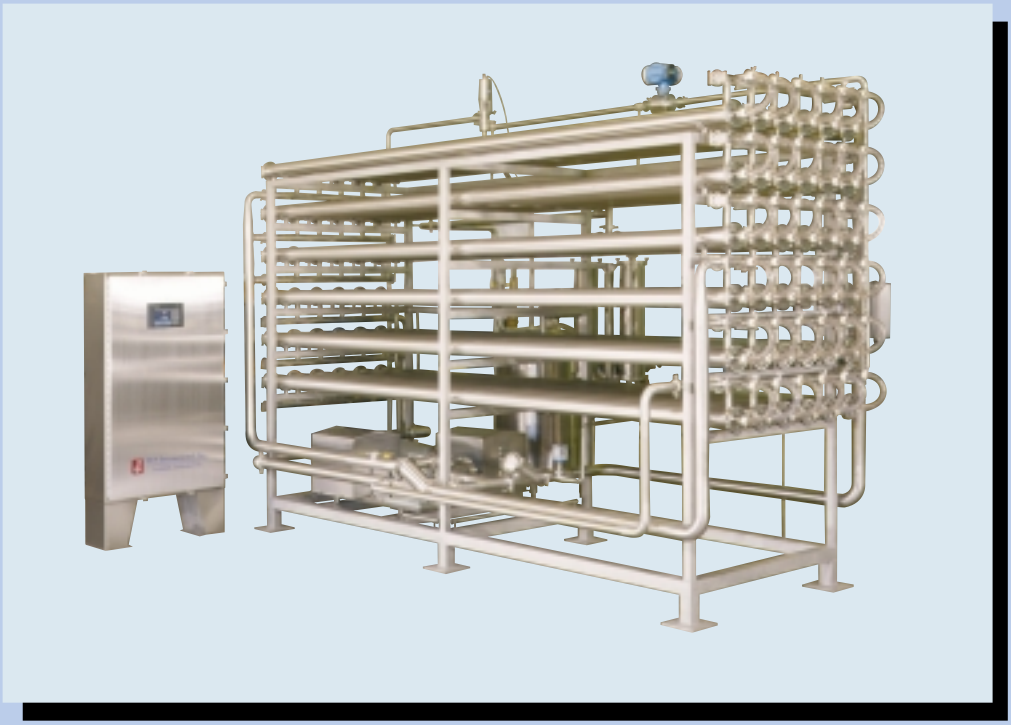
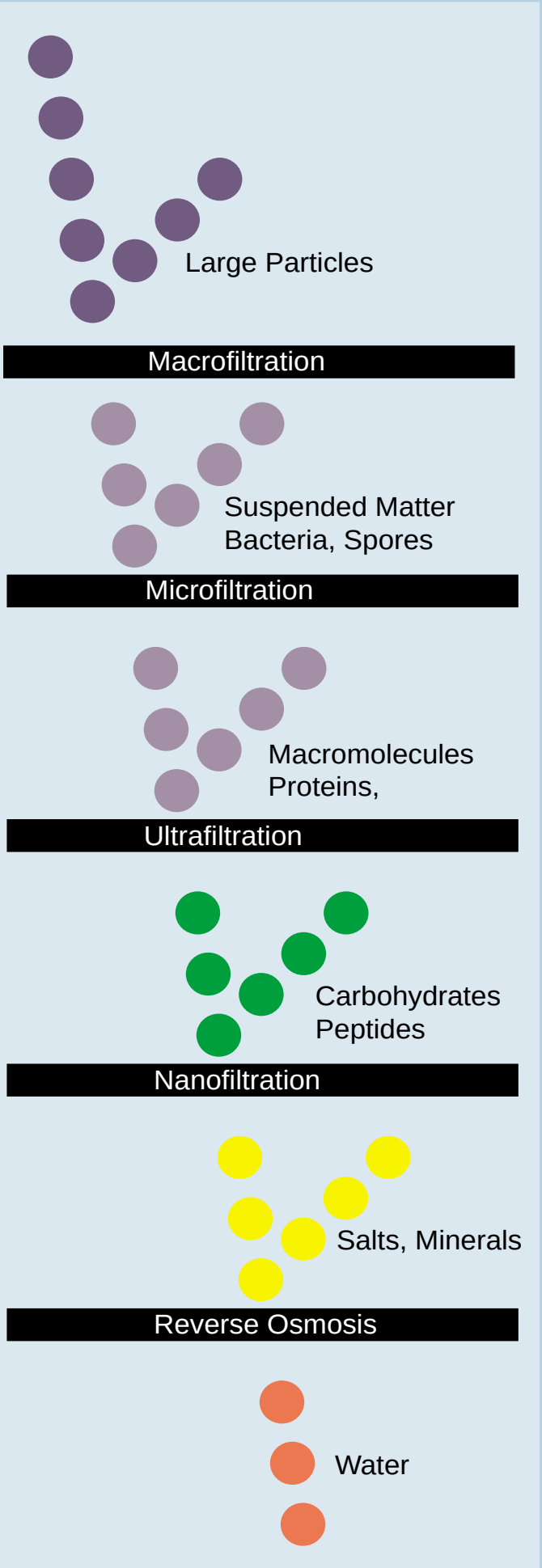
Membrane Separations for Food, Chemical and Pharmaceutical Processing



