Primary Coagulant Aid Outperforms Alum, Slashes Operating Costs

A water treatment plant in Cleveland, Ohio, is a 20-mgd capacity conventional surface water facility using Lake Erie as the water source. The plant provides high-quality potable water for 85,000 residents in the surrounding communities and also supplies water to heavy manufacturing, service and commercial firms.

With seasonal fluctuations, Lake Erie raw water turbidity ranges from 3 to 150 ntu and the pH ranges from 7.5 to 8.3. The goals for finished water at the plant include turbidity of 0.1 ntu or less, pH 8.1 to 8.3, chlorine residuals 2.2 to 2.5 mg/L, no taste and odor problems and no algae breakthrough in its mixed media filters.

Treatment Process

As the water enters the plant, a travelling water screen removes solids and debris, then potassium permanganate is added for taste and odor control. In the plant's chemical building, two 5,000-gallon rapid-mix tanks are used for the high velocity addition of a coagulant aid, caustic or chlorine. The building also contains six 105,000-gallon settling basins and two 60,000-gallon sludge thickeners.

After coagulation and flocculation, water from settling basins flows through a flume to the mixed-media filters in the plant's filter building. The filter media consist of layers of anthracite coal, sand and gravel. Filter beds are cleaned periodically by a standard backwashing process at 15.4 gpm/sq.ft. Wash water is pumped back to the rapid-mix tanks for retreatment. Powdered activated carbon, fluoride, chlorine or a filtration aid can be added to the water prior to filtration.

After filtration, water passes through storage tanks, clearwells and a chlorination chamber before it is pumped to the distribution system.

Alum-Related Problems

Alum was the only coagulant aid used during the first year and a half of operation at the water plant. Alum was added continuously to the rapid-mix tanks at a dose of 18 mg/L. Several inefficiencies and cost concerns associated with alum use led to investigations and selection of a polymer coagulant product. Alum-related problems included

- high sludge generation with a low 6.8 percent sludge solids content,
- high filterability index of 1.4 on settled water, and
- a –16 to –20 water corrosivity index range.

To remedy these problems and enhance plant performance, the plant discontinued alum use and converted to a CAT-FLOC liquid cationic coagulant. This coagulant neutralizes the negative charges on suspended particles, effectively coagulates fine colloidal turbidity and quickly forms a dense, rapidly settling floc.

Without requiring any changes in the existing alum storage and feed system, the plant began use of CAT-FLOC coagulant at a dose of 6–7 mg/L, less than half the alum dosage.

Enhanced Plant Performance

Sludge Reduction. The water plant has been producing only one third as much sludge since the new coagulant was introduced (down from 186,000 gallons per month to 50,000 gallons per month). Sludge reduction also cut in half the number of times that sludge hauling trucks from the county's wastewater treatment plant had to remove waste.

Corrosion Control Improvement. Because alum consumes the natural alkalinity of water, it produces a corrosive product. To compensate for loss of alkalinity, the plant added caustic soda in the flocculators for pH adjustment and in the distribution system for corrosion control. Since the coagulant product allows for less alkalinity consumption, nearly two thirds less caustic is required to adjust the pH of finished water. The plant now produces a stable product with a corrosivity index of 0 to 2 at a cost saving of approximately $21,000 per year.

Filtration Improvements. The plant's filterability of settled water has decreased from an average of 1.4 to less than 1.1. The plant has been able to increase filter runs from 48 hours with alum to 80 hours with coagulant polymer. Fewer filter backwashings are needed, and more finished water is sent to distribution. A 17 percent reduction in filter washes was achieved, and the plant realized savings of more than $14,000 in labor, chemical and electricity costs.

Total Savings Per Year

Sludge Reduction	$14,400
Filtration Operation	$14,000
Corrosion Control	$21,000
Total Cost Reduction	*$49,400*
Incremental Cost of New Programs	$8,200
Net Savings Per Year	**$41,200**

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Despite slightly higher chemical costs associated with the conversion from alum to liquid cationic coagulant, the plant has achieved an annual operating cost saving of more than $40,000.