ALUM RECOVERY AT A DRINKING WATER TREATMENT PLANT

City of Durham, N. C.

Pollution Prevention Challenge Grant: Project Summary
December 1985

Introduction

The treatment of water with alum (aluminum sulfate) during the production of drinking water generates a sludge that must be disposed of in an environmentally sound manner. The sludge generated in nearly all of the treatment systems is ultimately disposed of in a landfill. It was estimated in 1973, that 25,000 tons of alum sludge is produced in North Carolina each year. The disposal of alum sludge in a landfill results in the loss of a valuable asset (alum) and at the same time depletes the capacity of the landfill. The dewatering and disposal of alum sludge adds significantly to the cost of treating water. Alum recovery and reuse could reduce those costs.

The City of Durham's Water Resources Department performed a full-scale study of alum recovery at one of their drinking water treatment plants. This study evaluated the technical and economic feasibility of recovering the alum and using it to remove phosphorus at one of Durham's sewage treatment plants. Recovering and reusing the alum both at the drinking and sewage treatment plants would reduce both raw material and disposal costs.

Results

Full-scale testing was conducted at the Williams Water Treatment Plant to evaluate alum recovery. Two tests were conducted, one in August and one in September. The objectives were (1) to evaluate alum recovery, and (2) to determine the dewaterability of the solids remaining after alum recovery on sand-drying beds and (3) to evaluate the effectiveness of the recovered alum as a coagulant in the water plant and for phosphorus removal at the wastewater plant.

Sulfuric acid was used to recover the alum from the water treatment sludge. The sludge which remained after alum recovery was polymer-conditioned and applied to the drying beds. It was estimated that the existing 20,000 sf of sand bed area would be sufficient to dewater the acidified sludge. This compares to 40,000 to 60,000 sf needed to dewater the normally produced alum sludge.

To evaluate the effectiveness of the recovered alum, the water treatment plant was divided into two split treatment modes, with one-half the plant using recovered alum and the other half using commercial alum. About a 10% higher TOC was obtained in the finished water of the recovered alum side. All other finished water parameters were essentially equal. It was concluded that the recovered alum could be successfully used as a coagulant at the water plant on a one or two recycle basis and in conjunction with a monitoring program.
The recovered alum was also successfully used in jar tests for phosphorus removal at the wastewater plant. It was shown that recovered alum, directly acidified sludge, and commercial alum were all equally effective in reducing phosphorus levels.

Conclusions

Evaluation of the data showed that alum recovery is feasible and can reduce both operation and disposal costs as shown below:

- **Alum Recovery** = 75%
- **Dry Weight Solids Reduction** = 35 - 40%
- **Acid Demand** = 0.67 tons acid/ton alum dissolved
- **Recovered Alum Concentration** = 2 - 3%
- **Cost of Recovered Alum** = $50 - $70/ton
- **Current Alum Cost** = $112/ton

The process is a viable method of reducing sludge-handling requirements. The recovered alum can be used at the water plant and at the wastewater plant. The chemical cost of the recovered alum is about half that of commercial alum, also adding to the attractiveness of the process. It was recommended that the City proceed in a preliminary design report to define operational alternatives and the associated implementation costs, and that further study be conducted on the effects of recovered alum and acidified sludge on the performance at the wastewater plant.