in Montgomery, Ala.

Apr. 26 Steel and USW agree to postpone strike deadline to Sept. 1.

Apr. 30 Britian announces nationalization plan for steel industry.

Apr. 30 Abel defeats McDonald for presidency of USW.

Apr. - Aluminum and Unions in negotiations ahead of steel.

May 31 Aluminum and USA reach agreement.

1965 (Continued)

| | |
|---|---|
| June 1 | Aluminum and USA reach agreement. |
| June 1 | FRB warns of conditions similar to 1929, stock market drops sharply. |
| June 5 | U. S. forces engage in combat in South Viet Nam. |
| July 8 | USSR increases defense spending. |
| July 20 | Military situation in South Viet Nam deteriorates. |
| Aug. 29 | 75 day Maritime strike settled. |
| Aug. 30 | Steel and USW fail to reach agreement. |
| Aug. 31 | Johnson announces 8 day postponement of steel strike. |
| Sept. 3 | Steel and USW reach agreement. |
| Sept. 9 | deGaulle announces France's withdrawal from NATO. |
| Oct. 29 | Ormet initiates aluminum price increase. |
| Nov. 6 | U. S. releases 200,000 ton from aluminum stockpile, denounces price increase as inflationary. |
| Nov. 9 | Eastern U. S. and Canada blacked out by power failure. |
| Nov. 10 | Aluminum companies rescind price increase. |
| Nov. 17 | U. S. releases 200,000 tons from copper stockpile. |
| Nov. 23 | Aluminum stockpile disposal program established. |
| Dec. 29 | Peace efforts for Viet Nam continue. |

1966

| | |
|---|---|
| Jan. 5 | Steel companies compromise on price increase. |
| Feb. 8 | Johnson and Ky meet in Honolulu. |

1966 (Continued)

| | |
|---|---|
| Feb. 16 | Declining trend sets in in stock market. |
| Mar. 12 | Violent anticommunist demonstrations in Indonesia. |
| Apr. 3 | Four day railroad strike ended by court order. |
| Apr. 27 | ICC authorizes NYC-PRR merger. |
| May 16 | Britain seaman strike begins. |
| May - | Aluminum demand heavy. |
| June 13 | Eight nations renew loan to Britain. |
| June 20 | DeGaulle visits USSR. |
| June 29 | Britain seaman strike ends. |
| June - | Aluminum demand continues strong. |
| July 1 | France withdraws from NATO. |
| July 8 | IAM strike grounds major U. S. airlines. |
| July 20 | England takes deflationary measures. |
| July 25 | Stock market drops 16 points. |
| July - | Rioting in Chicago and Omaha. |
| Aug. 4 | White House denounces steel price increase. |
| Aug. 16 | U. S. banks increase discount rate to 6%. |
| Aug. 19 | IAM strike settled. |
| Sept. 9 | Auto safety legislation approved. |
| Sept. 22 | U. S. offers to halt bombing of North Viet Nam. |
| Nov. 8 | Republicans score major gains. |

1967

| | |
|---|---|
| Jan. 12 | Ormet initiates aluminum price increase. |
| Jan. 26 | Johnson predicts slower expansion, calls for wage and price restraint. |
| Feb. - | Wildcat strike at GM idles 174,000. |
| Mar. 9 | Johnson asks for restoration of investment tax credit. |
| Apr. 6 | FRB lowers discount rate to 4%. |
| Apr. 12 | Commerce Department announces lack of growth of GNP. |
| May 2 | Johnson signs bill banning rail strike until June 19. |
| May 23 | 6th fleet ordered to Eastern Mediterranean. |
| June 5 | Arab-Israeli war breaks out. |
| June 7 | Israel proclaims victory, cease fire agreement reached. |
| June 23 | Johnson and Kosygin meet in New Jersey. |
| July 15 | Copper miners strike. |
| July 18 | Johnson orders end to 2 day rail strike. |
| Aug. 3 | Johnson requests 10% surtax. |
| Sept. 1 | Steel raises prices. |
| Sept. 6 | UAW strikes Ford. |
| Oct. 3 | North Viet Nam rejects peace proposals. |
| Oct. 22 | Ford-UAW reach agreement. |
| Oct. - | Aluminum shipments down, inventories rising. |
| Nov. 18 | Britain devalues pound. |

1967 (Continued)

| | |
|---|---|
| Nov. 19 | FRB increases discount rate. |
| Dec. 6 | Johnson appeals for wage-price restraint. |
| Dec. - | FRB index shows sharp increase. |
| Dec. - | Aluminum shipments continue weak. |

1968

| | |
|---|---|
| Jan. 22 | Pueblo seized by North Korea. |
| Jan. 25 | Johnson orders some reserves to active duty. |
| Jan. 29 | TET offense mounted by Viet Cong. |
| Feb. 1 | Johnson calls for wage-price restraint. |
| Feb. 11 | U. S. rushes more troops to South Viet Nam. |
| Feb. 29 | Steel hedge buying begins. |
| Mar. 7 | Auto production cut, copper negotiators called to Washington. |
| Mar. 10-15 | Gold crisis develops, tentative agreement reached by copper industry. |
| Mar. 14 | FRB raises discount rate to 5%. |
| Mar. 28 | Steel stockpiling underway, aluminum shipments up sharply. |
| Mar. 28 | USW forms bargaining strategy. |
| Mar. 31 | Johnson announces he will not seek another term. |
| Apr. 1 | London gold market reopens. |
| Apr. 2 | U. S. Halts North Viet Nam air attacks. |
| Apr. 4 | King assassinated. |

1968 (Continued)

| | |
|---|---|
| Apr. 11 | Aluminum bargaining underway. |
| Apr. 18 | Aluminum and steel stockpiles reaching peaks. |
| Apr. 18 | FRB raises discount rate to 5½%. |
| May 10 | Peace talks begin in Paris. |
| May 31 | Alcoa initiates aluminum price increase. |
| May | Aluminum shipments continue strong, no agreement reached. |
| June 1 | Some aluminum plants shutdown by strike. |
| June 5 | Robert Kennedy shot. |
| July 30 | Steel-USW agree to 3 year contract. |
| July 31 | Johnson assails steel for price increase. |
| Aug. 7 | Compromise reached on steel price increases. |
| Aug. 8 | Nixon-Agnew named. |
| Aug. 15 | FRB reduces discount rate to 5¼%. |
| Aug. 20 | Czechoslavakia invaded. |
| Aug. 28 | Humphrey-Muskie nominated. |
| Aug. | Aluminum shipments down sharply, strike continues. |
| Sept. 10 | Czech-USSR sign agreement. |
| Sept. | Steel orders and shipments at low level. |
| Sept. | Aluminum on upswing as plants resume production. |
| Oct. 15 | UAW walks out at 5 GM plants. |
| Nov. 5 | Nixon elected president. |

<u>1968</u> (Continued)

Nov. 20 French franc weak.

Dec. 4 Wave of speculation in European foreign exchange markets.

Dec. 17 FRB raises discount rate to 5½%.

Dec. 22 Pueblo crewmen released.

Dec. - Aluminum and steel markets improving.

## APPENDIX B-Exhibit 1

Guide for use in Direct Industry Interviews, Questionnaires, and Telephone Follow-ups of Interviewees.

1. Can aluminum ingot, as produced by domestic primary producers, foreign primary producers, and domestic secondary producers, be considered a homogeneous product?

2. Is it a common industry practice to operate reduction plants at a constant level of output?

3. What stage of the over-all aluminum production process do you consider to be the controlling stage?

4. What type of aluminum reduction line (prebake or Soderburg) is less costly to shut down?

5. What factors influence your decision to change levels of production at reduction plants?

6. Do aluminum ingot producers attempt to maintain a constant stock-sales ratio?

7. Is it a normal policy to speculate on inventories at the reduction stage during periods of excess supply?

8. Does it appear that aluminum ingot purchasers hedge against threatened supply interruptions?

9. Is aluminum ingot pricing based on a policy of maintaining a relatively stable price structure?

10. A. Do you allow a period of price protection after announcing a price increase?

    B. What is the length of time that you provide price protection?

11. Is the over-all demand for aluminum responsive to price changes in the short run?

12. What is the explanation of the increase in aluminum ingot deliveries and shipments in December of each year?

APPENDIX B-Exhibit 1--Continued

13. A. What order backlog information do you have available?

    B. Is this information available to the general public?

14. A. What specific delivery leadtime information do you have available?

    B. Is this information available to the general public?

15. A. Does fabricating capacity, in total, exceed reduction capacity?

    B. If so, to what extent?

    C. Is accurate information available as to the actual amount of aggregate fabricating capacity?

## APPENDIX B-Exhibit 2

Aggregate Responses to Direct Industry Interviews, Questionnaires and Telephone Follow-ups of Interviewers.

1. Can aluminum ingot as produced by domestic primary producers, foreign primary producers, and domestic secondary producers be considered a homogeneous product?

   Responses: 5 - Yes
   2 - Not applicable
   1 - No response

2. Is it a common industry practice to operate reduction plants at a constant level of output?

   Responses: 7 - Yes
   1 - No response

3. What stage of the over-all aluminum production process do you consider to be the controlling stage?

   Responses: 5 - Reduction stage
   2 - Not applicable
   1 - No response

4. What type of aluminum reduction line (prebake or Soderburg) is less costly to shut down?

   Responses: 7 - Prebake Reduction Line
   1 - No response

5. What factors influence your decision to change levels of production at reduction plants?

   Responses: Level of Inventory
   Forecast of Demand
   Cost and Availability of Funds

6. Do aluminum ingot producers attempt to maintain a constant stock-sales ratio?

   Responses: 7 - No
   1 - No response

APPENDIX B-Exhibit 2--Continued

7. Is it a normal policy to speculate on inventories at the reduction stage during periods of excess supply?

Responses: 5 - Yes subject to conditions cited in question 5
2 - Not applicable
1 - No response

8. Does it appear that aluminum ingot purchasers hedge against threatened supply interruptions?

Responses: 5 - Yes
2 - Not applicable
1 - No response

9. Is aluminum ingot pricing based on a policy of maintaining a relatively stable price structure?

Responses: 5 - Yes
2 - Not applicable
1 - No response

10. A. Do you allow a period of price protection after announcing a price increase?

A. Responses: 5 - Yes
2 - Not applicable
1 - No response

B. What is the length of time that you provide price protection?

B. Responses: 5 - 30 days
2 - Not applicable
1 - No response

11. Is the over-all demand for aluminum responsive to price changes in the short run?

Responses: 7 - No
1 - No response

APPENDIX B-Exhibit 2--Continued

12. What is the explanation of the increase in aluminum ingot deliveries and shipments in December of each year?

    Responses: To avoid state inventory taxes
    To increase shipments for a specific year

13. A. What order backlog information do you have available?

    A. Responses: As required for planning purposes.

    B. Is this information available to the general public?

    B. Responses: 7 - No
    1 - No response

14. A. What specific delivery leadtime information do you have available?

    A. Responses: As required for planning purposes

    B. Is this information available to the general public?

    B. Responses: 7 - No
    1 - No response

15. A. Does fabricating capacity, in total, exceed reduction capacity?

    A. Responses: 5 - Yes
    2 - Not applicable
    1 - No response

    B. If so, to what extent?

    B. Responses: 3 - Approximately 1.5 - 1
    3 - Not applicable
    1 - Unknown
    1 - No response

    C. Is accurate information available as to the actual amount of aggregate fabricating capacity?

    C. Responses: 7 - No
    1 - No response

DOMESTIC PRIMARY ALUMINUM REDUCTION CAPACITY, 1959-1968
Summarized Monthly by Firm and Location
In 1000's of Tons Per Year

| Firm Location | Alcoa Alcoa, Tennessee | Badin No. Car. | Evansville, Indiana | Massena, New York | Point Comfort, Texas | Rockdale, Texas | VanCouver, Washington | Wenatchee, Washington | Anaconda Columbia Falls, Montana | Conalco New Johnsonville, Tennessee | Harvey The Dalles, Oregon | Intalco Ferndale, Wash. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1959 | | | | | | | | | | | | |
| Jan | 157.0 | 47.0 | 0 | 118.0 | 120.0 | 150.0 | 97.5 | 108.5 | 60.0 | 0 | 54.0 | 0 |
| Feb | 157.0 | 47.0 | 0 | 118.0 | 120.0 | 150.0 | 97.5 | 108.5 | 60.0 | 0 | 54.0 | 0 |
| Mar | 157.0 | 47.0 | 0 | 118.0 | 120.0 | 150.0 | 97.5 | 108.5 | 60.0 | 0 | 54.0 | 0 |
| Apr | 157.0 | 47.0 | 0 | 118.0 | 120.0 | 150.0 | 97.5 | 108.5 | 60.0 | 0 | 54.0 | 0 |
| May | 157.0 | 47.0 | 0 | 118.0 | 120.0 | 150.0 | 97.5 | 108.5 | 60.0 | 0 | 54.0 | 0 |
| Jun | 157.0 | 47.0 | 0 | 118.0 | 120.0 | 150.0 | 97.5 | 108.5 | 60.0 | 0 | 54.0 | 0 |
| Jul | 157.0 | 47.0 | 0 | 118.0 | 120.0 | 150.0 | 97.5 | 108.5 | 60.0 | 0 | 54.0 | 0 |
| Aug | 157.0 | 47.0 | 0 | 118.0 | 120.0 | 150.0 | 97.5 | 108.5 | 60.0 | 0 | 54.0 | 0 |
| Sep | 157.0 | 47.0 | 0 | 118.0 | 120.0 | 150.0 | 97.5 | 108.5 | 60.0 | 0 | 54.0 | 0 |
| Oct | 157.0 | 47.0 | 0 | 118.0 | 120.0 | 150.0 | 97.5 | 108.5 | 60.0 | 0 | 54.0 | 0 |
| Nov | 157.0 | 47.0 | 0 | 118.0 | 120.0 | 150.0 | 97.5 | 108.5 | 60.0 | 0 | 54.0 | 0 |
| Dec | 157.0 | 47.0 | 0 | 118.0 | 120.0 | 150.0 | 97.5 | 108.5 | 60.0 | 0 | 54.0 | 0 |

