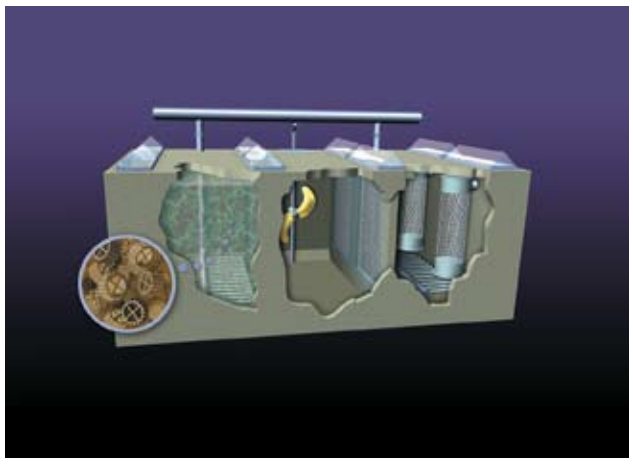
targeted chemical

Groundwater remediation plant adopts biofilm treatment process to eliminate organics

By Michael Johns

International Specialty Products (ISP) is recognized globally for developing, manufacturing and supplying innovative specialty ingredients that enhance product performance in personal care products, pharmaceuticals, beverages, coatings, adhesives and more. When the company needed to replace its aged conventional groundwater remediation plant at its Linden, N.J., facility, it decided to investigate the use of biofilm treatment processing.



This MBBR process is a continuously operating, fully biological effluent treatment procedure that requires no backwashing.

ARTICLE SUMMARY

Challenge: International Specialty Products was faced with having to replace its conventional groundwater remediation plant.

Solution: Biofilm treatment processes are becoming more popular for enhanced organics removal and biological nutrient removal of industrial and municipal wastewater. They are an alternative to conventional biological systems for groundwater remediation.

Conclusion: The new treatment plant with moving-bed biofilm reactor system is meeting performance requirements and achieving more than 95% removal of targeted contaminants.

Biofilm treatment processes are being used increasingly in the U.S. for enhanced organics removal and biological nutrient removal (BNR) of industrial and municipal wastewater and as an alternative to conventional biological systems for groundwater remediation for volatile organic compounds (VOCs). Following its investigation, ISP elected to install AnoxKaldnes moving-bed biofilm reactor (MBBR) technology for biological removal of volatile and semi-volatile organic compounds. The proprietary MBBR system, provided by Veolia Water Solutions & Technologies, is specifically designed as a biological treatment system for removal of volatile and semi-volatile organics.

Biological Removal of VOCs

Of the more than 500 major installations of the AnoxKaldnes MBBR technology worldwide, more than 15% have been installed in industrial and municipal facilities in the U.S. since its introduction here in 1995. The technology is a treatment system in which biofilm grows on unique plastic biofilm carriers in a reactor, while aeration facilitates the aerobic biological processes that degrade the organic contaminants. Effective biomass within the bioreactor is established through growth on the media, and nearly all of the biomass is resident on the media.

The basic concept behind the MBBR process is to have a nonclogging biofilm reactor with low headloss, high surface area and no need for backwashing. Through the use of multiple reactors in series, specialized populations of bacteria can be established in each reactor to provide optimized removals like those required for BNR. The process is designed to handle extremely high loading conditions yet function within a relatively small footprint. The system typically occupies one-fourth of the space required by a conventional plant.

ISP Installation Overview

The process train for the ISP groundwater remediation project includes an equalization basin, in which dosing of nutrients takes place using phosphoric acid and ammonium hydroxide as nutrient sources, followed by settled metals precipitation. Following an incubation period, the treated water flows to the MBBR, which aerates the biomass. The flow scheme consists of a single-train, single-stage MBBR system. The design is based on using biofilm carriers to supply surface area for the bacteria, which will then degrade the soluble organics contained in the groundwater. The system has a reduction target of 82% of soluble BOD5 at an average monthly load. This system was designed for treating an average flow of 0.186 million gal per day.

The MBBR process is a continuously operating, fully biological effluent treatment procedure. The synthetic-based media encourages microorganisms to colonize. The reactor is optimized by properly sizing the amount of carriers required and determining the most effective mixing pattern. This helps maintain proper mass transfer of nutrients, pollutants and oxygen to sustain uniform biofilm thickness. The density of the polyethylene biomedia is about 8.3 lb/gal—equivalent to the density of water. Filling rates within the bioractor may vary between 10% and 67% depending on the application.

The biofilm carrier elements, made from polyethylene, provide a large protected surface area for the biofilm and optimal conditions for the bacteria culture to grow and thrive in the reactor. A stainless steel wedgewire sieve is used to retain the media within the reactor. The vigorous action of the moving bed continually scours the surface of the sieve, eliminating the need for maintenance. A perforated, stainless steel aeration grid mounted at the bottom of the reactor is connected to high-efficiency blowers, producing a steady distribution of medium-sized bubbles across the bottom surface of the tank; the diffused air pattern also provides the necessary mixing. The construction materials and the optimized grid design allow for a maintenance-free MBBR reactor.

The MBBR system serving the ISP groundwater remediation project treats up to 186,000 gal per day and uses a 13-ft-diameter reactor tank with a 21-ft water depth, providing a volume capacity of approximately 21,000 gal.

The MBBR biofilm carriers are suspended and thoroughly mixed throughout the water phase, where they move freely in the tank. Excess biofilm continuously is removed from the media through collisions, erosion and detachment, and is carried out with the effluent.

Following MBBR treatment at the ISP groundwater remediation plant, flows proceed to a sand filter for additional solids polishing and a granular activated carbon adsorption system, followed by a retention zone for pH adjustment and effluent monitoring prior to discharge.

The basis of the MBBR process is the biofilm carrier elements made from polyethylene, which provide a large protected surface area for the biofilm.

Self-Regulating System

The biofilm will automatically adjust itself according to the local conditions in the reactor. During periods of higher loads, for example, the biofilm will thicken, then subsequently thin itself out during periods of lower loads.

Dissolved oxygen (DO) concentration is the critical measurement for process control with this MBBR process. The system self-regulates as long as a positive DO level in the tank is maintained and pretreatment nutrients are provided in sufficient quantities.

Air must be pumped into the system at all times to ensure oxygen for an active biomass. To achieve this at the ISP plant, the MBBR system is equipped with fully automated DO control. The online system automatically controls the blower's variable-speed drives based on current DO levels to maintain optimum DO concentrations in the system at all times. A minimum of 3 mg/L DO in the system is the target. If the DO rises too high, the blowers automatically will turn back to a minimum of 50% speed. If DO falls below 3 mg/L, the blowers return to full speed. The inherent simplicity of the MBBR lends itself well to unmanned operation.

Positive Results

The new treatment plant, with its addition of the MBBR system, is meeting the performance requirements at ISP, thereby enabling the company to comply efficiently and consistently with regulatory requirements. With the MBBR process, ISP is achieving more than 95% removal of the targeted contaminants. WWD

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