technical brief

The Problem With Water Treatment Plant Residuals

Energy Delivery & Utilization Division
Municipal Water and Wastewater Treatment Target

Water treatment in the U.S. relies heavily on a variety of chemicals to remove solids and achieve disinfection. Conventional practices, in place since the beginning of the century, have led to excellent benefits to public health and the elimination of numerous water-borne epidemics. One disadvantage of these practices, however, is that the use of chemicals generates large amounts of residuals which must be disposed. These residuals consist of solid material present in the raw water, coagulant chemicals, and water. In fact, in typical situations water accounts for more than 95 percent of the volume produced.

In the past, these residuals have often been disposed of through land application or in dedicated landfills. With the advent of stricter landfill laws these options are becoming less economical for some water utilities, so there is a need for newer and better ways to dispose of water treatment plant residuals. Research has shown that freeze/thaw conditioning of residuals aids in the separation of the solids from water, reducing the volume of material for final disposal. Thus, the EPRI Municipal Water and Wastewater Program launched the Freeze/Thaw Demonstration Project in 1995.

This project lead to the construction of a mobile demonstration unit used to evaluate the concept of freeze/thaw conditioning of water and wastewater treatment plant residuals at plants around the country. The concept has shown to be very effective at separating water from waste solids in numerous bench and pilot scale demonstrations. The objective of the trailer has been to evaluate the economics of the concept on a larger, more realistic scale and to identify those areas where additional research is needed to bring the concept to a full-scale design.

EPRI's MWW freeze thaw trailer in operation at the Dallas Elm Fork Water Treatment Facility.

Prior to 1999, there have been several pilot evaluations at water treatment plants in Missouri, South Carolina, New Jersey, and Ohio. This year pilot evaluations were conducted in California and Texas. This *Technical Brief* describes the results of those evaluations and how they fit into the growing body of data on freeze/thaw conditioning of water treatment plant residuals.


Comparison of settling of residual solids with (on left) and without (on right) freeze/thaw conditioning.

California Results

A pilot study was initiated at the LaVergne Water Treatment Plant of the Metropolitan Water District of Southern California. The system was initially used to assess the performance of freeze/thaw conditioning on the alum residuals produced at the facility. However, problems during the operation of the demonstration unit lead to the premature shutdown of demonstration before any data could be collected. Some anecdotal evidence was generated that freeze/thaw conditioning may be effective in desalting one of MWD's main water sources, Colorado River Water. Unfortunately, the current demonstration unit is not suited for such an evaluation. Researchers have identified another system better suited for such a demonstration. Plans are now underway to conduct the demonstration in early year 2000.

A view of one 25 lb (11.4 kg) of the frozen residuals. Note the dark band of solids in the middle of the block

Frozen residuals are lifted from the freezer before crushing and subsequent thawing.

Texas Results

A more extensive evaluation was conducted at the Elm Fork Water Production Facility in Dallas, Texas. The Elm Fork facility uses ferric sulfate as a coagulant, so this was the first study to evaluate the effects of freeze/thaw on a residual consisting predominately of ferric sulfate. While power consumption values were in line with those numbers obtained in previous studies, the gravity settled percent solids after conditioning was significantly lower than values obtained elsewhere.

The researchers identified two reasons for the poor performance of freeze/thaw on the residuals from the Dallas plant. First, ferrous sulfate residuals have less chemically-bound water in them than do alum residuals. Thus, the primary mechanism in freeze/thaw conditioning for separating the water from the solids is rendered useless when used with ferric salt residuals. In addition, the raw solids fed into the plant were quite dilute (typically 0.5 % or less); previous research has indicated that performance of the unit is poor if the feed solids are not greater than 1.0 % and preferably should be greater than 2.0 %. Interestingly, plant staff already get good settling of the residuals at the plant's lagoon. This observation has been duplicated by other plants using ferric salts as the primary coagulant.

Next Steps

Testing on the unit will continue, but it is unlikely that residuals from water treatment processes relying on ferric salts will be tested again. The Texas results demonstrate that the application of freeze/thaw conditioning on such residuals is unsatisfactory and, because of the chemistry, not suitable. However, testing will continue for alum-based residuals. Researchers are now trying to implement an intermediate dewatering step, prior to the freeze/thaw conditioning, so that the solids concentration of the residuals entering the freezer is between 7 and 9 percent. This should greatly improve the economics of such a system. The MWW Program is currently looking for suitable demonstration sites. Freeze/thaw conditioning may find its most beneficial use in industrial wastewater treatment, particularly with metal hydroxide sludges containing heavy metals.

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