| Firm Loca-tion | Kaiser Chalmette, Louisiana | Mead, Wash. | Ravenswood, West Va. | Tacoma, Wash. | Ormet Hannibal, Ohio | Reynolds Arkadelphia, Arkansas | Corpus Christi, Texas | Jones Mills, Arkansas | Sheffield, Alabama | Longview, Wash. | Massena, New York | Troutdale, Oregon | Total all Pro-ducers |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1959 | | | | | | | | | | | | | |
| Jan | 247.5 | 176.0 | 109.0 | 0 | 180.0 | 55.0 | 95.0 | 109.0 | 190.0 | 60.5 | 0 | 91.5 | 2225.5 |
| Feb | 247.5 | 176.0 | 109.0 | 0 | 180.0 | 55.0 | 95.0 | 109.0 | 190.0 | 60.5 | 0 | 91.5 | 2225.5 |
| Mar | 247.5 | 176.0 | 109.0 | 0 | 180.0 | 55.0 | 95.0 | 109.0 | 190.0 | 60.5 | 0 | 91.5 | 2225.5 |
| Apr | 247.5 | 176.0 | 109.0 | 0 | 180.0 | 55.0 | 95.0 | 109.0 | 190.0 | 60.5 | 0 | 91.5 | 2225.5 |
| May | 247.5 | 176.0 | 109.0 | 0 | 180.0 | 55.0 | 95.0 | 109.0 | 190.0 | 60.5 | 0 | 91.5 | 2225.5 |
| Jun | 247.5 | 176.0 | 109.0 | 0 | 180.0 | 55.0 | 95.0 | 109.0 | 190.0 | 60.5 | 0 | 91.5 | 2261.5 |
| Jul | 247.5 | 176.0 | 109.0 | 0 | 180.0 | 55.0 | 95.0 | 109.0 | 190.0 | 60.5 | 33.0 | 91.5 | 2294.5 |
| Aug | 247.5 | 176.0 | 109.0 | 0 | 180.0 | 55.0 | 95.0 | 109.0 | 190.0 | 60.5 | 33.0 | 91.5 | 2294.5 |
| Sep | 247.5 | 176.0 | 109.0 | 0 | 180.0 | 55.0 | 95.0 | 109.0 | 190.0 | 60.5 | 33.0 | 91.5 | 2294.5 |
| Oct | 247.5 | 176.0 | 109.0 | 0 | 180.0 | 55.0 | 95.0 | 109.0 | 190.0 | 60.5 | 33.0 | 91.5 | 2294.5 |
| Nov | 247.5 | 176.0 | 109.0 | 0 | 180.0 | 55.0 | 95.0 | 109.0 | 190.0 | 60.5 | 33.0 | 91.5 | 2294.5 |
| Dec | 247.5 | 176.0 | 109.0 | 0 | 180.0 | 55.0 | 95.0 | 109.0 | 190.0 | 60.5 | 33.0 | 91.5 | 2294.5 |

| Firm Location | Alcoa Alcoa, Tennessee | Badin No. Car. | Evansville, Indiana | Massena, New York | Point Comfort, Texas | Rockdale, Texas | VanCouver, Washington | Wenatchee, Washington | Anaconda Columbia Falls, Montana | Conalco New Johnsonville, Tennessee | Harvey The Dalles, Oregon | Intalco Ferndale, Wash. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1960 | | | | | | | | | | | | |
| Jan | 157.0 | 47.0 | 0 | 118.0 | 120.0 | 150.0 | 97.5 | 108.5 | 60.0 | 0 | 54.0 | 0 |
| Feb | 157.0 | 47.0 | 0 | 118.0 | 120.0 | 150.0 | 97.5 | 108.5 | 60.0 | 0 | 54.0 | 0 |
| Mar | 157.0 | 47.0 | 0 | 118.0 | 140.0 | 150.0 | 97.5 | 108.5 | 60.0 | 0 | 54.0 | 0 |
| Apr | 157.0 | 47.0 | 0 | 118.0 | 140.0 | 150.0 | 97.5 | 108.5 | 60.0 | 0 | 54.0 | 0 |
| May | 157.0 | 47.0 | 0 | 118.0 | 140.0 | 150.0 | 97.5 | 108.5 | 60.0 | 0 | 54.0 | 0 |
| Jun | 157.0 | 47.0 | 0 | 118.0 | 140.0 | 150.0 | 97.5 | 108.5 | 60.0 | 0 | 54.0 | 0 |
| Jul | 157.0 | 47.0 | 35.0 | 118.0 | 140.0 | 150.0 | 97.5 | 108.5 | 65.0 | 0 | 60.0 | 0 |
| Aug | 157.0 | 47.0 | 35.0 | 118.0 | 140.0 | 150.0 | 97.5 | 108.5 | 65.0 | 0 | 60.0 | 0 |
| Sep | 157.0 | 47.0 | 35.0 | 118.0 | 140.0 | 150.0 | 97.5 | 108.5 | 65.0 | 0 | 60.0 | 0 |
| Oct | 157.0 | 47.0 | 35.0 | 118.0 | 140.0 | 150.0 | 97.5 | 108.5 | 65.0 | 0 | 60.0 | 0 |
| Nov | 157.0 | 47.0 | 35.0 | 118.0 | 140.0 | 150.0 | 97.5 | 108.5 | 65.0 | 0 | 60.0 | 0 |
| Dec | 157.0 | 47.0 | 35.0 | 118.0 | 140.0 | 150.0 | 97.5 | 108.5 | 65.0 | 0 | 60.0 | 0 |

| Firm Location | Kaiser Chalmette, Louisiana | Mead, Wash. | Ravenswood, West Va. | Tacoma, Wash. | Ormet Hannibal, Ohio | Reynolds Arkadelphia, Arkansas | Corpus Christi, Texas | Jones Mills, Arkansas | Sheffield, Alabama | Longview, Wash. | Massena, New York | Troutdale Oregon | Total all Producers |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1960 | | | | | | | | | | | | | |
| Jan | 247.5 | 176.0 | 145.0 | 0 | 180.0 | 55.0 | 95.0 | 109.0 | 190.0 | 60.5 | 33.0 | 91.5 | 2294.5 |
| Feb | 247.5 | 176.0 | 145.0 | | 180.0 | 55.0 | 95.0 | 109.0 | 190.0 | 60.5 | 33.0 | 91.5 | 2294.5 |
| Mar | 247.5 | 176.0 | 145.0 | | 180.0 | 55.0 | 95.0 | 109.0 | 190.0 | 60.5 | 66.0 | 91.5 | 2347.5 |
| Apr | 247.5 | 176.0 | 145.0 | | 180.0 | 55.0 | 95.0 | 109.0 | 190.0 | 60.5 | 66.0 | 91.5 | 2347.5 |
| May | 247.5 | 176.0 | 145.0 | | 180.0 | 55.0 | 95.0 | 109.0 | 190.0 | 60.5 | 66.0 | 91.5 | 2347.5 |
| Jun | 247.5 | 176.0 | 145.0 | shut down | 180.0 | 55.0 | 95.0 | 109.0 | 190.0 | 60.5 | 66.0 | 91.5 | 2347.5 |
| Jul | 247.5 | 176.0 | 145.0 | | 180.0 | 55.0 | 95.0 | 109.0 | 190.0 | 60.5 | 66.0 | 91.5 | 2347.5 |
| Aug | 247.5 | 176.0 | 145.0 | | 180.0 | 55.0 | 95.0 | 109.0 | 190.0 | 60.5 | 66.0 | 91.5 | 2393.5 |
| Sep | 247.5 | 176.0 | 145.0 | | 180.0 | 55.0 | 95.0 | 109.0 | 190.0 | 60.5 | 66.0 | 91.5 | 2393.5 |
| Oct | 247.5 | 176.0 | 145.0 | | 180.0 | 55.0 | 95.0 | 109.0 | 190.0 | 60.5 | 66.0 | 91.5 | 2393.5 |
| Nov | 247.5 | 176.0 | 145.0 | | 180.0 | 55.0 | 95.0 | 109.0 | 190.0 | 60.5 | 66.0 | 91.5 | 2393.5 |
| Dec | 247.5 | 176.0 | 145.0 | 0 | 180.0 | 55.0 | 95.0 | 109.0 | 190.0 | 60.5 | 66.0 | 91.5 | 2393.5 |

| Firm Location | Alcoa Alcoa, Tennessee | Badin No. Car. | Evansville, Indiana | Massena, New York | Point Comfort, Texas | Rockdale, Texas | VanCouver, Washington | Wenatchee, Washington | Anaconda Columbia Falls, Montana | Conalco New Johnsonville, Tennessee | Harvey The Dalles, Oregon | Intalco Ferndale, Wash. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1961 | | | | | | | | | | | | |
| Jan | 157.0 | 47.0 | 35.0 | 118.0 | 140.0 | 150.0 | 97.5 | 108.5 | 65.0 | 0 | 60.0 | 0 |
| Feb | 157.0 | 47.0 | 35.0 | 118.0 | 140.0 | 150.0 | 97.5 | 108.5 | 65.0 | 0 | 60.0 | 0 |
| Mar | 157.0 | 47.0 | 35.0 | 118.0 | 140.0 | 150.0 | 97.5 | 108.5 | 65.0 | 0 | 75.0 | 0 |
| Apr | 157.0 | 47.0 | 35.0 | 118.0 | 140.0 | 150.0 | 97.5 | 108.5 | 65.0 | 0 | 75.0 | 0 |
| May | 157.0 | 47.0 | 35.0 | 118.0 | 140.0 | 150.0 | 97.5 | 108.5 | 65.0 | 0 | 75.0 | 0 |
| Jun | 157.0 | 47.0 | 35.0 | 118.0 | 140.0 | 150.0 | 97.5 | 108.5 | 65.0 | 0 | 75.0 | 0 |
| Jul | 157.0 | 47.0 | 35.0 | 118.0 | 140.0 | 150.0 | 97.5 | 108.5 | 65.0 | 0 | 75.0 | 0 |
| Aug | 157.0 | 47.0 | 35.0 | 118.0 | 140.0 | 150.0 | 97.5 | 108.5 | 65.0 | 0 | 75.0 | 0 |
| Sep | 157.0 | 47.0 | 35.0 | 118.0 | 140.0 | 150.0 | 97.5 | 108.5 | 65.0 | 0 | 75.0 | 0 |
| Oct | 157.0 | 47.0 | 35.0 | 118.0 | 140.0 | 150.0 | 97.5 | 108.5 | 65.0 | 0 | 75.0 | 0 |
| Nov | 157.0 | 47.0 | 35.0 | 118.0 | 140.0 | 150.0 | 97.5 | 108.5 | 65.0 | 0 | 75.0 | 0 |
| Dec | 157.0 | 47.0 | 35.0 | 118.0 | 140.0 | 150.0 | 97.5 | 108.5 | 65.0 | 0 | 75.0 | 0 |

| Firm Location | Kaiser Chalmette, Louisiana | Mead, Wash. | Ravenswood, West Va. | Tacoma, Wash. | Ormet Hannibal, Ohio | Reynolds Arkadelphia, Arkansas | Corpus Christi, Texas | Jones Mills, Arkansas | Sheffield, Alabama | Longview, Wash. | Massena, New York | Troutdale Oregon | Total all Producers |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1961 | | | | | | | | | | | | | |
| Jan | 247.5 | 176.0 | 145.0 | 0 | 180.0 | 55.0 | 95.0 | 109.0 | 190.0 | 60.5 | 66.0 | 91.5 | 2393.5 |
| Feb | 247.5 | 176.0 | 145.0 | | 180.0 | 55.0 | 95.0 | 109.0 | 190.0 | 60.5 | 66.0 | 91.5 | 2393.5 |
| Mar | 247.5 | 176.0 | 145.0 | | 180.0 | 55.0 | 95.0 | 109.0 | 190.0 | 60.5 | 66.0 | 91.5 | 2408.5 |
| Apr | 247.5 | 176.0 | 145.0 | | 180.0 | 55.0 | 95.0 | 109.0 | 190.0 | 60.5 | 66.0 | 91.5 | 2408.5 |
| May | 247.5 | 176.0 | 145.0 | | 180.0 | 55.0 | 95.0 | 109.0 | 190.0 | 60.5 | 66.0 | 91.5 | 2408.5 |
| Jun | 247.5 | 176.0 | 145.0 | shut down | 180.0 | 55.0 | 95.0 | 109.0 | 190.0 | 60.5 | 66.0 | 91.5 | 2408.5 |
| Jul | 247.5 | 176.0 | 145.0 | | 180.0 | 55.0 | 95.0 | 109.0 | 190.0 | 60.5 | 66.0 | 91.5 | 2408.5 |
| Aug | 247.5 | 176.0 | 145.0 | | 180.0 | 55.0 | 95.0 | 109.0 | 190.0 | 60.5 | 66.0 | 91.5 | 2408.5 |
| Sep | 247.5 | 176.0 | 145.0 | | 180.0 | 55.0 | 95.0 | 109.0 | 190.0 | 60.5 | 66.0 | 91.5 | 2408.5 |
| Oct | 247.5 | 176.0 | 145.0 | | 180.0 | 55.0 | 95.0 | 109.0 | 190.0 | 60.5 | 66.0 | 91.5 | 2408.5 |
| Nov | 247.5 | 176.0 | 145.0 | | 180.0 | 55.0 | 95.0 | 109.0 | 190.0 | 60.5 | 66.0 | 91.5 | 2408.5 |
| Dec | 247.5 | 176.0 | 145.0 | 0 | 180.0 | 55.0 | 95.0 | 109.0 | 190.0 | 60.5 | 66.0 | 91.5 | 2408.5 |

| Firm Location | Alcoa Alcoa, Tennessee | Badin No. Car. | Evansville, Indiana | Massena, New York | Point Comfort, Texas | Rockdale, Texas | VanCouver, Washington | Wenatchee, Washington | Anaconda Columbia Falls, Montana | Conalco New Johnsonville, Tennessee | Harvey The Dalles, Oregon | Intalco Ferndale, Wash. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1962 | | | | | | | | | | | | |
| Jan | 157.0 | 47.0 | 35.0 | 118.0 | 140.0 | 150.0 | 97.5 | 108.5 | 65.0 | 0 | 75.0 | 0 |
| Feb | 157.0 | 47.0 | 35.0 | 118.0 | 140.0 | 150.0 | 97.5 | 108.5 | 65.0 | 0 | 75.0 | 0 |
| Mar | 157.0 | 47.0 | 35.0 | 118.0 | 140.0 | 150.0 | 97.5 | 108.5 | 65.0 | 0 | 75.0 | 0 |
| Apr | 157.0 | 47.0 | 35.0 | 118.0 | 140.0 | 150.0 | 97.5 | 108.5 | 65.0 | 0 | 75.0 | 0 |
| May | 157.0 | 47.0 | 35.0 | 118.0 | 140.0 | 150.0 | 97.5 | 108.5 | 65.0 | 0 | 75.0 | 0 |
| Jun | 157.0 | 47.0 | 35.0 | 118.0 | 140.0 | 150.0 | 97.5 | 108.5 | 65.0 | 0 | 75.0 | 0 |
| Jul | 157.0 | 47.0 | 35.0 | 118.0 | 140.0 | 150.0 | 97.5 | 108.5 | 65.0 | 0 | 75.0 | 0 |
| Aug | 157.0 | 47.0 | 35.0 | 118.0 | 140.0 | 150.0 | 97.5 | 108.5 | 65.0 | 0 | 75.0 | 0 |
| Sep | 157.0 | 47.0 | 35.0 | 118.0 | 140.0 | 150.0 | 97.5 | 108.5 | 65.0 | 0 | 75.0 | 0 |
| Oct | 157.0 | 47.0 | 35.0 | 118.0 | 140.0 | 150.0 | 97.5 | 108.5 | 65.0 | 0 | 75.0 | 0 |
| Nov | 157.0 | 47.0 | 35.0 | 118.0 | 140.0 | 150.0 | 97.5 | 108.5 | 65.0 | 0 | 75.0 | 0 |
| Dec | 157.0 | 47.0 | 35.0 | 118.0 | 140.0 | 150.0 | 97.5 | 108.5 | 65.0 | 0 | 75.0 | 0 |

