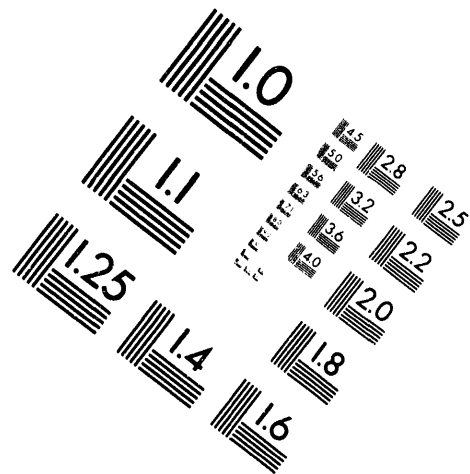
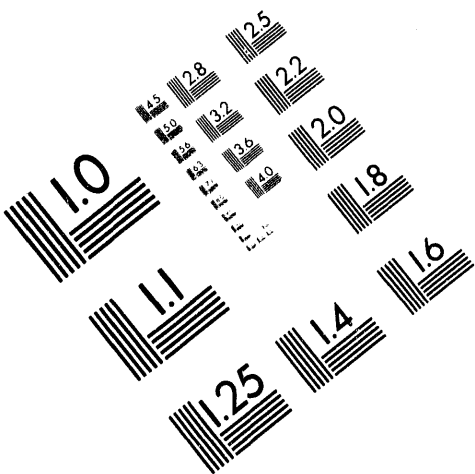




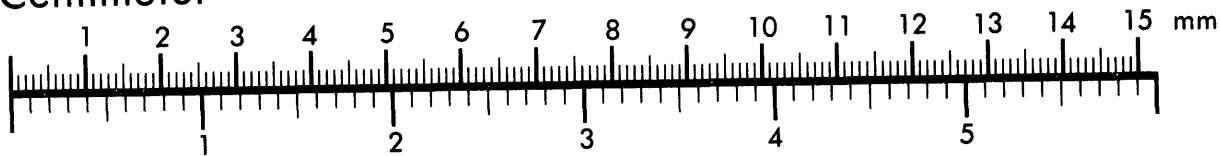
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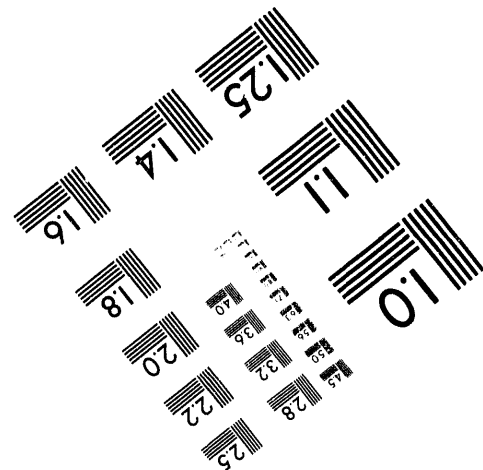
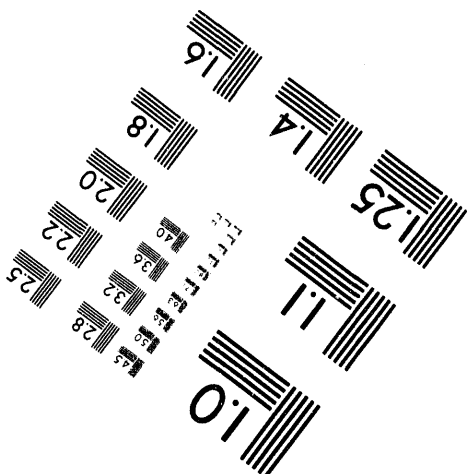
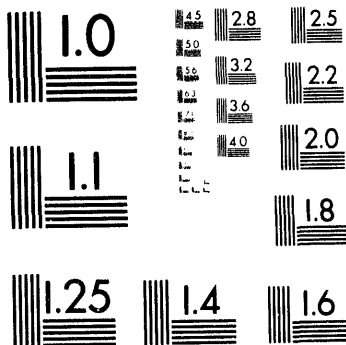
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Subject TURBIDITY FLOCCULATION IN COLUMBIA RIVER WATER

By R.D. Frank - Conley ^{w.f.} Memo 102

To C. P. Kidder

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Jan. 9, 1944

C. P. KIODER (2)

TURBIDITY FLOCCULATION IN COLUMBIA RIVER WATER

Object:

To study the character of floc obtained by use of commercial aluminum sulfate alone and together with other chemicals designed to improve flocculation.