FES International, Inc.

A WORLD LEADER IN PROCESS TECHNOLOGIES



Macrofiltration (conventional filtration) is primarily used to remove particles from liquids. Particles in the range of 10 - 250 µm are removed using macrofiltration. Unlike membrane processes, macrofiltration does not use crossflow (also referred to as tangential flow or normal flow). Basket centrifuges, strainers, and filters are examples of equipment used for macrofiltration.

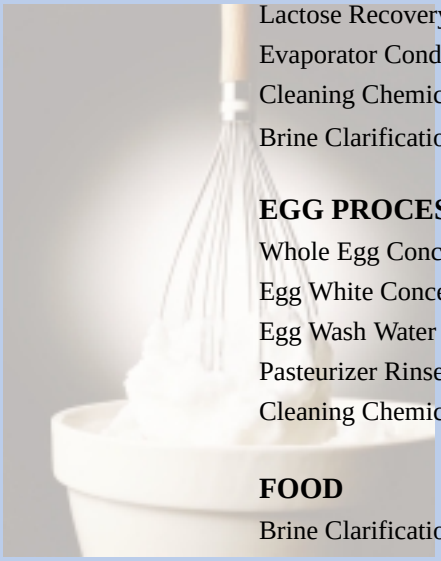
Microfiltration membranes use micron for its rating. For example, 0.2 µm microfiltration membrane means that it is able to retain 99% of the particles with diameter of 0.2 µm. It also means that any particle greater than 0.2 µm is retained to an extent greater than 99.99%. However, since the rating is based on the globular shaped particles, deviation may come from the different shape of the particles. Normally 0.01 to 10 µm is in the microfiltration range.

Ultrafiltration membranes use molecular weight cutoff (MWCO) for the rating. For example 10,000 MWCO membrane will reject 99% of the molecules with a molecular weight of 10,000. Again different conformation of molecules will cause deviation in the separation. The range of ultrafiltration membranes is 1000 - 100,000 MWCO.

Nanofiltration membranes let salts pass through the membrane. Generally these membranes retain molecules greater than 300 to 500 in molecular weight. However, nanofiltration membranes work quite differently with charged ions. Divalent ions such as calcium, magnesium, sulphate and phosphate are rejected, while monovalent ions such as sodium and chloride pass freely through the membrane.

Reverse Osmosis membranes retain nearly all ions and let only water pass through the membrane. These membranes are rated based upon sodium chloride rejection. Most reverse osmosis membranes have a sodium chloride rejection greater than 99%.

INDUSTRIAL APPLICATIONS OF MEMBRANE SEPARATIONS

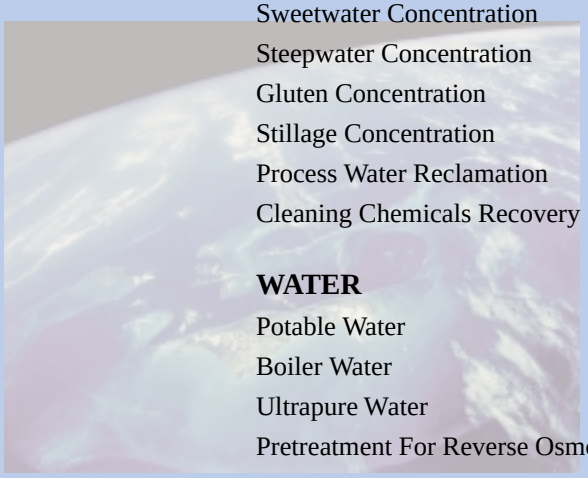


DAIRY
Skim Milk Concentration
Whey Processing
Lactose Recovery
Evaporator Condensate Recovery
Cleaning Chemicals Recovery
Brine Clarification