| Firm Location | Kaiser Chalmette, Louisiana | Mead, Wash. | Ravenswood, West Va. | Tacoma, Wash. | Ormet Hannibal, Ohio | Reynolds Arkadelphia, Arkansas | Corpus Christi, Texas | Jones Mills, Arkansas | Sheffield, Alabama | Longview, Wash. | Massena, New York | Troutdale, Oregon | Total all Producers |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1962 | | | | | | | | | | | | | |
| Jan | 247.5 | 176.0 | 145.0 | 0 | 180.0 | 55.0 | 95.0 | 109.0 | 190.0 | 60.5 | 66.0 | 91.5 | 2408.5 |
| Feb | 247.5 | 176.0 | 145.0 | | 180.0 | 55.0 | 95.0 | 109.0 | 190.0 | 60.5 | 66.0 | 91.5 | 2408.5 |
| Mar | 247.5 | 176.0 | 145.0 | | 180.0 | 55.0 | 95.0 | 109.0 | 190.0 | 60.5 | 66.0 | 91.5 | 2408.5 |
| Apr | 247.5 | 176.0 | 145.0 | | 180.0 | 55.0 | 95.0 | 109.0 | 190.0 | 60.5 | 66.0 | 91.5 | 2408.5 |
| May | 247.5 | 176.0 | 145.0 | | 180.0 | 55.0 | 95.0 | 109.0 | 190.0 | 60.5 | 100.0 | 91.5 | 2442.5 |
| Jun | 247.5 | 176.0 | 145.0 | | 180.0 | 55.0 | 95.0 | 109.0 | 190.0 | 60.5 | 100.0 | 91.5 | 2442.5 |
| Jul | 247.5 | 176.0 | 145.0 | shut down | 180.0 | 55.0 | 95.0 | 109.0 | 190.0 | 60.5 | 100.0 | 91.5 | 2442.5 |
| Aug | 247.5 | 176.0 | 145.0 | | 180.0 | 55.0 | 95.0 | 109.0 | 190.0 | 60.5 | 100.0 | 91.5 | 2442.5 |
| Sep | 247.5 | 176.0 | 145.0 | | 180.0 | 55.0 | 95.0 | 109.0 | 190.0 | 60.5 | 100.0 | 91.5 | 2442.5 |
| Oct | 247.5 | 176.0 | 145.0 | | 180.0 | 55.0 | 95.0 | 109.0 | 190.0 | 60.5 | 100.0 | 91.5 | 2442.5 |
| Nov | 247.5 | 176.0 | 145.0 | | 180.0 | 55.0 | 95.0 | 109.0 | 190.0 | 60.5 | 100.0 | 91.5 | 2442.5 |
| Dec | 247.5 | 176.0 | 145.0 | 0 | 180.0 | 55.0 | 95.0 | 109.0 | 190.0 | 60.5 | 100.0 | 91.5 | 2442.5 |

| Firm Location | Alcoa Alcoa, Tennessee | Badin No. Car. | Evansville, Indiana | Massena, New York | Point Comfort, Texas | Rockdale, Texas | VanCouver, Washington | Wenatchee, Washington | Anaconda Columbia Falls, Montana | Conalco New Johnsonville, Tennessee | Harvey The Dalles, Oregon | Intalco Ferndale, Wash. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1963 | | | | | | | | | | | | |
| Jan | 157.0 | 47.0 | 35.0 | 118.0 | 140.0 | 150.0 | 97.5 | 108.5 | 65.0 | 0 | 80.0 | 0 |
| Feb | 157.0 | 47.0 | 35.0 | 118.0 | 140.0 | 150.0 | 97.5 | 108.5 | 65.0 | 0 | 80.0 | 0 |
| Mar | 157.0 | 47.0 | 35.0 | 118.0 | 140.0 | 150.0 | 97.5 | 108.5 | 65.0 | 0 | 80.0 | 0 |
| Apr | 157.0 | 47.0 | 35.0 | 118.0 | 140.0 | 150.0 | 97.5 | 108.5 | 65.0 | 0 | 80.0 | 0 |
| May | 157.0 | 47.0 | 35.0 | 118.0 | 140.0 | 150.0 | 97.5 | 108.5 | 65.0 | 0 | 80.0 | 0 |
| Jun | 157.0 | 47.0 | 35.0 | 118.0 | 140.0 | 150.0 | 97.5 | 108.5 | 65.0 | 0 | 80.0 | 0 |
| Jul | 157.0 | 47.0 | 35.0 | 118.0 | 140.0 | 150.0 | 97.5 | 108.5 | 65.0 | 0 | 80.0 | 0 |
| Aug | 157.0 | 47.0 | 35.0 | 118.0 | 140.0 | 150.0 | 97.5 | 108.5 | 65.0 | 0 | 80.0 | 0 |
| Sep | 157.0 | 47.0 | 35.0 | 118.0 | 140.0 | 150.0 | 97.5 | 108.5 | 65.0 | 20.0 | 80.0 | 0 |
| Oct | 157.0 | 47.0 | 35.0 | 118.0 | 140.0 | 150.0 | 97.5 | 108.5 | 65.0 | 20.0 | 80.0 | 0 |
| Nov | 157.0 | 47.0 | 35.0 | 118.0 | 140.0 | 150.0 | 97.5 | 108.5 | 65.0 | 20.0 | 80.0 | 0 |
| Dec | 157.0 | 47.0 | 35.0 | 118.0 | 140.0 | 150.0 | 97.5 | 108.5 | 65.0 | 20.0 | 80.0 | 0 |

| Firm Loca-tion | Kaiser Chalmette, Louisiana | Mead, Wash. | Ravenswood, West Va. | Tacoma, Wash. | Ormet Hannibal, Ohio | Reynolds Arkadelphia, Arkansas | Corpus Christi, Texas | Jones Mills, Arkansas | Sheffield, Alabama | Longview, Wash. | Massena, New York | Troutdale, Oregon | Total all Pro-ducers |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1963 | | | | | | | | | | | | | |
| Jan | 247.5 | 176.0 | 145.0 | | 180.0 | 55.0 | 95.0 | 109.0 | 190.0 | 60.5 | 100.0 | 91.5 | 2447.5 |
| Feb | 247.5 | 176.0 | 145.0 | | 180.0 | 55.0 | 95.0 | 109.0 | 190.0 | 60.5 | 100.0 | 91.5 | 2447.5 |
| Mar | 247.5 | 176.0 | 145.0 | | 180.0 | 55.0 | 95.0 | 109.0 | 190.0 | 60.5 | 100.0 | 91.5 | 2447.5 |
| Apr | 247.5 | 176.0 | 145.0 | | 180.0 | 55.0 | 95.0 | 109.0 | 190.0 | 60.5 | 100.0 | 91.5 | 2447.5 |
| May | 247.5 | 176.0 | 145.0 | | 180.0 | 55.0 | 95.0 | 109.0 | 190.0 | 60.5 | 100.0 | 91.5 | 2447.5 |
| Jun | 247.5 | 176.0 | 145.0 | shut down | 180.0 | 55.0 | 95.0 | 109.0 | 190.0 | 60.5 | 100.0 | 91.5 | 2447.5 |
| Jul | 247.5 | 176.0 | 145.0 | | 180.0 | 55.0 | 95.0 | 109.0 | 190.0 | 60.5 | 100.0 | 91.5 | 2447.5 |
| Aug | 247.5 | 176.0 | 145.0 | | 180.0 | 55.0 | 95.0 | 109.0 | 190.0 | 60.5 | 100.0 | 91.5 | 2447.5 |
| Sep | 247.5 | 176.0 | 145.0 | | 180.0 | 55.0 | 95.0 | 109.0 | 190.0 | 60.5 | 100.0 | 91.5 | 2467.5 |
| Oct | 247.5 | 176.0 | 145.0 | | 180.0 | 55.0 | 95.0 | 109.0 | 190.0 | 60.5 | 100.0 | 91.5 | 2467.5 |
| Nov | 247.5 | 176.0 | 145.0 | | 180.0 | 55.0 | 95.0 | 109.0 | 190.0 | 60.5 | 100.0 | 91.5 | 2467.5 |
| Dec | 247.5 | 176.0 | 145.0 | | 180.0 | 55.0 | 95.0 | 109.0 | 190.0 | 60.5 | 100.0 | 91.5 | 2467.5 |

| Firm Location | Alcoa Alcoa, Tennessee | Badin No. Car. | Evansville, Indiana | Massena, New York | Point Comfort, Texas | Rockdale, Texas | VanCouver, Washington | Wenatchee, Washington | Anaconda Columbia Falls, Montana | Conalco New Johnsonville, Tennessee | Harvey The Dalles, Oregon | Intalco Ferndale, Wash. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1964 | | | | | | | | | | | | |
| Jan | 157.0 | 47.0 | 35.0 | 118.0 | 140.0 | 150.0 | 97.5 | 108.5 | 65.0 | 20.0 | 80.0 | 0 |
| Feb | 157.0 | 47.0 | 35.0 | 118.0 | 140.0 | 150.0 | 97.5 | 108.5 | 65.0 | 20.0 | 80.0 | 0 |
| Mar | 157.0 | 47.0 | 35.0 | 118.0 | 140.0 | 150.0 | 97.5 | 108.5 | 65.0 | 20.0 | 80.0 | 0 |
| Apr | 157.0 | 47.0 | 35.0 | 118.0 | 140.0 | 150.0 | 97.5 | 108.5 | 65.0 | 20.0 | 80.0 | 0 |
| May | 157.0 | 47.0 | 35.0 | 118.0 | 140.0 | 150.0 | 97.5 | 108.5 | 65.0 | 20.0 | 80.0 | 0 |
| Jun | 157.0 | 47.0 | 35.0 | 118.0 | 140.0 | 150.0 | 97.5 | 108.5 | 65.0 | 20.0 | 80.0 | 0 |
| Jul | 157.0 | 52.0 | 35.0 | 118.0 | 140.0 | 150.0 | 97.5 | 108.5 | 65.0 | 32.0 | 82.0 | 0 |
| Aug | 157.0 | 52.0 | 35.0 | 118.0 | 140.0 | 150.0 | 97.5 | 108.5 | 65.0 | 32.0 | 82.0 | 0 |
| Sep | 157.0 | 52.0 | 35.0 | 118.0 | 140.0 | 150.0 | 97.5 | 108.5 | 65.0 | 32.0 | 82.0 | 0 |
| Oct | 157.0 | 52.0 | 35.0 | 118.0 | 140.0 | 150.0 | 97.5 | 108.5 | 65.0 | 32.0 | 87.0 | 0 |
| Nov | 157.0 | 52.0 | 35.0 | 118.0 | 140.0 | 150.0 | 97.5 | 108.5 | 65.0 | 32.0 | 87.0 | 0 |
| Dec | 157.0 | 52.0 | 35.0 | 118.0 | 140.0 | 150.0 | 97.5 | 108.5 | 65.0 | 32.0 | 87.0 | 0 |

| Firm Location | Kaiser Chalmette, Louisiana | Mead, Wash. | Ravenswood, West Va. | Tacoma, Wash. | Ormet Hannibal, Ohio | Reynolds Arkadelphia, Arkansas | Corpus Christi, Texas | Jones Mills, Arkansas | Sheffield, Alabama | Longview, Wash. | Massena, New York | Troutdale, Oregon | Total all Producers |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1964 | | | | | | | | | | | | | |
| Jan | 247.5 | 176.0 | 145.0 | 0 | 180.0 | 55.0 | 95.0 | 109.0 | 190.0 | 60.5 | 100.0 | 91.5 | 2467.5 |
| Feb | 247.5 | 176.0 | 145.0 | | 180.0 | 55.0 | 95.0 | 109.0 | 190.0 | 60.5 | 100.0 | 91.5 | 2467.5 |
| Mar | 247.5 | 176.0 | 145.0 | | 180.0 | 55.0 | 95.0 | 109.0 | 194.5 | 65.0 | 100.0 | 91.5 | 2476.5 |
| Apr | 247.5 | 176.0 | 145.0 | | 180.0 | 55.0 | 95.0 | 109.0 | 194.5 | 65.0 | 115.0 | 91.5 | 2491.5 |
| May | 247.5 | 176.0 | 145.0 | | 180.0 | 55.0 | 95.0 | 109.0 | 194.5 | 65.0 | 115.0 | 91.5 | 2491.5 |
| Jun | 247.5 | 176.0 | 145.0 | | 180.0 | 55.0 | 95.0 | 109.0 | 194.5 | 65.0 | 115.0 | 91.5 | 2491.5 |
| Jul | 247.5 | 176.0 | 145.0 | shut down | 180.0 | 55.0 | 95.0 | 109.0 | 194.5 | 65.0 | 115.0 | 91.5 | 2510.5 |
| Aug | 247.5 | 176.0 | 145.0 | | 180.0 | 55.0 | 95.0 | 109.0 | 194.5 | 65.0 | 115.0 | 91.5 | 2510.5 |
| Sep | 247.5 | 176.0 | 145.0 | | 180.0 | 55.0 | 95.0 | 109.0 | 194.5 | 65.0 | 115.0 | 91.5 | 2510.5 |
| Oct | 247.5 | 176.0 | 145.0 | | 180.0 | 55.0 | 95.0 | 109.0 | 194.5 | 65.0 | 115.0 | 91.5 | 2515.5 |
| Nov | 247.5 | 176.0 | 145.0 | | 180.0 | 55.0 | 95.0 | 109.0 | 194.5 | 65.0 | 115.0 | 91.5 | 2515.5 |
| Dec | 247.5 | 176.0 | 145.0 | 41.0 | 180.0 | 55.0 | 95.0 | 109.0 | 194.5 | 65.0 | 115.0 | 91.5 | 2556.5 |

