

SMALL CHEMICAL MANUFACTURERS POLLUTION PREVENTION INITIATIVE: BEST POLLUTION
PREVENTION PRACTICES DOCUMENTATION PROJECT

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Best P2E2 Practices

Membrane Separations for Concentration or Purification (Recycle)

Membrane separations are used to concentrate wastes, purify effluents for recycle, purify and recover water, remove oils and solids from plating baths, etc. As a result of the high cost of water, disposal, and chemicals, the utilization of membrane technology is often justified. Excellent developments and improvements in the 90s have increased efficiencies, reduced costs, and significantly increased the number of applications of this relatively new technology.

This is a cross flow unit operation that has one influent and two effluents; the effluents are known as the permeate and the concentrate. The permeate passes through the membrane and the membrane rejects the flow of ions (Reverse Osmosis (RO)), or rejects higher molecular weight polymers and solids (Ultrafiltration (UF)), or rejects only insoluble's (microfiltration (MF)). One significant advantage of the cross flow configuration is the continuous self-cleaning of the membrane by the solutes and solids that are swept through to the concentrate. RO rejects chemicals with a molecular weight of 150 and sometimes lower (e.g. producing drinking water from brackish water), and UF rejects chemicals with a molecular weight above 1000 and solids (e.g. concentrate high molecular weight materials for disposal and/or recovering water and chemicals for cleaning baths).

Membrane Separations for Concentration or Purification (Recycle): Detailed Description

Abstract

Membrane separations are used to concentrate wastes, purify effluents for recycle, purify and recover water, remove oils and solids from plating baths, etc. As a result of the high cost of water, disposal, and chemicals, the utilization of membrane technology is often justified. Excellent developments and improvements in the 90s have increased efficiencies, reduced costs, and significantly increased the number of applications of this relatively new technology.

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Technical Details and Examples

The applications for membrane technology include three general categories: process, waste treatment, and water purification. Recovering and reusing valuable chemicals justify process applications. And waste treatment is justified by concentrating wastes for disposal or by removing chemicals from effluents to meet some specific regulation.

Membranes are chosen to optimize the performance for any specific application. RO membranes include cellulose acetate, aromatic polyamides; UF membranes include polysulfide, cellulose acetates, and fluorinated polymers; MF membranes include polypropylene, acrylonitrile, nylon, and PTFE, in addition to ceramics and titanium dioxide. The operating temperatures range between 32 and 185 OF, (200F+ with titanium dioxide/316L SS modules) depending on the membrane material; the pH range varies depending on materials of construction with certain MF modules being capable of operation over 0-14; and the operating pressures are: RO (200 to 1000 psig), UF (15 to 200 psig), and MF (3 to 150 psig). The mechanical designs of membrane systems include tubular, hollow fiber, plate and frame, and spiral-wound.

For every application, the vendors [1-3] design the system for specific objectives, the chemistry, corrosion factors, and requirements for prefiltration, etc. In most cases the justification for a membrane application is the recovery and reuse of valuable materials. For example, many parts cleaning and/or plating plants recover chemicals by recycling lubricant oils, cleaning chemicals and plating formulations. This is possible in small plants (50 gpd) and in large plants (50 to 100 gpm). Specifically, one plant used an RO system on a nickel-plating line. The permeate stream (116 gph) was recycled as rinse water and the concentrate stream (6 gph) containing the nickel salts was returned to the plating bath. Through chemical savings alone, another facility paid for its MF system in less than 12 months by recycling alkaline cleaner instead of continuing its past practice of disposal and recharge.

Membrane and membrane system companies have developed small plug-in systems that are very easy to use and maintain; for example: a) "Competitive Brand" [1], and b) Washer Washers [2]. The "Competitive Brand" (100 to 500 gpd) and the "Mini Competitive Brand" (2 to 50 gpd) were specifically developed to purify and recycle spent industrial fluids, such as aqueous cleaner baths, mass-finishing compounds, and water-based industrial fluids in any metalworking and parts repair operations. "Competitive Brand" units tied to baths have extended bath life by 10 times or more. The Washer Washers (WW) (50 to 150 gpd) and larger versions (up to 6,000 gpd) have been used successfully for a) the reduction of oils and soils that interfere with cleaning effectiveness, therefore parts are always perfect, b) processing rinse waters for recycle, and c) the volumetric reduction of wastes up to 99 percent. Chemical costs have been reduced by 50 to 80 percent. The plug-in Washer Washer systems are relatively inexpensive; i.e. the larger systems cost from <\$15K to <\$40K, and smaller units are less than \$10K. Systems were specifically developed for recycling cleaning solutions used in applications like: wash tanks, electro and soak cleaners, pressure water washer systems, vibratory cleaning solutions, press wash-down water, spray and dip or immersion parts washer water, etc. Customers typically indicate savings in the range of 50 to 80 percent in chemical purchases alone, and bath life has been extended 4 to 10 times. Additionally, this vendor [2] provides its systems with a spare membrane (or

membrane set) and offers a service to clean the membranes and return them to the user within days; at a cost lower than in-house wash processes. The recycling process, therefore, proceeds with only minimal (five minutes or less) interruption, requiring simple exchange of modules and emptying of the concentrate, before return to the recycling process.

In Summary, these results show the benefits of using membrane technology, such as: a) reducing chemical costs by reclaiming plating salts or aqueous cleaners, b) reducing shipping and disposal costs by concentrating (90 to 99 percent) effluents, and c) improving quality via removing solids and oils and recycling water and chemicals.

Companies:

1. Arbortech Corporation, sales@arbortech.com, 1-815-385-0001