SHORT COMMUNICATIONS

Precipitation of Silica in the Presence of Aluminum

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It is commonly received among geologists1) that silica in river water is colloidal and precipitated by electrolytes in sea water as a result of coagulation. It was shown in our previous reports2-4), that colloidal silica, unless its concentration is very high, can not be precipitated even in sea water, where colloidal silica rather depolymerizes into molecularly dispersed state, owing to the high solubility of silica.

On the other hand, molecularly dispersed silica is precipitated by the addition of a small amount of aluminum salt, which hydrolyses into aluminum hydroxide and coprecipitates the silica, as has been employed to remove silica from boiler-feed water5,6).

Thus a considerable literature has grown up around the subject of precipitation of molecularly dispersed silica by aluminum hydroxide, but little is known about the precipitation of colloidal silica.

Experimental

To a solution of silica, a known amount of aluminum was added as acidic solution of $AlCl_3$ or $Al_2(SO_4)_3$. The hydrogen ion concentration was adjusted to a pH 4 to 11 by the addition of dilute NaOH solution. The resulting solutions were filtered after about thirty minutes and analysed for the concentration of residual silica. As a similar effect was observed with $Al_2(SO_4)_3$ as well as with $AlCl_3$, the results obtained with $Al_2(SO_4)_3$ are described below. The colloidal solution of silica was prepared from sodium silicate solution containing 20 g. SiO_2 per litre by the ion-exchange method2) followed by aging for several months at pH about 8.

Figs. 1. and 2 show the effects of pH on the precipitation of molecularly dispersed silica as well as colloidal silica, by aluminum. It is interesting to note that the optimum pH for the precipitation of molecularly dispersed silica is about 9, while colloidal silica is precipitated most

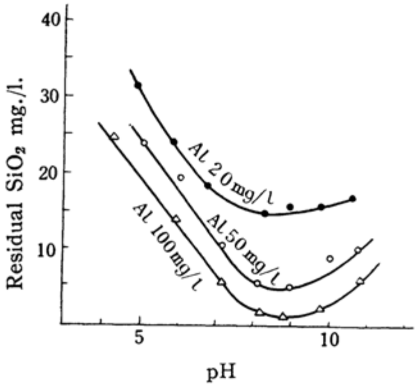

Fig. 1. Precipitation of molecularly dispersed silica. SiO_2 35 mg./l.

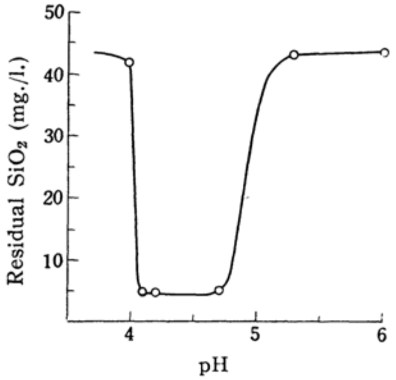

Fig. 2. Precipitation of colloidal silica SiO_2 45 mg./l., Al1 mg./l.

effectively at pH about 4.5. Much smaller amount of aluminum is sufficient for the precipitation of colloidal silica compared with that for molecularly dispersed silica. One milligram of aluminum precipitates as much as 40 mg. of colloidal silica. This may be closely connected with the fact that colloidal silica has a electrophoretic mobility much greater than that of molecularly dispersed silica[2,7].

Colloidal silica can not be precipitated, in the case where the ratio of colloidal silica to aluminum exceeds a certain value, as will be seen in Fig. 3. Neither aluminum nor colloidal silica precipitates in this case.

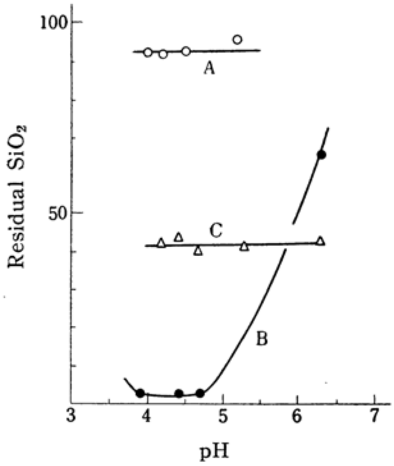

Fig. 3. Presipitation of colloidal silia.

A	SiO_2	92 mg./l.	Al	1 mg./l.
B	SiO_2	〃	Al	2 〃
C	SiO_2	43 mg./l.	Al	0.5 mg./l.

According to the results shown above, it is clear that a trace amount of aluminum plays an important role in the precipitation of silica, especially when the silica is colloidal. Biological sedimentation[1] of silica must also be taken into account, but at least in some cases, precipitation of colloidal silica by a trace amount of aluminum will successfully explain the sedimentation of silica in natural waters.

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