| Firm Location | Alcoa Alcoa, Tennessee | Badin No. Car. | Evansville, Indiana | Massena, New York | Point Comfort, Texas | Rockdale, Texas | VanCouver, Washington | Wenatchee, Washington | Anaconda Columbia Falls, Montana | Conalco New Johnsonville, Tennessee | Harvey The Dalles, Oregon | Intalco Ferndale, Wash. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1965 | | | | | | | | | | | | |
| Jan | 125.0 | 50.0 | 35.0 | 125.0 | 140.0 | 150.0 | 100.0 | 125.0 | 65.0 | 32.0 | 87.0 | 0 |
| Feb | 125.0 | 50.0 | 35.0 | 125.0 | 175.0 | 175.0 | 100.0 | 125.0 | 65.0 | 32.0 | 87.0 | 0 |
| Mar | 125.0 | 50.0 | 35.0 | 125.0 | 175.0 | 175.0 | 100.0 | 125.0 | 65.0 | 32.0 | 87.0 | 0 |
| Apr | 125.0 | 50.0 | 35.0 | 125.0 | 175.0 | 175.0 | 100.0 | 125.0 | 65.0 | 62.0 | 87.0 | 0 |
| May | 125.0 | 50.0 | 35.0 | 125.0 | 175.0 | 175.0 | 100.0 | 125.0 | 65.0 | 62.0 | 87.0 | 0 |
| Jun | 125.0 | 50.0 | 140.0 | 125.0 | 175.0 | 175.0 | 100.0 | 125.0 | 65.0 | 62.0 | 87.0 | 0 |
| Jul | 125.0 | 50.0 | 140.0 | 125.0 | 175.0 | 175.0 | 100.0 | 125.0 | 65.0 | 62.0 | 87.0 | 0 |
| Aug | 125.0 | 50.0 | 140.0 | 125.0 | 175.0 | 175.0 | 100.0 | 125.0 | 100.0 | 62.0 | 87.0 | 0 |
| Sep | 125.0 | 50.0 | 140.0 | 125.0 | 175.0 | 175.0 | 100.0 | 125.0 | 100.0 | 62.0 | 87.0 | 0 |
| Oct | 125.0 | 50.0 | 140.0 | 125.0 | 175.0 | 175.0 | 100.0 | 125.0 | 100.0 | 62.0 | 87.0 | 0 |
| Nov | 125.0 | 50.0 | 140.0 | 125.0 | 175.0 | 175.0 | 100.0 | 125.0 | 100.0 | 62.0 | 87.0 | 0 |
| Dec | 125.0 | 50.0 | 140.0 | 125.0 | 175.0 | 175.0 | 100.0 | 125.0 | 100.0 | 62.0 | 87.0 | 0 |

| Firm Location | Kaiser Chalmette, Louisiana | Mead, Wash. | Ravenswood, West Va. | Tacoma, Wash. | Ormet Hannibal, Ohio | Reynolds Arkadelphia, Arkansas | Corpus Christi, Texas | Jones Mills, Arkansas | Sheffield, Alabama | Longview, Wash. | Massena, New York | Troutdale, Oregon | Total all Producers |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1965 | | | | | | | | | | | | | |
| Jan | 247.5 | 176.0 | 145.0 | 41.0 | 180.0 | 55.0 | 95.0 | 109.0 | 194.5 | 65.0 | 115.0 | 91.5 | 2548.5 |
| Feb | 247.5 | 176.0 | 145.0 | 41.0 | 180.0 | 55.0 | 95.0 | 109.0 | 194.5 | 65.0 | 115.0 | 91.5 | 2608.5 |
| Mar | 257.0 | 193.0 | 145.0 | 41.0 | 180.0 | 55.0 | 95.0 | 109.0 | 194.5 | 65.0 | 115.0 | 91.5 | 2635.0 |
| Apr | 257.0 | 193.0 | 145.0 | 41.0 | 180.0 | 55.0 | 95.0 | 109.0 | 194.5 | 65.0 | 115.0 | 91.5 | 2665.0 |
| May | 257.0 | 193.0 | 145.0 | 41.0 | 180.0 | 55.0 | 95.0 | 109.0 | 194.5 | 65.0 | 115.0 | 91.5 | 2665.0 |
| Jun | 257.0 | 193.0 | 145.0 | 41.0 | 180.0 | 55.0 | 95.0 | 109.0 | 194.5 | 65.0 | 115.0 | 91.5 | 2770.0 |
| Jul | 257.0 | 193.0 | 145.0 | 41.0 | 180.0 | 55.0 | 95.0 | 109.0 | 194.5 | 65.0 | 115.0 | 91.5 | 2770.0 |
| Aug | 257.0 | 193.0 | 145.0 | 41.0 | 180.0 | 55.0 | 95.0 | 109.0 | 194.5 | 65.0 | 115.0 | 91.5 | 2805.0 |
| Sep | 257.0 | 193.0 | 145.0 | 41.0 | 180.0 | 55.0 | 95.0 | 109.0 | 194.5 | 65.0 | 115.0 | 91.5 | 2805.0 |
| Oct | 257.0 | 193.0 | 145.0 | 41.0 | 180.0 | 55.0 | 95.0 | 109.0 | 194.5 | 65.0 | 115.0 | 91.5 | 2805.0 |
| Nov | 257.0 | 193.0 | 145.0 | 41.0 | 180.0 | 55.0 | 95.0 | 109.0 | 194.5 | 65.0 | 115.0 | 91.5 | 2805.0 |
| Dec | 257.0 | 193.0 | 145.0 | 41.0 | 180.0 | 55.0 | 95.0 | 109.0 | 194.5 | 65.0 | 115.0 | 91.5 | 2805.0 |

| Firm Location | Alcoa Alcoa, Tennessee | Badin No. Car. | Evansville, Indiana | Massena, New York | Point Comfort, Texas | Rockdale, Texas | VanCouver, Washington | Wenatchee, Washington | Anaconda Columbia Falls, Montana | Conalco New Johnsonville, Tennessee | Harvey The Dalles, Oregon | Intalco Ferndale, Wash. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1966 | | | | | | | | | | | | |
| Jan | 125.0 | 50.0 | 140.0 | 125.0 | 175.0 | 175.0 | 100.0 | 125.0 | 100.0 | 62.0 | 87.0 | 0 |
| Feb | 125.0 | 50.0 | 140.0 | 125.0 | 175.0 | 175.0 | 100.0 | 125.0 | 100.0 | 62.0 | 87.0 | 0 |
| Mar | 125.0 | 50.0 | 140.0 | 125.0 | 175.0 | 175.0 | 100.0 | 125.0 | 100.0 | 62.0 | 87.0 | 0 |
| Apr | 125.0 | 50.0 | 140.0 | 125.0 | 175.0 | 175.0 | 100.0 | 125.0 | 100.0 | 62.0 | 87.0 | 0 |
| May | 125.0 | 50.0 | 175.0 | 125.0 | 175.0 | 175.0 | 100.0 | 125.0 | 100.0 | 62.0 | 87.0 | 0 |
| Jun | 125.0 | 50.0 | 175.0 | 125.0 | 175.0 | 175.0 | 100.0 | 125.0 | 100.0 | 62.0 | 87.0 | 76.0 |
| Jul | 125.0 | 50.0 | 175.0 | 125.0 | 175.0 | 175.0 | 100.0 | 125.0 | 100.0 | 70.0 | 87.0 | 76.0 |
| Aug | 125.0 | 50.0 | 175.0 | 125.0 | 175.0 | 175.0 | 100.0 | 125.0 | 100.0 | 70.0 | 87.0 | 76.0 |
| Sep | 125.0 | 50.0 | 175.0 | 125.0 | 175.0 | 175.0 | 100.0 | 125.0 | 100.0 | 70.0 | 87.0 | 76.0 |
| Oct | 125.0 | 50.0 | 175.0 | 125.0 | 175.0 | 175.0 | 100.0 | 125.0 | 100.0 | 70.0 | 87.0 | 76.0 |
| Nov | 125.0 | 50.0 | 175.0 | 125.0 | 175.0 | 175.0 | 100.0 | 125.0 | 100.0 | 70.0 | 87.0 | 76.0 |
| Dec | 125.0 | 50.0 | 175.0 | 125.0 | 175.0 | 175.0 | 100.0 | 125.0 | 100.0 | 70.0 | 87.0 | 76.0 |

| Firm Location | Kaiser Chalmette, Louisiana | Mead, Wash. | Ravenswood West Va. | Tacoma, Wash. | Ormet Hannibal, Ohio | Reynolds Arkadelphia Arkansas | Corpus Christi, Texas | Jones Mills, Arkansas | Sheffield, Alabama | Longview, Wash. | Massena, New York | Troutdale, Oregon | Total all Producers |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1966 | | | | | | | | | | | | | |
| Jan | 257.0 | 193.0 | 145.0 | 41.0 | 180.0 | 55.0 | 95.0 | 109.0 | 194.5 | 65.0 | 115.0 | 91.5 | 2805.0 |
| Feb | 257.0 | 193.0 | 145.0 | 41.0 | 180.0 | 55.0 | 95.0 | 109.0 | 194.5 | 65.0 | 115.0 | 91.5 | 2805.0 |
| Mar | 257.0 | 193.0 | 145.0 | 41.0 | 180.0 | 55.0 | 95.0 | 109.0 | 194.5 | 65.0 | 115.0 | 91.5 | 2805.0 |
| Apr | 257.0 | 193.0 | 145.0 | 41.0 | 180.0 | 55.0 | 95.0 | 109.0 | 194.5 | 65.0 | 115.0 | 91.5 | 2805.0 |
| May | 257.0 | 193.0 | 159.0 | 41.0 | 180.0 | 55.0 | 95.0 | 109.0 | 194.5 | 65.0 | 115.0 | 91.5 | 2854.0 |
| Jun | 257.0 | 193.0 | 159.0 | 41.0 | 180.0 | 55.0 | 95.0 | 109.0 | 194.5 | 65.0 | 115.0 | 91.5 | 2930.0 |
| Jul | 257.0 | 193.0 | 159.0 | 41.0 | 185.0 | 55.0 | 95.0 | 109.0 | 194.5 | 65.0 | 115.0 | 91.5 | 2943.0 |
| Aug | 257.0 | 193.0 | 159.0 | 41.0 | 185.0 | 55.0 | 95.0 | 109.0 | 194.5 | 65.0 | 115.0 | 91.5 | 2943.0 |
| Sep | 257.0 | 193.0 | 159.0 | 41.0 | 185.0 | 55.0 | 95.0 | 109.0 | 194.5 | 65.0 | 115.0 | 91.5 | 2943.0 |
| Oct | 257.0 | 193.0 | 159.0 | 41.0 | 185.0 | 55.0 | 95.0 | 109.0 | 194.5 | 65.0 | 115.0 | 91.5 | 2943.0 |
| Nov | 257.0 | 193.0 | 159.0 | 41.0 | 185.0 | 55.0 | 95.0 | 109.0 | 194.5 | 65.0 | 115.0 | 91.5 | 2943.0 |
| Dec | 257.0 | 193.0 | 159.0 | 41.0 | 185.0 | 55.0 | 95.0 | 109.0 | 194.5 | 65.0 | 115.0 | 91.5 | 2943.0 |

| Firm Location | Alcoa Alcoa, Tennessee | Badin No. Car. | Evansville, Indiana | Massena, New York | Point Comfort, Texas | Rockdale, Texas | VanCouver, Washington | Wenatchee, Washington | Anaconda Columbia Falls, Montana | Conalco New Johnsonville, Tennessee | Harvey The Dalles, Oregon | Intalco Ferndale, Wash. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1967 | | | | | | | | | | | | |
| Jan | 125.0 | 50.0 | 175.0 | 125.0 | 175.0 | 175.0 | 100.0 | 125.0 | 100.0 | 70.0 | 87.0 | 152.0 |
| Feb | 125.0 | 50.0 | 175.0 | 125.0 | 175.0 | 175.0 | 100.0 | 125.0 | 100.0 | 70.0 | 87.0 | 152.0 |
| Mar | 125.0 | 100.0 | 175.0 | 125.0 | 175.0 | 175.0 | 100.0 | 125.0 | 100.0 | 70.0 | 87.0 | 152.0 |
| Apr | 125.0 | 100.0 | 175.0 | 125.0 | 175.0 | 175.0 | 100.0 | 125.0 | 100.0 | 70.0 | 87.0 | 152.0 |
| May | 125.0 | 100.0 | 175.0 | 125.0 | 175.0 | 175.0 | 100.0 | 125.0 | 100.0 | 70.0 | 87.0 | 152.0 |
| Jun | 125.0 | 100.0 | 175.0 | 125.0 | 175.0 | 175.0 | 100.0 | 125.0 | 100.0 | 70.0 | 87.0 | 152.0 |
| Jul | 125.0 | 100.0 | 175.0 | 125.0 | 175.0 | 175.0 | 100.0 | 125.0 | 105.0 | 70.0 | 88.0 | 152.0 |
| Aug | 125.0 | 100.0 | 175.0 | 125.0 | 175.0 | 175.0 | 100.0 | 125.0 | 105.0 | 70.0 | 88.0 | 152.0 |
| Sep | 125.0 | 100.0 | 175.0 | 125.0 | 175.0 | 175.0 | 100.0 | 175.0 | 105.0 | 70.0 | 88.0 | 152.0 |
| Oct | 125.0 | 100.0 | 175.0 | 125.0 | 175.0 | 175.0 | 100.0 | 175.0 | 105.0 | 106.0 | 88.0 | 152.0 |
| Nov | 125.0 | 100.0 | 175.0 | 125.0 | 175.0 | 175.0 | 100.0 | 175.0 | 105.0 | 106.0 | 88.0 | 152.0 |
| Dec | 125.0 | 100.0 | 175.0 | 125.0 | 175.0 | 175.0 | 100.0 | 175.0 | 105.0 | 106.0 | 88.0 | 152.0 |

| Firm Location | Kaiser Chalmette, Louisiana | Mead, Wash. | Ravenswood West Va. | Tacoma, Wash. | Ormet Hannibal, Ohio | Reynolds Arkadelphia, Arkansas | Corpus Christi, Texas | Jones Mills, Arkansas | Sheffield, Alabama | Longview, Wash. | Massena, New York | Troutdale, Oregon | Total all Producers |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1967 | | | | | | | | | | | | | |
| Jan | 257.0 | 193.0 | 159.0 | 41.0 | 185.0 | 55.0 | 111.0 | 122.0 | 221.0 | 70.0 | 128.0 | 100.0 | 3101.0 |
| Feb | 257.0 | 193.0 | 159.0 | 41.0 | 185.0 | 55.0 | 111.0 | 122.0 | 221.0 | 70.0 | 128.0 | 100.0 | 3101.0 |
| Mar | 257.0 | 193.0 | 159.0 | 41.0 | 185.0 | 55.0 | 111.0 | 122.0 | 221.0 | 70.0 | 128.0 | 100.0 | 3151.0 |
| Apr | 257.0 | 193.0 | 159.0 | 41.0 | 185.0 | 55.0 | 111.0 | 122.0 | 221.0 | 70.0 | 128.0 | 100.0 | 3151.0 |
| May | 257.0 | 193.0 | 159.0 | 41.0 | 185.0 | 55.0 | 111.0 | 122.0 | 221.0 | 70.0 | 128.0 | 100.0 | 3151.0 |
| Jun | 257.0 | 193.0 | 159.0 | 41.0 | 185.0 | 55.0 | 111.0 | 122.0 | 221.0 | 70.0 | 128.0 | 100.0 | 3151.0 |
| Jul | 257.0 | 193.0 | 159.0 | 41.0 | 190.0 | 55.0 | 111.0 | 122.0 | 221.0 | 70.0 | 128.0 | 100.0 | 3162.0 |
| Aug | 257.0 | 193.0 | 159.0 | 41.0 | 200.0 | 55.0 | 111.0 | 122.0 | 221.0 | 70.0 | 128.0 | 100.0 | 3172.0 |
| Sep | 257.0 | 193.0 | 159.0 | 41.0 | 210.0 | 55.0 | 111.0 | 122.0 | 221.0 | 70.0 | 128.0 | 100.0 | 3232.0 |
| Oct | 257.0 | 193.0 | 159.0 | 41.0 | 220.0 | 55.0 | 111.0 | 122.0 | 221.0 | 70.0 | 128.0 | 100.0 | 3278.0 |
| Nov | 257.0 | 193.0 | 159.0 | 41.0 | 230.0 | 55.0 | 111.0 | 122.0 | 221.0 | 70.0 | 128.0 | 100.0 | 3288.0 |
| Dec | 257.0 | 193.0 | 159.0 | 41.0 | 240.0 | 55.0 | 111.0 | 122.0 | 221.0 | 70.0 | 128.0 | 100.0 | 3298.0 |

