

nearly the same, the greatest difference being 0.15 per cent. in 12-1-115. It will also be seen that there is a variation in the results of the two different men using the same soils and Rather method, being a difference of 0.37 per cent. in soil 12-1-110. In only one soil, 12-1-143, do the results agree. This seems to indicate that if the exact amount of ammonium carbonate is not added each time and the solutions do not have exactly the same treatment, different results are obtained.

The per cent. of humus obtained by Chemist No. 3 was slightly higher than that obtained by Chemist No. 2; also the per cent. of ash was higher. But this is easily explained by the fact that this determination was the first time Chemist No. 3 had used this method. The solutions from which he drew his aliquot gave a slight deposit of clay on standing. He did not allow the filtrate to become perfectly clear before he took the portion for the determination. In our routine analyses, we allowed about fifty of these solutions to stand two weeks and at the end of that time only two or three showed any precipitate at all. The greatest difference between the results of the two men doing the proposed method is 0.14 per cent. in soil 12-1-122, notwithstanding the fact that one of the men had never used the method before.

SUMMARY

1. The weighing out of an exact amount of ammonium carbonate is not necessary.
2. The time taken for the determination is shorter in most cases.
3. Nothing is added that could precipitate part of the humus.
4. It seems to give more uniform results.

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THE DETERMINATION OF LIME IN COW FECES¹

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Received June 8, 1912

While conducting the analytical work on the ash of cow feces, in a mineral nutrition experiment, it was found that the results were not concordant. This is due to the fact that the ash of cow feces runs abnormally high. The ash content of the feces used in this investigation was 20.55 per cent., while Dr. P. F. Trowbridge,² of the Missouri Experiment Station, has found the ash to run as high as 39 per cent. This unusually high ash content is due to the large amount of sand, dirt, etc., that the cow receives with the feed.

Methods of ash analysis are very lax with reference to the acid treatment of the ash. The time varies from 10 minutes³ boiling with acid, for plant ash; to 10 hours⁴ digestion over steam, for soils.

As nothing could be found relating to the ash of cow feces, it was decided to determine the factors which influenced the removal of the mineral constituents.

¹ Abstract of thesis submitted in partial fulfillment for Degree of Master of Arts, University of Missouri, 1912.

² Private communication.

³ "Food Inspection and Analysis," Leach, p. 303.

⁴ Bulletin 107, Official and Provisional Methods, U. S. Dept. of Agriculture.

The preliminary work showed that the calcium was the constituent removed with the greatest difficulty and therefore might serve as an index to all of the other mineral constituents.

The factors which it seemed necessary to determine may be outlined as follows:—

1. The time necessary to remove the lime by, (a) digestion of ash with acid over steam, (b) boiling the ash with acid on a hot plate.
2. The comparison of the efficiency of dilute and concentrated acid. (It was finally concluded to use concentrated hydrochloric acid, concentrated nitric acid and dilute hydrochloric acid of specific gravity 1.11.¹ This dilution is made by mixing equal parts of concentrated hydrochloric acid and water.)
3. The determination of which acid (nitric or hydrochloric) is most efficient.
4. The effect of dilute sodium hydroxide to break up silicates not decomposed by acid.
5. The efficiency of moist combustion as compared with ordinary combustion.

The feces were ground to a fine powder when dry and preserved in air-tight bottles. A large portion of the powdered sample was ashed to a cream white ash and preserved for analysis.

The moist combustions were conducted in Kjeldahl flasks, the boiling of the ash was conducted in Erlenmeyer flasks and the digestions were made in beakers, all of which were made of standard glass. Watch glass covers (on the beakers) and test tubes of water (suspended in the flasks) acted as condensers, and prevented loss of acid by evaporation.

After treatment with acid, the sample was diluted to twice its volume to prevent the acid from attacking the filter paper, and the sample was filtered and washed. The filtrate was then evaporated to dryness. The silica residue was taken up with dilute acid, filtered and washed. This filtrate was made up to volume for analysis.

Aliquots were made alkaline with ammonium hydroxide and brought back to faint acidity with acetic acid. After boiling a few seconds, the insoluble phosphates were filtered off and washed thoroughly.

The calcium was then precipitated as the oxalate and determined with N/50 potassium permanganate in the usual manner.

The following data shows (1) that the lime is removed in a shorter period of time when the ash is boiled with acid than when it is digested over steam. (2) That the ash must be boiled three hours to insure complete removal of the lime. (3) That in digestion, concentrated acid is more efficient than the acid diluted 1 : 1. (4) That when boiled, the concentrated acid has no advantages over the weaker acid.

When the acid is incapable of breaking up the silicates, it is advisable to treat the large silica residue with sodium hydroxide as proposed by the Fresenius-Will method.² When these alkaline washings are

¹ This is the strength of acid used in soil analysis (Bull. 107, U. S. Dept. of Agriculture).

² Jour. f. Gasbeleuchtung, 49, 853 (1906).

