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SITE
SUPERFUND INNOVATIVE
TECHNOLOGY EVALUATION

Demonstration Bulletin

Membrane Microfiltration

E. I. DuPont de Nemours and Company, Inc.
Oberlin Filter Company

TECHNOLOGY DESCRIPTION: The DuPont/Oberlin microfiltration technology is a physical separation process that removes solid particles from liquid wastes. The process can filter particles that are submicron or larger in diameter. Pretreatment, such as chemical additions, will be required if dissolved contaminants are present in the liquid waste. The end microfiltration products are filtered solids, called filter cake, and filtered liquids, called filtrate.

The DuPont/Oberlin microfiltration system is transportable and requires little or no attention during operation. The system uses Oberlin's automatic pressure filter and DuPont's special spunbonded olefin style filter material called Tyvek® T-980. The automatic pressure filter has two chambers—an upper chamber that feeds liquid waste under pressure through the Tyvek® and a lower chamber that collects the filtrate (Figure 1).

A typical microfiltration cycle consists of four steps: (1) initial filtration, (2) main filtration and cake forming, (3) cake drying, and (4) cake discharge. The process begins with liquid waste being pumped usually from a waste feed tank into the upper chamber. During the first minute of filtration, or the initial filtration step, the filtrate is usually recycled to the waste feed tank. During the main filtration step, solids accumulate on the Tyvek® and form a filter cake, while filtrate drains from the lower chamber to a filtrate collection tank. When the pressure in the upper chamber reaches a preset value (blowdown pressure), the waste feed valve closes and the cake drying step begins. Pressurized air (typically, 35 psig) is fed into the upper chamber to further dry the cake. After air breaks through the cake, drying continues for a preset time (blowdown time). During this step, any remaining liquids are forced through the Tyvek® and are recycled to the waste feed tank. Immediately following the cake drying step, the upper chamber is lifted, clean Tyvek® is drawn from a roll into the unit for the next cycle, and the filter cake is discharged.

WASTE APPLICABILITY: The combined DuPont/Oberlin microfiltration system has been applied to landfill leachate, groundwater containing cyanide, wastewaters containing uranium, and electroplating wastewaters containing heavy metals. The technology is best suited for treating wastes with solid concentrations less than 5,000 parts per million prior to pretreatment; otherwise, cake capacity and handling become limiting factors.

DEMONSTRATION RESULTS: The DuPont/Oberlin microfiltration system was demonstrated at the Palmerton Zinc Superfund (PZS) site in Palmerton, Pennsylvania, over a 4-week period in April and May of 1990. During the demonstration, about 3,000 gallons of groundwater contaminated primarily with zinc from the PZS site were treated by the microfiltration system. The demonstration was carried out in four phases. Phases 1 and 2 involved nine runs each, and Phases 3 and 4 involved two runs each. Each run consisted of three cycles, as described above.

To evaluate the technology under different operating conditions, chemical operating parameters (precipitation pH and filter aid dose) and filter operating parameters (blowdown pressure and blowdown time) were varied in Phases 1 and 2, respectively. The precipitation pH was controlled by adding lime slurry to the untreated groundwater in the precipitation tank. A filter aid, ProFix, was added in-line prior to the microfiltration unit to improve the filtering characteristics of the precipitated solids. The filter operating parameters were set using the controls on the microfiltration unit. The operating conditions were varied as follows: pH, 8 to 10; ProFix dose, 6 to 14 g/L; blowdown pressure, 30 to 45 psig; and blowdown time, 0.5 to 3 minutes. Phase 3 runs were performed at optimum conditions, based on the results from Phases 1 and 2, to verify the reproducibility of the microfiltration system's performance. Phase 4 runs were performed to evaluate the reusability of the Tyvek® filter media.

Key findings from the technology demonstration are summarized below:

- The DuPont/Oberlin microfiltration system achieved the following: (1) zinc and total suspended solids (TSS) removal efficiencies ranged from 99.75 to 99.99 percent; and (2) the percent solids in the filter cake ranged from 30.5 to 47.1 percent. At the optimum conditions, shown in Table 1, the zinc and TSS removal efficiencies were about 99.95 percent; and the filter cake percent solids were about 41 percent.
- The treated groundwater (filtrate) met the applicable National Pollutant Discharge Elimination System (NPDES) standards, established for disposal into a local waterway, for metals and TSS at the 95 percent confidence level. However, the filtrate did not meet the NPDES standard for pH. The filtrate pH was typically 11.5, whereas the discharge standard is 6 to 9 pH units.
- The filter cake passed the paint filter liquid test (PFLT) in all runs. Also, a composite filter cake sample from the demonstration runs passed the extraction procedure (EP) toxicity and the toxicity characteristic leaching procedure (TCLP) tests.

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