| Firm Location | Alcoa Alcoa, Tennessee | Badin No. Car. | Evansville, Indiana | Massena, New York | Point Comfort, Texas | Rockdale, Texas | VanCouver, Washington | Wenatchee, Washington | Anaconda Columbia Falls, Montana | Conalco New Johnsonville, Tennessee | Harvey The Dalles, Oregon | Intalco Ferndale, Wash. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1968 | | | | | | | | | | | | |
| Jan | 125.0 | 100.0 | 175.0 | 125.0 | 175.0 | 175.0 | 100.0 | 175.0 | 105.0 | 106.0 | 88.0 | 152.0 |
| Feb | 125.0 | 100.0 | 175.0 | 125.0 | 175.0 | 175.0 | 100.0 | 175.0 | 105.0 | 106.0 | 88.0 | 152.0 |
| Mar | 125.0 | 100.0 | 175.0 | 125.0 | 175.0 | 175.0 | 100.0 | 175.0 | 105.0 | 140.0 | 88.0 | 152.0 |
| Apr | 125.0 | 100.0 | 175.0 | 125.0 | 175.0 | 175.0 | 100.0 | 175.0 | 105.0 | 140.0 | 88.0 | 152.0 |
| May | 125.0 | 100.0 | 175.0 | 125.0 | 175.0 | 175.0 | 100.0 | 175.0 | 105.0 | 140.0 | 88.0 | 152.0 |
| Jun | 125.0 | 100.0 | 175.0 | 125.0 | 175.0 | 175.0 | 100.0 | 175.0 | 105.0 | 140.0 | 88.0 | 152.0 |
| Jul | 125.0 | 100.0 | 175.0 | 125.0 | 175.0 | 175.0 | 100.0 | 175.0 | 105.0 | 140.0 | 88.0 | 152.0 |
| Aug | 125.0 | 100.0 | 175.0 | 125.0 | 175.0 | 175.0 | 100.0 | 175.0 | 105.0 | 140.0 | 91.0 | 152.0 |
| Sep | 125.0 | 100.0 | 175.0 | 125.0 | 175.0 | 175.0 | 100.0 | 175.0 | 105.0 | 140.0 | 91.0 | 152.0 |
| Oct | 125.0 | 100.0 | 175.0 | 125.0 | 175.0 | 175.0 | 100.0 | 175.0 | 140.0 | 140.0 | 91.0 | 152.0 |
| Nov | 125.0 | 100.0 | 175.0 | 125.0 | 175.0 | 175.0 | 100.0 | 175.0 | 140.0 | 140.0 | 91.0 | 228.0 |
| Dec | 125.0 | 100.0 | 175.0 | 125.0 | 175.0 | 220.0 | 100.0 | 175.0 | 175.0 | 140.0 | 91.0 | 228.0 |

| Firm Location | Kaiser Chalmette, Louisiana | Mead, Wash. | Ravenswood, West Va. | Tacoma, Wash. | Ormet Hannibal, Ohio | Reynolds Arkadelphia, Arkansas | Corpus Christi, Texas | Jones Mills, Arkansas | Sheffield, Alabama | Longview, Wash. | Massena, New York | Troutdale, Oregon | Total all Producers |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1968 | | | | | | | | | | | | | |
| Jan | 257.0 | 193.0 | 159.0 | 41.0 | 240.0 | 63.0 | 111.0 | 122.0 | 221.0 | 70.0 | 128.0 | 100.0 | 3306.0 |
| Feb | 257.0 | 213.0 | 159.0 | 41.0 | 240.0 | 63.0 | 111.0 | 122.0 | 221.0 | 70.0 | 128.0 | 100.0 | 3326.0 |
| Mar | 257.0 | 213.0 | 159.0 | 41.0 | 240.0 | 63.0 | 111.0 | 122.0 | 221.0 | 70.0 | 128.0 | 100.0 | 3360.0 |
| Apr | 257.0 | 213.0 | 159.0 | 41.0 | 240.0 | 63.0 | 111.0 | 122.0 | 221.0 | 70.0 | 128.0 | 100.0 | 3360.0 |
| May | 257.0 | 213.0 | 159.0 | 41.0 | 240.0 | 63.0 | 111.0 | 122.0 | 221.0 | 70.0 | 128.0 | 100.0 | 3360.0 |
| Jun | 257.0 | 213.0 | 159.0 | 41.0 | 240.0 | 63.0 | 111.0 | 122.0 | 221.0 | 70.0 | 128.0 | 100.0 | 3360.0 |
| Jul | 257.0 | 213.0 | 159.0 | 41.0 | 240.0 | 63.0 | 111.0 | 122.0 | 221.0 | 70.0 | 128.0 | 100.0 | 3363.0 |
| Aug | 257.0 | 213.0 | 159.0 | 41.0 | 240.0 | 63.0 | 111.0 | 122.0 | 221.0 | 70.0 | 128.0 | 100.0 | 3363.0 |
| Sep | 257.0 | 213.0 | 159.0 | 41.0 | 240.0 | 63.0 | 111.0 | 122.0 | 221.0 | 110.0 | 128.0 | 100.0 | 3438.0 |
| Oct | 257.0 | 213.0 | 159.0 | 61.0 | 240.0 | 63.0 | 111.0 | 122.0 | 221.0 | 110.0 | 128.0 | 100.0 | 3458.0 |
| Nov | 257.0 | 213.0 | 159.0 | 61.0 | 240.0 | 63.0 | 111.0 | 122.0 | 221.0 | 110.0 | 128.0 | 100.0 | 3534.0 |
| Dec | 257.0 | 213.0 | 159.0 | 61.0 | 240.0 | 63.0 | 111.0 | 122.0 | 221.0 | 150.0 | 128.0 | 100.0 | 3654.0 |

APPENDIX D

PRIMARY AND SECONDARY ALUMINUM INGOT PRODUCTION,
SHIPMENT, AND INVENTORY DATA
In Short Tons

| r | Primary Ingot Data | | | Secondary Ingot Data | | |
|---|---|---|---|---|---|---|
| th | Production | Shipments | Inventory Month End | Production | Shipments | Inventory, Month End |
| 9 | | | | | | |
| | 156700 | 127678 | 175108 | 22722 | 24206 | 16615 |
| | 142116 | 133397 | 183827 | 25995 | 26861 | 15784 |
| | 157189 | 181839 | 159177 | 26844 | 27622 | 15217 |
| | 155213 | 182930 | 131460 | 31304 | 30951 | 15268 |
| | 163857 | 182607 | 112710 | 30261 | 31073 | 14757 |
| | 167323 | 191421 | 88612 | 30772 | 31109 | 14739 |
| | 179194 | 187387 | 80419 | 27207 | 25285 | 16586 |
| | 172816 | 159206 | 94029 | 27838 | 24780 | 19664 |
| | 168206 | 153170 | 109065 | 26326 | 24798 | 21204 |
| | 173742 | 151683 | 131124 | 27266 | 24604 | 23336 |
| | 153665 | 152024 | 132765 | 24206 | 24306 | 22984 |
| | 162996 | 184123 | 111638 | 27205 | 27043 | 22862 |
| 0 | | | | | | |
| | 164023 | 148129 | 127532 | 29141 | 29784 | 21841 |
| | 156825 | 167215 | 117142 | 29206 | 29570 | 21231 |
| | 170688 | 172846 | 114984 | 29199 | 28125 | 22395 |
| | 168596 | 144469 | 139111 | 24018 | 22935 | 22610 |
| | 175863 | 166403 | 148571 | 22627 | 21753 | 23254 |
| | 171356 | 149917 | 170010 | 22810 | 21591 | 24545 |
| | 177564 | 143948 | 203626 | 18240 | 18341 | 23816 |
| | 172973 | 164883 | 211716 | 24946 | 22393 | 25763 |
| | 162882 | 148724 | 225874 | 20801 | 20814 | 25612 |
| | 167015 | 144449 | 248066 | 21716 | 21225 | 25285 |
| | 161208 | 152213 | 257061 | 19959 | 20401 | 24463 |
| | 165504 | 163054 | 259511 | 19126 | 19120 | 24525 |

APPENDIX D--Continued

| ear nd onth | Primary Ingot Data | | | Secondary Ingot Data | | |
|---|---|---|---|---|---|---|
| | Produc- tion | Ship- ments | Inventory, Month End | Produc- tion | Ship- ments | Inventory, Month End |
| 961 | | | | | | |
| an | 161427 | 129566 | 291372 | 20639 | 21830 | 22115 |
| eb | 138560 | 142540 | 287392 | 19031 | 19212 | 22062 |
| ar | 152023 | 161495 | 277595 | 21951 | 21863 | 21737 |
| pr | 144637 | 155843 | 266389 | 21275 | 20857 | 23564 |
| ay | 157544 | 171068 | 252864 | 22624 | 24812 | 21421 |
| un | 159092 | 164451 | 247504 | 25943 | 22986 | 24493 |
| ul | 164732 | 155379 | 256857 | 20852 | 20862 | 24328 |
| ug | 167040 | 164695 | 259202 | 25732 | 25532 | 24491 |
| ep | 159572 | 163332 | 255442 | 23524 | 25092 | 22936 |
| ct | 167295 | 167086 | 255441 | 26227 | 27413 | 21763 |
| ov | 164125 | 179432 | 240343 | 28288 | 28723 | 21339 |
| ec | 167992 | 201281 | 207055 | 26558 | 25968 | 21884 |
| 962 | | | | | | |
| an | 170140 | 178771 | 198424 | 29975 | 30416 | 21955 |
| eb | 157701 | 165374 | 190751 | 30353 | 30087 | 22696 |
| ar | 177425 | 197440 | 170736 | 32061 | 31527 | 22991 |
| pr | 173659 | 189866 | 154529 | 32021 | 30228 | 24730 |
| ay | 184211 | 200976 | 137764 | 33002 | 32031 | 26151 |
| un | 179122 | 184284 | 132602 | 32638 | 31447 | 26843 |
| ul | 184106 | 184993 | 131715 | 25188 | 26717 | 24882 |
| ug | 168086 | 169016 | 130785 | 31573 | 29787 | 27032 |
| ep | 176185 | 158702 | 148268 | 30121 | 31659 | 26010 |
| ct | 185191 | 185338 | 148120 | 36451 | 37216 | 25424 |
| ov | 179679 | 174947 | 152852 | 35401 | 36723 | 24681 |
| ec | 182424 | 195150 | 140108 | 33950 | 34660 | 23377 |

APPENDIX D--Continued

| ear nd onth | Primary Ingot Data | | | Secondary Ingot Data | | |
|---|---|---|---|---|---|---|
| | Produc- tions | Ship- ments | Inventory, Month End | Produc- tions | Ship- ments | Inventory, Month End |
| 963 | | | | | | |
| an | 184158 | 169867 | 154399 | 37964 | 38218 | 23340 |
| eb | 162977 | 178356 | 139020 | 36004 | 36660 | 26485 |
| ar | 181590 | 201056 | 119554 | 37401 | 37384 | 27055 |
| pr | 181329 | 199223 | 101660 | 38998 | 39734 | 27296 |
| ay | 192868 | 206333 | 88195 | 38000 | 39371 | 25840 |
| un | 192491 | 197379 | 83307 | 35397 | 35689 | 26496 |
| ul | 201355 | 198934 | 85728 | 31385 | 30192 | 27244 |
| ug | 203074 | 194268 | 94534 | 35899 | 34751 | 29187 |
| ep | 197378 | 198133 | 93779 | 35867 | 34315 | 30471 |
| ct | 205117 | 202001 | 96895 | 39381 | 37338 | 32418 |
| ov | 201117 | 187355 | 110657 | 37227 | 35381 | 33765 |
| ec | 209074 | 220719 | 99012 | 33600 | 35008 | 32235 |
| 964 | | | | | | |
| an | 212008 | 202986 | 108034 | 39246 | 39263 | 32423 |
| eb | 200189 | 200400 | 107823 | 38203 | 39171 | 31255 |
| ar | 214221 | 216079 | 105965 | 41273 | 40569 | 32431 |
| pr | 208301 | 220922 | 93344 | 43125 | 42994 | 32748 |
| ay | 214630 | 208462 | 99512 | 38157 | 37694 | 32642 |
| un | 203749 | 216281 | 86980 | 39416 | 38781 | 33277 |
| ul | 216100 | 211069 | 92011 | 34246 | 34441 | 33098 |
| ug | 217198 | 204947 | 104262 | 37762 | 38865 | 31520 |
| ep | 211314 | 205659 | 109917 | 38184 | 39020 | 30687 |
| ct | 218422 | 206945 | 121394 | 39805 | 40909 | 29583 |
| ov | 213993 | 219242 | 116145 | 36892 | 37361 | 29114 |
| ec | 222845 | 242129 | 96861 | 39491 | 40526 | 29079 |

