ON THE PRECIPITATION OF SUSPENDED CLAY BY ALUMINIC OR FERRIC HYDROXIDES, OR BY MEANS OF CALCIUM HYDRATE.

BY ALBERT R. LEEDS.

In many river waters there is, in addition to the coarser particles, more or less of suspended clay so finely subdivided that it readily passes through the pores of a paper or of a sand filter, unless the latter is itself of fine grain of considerable depth and the rate of filtration slow. These river waters are usually quite soft, containing but from two to six parts of dissolved carbonates of lime and magnesia. Harder waters rapidly become clear, the earthy matters not remaining in suspension when they are allowed to come to rest, whereas the soft waters may remain turbid or opalescent for weeks after the mud has precipitated and only the finest silt remains suspended.

The addition of alumina and iron salts and of lime is largely practised in order to overcome this difficulty. In order to ascertain what takes place, I have performed the following experiments upon an impure kaolin suspended in water. The kaolin experimented upon was in very minute hexagonal scales or plates, intermingled with other mineral matter. Inasmuch as kaolin is a decomposition product obtained by the weathering action of waters containing carbon dioxide in solution upon feldspars, it seemed not improbable that by reversing the action and by causing lime to react upon kaolin suspended in water, a part of the latter might be expelled and some of the lime replace the basic hydrogen. The following experiments are in accordance with this hypothesis.

An analysis was made of the material used, and its composition was found to be :

	Kaolin.	Associated Impurities.
Alumina	15.81 %	
Ferric Oxide	4.87 %	
Water	6.675%	13.658%
Silica	22.25 %	26.55 %
Lime		4.15 %
Undetermined		6.037%
	49.605%	50.395%

A sample of the dried kaolin, or clay, was taken weighing 0.525 grm. and diffused through a solution of lime water, containing 0.228 grm. of CaO. This was on the assumption made prior to the analysis that the kaolin was pure, and that all the combined water might be replaced by lime. After standing for a week with repeated shaking, the lime remaining in solution amounted to 0.205 grm. instead of 0.113 grm., or about 20.3 per cent. of the amount required upon the above assumption by the kaolin present.

In another experiment half a gramme of the mineral was diffused through lime water containing in solution 1 mgrm. CaO per c. c., and contained like the former in a very carefully stopped flask. After three days, 20.01 mgrms. of lime had passed out of solution.

The experiment was again repeated upon 2.5 grms. of the kaolin suspended in a half litre of water containing in solution 0.5 grm. CaO. After 30 hrs., with shaking at intervals, 0.114 grm. CaO or 29.4 per cent. had gone out of solution. At the end of 12 days an additional 19 per cent. of lime had been absorbed, or 40 per cent. in all.

For these reasons the use of lime is to be preferred where the waters need both softening and clarification, and where there is no notable amount of dissolved peaty extractive matters which impart even to the filtered waters a yellow color. In the latter case lime will not answer since it forms soluble compounds with these peaty substances, and precipitation and clarification only are attained, but attended with little or no decolorization. In such cases aluminium hydroxide is the best available reagent. The hydrate is thrown down by the calcium carbonate naturally present, and passes out of solution along with the co-precipitated peaty matters, the waters becoming pellucid and colorless. When fine silt is present this is removed at the same time. With kaolin suspended in distilled water artificially hardened by the addition of dissolved carbonate of lime, the kaolin was readily precipitated on the addition of an alumina salt in amount exactly equivalent to the small quantity of dissolved calcium carbonate. But it appeared to be simply entangled in the flocculi of the aluminium hydrate, and, as indeed might have been anticipated, did not enter into combination with the kaolin.

As remarked above the alum salt is necessarily used when both suspended silt and peat extract are present; iron salts will not answer. The latter behave precisely like those of alumina so far as the silt is concerned, but form soluble compounds with the peat. Indeed the color of the clarified water may be deeper than the original owing to the dark tint struck by the ferric humus compound, and when this result is obtained just as much alum salt must be employed to get rid of the dissolved iron compound and render the water colorless, as if the original peaty water itself had to be dealt with.

A NEW LABORATORY STAND.

BY DR. G. C. CALDWELL.

This stand takes the place in my student laboratory of filter stands, lamp stands and burette stands, one stand serving two students working on opposite sides of the table and carrying also a shelf long enough to hold four bottles for the reagents most commonly used in quantitative work, such as ammonia, and the acids.