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Demonstration Bulletin

Membrane Filtration

SBP Technologies, Inc.

Technology Description: SBP Technologies Inc. (SBP) has developed a membrane-based separation technology that can reduce the volume of contaminated groundwater requiring treatment. The SBP Filtration Unit consists of porous, sintered, stainless steel tubes arranged in a shell-and-tube module configuration (Figure 1). Multi-layered inorganics and polymeric "formed-in-place" membranes are coated at microscopic thickness on the inside diameter of the porous stainless steel tubing by the recirculation of an aqueous slurry of membrane formation chemicals. This "formed-in-place" membrane functions as a hyperfiltration unit, removing species with molecular weights as low as 200. The formed-in-place membranes can be easily and readily modified to conform to waste characteristics and separation requirements.

The filtration unit is operated in a crossflow mode where the feed stream is directed parallel to the surface of the membrane. The goal of the crossflow filtration is not to trap components within the pore structure of the membrane. In crossflow filtration, particulates and dissolved chemical species larger than the surface porosity are temporarily retarded on the membrane surface, and are then swept clean by the crossflow action. A portion of the fluid stream, along with smaller species, passes through the membrane. This process concentrates large species by reducing the volume of fluid in the crossflow stream. The product crossflow stream containing the excluded species is called the "concentrate." The material passing through the membrane is called the "permeate."

In crossflow mode, the buildup of dissolved and particulate species on the surface of the membrane (fouling) is minimized by the parallel flow direction of the fluid. Periodic cleaning of the membrane is necessary when the buildup of materials becomes excessive.

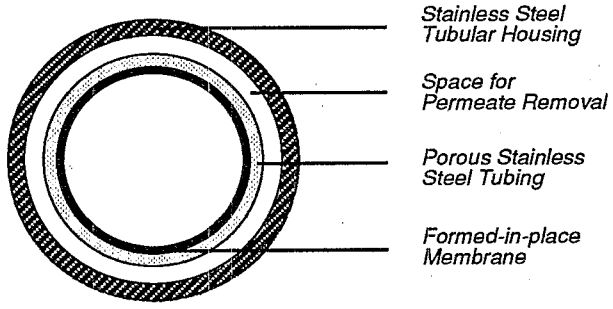

Figure 1. *Cross-section of shell-and-tube module*

The test unit was operated with four modules. The filtration unit used was approximately 13 ft long, 5 ft wide and 7 ft high. The effective membrane area of each module is 72 ft². Automatic level controls provide for unattended operation with continuous feed to a tank. Temperature and concentrate recycle flow are also controlled automatically.

A schematic of the filtration unit is shown in Figure 2. Contaminated water is fed into the filtration unit. The contaminant wastes are contained within the piping system while the permeate is filtered through the tube walls and is captured within the system outside the tubular bundle. Permeate may be disposed of in a manner consistent with local permitting requirements. The concentrated contaminant stream can be repeatedly recycled to achieve a desirable volume reduction level. The final concentrated waste is transferred to a holding tank to await subsequent treatment.

Waste Applicability: SBP states that their membrane filtration technology is applicable to groundwaters and process waters with COD levels between 100 and 500 mg/L where the molecular weight of contaminants being concentrated are over 200. Based on the Site demonstration, waste streams rich in polyaromatic hydrocarbons (PAHs) would probably be suitable while those with a goal of concentrating phenols would probably not be appropriate.

Dilute feedwaters may require more permeate removal to achieve desired concentrations, but the rate of permeate production would likely be higher. Waste streams with contaminant concentrations exceeding the desired range may require less permeate removal to achieve desired concentrations, but the rate of permeate production would likely be less due to accelerated fouling of the membrane. More frequent downtime for washing may be required with elevated levels of contaminants in the feedstream. In either case, operation should not be affected, since adjustments in membrane surface area and cleaning cycles allow for tailored performance.

SBP believes the membrane can be customized to achieve different rejection characteristics that could be applied to a wide range of contaminants. For example, crossflow membrane filtration may be applicable to wastestreams containing high molecular weight or non-polar organic contaminants, such as polychlorinated biphenyls. The process may also be useful for separating other emulsified or dispersed organics which do not lend themselves to simple physical phase separation.

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Demonstration Results: The SBP membrane microfiltration process was demonstrated at the American Creosote Works (ACW) Superfund site near Pensacola, Florida, in October, 1991. Approximately 6,000 gallons of feedwater contaminated with wood preserving wastes was treated over a six day period. The 6-day average total semivolatile feed concentration was 88.5 mg/L, with phenanthrene (17.1 mg/L) and naphthalene (12.9 mg/L) as the major components.

The same test was essentially conducted for each of the six days with small variations in operating conditions to account for membrane fouling. The unit was cleaned every two days to eliminate any contaminant buildup. Feedwater (approx. 1,000 gal) was taken from a tank every day and initially run through the unit for 2 hr. Thereafter, the concentrate was recycled until the desired 80% volume reduction was achieved.

Process operating data were collected, including flow rates, temperatures, pressures and electrical and potable water usage. The feedwater, permeate, concentrate and washwater were all analyzed for volatile organic compounds, total dissolved and suspended solids, oil and grease, total organic carbon and chemical oxygen demand.

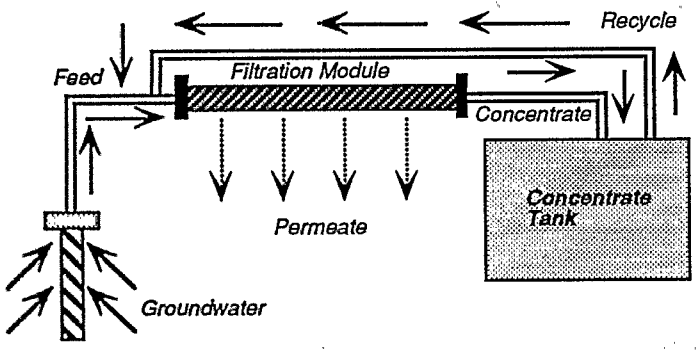

Figure 2. Filtration Unit Schematic

The key conclusions from the SBP SITE demonstration can be summarized as follows:

- The system can effectively concentrate the PAHs into a smaller volume.
- The process is effective (>95%) at removing PAHs found in creosote from the feed and producing a permeate stream with concentrations low enough that it should be acceptable for discharge to POTWs with little or no polishing required.
- The membrane is not very effective (25-35%) at removing one-ringed compounds such as the phenolics.
- Based on comparison of the total concentrations of creosote constituents (phenolics and PAHs) in the feedwater and permeate, the system removed an average of about 80% of these compounds instead of the claimed removal efficiency of 90%. However, the major creosote constituents which contributed to the lower than claimed removal efficiency are less toxic, one-ringed compounds (phenolics) which may be discharged or are easily treated.

An Applications Analysis Report and a Technology Evaluation Report describing the complete SBP SITE demonstration will be available in the Fall of 1992.

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