APPENDIX D--Continued

| r | Primary Ingot Data | | | Secondary Ingot Data | | |
|---|---|---|---|---|---|---|
| th | Produc-tion | Ship-ments | Inventory, Month End | Produc-tion | Ship-ments | Inventory, Month End |
| 5 | | | | | | |
| | 222749 | 212139 | 107471 | 41423 | 43869 | 25633 |
| | 203159 | 212950 | 97680 | 40022 | 42550 | 23530 |
| | 230026 | 246663 | 81043 | 43581 | 48512 | 18408 |
| | 226645 | 231803 | 75885 | 43909 | 44032 | 17378 |
| | 236951 | 249484 | 63352 | 43155 | 43072 | 17633 |
| | 227638 | 211578 | 79412 | 44438 | 41296 | 20747 |
| | 235072 | 231435 | 83049 | 38042 | 33444 | 24874 |
| | 234869 | 236863 | 81055 | 40880 | 34814 | 30952 |
| | 218657 | 228740 | 70972 | 39247 | 38703 | 32780 |
| | 237213 | 231393 | 76792 | 39571 | 39546 | 33137 |
| | 236506 | 238261 | 75037 | 40897 | 39760 | 34273 |
| | 244991 | 255273 | 64755 | 41189 | 38799 | 37157 |
| 6 | | | | | | |
| | 247311 | 233790 | 78276 | 42953 | 44945 | 35141 |
| | 223518 | 230008 | 71786 | 40666 | 42973 | 32784 |
| | 249005 | 256019 | 64772 | 49758 | 50230 | 32295 |
| | 240726 | 245213 | 60285 | 45958 | 46449 | 31783 |
| | 252291 | 244902 | 67674 | 44322 | 45358 | 30790 |
| | 244966 | 249564 | 63076 | 43977 | 43263 | 31534 |
| | 252830 | 245925 | 69981 | 36145 | 35904 | 31794 |
| | 239818 | 247859 | 61940 | 45096 | 45283 | 31607 |
| | 245905 | 245645 | 62200 | 46954 | 45800 | 32761 |
| | 258375 | 254810 | 65765 | 44644 | 48135 | 29245 |
| | 251004 | 250008 | 66761 | 45339 | 47955 | 26629 |
| | 262142 | 254056 | 74847 | 49932 | 48825 | 27757 |

APPENDIX D--Continued

| 'ear ınd Ionth | Primary Ingot Data | | | Secondary Ingot Data | | |
|---|---|---|---|---|---|---|
| | Produc-tion | Ship-ments | Inventory, Month End | Produc-tion | Ship-ments | Inventory, Month End |
| 967 | | | | | | |
| Jan | 265228 | 263487 | 76588 | 47601 | 48064 | 27296 |
| 'eb | 243581 | 251056 | 69113 | 45326 | 47598 | 25024 |
| Iar | 274381 | 273681 | 69823 | 48832 | 46421 | 27433 |
| pr | 268446 | 255123 | 83146 | 45167 | 42448 | 30124 |
| Iay | 278924 | 268801 | 93269 | 46658 | 46801 | 30048 |
| 'un | 270075 | 253516 | 109828 | 44934 | 45113 | 30922 |
| ul | 276969 | 244761 | 142036 | 42192 | 40519 | 32581 |
| ug | 277557 | 249035 | 170558 | 52160 | 51109 | 33275 |
| ep | 270393 | 253359 | 187592 | 40445 | 45681 | 27722 |
| ct | 283792 | 266435 | 204948 | 52510 | 52772 | 27143 |
| ov | 277232 | 266080 | 216100 | 50999 | 51766 | 25918 |
| ec | 282682 | 290812 | 207970 | 54749 | 55176 | 25135 |
| 968 | | | | | | |
| an | 285283 | 291212 | 212998 | 48274 | 51576 | 20727 |
| eb | 267112 | 292442 | 187668 | 52938 | 51623 | 22042 |
| ar | 288328 | 314805 | 161191 | 52893 | 52783 | 22152 |
| pr | 280287 | 328079 | 113399 | 51336 | 52048 | 21439 |
| ay | 289037 | 305080 | 97356 | 54578 | 53073 | 23064 |
| un | 218540 | 206571 | 109325 | 47906 | 45386 | 25519 |
| ul | 225954 | 221089 | 114190 | 41614 | 40175 | 26958 |
| ug | 246503 | 269447 | 91246 | 42866 | 40574 | 29184 |
| ep | 268973 | 266321 | 93898 | 42244 | 42191 | 31145 |
| ct | 293410 | 288065 | 99243 | 51747 | 50187 | 32745 |
| ov | 291551 | 291396 | 99398 | 45006 | 45848 | 31738 |
| ec | 300063 | 328547 | 70914* | 49290 | 51066 | 29456 |

ource: Metals Industry Survey, Aluminum Monthly, U. S. Department of Interior, Bureau of Mines, Washington, D.C.

December, 1968 inventory data do not correlate with other monthly data because of a revised reporting method by one firm.

IMPORTS AND EXPORTS AND STOCKPILE DATA

| | Primary Ingot | | | Scrap | | | Stockpile | |
|---|---|---|---|---|---|---|---|---|
| | Imports | Exports | Net Imports (Exports) | Imports | Exports | Net Imports (Exports) | Withdrawal Year End | Deliveries Balance |
| 1959 | | | | | | | | |
| Jan | 12719 | 5048 | 7671 | 637 | 1710 | (1073) | 0 | 6917 |
| Feb | 9724 | 9248 | 476 | 466 | 1356 | ( 890) | " | " |
| Mar | 14234 | 1298 | 12936 | 1237 | 2333 | (1096) | " | " |
| Apr | 14036 | 2135 | 11901 | 1052 | 1730 | ( 678) | " | " |
| May | 22834 | 6383 | 16451 | 964 | 1898 | ( 934) | " | " |
| Jun | 30472 | 10434 | 20038 | 1442 | 2347 | ( 905) | " | " |
| Jul | 30838 | 4900 | 25938 | 571 | 3216 | (2645) | " | " |
| Aug | 31392 | 9478 | 21914 | 1558 | 2890 | (1302) | " | " |
| Sep | 14783 | 13559 | 1224 | 1004 | 5239 | (4235) | " | " |
| Oct | 18546 | 12829 | 5717 | 636 | 3506 | (2870) | " | " |
| Nov | 15821 | 21861 | (6040) | 602 | 4123 | (3521) | " | " |
| Dec | 26397 | 23907 | 2490 | 720 | 5000 | (4280) | " | 6913 |
| | | | | | | | 1851500 | |
| 1960 | | | | | | | | |
| Jan | 12047 | 23958 | (11911) | 608 | 5088 | (4480) | 0 | 3667 |
| Feb | 10600 | 42548 | (31948) | 403 | 5878 | (5475) | " | " |
| Mar | 16776 | 28165 | (11389) | 410 | 7617 | (7207) | " | " |

| | Primary Ingot | | | Scrap | | | Stockpile | |
|---|---|---|---|---|---|---|---|---|
| | Imports | Exports | Net Imports (Exports) | Imports | Exports | Net Imports (Exports) | Withdrawal | Deliveries |
| | | | | | | | Year End Balance | |
| Apr | 7550 | 26420 | (18870) | 530 | 8157 | (7627) | 0 | 3667 |
| May | 11073 | 15954 | ( 4881) | 597 | 6587 | (5990) | " | " |
| Jun | 15209 | 24551 | ( 9342) | 599 | 6603 | (6004) | " | " |
| Jul | 12888 | 18585 | ( 5697) | 286 | 6237 | (5951) | " | " |
| Aug | 14351 | 29291 | (14940) | 364 | 7206 | (6842) | " | " |
| Sep | 13600 | 15877 | ( 2277) | 261 | 5898 | (5637) | " | " |
| Oct | 16062 | 10829 | 5233 | 412 | 7238 | (6826) | " | " |
| Nov | 14357 | 22453 | ( 8096) | 302 | 6632 | (6330) | " | " |
| Dec | 11270 | 26169 | (14899) | 270 | 6421 | (6151) | " | 3683 |
| | | | | | | | 1895500 | |
| 1961 | | | | | | | | |
| Jan | 10823 | 16555 | ( 5732) | 455 | 6471 | (6016) | 0 | 4333 |
| Feb | 8634 | 12168 | ( 3534) | 625 | 7051 | (6426) | " | " |
| Mar | 15497 | 12255 | 3242 | 393 | 8354 | (7961) | " | " |
| Apr | 12399 | 7967 | 4432 | 218 | 7334 | (7116) | " | " |
| May | 16777 | 6927 | 9850 | 300 | 9573 | (9273) | " | " |
| Jun | 17101 | 13493 | 3608 | 628 | 7119 | (6491) | " | " |
| Jul | 15332 | 14442 | 890 | 229 | 6235 | (6006) | " | " |
| Aug | 21911 | 7760 | 14151 | 825 | 5119 | (4294) | " | " |

| | Primary | | | Scrap | | | Stockpile | | |
|---|---|---|---|---|---|---|---|---|---|
| | Imports | Exports | Net Imports (Exports) | Imports | Exports | Net Imports (Exports) | Withdrawal | Deliveries | Year End Balance |
| Sep | 19459 | 6822 | 12637 | 404 | 4741 | (4337) | 0 | 4333 | |
| Oct | 22793 | 11826 | 10967 | 543 | 6442 | (5899) | " | " | |
| Nov | 18396 | 9447 | 8949 | 838 | 7708 | (6870) | " | " | |
| Dec | 19951 | 8682 | 11269 | 544 | 6390 | (5846) | " | 4337 | |
| | | | | | | | | | 1947500 |
| 1962 | | | | | | | | | |
| Jan | 17276 | 19769 | (2493) | 459 | 5961 | (5502) | 0 | 3458 | |
| Feb | 13518 | 10249 | 3269 | 396 | 5695 | (5299) | " | " | |
| Mar | 18922 | 12178 | 6744 | 353 | 6881 | (6528) | " | " | |
| Apr | 19879 | 10405 | 9474 | 648 | 5414 | (4766) | " | " | |
| May | 29966 | 9717 | 20249 | 331 | 5006 | (4675) | " | " | |
| Jun | 32960 | 10278 | 22682 | 768 | 5928 | (5160) | " | " | |
| Jul | 38888 | 12693 | 26195 | 290 | 5456 | (5166) | " | " | |
| Aug | 27289 | 10284 | 17005 | 564 | 5245 | (4681) | " | " | |
| Sep | 29834 | 17080 | 12754 | 520 | 5683 | (5163) | " | " | |
| Oct | 27816 | 11491 | 16325 | 896 | 4934 | (4038) | " | " | |
| Nov | 25742 | 9666 | 16076 | 622 | 4481 | (3859) | " | " | |
| Dec | 22174 | 13759 | 8415 | 649 | 4850 | (4201) | " | 3462 | |
| | | | | | | | | | 1989000 |

| | Primary | | | Scrap | | | Stockpile | |
|---|---|---|---|---|---|---|---|---|
| | Imports | Exports | Net Imports (Exports) | Imports | Exports | Net Imports (Exports) | Withdrawal | Deliveries |
| | | | | | | | Year End Balance | |
| 1963 | | | | | | | | |
| Jan | 22294 | 5153 | 17141 | 444 | 2693 | (2249) | 2042 | 2042 |
| Feb | 21460 | 17011 | 4449 | 343 | 6077 | (5734) | " | " |
| Mar | 18554 | 16590 | 1964 | 899 | 6877 | (5978) | " | " |
| Apr | 30562 | 16814 | 13748 | 450 | 6460 | (6010) | " | " |
| May | 35526 | 16875 | 18651 | 561 | 7993 | (7432) | " | " |
| Jun | 47364 | 12565 | 34799 | 616 | 6409 | (5793) | " | " |
| Jul | 53906 | 16041 | 37865 | 645 | 5343 | (4698) | " | " |
| Aug | 40314 | 13582 | 26732 | 906 | 6230 | (5324) | " | " |
| Sep | 38160 | 12970 | 25190 | 987 | 5883 | (4896) | " | " |
| Oct | 34490 | 13237 | 21253 | 969 | 6503 | (5534) | " | " |
| Nov | 36878 | 12573 | 24305 | 1532 | 5568 | (4036) | " | " |
| Dec | 36135 | 11929 | 24206 | 954 | 5023 | (4069) | " | " |
| | | | | | | | 1989000 | |
| 1964 | | | | | | | | |
| Jan | 34320 | 16850 | 17470 | 1386 | 5248 | (3862) | 4458 | 0 |
| Feb | 28836 | 13034 | 15802 | 988 | 5102 | (4114) | " | " |
| Mar | 36517 | 15884 | 20633 | 574 | 7774 | (7200) | " | " |
| Apr | 35240 | 19950 | 15290 | 603 | 6268 | (5665) | " | " |

| | Primary | | | Scrap | | | Stockpile | |
|---|---|---|---|---|---|---|---|---|
| | Imports | Exports | Net Imports (Exports) | Imports | Exports | Net Imports (Exports) | Withdrawal | Deliveries |
| | | | | | | | Year End Balance | |
| May | 35603 | 19387 | 16216 | 655 | 6267 | (5612) | 4458 | 0 |
| Jun | 36835 | 18226 | 18609 | 836 | 5062 | (4226) | " | " |
| Jul | 40408 | 14627 | 25781 | 382 | 5106 | (4724) | " | " |
| Aug | 26705 | 18934 | 7771 | 591 | 6551 | (5960) | " | " |
| Sep | 44267 | 19116 | 25151 | 430 | 6122 | (5692) | " | " |
| Oct | 25566 | 3517 | 22049 | 634 | 5454 | (4820) | " | " |
| Nov | 20306 | 15093 | 5213 | 514 | 3925 | (3411) | " | " |
| Dec | 27816 | 20293 | 7523 | 559 | 5740 | (5181) | 4462 | " |
| | | | | | | | 1935500 | |
| 1965 | | | | | | | | |
| Jan | 12869 | 17521 | (4652) | 436 | 1494 | (1058) | 2461 | 0 |
| Feb | 33433 | 15561 | 17872 | 518 | 1986 | (1468) | " | " |
| Mar | 46207 | 27735 | 18472 | 673 | 4652 | (3979) | " | " |
| Apr | 41659 | 12233 | 29426 | 1827 | 7334 | (5507) | " | " |
| May | 51070 | 18289 | 32781 | 1444 | 4278 | (2834) | " | " |
| Jun | 65605 | 16676 | 48929 | 5854 | 2343 | 3511 | " | " |
| Jul | 51416 | 18984 | 32432 | 2017 | 3073 | (1056) | " | " |
| Aug | 45580 | 15673 | 29907 | 2954 | 2880 | 74 | " | " |

| | Primary | | | Scrap | | | Stockpile | |
|---|---|---|---|---|---|---|---|---|
| | Imports | Exports | Net Imports (Exports) | Imports | Exports | Net Imports (Exports) | Withdrawal / Year End Balance | Deliveries |
| Sep | 39629 | 17559 | 22070 | 1793 | 2096 | ( 303) | 2461 | 0 |
| Oct | 42816 | 13200 | 29616 | 5281 | 2486 | 2795 | " | " |
| Nov | 41640 | 14496 | 27144 | 2779 | 2886 | ( 107) | " | " |
| Dec | 55286 | 18148 | 37138 | 1452 | 3039 | (1587) | 9374 | 0 |
| | | | | | | | 1899000 | |
| 1966 | | | | | | | | |
| Jan | 24844 | 18965 | 5879 | 2959 | 2968 | ( 9) | 28368 | 0 |
| Feb | 51943 | 12768 | 39175 | 1549 | 2792 | (1243) | 28696 | " |
| Mar | 57667 | 17448 | 40219 | 3684 | 3021 | 663 | 38970 | " |
| Apr | 54548 | 10662 | 43886 | 2424 | 2997 | ( 573) | 37307 | " |
| May | 52531 | 13012 | 39519 | 4118 | 3988 | 130 | 40517 | " |
| Jun | 51683 | 15718 | 35965 | 2969 | 4488 | (1519) | 28599 | " |
| Jul | 37303 | 13195 | 24108 | 3273 | 6173 | (2900) | 20769 | " |
| Aug | 40486 | 13076 | 27410 | 2883 | 4489 | (1606) | 24729 | " |
| Sep | 39590 | 16439 | 23151 | 2046 | 4278 | (2232) | 27919 | " |
| Oct | 36487 | 18689 | 17798 | 2103 | 4344 | (2241) | 24736 | " |
| Nov | 33942 | 16470 | 17472 | 2727 | 5316 | (2589) | 13839 | " |
| Dec | 40732 | 21797 | 18935 | 2881 | 3811 | ( 930) | 11551 | " |
| | | | | | | | 1573000 | |

