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DYNAMIC RESPONSE OF FINAL CLARIFIERS

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As a consequence of the significant variations in hydraulic loading which are routinely experienced at most wastewater treatment facilities, the dynamic response of final clarifiers in the activated sludge process is an important determinant of effluent quality. Unless specific treatment plant components are provided for the purpose of flow equalization, perturbations in the influent flow rate would be rapidly propagated throughout the treatment facility due to the negligible hydraulic capacitance of constant volume tanks. An experimental program was formulated to characterize the transient response of a clarifier subjected to variations in the hydraulic loading.

A system forcing was selected which approximates conditions experienced in the field. A step forcing in overflow rate (increase of 50%) was imposed while maintaining a constant underflow rate. This scenario corresponds to an increase in influent flow rate in the absence of an operator response. A flocculent chemical slurry was selected in lieu of a biological slurry such as activated sludge to minimize variation in slurry characteristics with time. The clarifier dynamics were not affected by the dynamics of other system components for the uncoupled configuration employed in this research program.

The system response to the increase in flow was immediate in all experiments as indicated in Figures 1 and 2. Steady-state was attained within two hours of operation at the elevated flow conditions. A significant increase in effluent concentration was experienced in response to the variation in flow. Based on an inspection of the data, a first-order process with no time delay was confirmed.

Clarification dynamics were found to be very rapid, with process time constants smaller than 30 minutes. There was no apparent lag in the response. Although a first-order process was demonstrated to be consistent with the experimental results, a steady-state approximation model could be employed with very little sacrifice in accuracy due to the rapid dynamics.

The dynamical changes observed suggest that short-term perturbations in the overflow rate would produce an immediate response. Precautions to minimize variation in flow rate are advised to minimize the adverse effects associated with elevated flow conditions. Specific measures would include:

1. flow equalization, including recycle streams

2. avoidance of flow surges due to cycling of pumps

3. infiltration/inflow correction

4. attention to design of hydraulic devices including splitter boxes and recycle pumping facilities to ensure constant and equal division of flow to and from the individual clarifiers, and

5. dedication of recycle pumps to individual clarifiers to facilitate flow control.

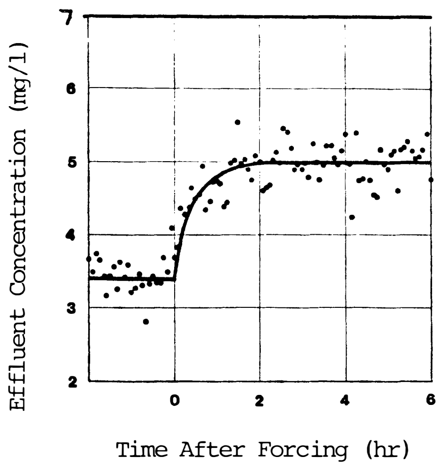

Fig. 1. Clarifier step response for experiment 1. (Feed well submergence = 1.67 m).

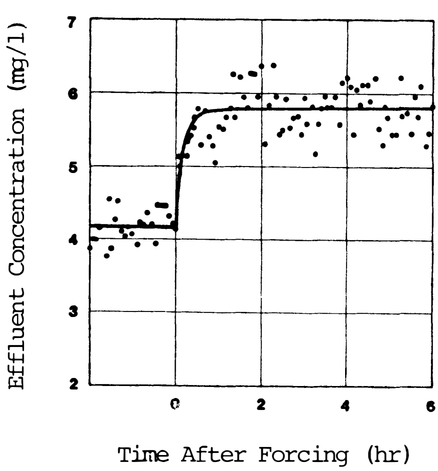

Fig. 2. Clarifier step response for experiment 2. (Feed well submergence = 0.83 m).