A STUDY OF THE EFFECT OF CELITE ON SEGREGATION

Thesis for the Degree of B. S.

W. L. Davis

1927

THESIS

A STUDY OF THE EFFECT OF OILITE ON SEGREGATION

A Thesis

Submitted to the Faculty of the
Michigan State College of
Agriculture and Applied Science

by

W. L. Davis

Candidate for the Degree of Bachelor of Science
June 1927.

This thesis is a study of the effect of Celite, (a special grade of diatomaceous silica of exceptionally high purity, manufactured by the Celite Products Co. and obtained from Lompoc California) on the segregation of concrete when hauled.

A study of the effect of this material and various other admixtures on the strength, workability, density, yield, and such properties has been made, but to the authors knowledge no studies on their effect on segregation has been attempted. In view of the present aggitation for and against centralized mixing plants and the hauling of concrete to the jobs it seems as if a definite study of the different admixtures on segregation would be of value, Celite was chosen because according to investagations made by J. C. Pearson and Frank A. Hitchcock of the U. S. Bureau of Standards at Washington D. C. Celite gives the better results along other lines than the other admixtures so this admixture seemes to be the most logical one to use providing it gives good results in this case.

In running these experiments the concrete was mixed and placed in a wash tub in the back of an Overland Coupe The tub being filled from half to three fourths full to allow the concrete to work around without losing any of it, the speed maintained while hauling was from 20to 25 miles per hour. This prehaps was a little faster than a truck would have been driven over the rough roads, but it was thought that this extra speed would compensate for the fact that the car used was eaiser riding than a truck would be.

As there is no standard tests for segregation it was desided to use the following method. After the concrete was placed in the tub preparatory to hauling a sample was taken by shoving a cylinder into the concrete and working a trowel under the cylinder in such a manner as to remove a portion of the concrete from the upper surface of the tub, this sample was then placed on a standard No. 4 sieve and washed , the portion which was retained on the sieve was then dried and weighed. The load was then hauled the resired distance and a sample was taken from the top of the load, by the use of the same cylinder (which was used befor) pushed down to the same depth as befor and removed in the same manner. This sample was also washed on a No. 4 sieve and dried and weighed. The weight of this last sample devided by the weight of the first sample and multiplied by 100 to obtain the result in percentage. This result was then subtracted from 100% giving the final result , which will be called in this thesis the percent of segregation.

The following is a sample computation:

Wt. of material retained on no. 4 sieve befor hauling = 620 grams
" " " " " " " " after " = 435 "

$$\frac{435}{620} * 100 = 70\%$$

100% - 70% = 30% segregation.

The tests used in running these tests was a 1:2:4 mix with a 5 to 6 inch slump and a 4 to 5 inch slump.

It was desided that a wetter mix than this would very seldom be used and in trying to use dryer mixes great difficulty was experianced due to the fact that the concrete seemed to obtain its initial set and was hard to remove from the tub after hauling it was practically impossiable toremove a fair sample from the top in the usual manner.

The amount of water used was not constant but was allowed to vary to give the desired slump. It was found that bybadding Celite more water was necessary to give the desired slump but it was consirered that this was the only fair way in which to conduct the expermints because by keeping the water constant and varying the amount of Celite mixes would be obtained of varying consistenct and workability which would cause results which would be untrue in so far as segregation is concerned as a mix with a smaller slump under ordinary conditions has less segragation after hauling than one with a larger slump.

A sample mix without any Celite in it having a 4 tp 5 inch or a 5 to 6 inch slump was hauled the desired distance and the percent of segregation computed then the samples using Celite were hauled and theprecent of segregation of these computed.

This did not give results which at aglance showed the improvement due to the use of [redacted] Celite so it was desided that the precent of segregation as found for the samples which contained Celite should be devided by the precent of segregation as found for the corresponding sample without Celite and multiplied by 100 which gave theresult in percent. Then this result was subtracted from 100% which gives the percent of improvement due to Celite at a glance.

The following is a sample computation showing how the percent of improvement due to Celite is obtained:

Percent of segregation of sample containing no Celite =30
" " " " " " 3% " =5.5

$$\frac{5.5}{30} * 100 = 18.4\%$$

100 -18.4= 81.6% improvement due to Celite.

Trips were made hauling the concrete two and five miles over rough roads , trips were also made of ten miles on smooth pavement. It was thought that in most cases where a central mix ing plant would be used that the average length of hauling would be between two and five miles and that by using these distances over rough roads the worst conditions which would be met in practice would at least be paralled in these experiments. The ten mile distance over smooth pavement was chosen as a maximium distance that concrete wouldprobably ever be hauled because if hauled much farther the concrete would begin to set. It was also thought that the ten mile trip over smooth pavement wouldgive some idea of what results could be expected if the trips were made over paved streets.

