24. New Treatment Trends : Membranes and Biotechnology

Presenter

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New Treatment Trends: Membranes and Biotechnology

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New Technology—Drivers

- Space: new technologies can provide more capacity on a smaller footprint
- Regulations: government authorities are becoming increasingly strict about nutrients entering receiving waters
- Reuse: as freshwater becomes more limited, reuse of wastewater will become more common

Membrane Projects

Note: WERF is not working on membrane development, but on application, design and operation, cost, and residuals issues.

Many membrane projects may result in cost savings in terms of system efficiency or increased capacity.

Membrane Projects: Footprint and/or Cost Reduction

- autotrophic denitrification using membranes for hydrogen delivery (00-CTS-14ET);
- membrane-aerated bioreactor system (00-CTS-11);
- membranes for reuse of secondary effluent (01-CTS-6),

Membrane Projects: Footprint and/or Cost Reduction

- membrane pre-filter (01-CTS-31ET);
- membrane tools for applicability and sizing (00-CTS-8);
- anaerobic membrane bioreactors (02-CTS-4);
- membrane fouling and sludge characteristics (01-CTS-19UR).

Membrane Projects

Membranes assist in the production of high-quality effluents by replacing or supplementing traditional effluent polishing.

Membrane Projects: High-quality Effluent and Direct Reuse

- membranes for reuse of secondary effluent (01-CTS-6),
- membrane tools for applicability and sizing (00-CTS-8);
- membrane bioreactors for water reclamation (98-CTS-5)

Membrane Projects—Highlights

00-CTS-8: will produce tools that will assist plant managers in deciding whether membranes for solid-liquid separation are appropriate at their plant and will provide help in initial sizing.

Membrane Projects—Highlights

00-CTS-11: will further research in membrane-aerated bioreactors by characterizing the biofilm, testing whether they support denitrification, and improving start-up. Has been shown to result in lower aeration costs.

Biotechnology Projects

Various biotechnologies are being developed to improve the quality of the final effluent.

Biotechnology Projects: Quality Maintenance/ Prevention of Upset

- source-cause-effect relationship (01-CTS-2);
- upset early warning detection workshop (99-WWF-2);
- toxicity screening using a bioluminescent reporter (98-CTS-6);

Biotechnology Projects: Quality Maintenance/ Prevention of Upset

- water quality monitoring with bioluminescent microorganisms (01-WSM-2a);
- upsets in the petroleum industry (98-CTS-3T)

Biotechnology Projects

Biotechnology is aiding in the rapid identification of organisms in order to protect the public and produce a high-quality effluent

Biotechnology Projects: Organism Identification

- new platform technologies (00-HHE-2A);
- quantitative PCR (00-HHE-2B);
- fiber-optic biosensors (00-HHE-2C);
- DNA microarray technology applications (01-HHE-1);

Biotechnology Projects: Organism Identification

- phenotype quantification in biological treatment processes (98-CTS-2);
- real-time PCR (01-HHE-2A);
- microarray technology (01-HHE-2B);
- molecular methods for detection of infectious viruses (99-HHE-5UR);
- hand-held instrument for the rapid identification of pathogens (99-HHE-4ET)

Biotechnology Projects—Highlights

01-CTS-2: investigating the root causes of upset conditions, and how various toxic compounds affect the activated sludge process.

Biotechnology Projects—Highlights

01-HHE-2B: development of microarray technology for pathogen and indicator monitoring will lead to near real time analysis of human health risk. The methods developed may also provide insight into source reduction and contributions to loadings.

Membranes and Biotechnology—Other Research

- AwwaRF has a number of projects dealing with PCR/ RT-PCR and molecular fingerprinting.
- AwwaRF also has several projects related to source and drinking water treatment using ultrafiltratiion or nanofiltration.
- USBR is sponsoring research in various membrane applications for water reuse and desalination.

Future Directions

- Designation of water as a resource will continue to expand as supplies become more limited, increasing the value of water.
- The use of membranes to generate marketable products from wastewater, such as water for reuse, phosphorus, methane and biosolids, will likely expand.

Future Directions (Continued)

- Efforts need to be made to improve stakeholders' comfort level with the quality of reused water.
- Traditional methods of collection and treatment of wastewater need to be assessed; the expense of repairing and replacing old infrastructure is significant.

Future Directions (Continued)

- The protection of public health by direct measurement of pathogens rather than using indicator organisms deserves further research.
- Treatment for very low levels of nitrogen and phosphorus will become more common.

Future Directions (Continued)

- WERF has funded projects directed toward reducing biomass or selecting for specific treatment capabilities. The issue of biomass characterization will develop more fully as we gain an understanding of biological systems at the molecular level, allowing WERF to support more research in this area if necessary.

Future Directions (Continued)

- A better understanding of the presence and concentration of Hormonally Active Agents and Pharmaceutically Active Compounds in wastewater and effluents needs to be achieved and their fate determined.