| | Primary | | | Scrap | | | Stockpile | |
|---|---|---|---|---|---|---|---|---|
| | Imports | Exports | Net Imports (Exports) | Imports | Exports | Net Imports (Exports) | Withdrawals | Deliveries |
| | | | | | | | Year End Balance | |
| 1967 | | | | | | | | |
| Jan | 36434 | 20520 | 15914 | 1957 | 4498 | (2541) | 12464 | 0 |
| Feb | 32669 | 24927 | 7742 | 2610 | 3882 | (1272) | 17658 | " |
| Mar | 40993 | 24016 | 16977 | 2508 | 4061 | (1553) | 18027 | " |
| Apr | 44486 | 21940 | 22546 | 4043 | 4902 | ( 859) | 12367 | " |
| May | 39038 | 19587 | 19451 | 2474 | 4634 | (2160) | 787 | " |
| Jun | 37749 | 18273 | 19476 | 2243 | 4004 | (1761) | 110 | " |
| Jul | 26371 | 20255 | 6116 | 2553 | 4014 | (1461) | 87 | " |
| Aug | 30724 | 12309 | 18415 | 1821 | 4974 | (3153) | 0 | " |
| Sep | 43004 | 12754 | 30250 | 2403 | 5749 | (3346) | 0 | " |
| Oct | 35314 | 10960 | 24354 | 2146 | 4402 | (2256) | 0 | " |
| Nov | 37653 | 12401 | 25252 | 2580 | 5422 | (2842) | 0 | " |
| Dec | 45662 | 11067 | 34595 | 3153 | 3989 | ( 836) | 0 | " |
| | | | | | | | 1511500 | |
| 1968 | | | | | | | | |
| Jan | 54620 | 13318 | 41302 | 1269 | 2827 | (1558) | 3804 | 0 |
| Feb | 44728 | 13661 | 31067 | 1831 | 4410 | (2579) | 1004 | " |
| Mar | 89595 | 12301 | 77294 | 3174 | 3721 | ( 547) | 2172 | " |
| Apr | 68393 | 15548 | 52845 | 4365 | 5064 | ( 699) | 8038 | " |

| | Primary | | | Scrap | | | Stockpile | |
|---|---|---|---|---|---|---|---|---|
| | | | Net Imports | | | Net Imports | Withdrawals | Deliveries |
| | Imports | Exports | (Exports) | Imports | Exports | (Exports) | Year End | Balance |
| May | 57945 | 15385 | 42560 | 3750 | 5277 | (1527) | 2926 | 0 |
| Jun | 72816 | 13405 | 60411 | 2700 | 4539 | (1839) | 3089 | " |
| Jul | 61207 | 11932 | 49275 | 3278 | 4356 | (1078) | 2130 | " |
| Aug | 40048 | 13112 | 26936 | 2982 | 4726 | (1744) | 9081 | " |
| Sep | 52532 | 20412 | 32120 | 4666 | 4905 | ( 239) | 7386 | " |
| Oct | 49665 | 16683 | 32982 | 3659 | 3410 | 249 | 7004 | " |
| Nov | 38372 | 18082 | 20290 | 2850 | 3888 | (1038) | 4723 | " |
| Dec | 51845 | 16440 | 35405 | 4005 | 2303 | 1702 | 5198 | " |
| | | | | | | | 1454945 | |

Source: Import and Export Data, U. S. Department of the Interior, Bureau of Mines. "Metals Industry Survey, Aluminum Monthly," Washington, U. S. Government Printing Office.

Stockpile Data, U. S. Department of Commerce, Business and Defense Services Administration, Aluminum and Magnesium Div., Washington, D.C.

ALUMINUM INGOT AVERAGE DAILY ACTIVITY IN PRODUCTION, DELIVERIES, SHIPMENTS, CAPACITY UTILIZATION - IN SHORT TONS

| Year and Month | Monthly Operating Days | | Primary Capacity | % Capacity Utilization | Avg. Daily Production | Total Deliveries | Avg. Daily Deliveries | Avg. Daily Shipments |
|---|---|---|---|---|---|---|---|---|
| | Calendar | Work | | | | | | |
| 1959 | | | | | | | | |
| Jan | 31 | 21 | 189012 | 82.9 | 5054.8 | 151565 | 7214.5 | 6077.5 |
| Feb | 28 | 20 | 170718 | 83.2 | 5075.6 | 152927 | 7646.4 | 6669.9 |
| Mar | 31 | 21 | 189012 | 83.2 | 5070.6 | 214384 | 10204.7 | 8655.5 |
| Apr | 30 | 22 | 182914 | 84.9 | 5173.8 | 218187 | 9927.5 | 8323.3 |
| May | 31 | 21 | 189012 | 86.7 | 5285.7 | 222280 | 10580.5 | 8692.1 |
| Jun | 30 | 22 | 185873 | 90.0 | 5577.4 | 234746 | 10680.9 | 8709.7 |
| Jul | 31 | 22 | 194872 | 92.0 | 5780.5 | 229048 | 10421.7 | 8526.1 |
| Aug | 31 | 21 | 194872 | 88.7 | 5574.7 | 197681 | 9409.6 | 7578.2 |
| Sep | 30 | 21 | 188585 | 89.2 | 5606.9 | 168040 | 7998.7 | 7290.9 |
| Oct | 31 | 22 | 194872 | 89.2 | 5604.6 | 172217 | 7835.9 | 6901.6 |
| Nov | 30 | 20 | 188585 | 81.5 | 5122.2 | 159852 | 7992.6 | 7601.2 |
| Dec | 31 | 22 | 194872 | 83.6 | 5257.9 | 202463 | 9212.1 | 8377.6 |
| 1960 | | | | | | | | |
| Jan | 31 | 20 | 194872 | 84.2 | 5291.1 | 157855 | 7892.8 | 7406.5 |
| Feb | 29 | 21 | 182297 | 86.0 | 5407.8 | 155695 | 7411.1 | 7959.4 |
| Mar | 31 | 23 | 199373 | 85.6 | 5506.1 | 178708 | 7773.8 | 7518.8 |

| Year and Month | Monthly Operating Days | | Primary Capacity | % Capacity Utilization | Avg. Daily Production | Total Deliveries | Avg. Daily Deliveries | Avg. Daily Shipments |
|---|---|---|---|---|---|---|---|---|
| | Calendar | Work | | | | | | |
| Apr | 30 | 20 | 192941 | 87.4 | 5619.9 | 137240 | 6862.0 | 7223.5 |
| May | 31 | 21 | 199373 | 88.2 | 5673.0 | 173618 | 8264.2 | 7920.8 |
| Jun | 30 | 22 | 192941 | 88.8 | 5711.9 | 152495 | 6938.5 | 6821.2 |
| Jul | 31 | 20 | 203280 | 87.3 | 5727.9 | 146974 | 7348.7 | 7197.4 |
| Aug | 31 | 23 | 203280 | 85.1 | 5579.8 | 161827 | 7039.5 | 7172.4 |
| Sep | 30 | 21 | 196722 | 82.8 | 5429.4 | 157957 | 7518.8 | 7079.3 |
| Oct | 31 | 21 | 203280 | 82.2 | 5387.6 | 160414 | 7635.7 | 6875.8 |
| Nov | 30 | 21 | 196722 | 81.9 | 5373.6 | 154521 | 7355.2 | 7245.3 |
| Dec | 31 | 21 | 203280 | 81.4 | 5338.8 | 157461 | 7498.1 | 8767.7 |
| 1961 | | | | | | | | |
| Jan | 31 | 22 | 203280 | 79.4 | 5207.3 | 135315 | 6156.8 | 5895.3 |
| Feb | 28 | 20 | 183605 | 75.5 | 4948.6 | 147459 | 7373.0 | 7127.0 |
| Mar | 31 | 22 | 204554 | 74.3 | 4904.0 | 174306 | 7930.9 | 7348.0 |
| Apr | 30 | 20 | 197955 | 73.1 | 4821.2 | 169683 | 8484.2 | 7792.2 |
| May | 31 | 22 | 204554 | 77.0 | 5082.1 | 192124 | 8741.6 | 7783.6 |
| Jun | 30 | 22 | 197955 | 80.4 | 5303.1 | 180221 | 8200.1 | 7482.5 |
| Jul | 31 | 20 | 204554 | 80.5 | 5313.9 | 166792 | 8339.6 | 7769.0 |
| Aug | 31 | 23 | 204554 | 81.7 | 5388.4 | 195751 | 8515.2 | 7164.2 |
| Sep | 30 | 20 | 197955 | 80.6 | 5319.1 | 192391 | 9619.6 | 8166.6 |

| Year and Month | Monthly Operating Days Calendar | Monthly Operating Days Work | Primary Capacity | % Capacity Utilization | Avg. Daily Production | Total Deliveries | Avg. Daily Deliveries | Avg. Daily Shipments |
|---|---|---|---|---|---|---|---|---|
| Oct | 31 | 22 | 204554 | 81.8 | 5396.6 | 195234 | 8883.1 | 7602.4 |
| Nov | 30 | 21 | 197955 | 82.9 | 5470.8 | 205901 | 9800.9 | 8541.0 |
| Dec | 31 | 20 | 204554 | 82.1 | 5419.1 | 228335 | 11416.8 | 10064.1 |
| 1962 | | | | | | | | |
| Jan | 31 | 22 | 204554 | 83.2 | 5488.4 | 197734 | 8996.9 | 8134.1 |
| Feb | 28 | 20 | 184756 | 85.4 | 5632.2 | 189973 | 9498.6 | 8268.7 |
| Mar | 31 | 22 | 204554 | 86.7 | 5723.4 | 225725 | 10270.5 | 8983.5 |
| Apr | 30 | 20 | 197955 | 87.7 | 5788.6 | 221344 | 11067.2 | 9493.3 |
| May | 31 | 22 | 207442 | 88.8 | 5942.3 | 245123 | 11153.1 | 9144.4 |
| Jun | 30 | 21 | 200749 | 89.2 | 5970.7 | 229795 | 10938.2 | 8771.9 |
| Jul | 31 | 21 | 207442 | 88.8 | 5938.9 | 229281 | 10913.8 | 8805.7 |
| Aug | 31 | 23 | 207442 | 81.0 | 5422.1 | 207669 | 9033.6 | 7352.2 |
| Sep | 30 | 19 | 200749 | 87.8 | 5872.8 | 194494 | 10236.2 | 8347.7 |
| Oct | 31 | 23 | 207442 | 89.3 | 5973.9 | 231383 | 10065.2 | 8062.2 |
| Nov | 30 | 21 | 200749 | 89.5 | 5989.3 | 220429 | 10492.4 | 8327.5 |
| Dec | 31 | 20 | 207442 | 87.9 | 5884.6 | 230562 | 11528.1 | 9757.5 |
| 1963 | | | | | | | | |
| Jan | 31 | 22 | 207866 | 88.6 | 5940.6 | 222977 | 10145.5 | 7728.9 |

| Year and Month | Monthly Operating Days | | Primary Capacity | % Capacity Utilization | Avg. Daily Production | Total Deliveries | Avg. Daily Deliveries | Avg. Daily Shipments |
|---|---|---|---|---|---|---|---|---|
| | Calendar | Work | | | | | | |
| Feb | 28 | 20 | 187748 | 86.8 | 5820.6 | 213731 | 10686.6 | 8917.8 |
| Mar | 31 | 21 | 207866 | 87.4 | 5857.7 | 234426 | 11158.7 | 9570.3 |
| Apr | 30 | 21 | 201160 | 90.1 | 6044.3 | 246695 | 11742.7 | 9483.0 |
| May | 31 | 22 | 207866 | 92.8 | 6221.6 | 256923 | 11690.0 | 9388.2 |
| Jun | 30 | 20 | 201160 | 95.7 | 6416.4 | 262074 | 13103.7 | 9869.0 |
| Jul | 31 | 22 | 207866 | 96.9 | 6495.3 | 262293 | 11934.3 | 9051.5 |
| Aug | 31 | 22 | 207866 | 97.7 | 6550.8 | 250427 | 11394.4 | 8839.2 |
| Sep | 30 | 20 | 202804 | 97.3 | 6579.3 | 252742 | 12637.1 | 9906.7 |
| Oct | 31 | 23 | 209565 | 97.9 | 6616.7 | 255058 | 11095.0 | 8787.0 |
| Nov | 30 | 20 | 202804 | 99.2 | 6703.9 | 243005 | 12150.2 | 9367.8 |
| Dec | 31 | 21 | 209565 | 99.8 | 6744.3 | 275324 | 13105.4 | 10506.2 |
| 1964 | | | | | | | | |
| Jan | 31 | 22 | 209565 | 101.2 | 6839.0 | 260315 | 11844.3 | 9235.9 |
| Feb | 29 | 20 | 196040 | 102.1 | 6903.1 | 255717 | 12785.9 | 10020.0 |
| Mar | 31 | 21 | 210329 | 101.9 | 6910.4 | 274539 | 13068.1 | 10285.4 |
| Apr | 30 | 22 | 204776 | 101.7 | 6943.4 | 277999 | 12649.0 | 10052.0 |
| May | 31 | 21 | 211603 | 101.4 | 6923.6 | 261218 | 12434.0 | 9922.8 |
| Jun | 30 | 22 | 204776 | 99.5 | 6791.6 | 273903 | 12462.6 | 9840.8 |