Equipment:

The equipment consisted of a motor driven variable speed laboratory mixer with six agitators. The flocculation tests were performed in one liter beakers.

Procedure:

To series of one liter beakers containing raw Columbia River water were added known amounts of alum, alum and lime, alum and sulfuric acid, alum, sulfuric acid, and lime, and alum and artificial turbidity. The water and chemicals were mixed for fifteen minutes and the character of floc noted.

Results:

1. Enough sulfuric acid was added to the water to give a pH as tabulated before the alum additions:

pH	Alum	Results
5	10	No floc
6	10	No floc
6½	10	Floc small and light, settled very slowly
7	10	" " " " " " " "
7½	10	" " " " " " " "
8	10	" " " " " " " "
6½	20	" " " " " " " "
7	20	" " " " " " " "
7½	20	" " " " " " " "

2. Sandy loam from River bluffs was added in amounts tabulated as follows:

P.P.M. Turb.	P.P.M. Alum	Results
2	20	Small light floc, settled slowly
5	20	Slight improvement
10	20	Fairly large floc, settled faster
20	20	Very good floc, settled rapidly
20	10	" " " " " " " "
40	10	" " " " " " " "

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- 3. A filtered solution of $\text{Ca}(\text{OH})_2$ was added to the water in amount tabulated and pH adjusted to 7 with sulfuric acid before the alum additions:

<u>P.P.M.</u> <u>$\text{Ca}(\text{OH})_2$</u>	<u>P.P.M.</u> <u>Alum</u>	<u>Results</u>
0	10	Small light floc, settled slowly
20	10	" " " " "
40	10	" " " " "
60	10	" " " " "
80	10	Slightly better
40	20	Better but still light and fine
60	20	" " " " "

- 4. Calcium Hydroxide, suspended in water, was added to the raw water along with the calculated amount of acid necessary to bring the solution to a pH of 7 before the alum additions:

<u>P.P.M.</u> <u>Lime</u>	<u>P.P.M.</u> <u>Alum</u>	<u>Results</u>
0	10	Small light floc, settled slowly
15	10	Slightly better
25	10	Slightly better
50	10	Very marked improvement, settled rapidly
75	10	" " " " "

Conclusions:

The following conclusions apply only to the laboratory beaker tests as noted above.

1. Commercial alum (8-20 ppm) in raw Columbia River water containing less than 5 ppm of turbidity does not give a satisfactory floc. The floc which is formed settles slowly and probably would not settle out in the conventional type settling basin on a filter plant. It would probably carry over to the sand filters and some of it might pass through the filter into the clean well.
2. When 10 or more p.p.m. of turbidity is added to Columbia river water along with 10 to 20 p.p.m. of alum, a heavy floc is formed which settles rapidly. Therefore, it is indicated that when the turbidity in the river is greater than 10 p.p.m., flocculation should be satisfactory.
3. The addition of 40 or more p.p.m. of a filtered calcium hydroxide solution to Columbia River water with 20 p.p.m. of alum resulted in a satisfactory floc. The pH of the water was adjusted to 7 with H_2SO_4 . An addition of this type does not seem practical on a large scale plant.
4. The addition of 50 or more ppm of lime in a suspension to Columbia River water along with 10 p.p.m. of alum gave a satisfactory floc. The pH of the water was adjusted to 7 with H_2SO_4 . It is thought

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G. P. Kidder

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that the particles of lime act as a nucleus around which the floc can form, similar to turbidity.

Recommendations:

Of the four different types of treatment which were tested, the addition of turbidity gave the best results and seemed to be the more practical from an economy and simplicity viewpoint. It is indicated that the plant will have difficulty in the coagulation of turbidities below 5 p.p.m. with alum. If coagulation of such low turbidity is necessary, it is suggested that consideration be given to equipment for feeding at least 20 p.p.m. of turbidity to the water.

R. D. FRANK

R.D.F.

By W. R. Conley, Jr.
W. R. Conley, Jr.

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