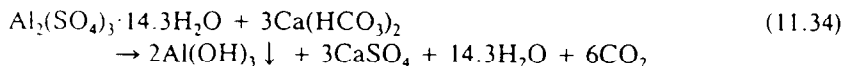


## Aluminum Sulfate (Filter Alum)

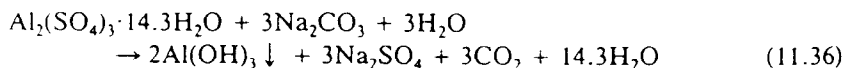
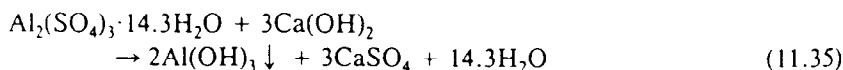
Aluminum sulfate is the standard coagulant used in water treatment. The commercial product strength ranges from 15% to 22% as  $\text{Al}_2\text{O}_3$  with a hydration of about 14 moles of water. A formula used for filter alum is  $\text{Al}_2(\text{SO}_4)_3 \cdot 14.3\text{H}_2\text{O}$  with a molecular weight of 600. The material is commonly shipped and fed in a dry granular form, although it is available as a powder or liquid alum syrup.

Aluminum sulfate reacts with natural alkalinity in water to form aluminum hydroxide floc.



Each mg/l of alum decreases water alkalinity by 0.50 mg/l (as  $\text{CaCO}_3$ ) and produces 0.44 mg/l of carbon dioxide. Production of carbon dioxide is undesirable since this increases the corrosiveness of water.

If water does not contain sufficient alkalinity to react with the alum, lime or soda ash is fed to provide the necessary alkalinity.



An advantage of using sodium carbonate (soda ash) is that unlike lime it does not increase water hardness, only corrosiveness. Lime, which is more popular, is less expensive than soda ash.

The dosage of alum used in water treatment is in the range 5–50 mg/l. The effective pH range for alum coagulation is 5.5–8.0. Alum is preferred in treating relatively high-quality surface waters because it is the only chemical needed for coagulation.

- 11.12 The results from a jar test for coagulation of a turbid alkaline raw water are given in the table. Each jar contained 1000 ml of water. The aluminum sulfate solution used for chemical addition had such strength that each milliliter of the solution added to a jar of water produced a concentration of 8.0 mg/l of aluminum sulfate. Based on the jar test results, what is the most economical dosage of aluminum sulfate in mg/l?

Jar	Aluminum sulfate solution (ml)	Floc formation
1	1	None
2	2	Smoky
3	3	Fair
4	4	Good
5	5	Good
6	6	Very heavy

If another jar had been filled with freshly distilled water and dosed with 5 ml of aluminum sulfate solution, what would have been the degree of floc formation?

- 11.12 Jar 4 with a dosage =  $\frac{4}{1000} \times 8.0 = 0.032$  mg/l  
 With distilled water, no coagulation occurs because of the lack of alkalinity for the chemical reaction, Eq. 11.34.