

CHALK ROCK. III.

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The first report on this subject, in the 1935 proceedings of this Academy, showed that by means of a simple washing apparatus the calcium carbonate content of chalk rock from the quarries west of Yankton could be increased from eighty-eight to ninety-one per cent. The results were analyzed for carbon dioxide only. The 1936 report was simply a confirmation of these results by means of mineral analyses.

The first analyses for the year 1936-37 showed that there was no significant difference in composition between 20-mesh and 60-mesh quarry-run material. An apparatus was then assembled for washing larger quantities of material. This consisted of a motor-driven stirring device and a water inlet fitted into a gallon stone jar (container 1). Wash water overflowed from this into a dishpan (container 2) and from this into a large evaporating dish (container 3) and thence to waste. The dishpan and evaporating dish thus constituted two settling basins in which successive fractions of the material accumulated. The washing was conducted by placing about two hundred grams of the material in the crock, starting stirrer and water and allowing to run until the overflow water from the crock became clear. After thorough settling, the most of the water was carefully siphoned off from the container, the remainder removed by drying, and the sediment removed and prepared for analysis. Unscreened material was first washed, but no significant difference in composition was shown. A sample was then ground until it all passed a 100-mesh sieve, but several washings with variation of stirring and water velocity showed no difference in appearance so it was not analyzed. It was concluded that this was too finely ground, coming under the heading of "slimes" which are reputedly not separable by such washing methods.

For work in the year 1937-38 a new sample was obtained from the quarry but although taken as nearly as possible from the same location proved to be even poorer

than the others, having a calcium carbonate content of only eighty-two per cent. More paddles were added to the stirring shaft of the washing apparatus and arrangements made to increase the water velocity, if desired.

Material passing 20-mesh, but remaining on 60-mesh, screens, was subjected to treatments which may be roughly classified as follows: (A) rapid stirring, with water velocity comparatively low, about as in former work; (B) very rapid water, with practically no stirring after the material was wetted; and (C) a combination of rapid stirring and rapid water. Rather to our surprise the second method gave the best results. This, however, agrees with the first year's work, in which no stirring was used. The material in the third container, the evaporating dish, was of little importance, as less than five per cent passed beyond the dishpan and only two or three per cent was retained in the evaporating dish. The analyses and per cent yields are given in Tables 1, 2, and 3. The analysis of the original material is repeated for comparison.

Table I. Method A

	Original Limestone	Crock Residue	Dishpan Residue	Evapor- ating Dish
		40 %	60 %	Omitted
(1) Loss on Ignition	41.45	42.78	42.94	-----
(2) Silica	4.66	3.89	3.37	-----
(3) Iron & Aluminum oxide ..	7.06	2.11	2.17	-----
(4) Calcium oxide	46.10	47.74	48.49	-----
(5) Magnesium oxide	0.08	0.08	0.09	-----
(6) (1) + (4) + (5)	87.63	90.60	91.52	-----
(7) Calcium carbonate from (4)	82.3	85.3	86.5	-----

Table II. Method B

	Original Limestone	Crock Residue	Dishpan Residue	Evapor- ating Dish
		61 %	34 %	3 %
(1) Loss on Ignition	41.45	40.54	42.43	41.83
(2) Silica	4.66	4.00	3.69	3.90
(3) Iron & Aluminum oxide ..	7.06	3.60	5.04	2.63
(4) Calcium oxide	46.10	50.74	46.25	50.50
(5) Magnesium oxide	0.08	0.10	0.08	0.06
(6) (1) + (4) + (5)	87.63	91.38	88.76	92.39
(7) Calcium carbonate from (4)	82.3	90.6	82.5	90.1

Table III. Method C

	(Original) (chalk)	1 (65 %)	2 (31 %)	3 (2 %)
(1) Loss on Ignition	41.45	41.38	41.93	42.23
(2) Silica	4.66	3.78	3.36	3.79
(3) Iron & Aluminum oxide ..	7.06	6.44	3.26	3.48
(4) Calcium oxide	46.10	44.21	46.05	50.11
(5) Magnesium oxide	0.08	0.29	0.34	0.50
(6) (1) + (4) + (5)	87.63	85.88	87.32	92.84
(7) Calcium carbonate from (4)	82.3	79.0	82.2	89.4

Inspection of these tables reveals several matters of interest.

(1) The magnesium is of little importance, any differences being probably experimental error.

(2) A material balance shows that from two to three sevenths of the iron oxide disappears entirely, while there is little or no loss of silica or calcium oxide.

(3) In pure limestone (4) would be zero, and (6) and (7) would be identical. The actual results indicate that something besides carbon dioxide is being lost in ignition, probably organic matter. It will be noted that the material from container 1, method B, shows the greatest gain in calcium carbonate content over the original material. In this fraction (6) and (7) approach equality, indicating that this organic matter is also being removed by the washing.

(4) Last and most important, the proportion of the desired constituent, pure calcium carbonate, has been increased from eighty-two to almost ninety-one per cent. While this final per cent is no higher than that obtained in the first year's work, the amount of increase is greater and it has been obtained in larger quantities. This is, however, still far removed from commercially utilizable chalk and further work must yet be done.