Senior Agricultural Thesis.

"Fixation of Ammonia by Land Plaster."

by

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THESIS

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From the times of the Greeks and Romans, land plaster or plaster of Paris has been used as a fertilizer. It has the composition CASO4, 2H2O. As a fertilizer it still holds a place among mineral manures. Many statements are found in old works on agricultural chemistry relating to the power of plaster or gypsum to absorb and retain ammonia. At present this is a live question. Many writers on dairying claim that it is valuable for absorbing and fixing ammonia. When the ammonia is in the form of the carbonate the re-action is claimed to be as follows:

$$(NH4)_2\ CO3 + CaSO4 = CaCO3 + (NH4)_2\ SO4.$$

Storer says, "The use of dampened gypsum around stables may be appropriate."

When I commenced this subject, by advise of Proffesor Kedzie, I tried sulphuric acid, intending to call that a perfect fixing medium, and use it as a standard by which to measure the fixing power of other substances. But I soon found that this would involve extra labor for which I had no time. In all these analyses I used a deci-normal solution of ammonia containing 1.7 grams of NH3 in 1000 cubic centimeters of water, and in the reports of analyses the ammonia is given in cubic centimeters of this solution.

For my experiments with sulphuric acid, I placed

4 c.c. of the acid in a watch glass which I set under a bell jar. Under the same jar was placed another watch glass containing 5 c.c. of NH4HO. Under another bell jar were placed other watch glasses containing similar amounts of the acid and of the alkali. One of the jars was a gallon jar, the other was a two gallon jar. The acid was left under the jars for twenty four hours, when it was removed and analized. The acid under the small jar was found to contain .3705 grams of NH3, or an equivalent of 238.8 c.c. of the standard ammonia used. The acid under the other jar contained the equivalent of 190.7 c.c. of ammonia. I repeated the above experiment with the exception of leaving the acid under the jars for forty-eight hours instead of twenty-four. When the acid was analized, that under the small jar was found to contain 214 c.c. of deci-normal ammonia, while that under the larger jar had 168.4.

I now analized five grams of the plaster and found no trace of NH3. I then placed five grams of the plaster under a bell jar with a watch glass containing 5 c.c. NH4HO. The plaster was placed in a watch glass and 5 c.c. of H2O was poured over it. This was left under the bell jar for forty-eight hours, when the plaster was analized, and found to contain the equivalent of 4.5 c.c. of the ammonia solution. At this time college closed for the spring vacation of ten days. I placed five grams of dry plaster under the jars with 5 c.c. of ammonia, and left it there

until the beginning of the summer term. The plaster under the small jar was found to contain .2 c.c. of ammonia, and that under the large jar only .1. This led me to think that perhaps it was the water instead of the plaster which held the ammonia, so I placed 3 c. c. of water under the jars with the ammonia hydrate. The water was left under the jars for forty-eight hours, when it was analized, and the water under the large jar contained 2.5c.c. of ammonia, while that under the small jar contained an equivalent of 3.3. c. c. of ammonia. You will notice that the amount of water used was same as was used in the plaster.

I next placed three grams plaster, ~~mustered~~ moistened with 6 c.c. water under the jars. It was left there for forty-eight hours and then placed in my desk for forty-eight hours to dry out. The NH_3, was then estimated and found equivalent to .6 c.c. of tenth-normal NH4HO, In other words the plaster had little attraction for the NH3 after the water had left.

My next experiment was to place water, plaster, and sulphuric acid in crystalizing dishes under the floor of the stable where the fumes of ammonia were very strong. In one dish were placed ~~five~~ 15 grams of plaster, moistened with 15 c. c. of water. In another dish were placed 15 c. c. of water, while 15 c. c. of H_2SO_4 were placed in still another dish. These were left under the stable floor for four days, when they were analized with the following results:

CaSO4 contained ammonia equivalent to 25.8 c.c. of the standard ammonia hydrate.

The Sulphuric acid contained ammonia equivalent to 199.4 c. c..

The H2O contained ammonia equivalent to 10.8 c. c.

The dishes allowed less surface exposure for the materials than under the bell jars. The experiment was repeated, the water held the equivalent of 1.5 c. c. of the standard ammonia hydrate, ~~whi~~ while the plaster held the equivalent of 6.5 c.c. The H2SO4 was spilled before being analized. The water had evaporated so that instead of 15 c. c. there was less than ten.

I next compared sand with plaster. I weighed out five grams of plaster and five grams of sand, and placed them in watch glasses. I then poured over each five c. c. of water and placed them under a bell jar with another watch glass containing ammonia. At the end of twenty-four hours the ammonia was estimated when it was found that the sand had absorbed enough to equal 11.5 c. c. of the standard alkali, while the amount held by the plaster was equal to only 7 c. c. This experiment was repeated, the dishes being set under the stable floor and left for four days, when the proportion was found to be reversed, the plaster having the equivalent of 7.4 c. c., while the sand had but 4.3 c.c. of the deci-normal NH4HO. In another experiment the dishes were left three days, when the plaster had absorbed the equivalent of 6.5 c.c. of the ammonia to 1. 1-3 c.c. for the sand.

I now compared plaster with muck. I put five grams of muck and five grams of plaster in watch glasses, and placed them under the same bell jar with ammonia. At the end of three days the ammonia was estimated when the plaster contained the equivalent of 10.2 c. c. to 32.1 c. c., of the standard NH4HO, for the muck. The experiment was repeated and the dishes left twenty-four hours, when the plaster contained 7.5 c. c. to 34.3 c. c. for the muck. The experiment was carried still farther by placing the muck and the plaster in crystalizing dishes, and leaving them under the stable floor for three days, when the proportion of ammonia was 6.6. to 31.5 in favor of the muck. In above experiments more water was used than the material would absorb. I repeated the experiment using just water enough to thoroughly wet the plaster and the muck. After remaining under the bell jar for twenty-four hours, an analysis showed a proportion of 37 to 1.7 in favor of the muck. The result seemed to show that it was the water instead of the plaster which held the ammonia.

For the last experiment on this subject, I placed five grams of plaster in each of two crystalizing dishes. In two other dishes of same size I placed five grams of muck. 5 c. c. of water was poured into each dish, when the dishes were placed together under the stable floor. After leaving them there for three days, one sample of the muck and one sample of the plaster were analiz-

ed the following results, muck 16.7 cc. to 4.8 cc. for the plaster. The two remaining dishes were left in my room for two days to dry out, when the material in them was analyzed. The muck had an equivalent of 6.9 cc. of the standard ammonia to an equivalent of .7cc. for the plaster.

In conclusion, dry plaster seems to have little power to absorb and fix ammonia. The fact that dampened plaster absorbed ammonia, but lost most of it on drying out, led me to think that this power of absorption depended more upon the water than upon the plaster.