| Year and Month | Monthly Operating Days Calendar | Work | Primary Capacity | % Capacity Utilization | Avg. Daily Production | Total Deliveries | Avg. Daily Deliveries | Avg. Daily Shipments |
|---|---|---|---|---|---|---|---|---|
| Jul | 31 | 23 | 213217 | 101.4 | 6971.0 | 271025 | 11789.6 | 9181.5 |
| Aug | 31 | 21 | 213217 | 101.9 | 7006.4 | 250081 | 11903.9 | 9755.5 |
| Sep | 30 | 21 | 206338 | 102.4 | 7043.8 | 268596 | 12785.2 | 9789.4 |
| Oct | 31 | 22 | 213641 | 102.2 | 7045.9 | 269541 | 12264.1 | 9416.0 |
| Nov | 30 | 20 | 206749 | 103.5 | 7133.1 | 262863 | 13143.2 | 10962.1 |
| Dec | 31 | 21 | 217124 | 102.6 | 7188.6 | 289459 | 13783.7 | 11529.9 |
| 1965 | | | | | | | | |
| Jan | 31 | 20 | 216444 | 102.9 | 7185.5 | 252759 | 12638.0 | 10607.0 |
| Feb | 28 | 20 | 200098 | 101.5 | 7255.7 | 274365 | 13718.3 | 10647.5 |
| Mar | 31 | 23 | 223791 | 102.8 | 7420.2 | 312129 | 13577.6 | 10729.8 |
| Apr | 30 | 21 | 219036 | 103.5 | 7554.8 | 302215 | 14385.4 | 11033.8 |
| May | 31 | 21 | 226338 | 104.7 | 7643.6 | 324964 | 15468.3 | 11875.4 |
| Jun | 30 | 22 | 227666 | 100.0 | 7587.9 | 307775 | 14003.8 | 9626.8 |
| Jul | 31 | 22 | 235256 | 99.9 | 8783.0 | 298716 | 13591.6 | 10530.3 |
| Aug | 31 | 22 | 238229 | 98.6 | 7576.4 | 304119 | 13837.4 | 10777.3 |
| Sep | 30 | 21 | 230543 | 94.8 | 7288.6 | 291671 | 13883.5 | 10888.0 |
| Oct | 31 | 21 | 238229 | 99.6 | 7652.0 | 305811 | 14556.6 | 11014.3 |
| Nov | 30 | 21 | 230543 | 102.6 | 7883.5 | 307519 | 14637.9 | 11341.2 |
| Dec | 31 | 21 | 238229 | 102.8 | 7902.9 | 338997 | 16142.7 | 12155.8 |

| Year and Month | Monthly Operating Days | | Primary Capacity | % Capacity Utilization | Avg. Daily Production | Total Deliveries | Avg. Daily Deliveries | Avg. Daily Shipments |
|---|---|---|---|---|---|---|---|---|
| | Calendar | Work | | | | | | |
| 1966 | | | | | | | | |
| Jan | 31 | 21 | 238229 | 103.8 | 7977.8 | 312973 | 14897.5 | 11284.0 |
| Feb | 28 | 20 | 215172 | 103.9 | 7982.8 | 339609 | 16980.5 | 11500.4 |
| Mar | 31 | 23 | 238229 | 104.5 | 8032.4 | 386101 | 16795.4 | 11136.8 |
| Apr | 30 | 20 | 230043 | 104.4 | 8024.2 | 372282 | 18614.1 | 12260.7 |
| May | 31 | 21 | 242395 | 104.1 | 8138.4 | 370426 | 17632.3 | 11657.3 |
| Jun | 30 | 22 | 240822 | 101.7 | 8165.5 | 355872 | 16192.2 | 11355.2 |
| Jul | 31 | 20 | 249953 | 101.2 | 8155.8 | 323806 | 16190.3 | 12296.3 |
| Aug | 31 | 23 | 249953 | 95.9 | 7736.1 | 343675 | 14949.9 | 10781.9 |
| Sep | 30 | 21 | 241890 | 101.7 | 8196.8 | 340283 | 16197.5 | 11692.7 |
| Oct | 31 | 21 | 249953 | 103.4 | 8334.7 | 343238 | 16338.1 | 12129.0 |
| Nov | 30 | 21 | 241890 | 103.8 | 8366.8 | 326685 | 15550.2 | 11900.4 |
| Dec | 31 | 20 | 249953 | 104.9 | 8456.2 | 332437 | 16621.8 | 12702.8 |
| 1967 | | | | | | | | |
| Jan | 31 | 22 | 263368 | 100.7 | 8555.7 | 337388 | 15351.2 | 11988.7 |
| Feb | 28 | 20 | 237878 | 102.4 | 8699.3 | 322782 | 16139.1 | 12552.8 |
| Mar | 31 | 22 | 267614 | 102.5 | 8851.0 | 353553 | 16086.7 | 12452.5 |
| Apr | 30 | 20 | 258981 | 103.7 | 8948.2 | 331625 | 16581.3 | 12756.2 |
| May | 31 | 22 | 267614 | 104.2 | 8997.6 | 333680 | 15182.4 | 12230.4 |

| Year and Month | Monthly Operating Days Calendar | Monthly Operating Days Work | Primary Capacity | % Capacity Utilization | Avg. Daily Production | Total Deliveries | Avg. Daily Deliveries | Avg. Daily Shipments |
|---|---|---|---|---|---|---|---|---|
| Jun | 30 | 22 | 258981 | 104.3 | 9002.5 | 316454 | 14398.7 | 11535.0 |
| Jul | 31 | 20 | 268549 | 103.1 | 8934.5 | 290022 | 14501.1 | 12238.1 |
| Aug | 31 | 23 | 269398 | 103.0 | 8953.5 | 315406 | 13720.2 | 10833.0 |
| Sep | 30 | 20 | 265638 | 101.8 | 9013.1 | 325944 | 16297.2 | 12668.0 |
| Oct | 31 | 22 | 278401 | 101.9 | 9154.6 | 341305 | 15529.4 | 12122.8 |
| Nov | 30 | 21 | 270241 | 102.6 | 9241.1 | 340256 | 16196.2 | 12665.4 |
| Dec | 31 | 19 | 280099 | 100.9 | 9118.8 | 379747 | 19986.6 | 15305.8 |
| 1968 | | | | | | | | |
| Jan | 31 | 22 | 280779 | 101.6 | 9202.7 | 386336 | 17578.3 | 13250.1 |
| Feb | 29 | 21 | 263519 | 101.4 | 9210.8 | 373557 | 17781.3 | 13920.2 |
| Mar | 31 | 21 | 285365 | 101.0 | 9300.9 | 446507 | 21253.7 | 14984.7 |
| Apr | 30 | 21 | 276158 | 101.5 | 9342.9 | 440311 | 20958.8 | 15616.6 |
| May | 31 | 22 | 285365 | 101.3 | 9323.8 | 402112 | 18296.1 | 13881.1 |
| Jun | 30 | 20 | 276158 | 79.1 | 7284.7 | 313618 | 15680.9 | 10328.6 |
| Jul | 31 | 22 | 285620 | 79.1 | 7288.8 | 311591 | 14177.4 | 10060.0 |
| Aug | 31 | 22 | 285620 | 86.3 | 7951.7 | 344294 | 15665.4 | 12260.0 |
| Sep | 30 | 20 | 282569 | 95.2 | 8965.8 | 347779 | 17389.0 | 13316.1 |
| Oct | 31 | 23 | 293688 | 99.9 | 9464.8 | 378487 | 16464.2 | 12530.8 |

APPENDIX F--Continued

| Year and Month | Monthly Operating Days | | Primary Capacity | % Capacity Utilization | Avg. Daily Production | Total Deliveries | Avg. Daily Deliveries | Avg. Daily Shipments |
|---|---|---|---|---|---|---|---|---|
| | Calendar | Work | | | | | | |
| Nov | 30 | 20 | 290459 | 100.4 | 9718.4 | 361219 | 18061.0 | 14569.8 |
| Dec | 31 | 20 | 310334 | 96.7 | 9679.5 | 421918 | 21095.9 | 16427.4 |

APPENDIX G

## Calculation of Linear Trend Lines

The trend lines plotted in Figure 4 and Figure 6 follow the form of a linear equation:

$$y = a + b \cdot x \qquad (1)$$

The values of a and b are determined from the normal equations:

$$\Sigma y = n \cdot a + b \cdot \Sigma x \qquad (2)$$

$$\Sigma x \cdot y = a \cdot \Sigma x + b \cdot \Sigma x^2 \qquad (3)$$

where:

x = a number assigned to each month in the series.

y = value of the dependent variable.

In performing the calculations, the value of x assigned to the central month in the series is 0. The balance of the months in the series are numbered positively and negatively from the central month. This simplifying step establishes a condition where:

$$\Sigma x = 0 \qquad (4)$$

The normal equations then reduce to:

$$\Sigma y = n \cdot a$$
$$a = \frac{\Sigma y}{n} \qquad (5)$$

$$\Sigma x \cdot y = b \cdot \Sigma x^2$$
$$b = \frac{\Sigma x \cdot y}{\Sigma x^2} \qquad (6)$$

Calculation of the Trend Line for Average Daily Total Deliveries

The following summary of calculations follows the technique outlined above. These calculations cover total deliveries for the period 1960-1968.

The values of the variables are:

$$n = 107$$

$$\Sigma y = 1,372,831.4$$

$$\Sigma x \cdot y = 11,043,868.2$$

$$\Sigma x^2 = 102,078$$

Substituting the above values in equation (5), the value of a is determined to be:

$$a = \frac{1,372,831.4}{107}$$

$$a = 12,830.2$$

Likewise, substituting the above values in equation (6), the value of b is determined to be:

$$b = \frac{11,043,868.2}{102,078}$$

$$b = 108.2$$

The final equation for the trend line for average daily total deliveries is determined by substituting the values of a and b into equation (1):

$$y = 12,830.2 + 108.2 \cdot x$$

<u>Calculation of the Trend Line for Average Daily Shipments</u>

The following summary of calculations, for the period 1960-1968, follows the procedure outlined above. The values of the variables are:

$$n = 107$$

$$\Sigma y = 1{,}091{,}791.8$$

$$\Sigma x \cdot y = 6{,}573{,}545.2$$

$$\Sigma x^2 = 102{,}078$$

Substituting the above values in equation (5), the value of a is determined to be:

$$a = \frac{1{,}091{,}791.8}{107}$$

$$a = 10{,}203.7$$

Substituting the above values in equation (6), the value of b is determined to be:

$$b = \frac{6{,}573{,}545.2}{102{,}078}$$

$$b = 64.4$$

The final equation for the trend line for average daily shipments, from equation (1), is:

$$y = 10{,}203.7 + 64.4 \cdot x$$

Calculation of the Trend Line for Average Daily Production

The trend line for average daily production covers the period 1961-1968. The calculations follow the procedure outline in the above section.

The values of the variables are:

$$n = 95$$

$$\Sigma y = 688{,}991.8$$

$$\Sigma x \cdot y = 3{,}371{,}290.3$$

$$\Sigma x^2 = 74{,}440$$

The value of a is determined from equation (5):

$$a = \frac{688{,}991.8}{95}$$

$$a = 7{,}252.5$$

The value of b is determined from equation (6):

$$b = \frac{3{,}371{,}290.3}{74{,}440}$$

$$b = 47.2$$

The final equation for the trend line for average daily production is:

$$y = 7{,}252.5 + 47.2 \cdot x$$

## APPENDIX H

## EXAMPLES OF DISCREPANCIES IN REPORTED ALUMINUM INGOT CAPACITY, 1959-1968

The following list of discrepancies in the reported capacities of aluminum ingot reduction plants is not an exhaustive list. It is included to acquaint the reader with selected sources of information on aluminum ingot capacity, and to illustrate the type of discrepancies observed during the study.

> Example 1: The Minerals Yearbook, 1962[1] reported the 1962 year end capacity of Harvey Aluminum at 75,000 tons per year. The Aluminum Association[2] reported the capacity at 80,000 tons per year.

> Example 2: The Minerals Yearbook, 1964[3] reported the 1964 year end capacity for Kaiser Aluminum and Chemical Co. at 609,000 tons per year. The Aluminum Association[4] reported the capacity at 650,000 tons per year. The same two references reported the capacity of Anaconda Aluminum Co. at 67,500 and 67,000 tons per year respectively.

---

[1]Minerals Yearbook, 1962, U. S. Department of the Interior, Bureau of Mines (Washington: U. S. Government Printing Office, 1963), p. 217.

[2]"1967 Aluminum Statistical Review" (New York: The Aluminum Association, 1968), pp. 12-13.

[3]Minerals Yearbook, 1964, op. cit., p. 187.

[4]"1967 Aluminum Statistical Review," loc. cit.

APPENDIX H--Continued

Example 3: The Minerals Yearbook, 1965[5] reported the 1965 year end capacity for Ormet Corporation at 185,000 tons per year, while the Aluminum Association[6] reported the same capacity at 184,284 tons per year.

Example 4: The following discrepancies occurred between published data in the Yearbook of the American Bureau of Metal Statistics[7] and The Aluminum Association.[8] These data cover the year end capacity for 1965.

| Producer | American Bureau of Metal Statistics | The Aluminum Association |
|---|---|---|
| Anaconda | 65,000 tons per year | 100,000 tons per year |
| Intalco | 76,000 tons per year | -0- tons per year |
| Ormet | 180,000 tons per year | 184,284 tons per year |

An additional discrepancy, covering 1965 year end capacity for Kaiser Aluminum and Chemical Company, occurred between The American Metal Market[9] and The Aluminum Association.[10] These two publications reported the capacity at 609,500 tons per year and 650,000 tons per year respectively.

---

[5]Minerals Yearbook, 1965, op. cit., p. 167.

[6]"1967 Aluminum Statistical Review," loc. cit.

[7]Yearbook of the American Bureau of Metal Statistics (York: The Maple Press Co., 1966), p. 96.

[8]"1967 Aluminum Statistical Review," loc. cit.

[9]Metal Statistics 1965 (New York: The American Metal Market Co., 1965), p. 549.

[10]"1967 Aluminum Statistical Review," loc. cit.

APPENDIX H--Continued

Example 5: The following discrepancies occurred between published data in The Yearbook of the American Bureau of Metal Statistics[11] and The Aluminum Association.[12] These data cover the year end capacity for 1967.

| Producer | American Bureau of Metal Statistics | The Aluminum Association |
|---|---|---|
| Intalco | 100,000 tons per year | 152,000 tons per year |
| Kaiser | 650,000 tons per year | 670,000 tons per year |
| Ormet | 180,000 tons per year | 184,284 tons per year |

Example 6: The following discrepancies occurred between The American Metal Market[13] and The Aluminum Association,[14] covering 1968 year end capacities.

| Producer | American Bureau of Metal Statistics | The Aluminum Association |
|---|---|---|
| Alcoa | 1,150,000 tons per year | 1,200,000 tons per year |
| Kaiser | 670,000 tons per year | 690,000 tons per year |
| Reynolds | 855,000 tons per year | 895,000 tons per year |

---

[11] Yearbook of the American Bureau of Metal Statistics (York: The Maple Press Co., 1967), p. 98.

[12] "1967 Aluminum Statistical Review," loc. cit.

[13] Metal Statistics 1969 (Somerset: The American Metal Market Co., 1969), p. 75.

[14] "1968 Aluminum Statistical Review" (New York: The Aluminum Association, 1969), pp. 12-13.