TABLE I.—BOILING ON HOT PLATE

| HCl (conc.) | | HCl (1 : 1) | |
|-----------------|-----------------|----------------|-----------------|
| Time | CaO Per cent | Time | CaO Per cent |
| 10 minutes..... | 1.36 | 5 minutes..... | 1.34 |
| 30 " | 1.40 | 10 " | 1.34 |
| 1 hour..... | 1.40 | 20 " | 1.39 |
| 2 hours..... | 1.44 | 30 " | 1.37 |
| 3 " | 1.48 | 40 " | 1.39 |
| 4 " | 1.47 | 1 hour..... | 1.44 |
| | | 2 hours..... | 1.47 |
| | | 3 " | 1.46 |

TABLE II.—DIGESTION OVER STEAM

| HCl (conc.) | | HCl (1 : 1) | |
|--------------|------------------|---------------|------------------|
| Time | CaO Per cent. | Time | CaO Per cent. |
| 1 hour..... | 1.44 | 0.5 hour..... | 1.33 |
| 5 hours..... | 1.46 | 1 " | 1.33 |
| 8 " | 1.46 | 2 hours..... | 1.37 |
| 10 " | 1.47 | 3 " | 1.37 |
| | | 4 " | 1.37 |
| | | 5 " | 1.38 |
| | | 6 " | 1.37 |
| | | 10 " | 1.47 |
| | | 15 " | 1.47 |

added to the acid solution, there is a distinct tendency toward higher results, as is shown by the fact that the writer obtained 1.50 per cent. of CaO when the alkali was used with the ash that had been treated with concentrated hydrochloric acid; and when the alkali

was used with the ash which had been treated with nitric acid, the per cent. of CaO was 1.49.

When the feces were destroyed with moist combustion by the use of concentrated nitric acid, the per cent. of CaO in the feces (not the ash) was 0.304; and when the feces were destroyed with aqua regia, the per cent. was 0.300.

If these percentages are divided by 0.2055 (the percentage of ash in the feces) we find the percentages of CaO in the ash to be 1.47 and 1.45, respectively. This seems to show that there are no insoluble compounds formed in the heat of ashing.

Where the feces were destroyed with moist combustion and the acid-insoluble residue was treated with dilute alkali, the per cent. of CaO was 0.314, which, divided by 0.2055 gives 1.52 per cent. There is, unquestionably, a slight tendency toward higher results when the alkali is used.

In conducting mineral analyses on the ash of cow feces the writer advises that the ash be boiled at least three hours with concentrated nitric or hydrochloric acid and that the acid-insoluble residue be evaporated to dryness with dilute sodium hydroxide to break up all silicates. This alkaline residue should then be taken up with dilute acid and added to the original solution for analysis.

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LABORATORY AND PLANT

THE PLANT OF THE SAKAI CELLULOID COMPANY AT SAKAI, JAPAN

By F. C. AXTELL

Received November 4, 1912

In the year 1908, the writer received a commission from the Mitsui family of Japan for the design and construction of a plant for the manufacture of celluloid in that country. A long previous experience in this and allied industries in the United States had demonstrated that the machinery and processes hitherto employed left much to be desired in the way of improvement, of which there had been practically none during twenty years. This condition was and is due, in all probability, to the mistaken policy of manufacturers in the maintenance of secrecy, as a consequence of which inventors, manufacturers of machinery and scientists are kept in ignorance of the necessity for the application of their knowledge and energies in the progressive improvement which is necessary to the proper development of any industry.

With these facts in view, the writer advised that he be permitted to design all machinery, have it constructed in the United States, design all buildings and send the architectural drawings to Japan, where work on the buildings might be prosecuted while the machinery and other apparatus were under construction in America. This proposal received the approval of the interested parties, and work was at once commenced. A corps of draftsmen and tracers was engaged, and as rapidly as detailed drawings of a

machine were finished, such drawings, together with the necessary specifications, were submitted to manufacturers for bids, contracts were drawn, the machinery constructed, tested and shipped to Japan. In the meantime, detailed drawings of all buildings had been prepared and sent forward and construction commenced.

For the erection of the plant, the Company had purchased a plot of ground containing about 15,000 tsubo (13 acres) situated on the Yamato river, at the northern limit of the old town of Sakai, and exactly five miles from the Imperial city of Osaka. Considerable difficulty was experienced in securing a site, by reason of the strict regulations relating to the contamination of streams by factory or other waste-matter—not for sanitary reasons, but for the protection of fish, which form an important item of the national diet. The advantages of the site selected were: (1) cheap transportation by canal directly to Sakai harbor on the Inland Sea; (2) a plentiful supply of unskilled labor; (3) good and unrestricted drainage; (4) its proximity to Osaka, which is the principal commercial and manufacturing city of Japan; and (5) the fact that a practically unlimited supply of ground water of excellent quality could be obtained. The disadvantages were: (1) that the ground was low, thus necessitating an enormous amount of filling, and (2) the fact that the plot had as its easterly boundary the twenty-foot embankment of the Nankai Railway, the only entrance to the plant from the main highway being by means of a