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Project Summary

Top-Feed Vacuum Filtration of Waste-Activated Sludge

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The objectives of the project were to evaluate the effectiveness of a top-feed vacuum filter on a prototype basis and to compare the performance and cost-benefit relationship of a top-feed vacuum filter with a conventional bottom-feed vacuum filter. This project evolved out of earlier work done under EPA Grant No. WPRD 71-01-68, which studied the performance of a pilot-scale top-feed vacuum filter. The results from this study indicated that a top-feed vacuum filter would increase the sludge dewatering capacity of each filter, produce a drier sludge cake, and use less ferric chloride than a conventional bottom-feed vacuum filter. A significant drawback of the pilot-scale study was that no statistically valid comparison could be made between the pilot-scale top-feed vacuum filter and a full-scale conventional botton-feed vacuum filter. Thus, an evaluation of two full-scale units, operating on a side-by-side basis, was undertaken.

This Project Summary was developed by EPA's Municipal Environmental Research Laboratory, Cincinnati, OH, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

A full-scale evaluation was performed at the Jones Island Wastewater Treatment Plant of the Milwaukee (Wisconsin) Metropolitan Sewerage District to determine the effectiveness of a top-feed vacuum filter and to compare its performance and cost-benefit relationship with a conventional bottom-feed vacuum filter. As part of this project, two 12-ft-diameter (3.7-m) by 16-ft-long (4.9-m) vacuum filters were purchased and installed in the Filter Building at the Jones Island Plant. The filters and support equipment were identical, except for the method of sludge pickup.

Testing was performed around the clock for approximately 9 months during two time periods (from June to September 1979 and from February to August 1980). Shutdown was limited to maintenance work and routine filter washing. All tests were performed only on thickened waste-activated sludge since the Jones Island Plant had no primary treatment at the time. The thickened waste-activated sludge had a feed concentration of approximately 18,000 mg/L. Before filtration, the sludge was conditioned with ferric chloride, reducing the pH to between 3 and 4.

Results and Conclusions

The top-feed filter was found to be more efficient when forming a filter cake because of its basic design configuration (resulting in a longer drying time even at similar cycle times). At equivalent solids loading rates of approximately 1.5 lb/hr/ft^2 (7.34 kg/hr/m^2), a 3-minute, 40-second cycle time produced the optimum cake

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solids (15.0 percent) for the top-feed filter, which was significantly (based on statistical analysis) drier than the bottom-feed filter (14.4 percent). Further increase in cycle time to 4 minutes did not produce any significant increase in cake solids from the top-feed filter, but did produce an increase for the bottom-feed filter, with the resultant cake solids comparable to the top-feed filter.

Chemical conditioning studies using similar flocculation facilities located adjacent to each experimental filter indicated that there is no significant difference between the chemical dosages required to operate the top-feed filter and the bottom-feed filter at optimum levels. Dewaterability appears to be a function of the sludge itself and is not influenced by the filter design. Local sludge conditioning (ferric chloride conditioning done adjacent to experimental filters) produced drier filter cakes at higher solids yields for both filters than centralized sludge conditioning done remotely. Shear forces in sludge distribution lines appear to have adverse effects on floc particle structure. When such sludge is filtered, the sheared floc particles reduce filter cake porosity by filling in the voids between the larger floc particles.

Critical to the routine operation of vacuum filters of the top-feed design is a hopper seal that is effective and has a long life. Whereas considerable progress was made during the course of the project, more work needs to be devoted to developing a seal and wear sheet having better sealing properties and a longer life.

Analysis of the unique operating and maintenance and capital costs pertinent to the individual experimental filters show the top-feed filter capital costs to be significantly lower than the bottom-feed filter ($15,350 vs. $22,400 per filter), whereas the operating costs are significantly higher ($1,120 vs. $154 per filter per year). A cost comparison of the operating and amortized capital costs indicates there is no significant difference between the top-feed filter and bottom-feed filter costs ($2,682 vs. $2,434 per filter per year, respectively).

These values are based on an analysis of the operating and capital costs that are unique to each filter. Any operating cost common to both filters such as the cost of the filter drum were not included in the cost analysis. All costs have been adjusted to mid-1980 dollars. The net costs are amortized on a 20-year basis at an 8-percent interest rate.

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The complete report, entitled "Top-Feed Vacuum Filtration of Waste-Activated Sludge," (Order No. PB 82-227 687; Cost $13.50, subject to change) will be available only from:
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