The Celite used was computed as a percentage of the cement used. The measurements being based on weight instead of volume

All samples which seemed to be eratic were run twice and if one of them was found to give results which did not check up with the rest it was discarded but in some cases where small differences were encountered the results were averaged. The following list of data was computed in that manner.

Distar and l	cent of gregation	Precent of improvement due to Celite.
	45.6	----------
5 mil road	35	23.4
	23.5	48.5
	40.6	----------
	26.5	34.7
	19.4	52.3
	30	----------
10 mi pa	5.5	81.6
	2.3	----------
	15.7	51.2
2 mil r	29.3	9
	7.7	78.1

gh

It is readily seen from these experiments that Celite helps to decrease segregation. It is also very noticable that the use of three percent of Celite gives the best results except for the one test in which ten percent was used.

These results need careful thought and attention in this connection or one is liable to draw the wrong conclusions. This particular tests in which the ten percent of Celite was used had only a four to five inch slump. No test using three percent of Celite and a four to five inch slump was made. However a test using five percsnt of Celite and having a four to five inch slump was made, this test gave a percent of improvement which was 11.3 percent higher than the result obtained by using five percent of Celite with a five to six inch slump. From this it seems safe to conclude that the percent of improvement due to a three percent test with a four to five inch slump should be at least ten percent higher than that due to a three percent test with a five to six inch slump. At that rate it would make the percent of improvment due to the use of three percent of Celite greater than the percent of improvement due to the use of any of the other precentages of Celite.

While discussing the difference between the results obtained from the four to five inch slump. This leads to the conclusion that segregation does not take place to such a great extent in the dryer mixes.

The percent of improvement due to the use of Celitealso was larger in the mix having a four to five inch slump, this shows that better results can be obtained in the dryer mixes by the use of Celite even than have been obtained in this set of experiments.

The reason for spending most of the time making tests for small percentages of Celite were that most of the other tests (for workability, strength,density, etc.) which are on record have been made in the lower percentages. The percentages which these other tests have used and found favorable lie from one percent to eight percent. With the best results rangeing below five percent.

The percent of segregation of tests hauled two miles over rough roads were, as one would expect very much lower than the percent of segregation obtained in the tests which were hauled five miles. The percent of improvement due to Celite also ran higher except for the one test in which four percent of Celite was used. This test should have been run again but due to the lack of time it was impossiable.

The resultd obtained from the test which was hauled ten miles over smooth pavement are rather surprising . They show a large decrease in segregation over the tests which were hauled five miles over rough roads and a slight decrease in the precent of segregation over the tests which were hauled two miles over rough roads. The test hauled ten miles over smooth pavement also showed a greater percent of improvement due to Celite than tests hauled two or five miles over rough roads. These results are rather surprising because even though hauled over much better roads it was hauled twice as far as the five mile test and five times as far as the two mile

tests but in spite of this better results were obtained. This shows that if the tests were made by hauling over smooth pavement much better results would be obtained from these additional tests.

In summerizing the results obtained from these tests and the conclusions drawn from them , it is safe to say that under all conditions of the tests the addition of Celite helped to reduce the amount of segregation. It should also be noted that most of the tests were very severe and that probably never in practice would they be equaled for it is hard to think of a case where a central mixing plant would be used and the concrete hauled for five miles over rough roads , it might in all probility be hauled five miles but most of this would be either pavement or improved streets of some type.

This last statment grows out of the theory that central mixing plants will be more economical and profitable in cities and communities where large amounts if concrete are used every year for a number of years . At that rate it is hardly possiable that concrete would be hauled over two miles of rough road. With these supisitions and the results of the test which was hauled ten miles over smooth pavement it is very safe to assume that in the ordinary case of a central mixing plant that the addition of three percent of Celite would give a percent of improvement of around 75 or in other words it would reduce the amount of sggregation 3/4 , this is an improvement which it seems should be in favor of centralized mixing plants as well as the use of Celite. If segregatoon can be reduced by 3/4 it will leave it small enough so that it will cause no difficulty in most uses to which concrete is put. Also it is apparent that if the addition of three percent of Celite reduces the amount of segregation by 3/4 it will give a better concrete than if Celite is not used for the addition of this amount of Celite , (according to the experiments of Pearson and Hitchcock) does not seriously effect the strength of 1:2:4 or leaner concretes , while it is general knowledge that segregation to any marked amount does reduce the strength greatly.

ROOM USE ONLY

A study of the effect of cellite on segregation.

T620.1 D265 cop.2 Davis 95464