EGG PROCESSING
Whole Egg Concentration
Egg White Concentration
Egg Wash Water
Pasteurizer Rinse Water
Cleaning Chemicals Recovery

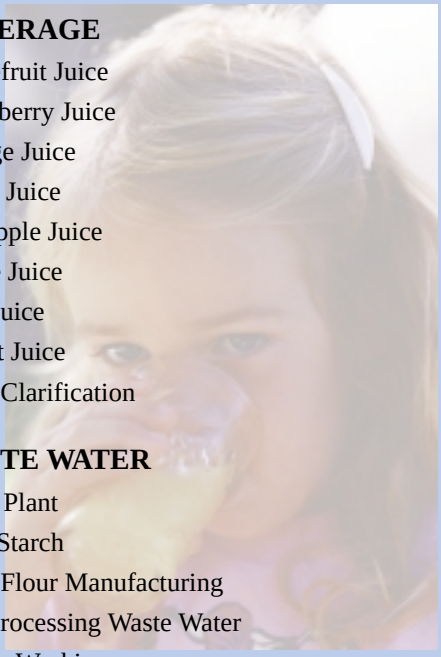
FOOD
Brine Clarification
Process Water Reclamation
Soy Protein Isolate
Shrimp Protein Concentrate
Langostino Protein Concentrate
Pasteurizer Rinse Waters
Maple Syrup
Gelatin Production
Blood Plasma Concentration

GRAIN PROCESSING
Starch Recovery
Gluten Recovery
Dextrose Clarification
Corn Syrup Clarification
Maltodextrin Clarification
Fructose Clarification
Sweetwater Clarification
Continuous Reactor for Dextrose
Continuous Reactor For Ethanol
Sweetwater Concentration
Steepwater Concentration
Gluten Concentration
Stillage Concentration
Process Water Reclamation
Cleaning Chemicals Recovery



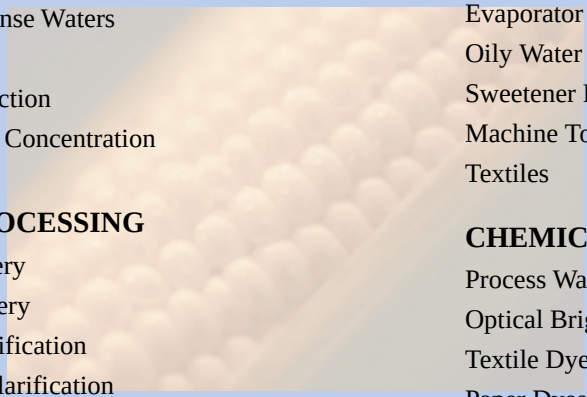
WATER
Potable Water
Boiler Water
Ultrapure Water
Pretreatment For Reverse Osmosis

MICROELECTRONICS
Ultrapure Water

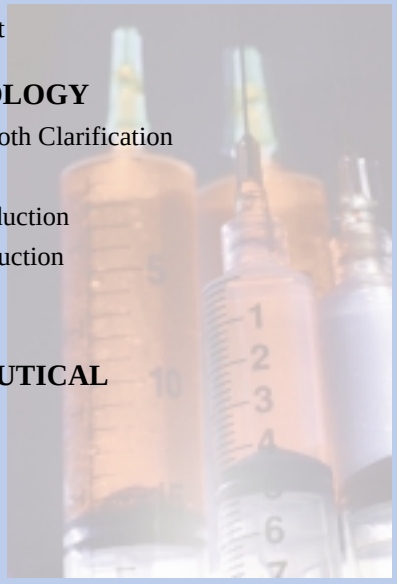


BEVERAGE
Grapefruit Juice
Strawberry Juice
Orange Juice
Peach Juice
Pineapple Juice
Apple Juice
Pear Juice
Carrot Juice
Wine Clarification

WASTE WATER
Dairy Plant
Corn Starch
Masa Flour Manufacturing
Egg Processing Waste Water
Metals Working
CIP Chemicals Recovery
Evaporator Condensate Recovery
Oily Water Recovery
Sweetener Recovery
Machine Tool Lubricants
Textiles



CHEMICAL
Process Water Reclamation
Optical Brighteners
Textile Dyes
Paper Dyes
Nutraceuticals
Printing Inks
Electrocoat Paint



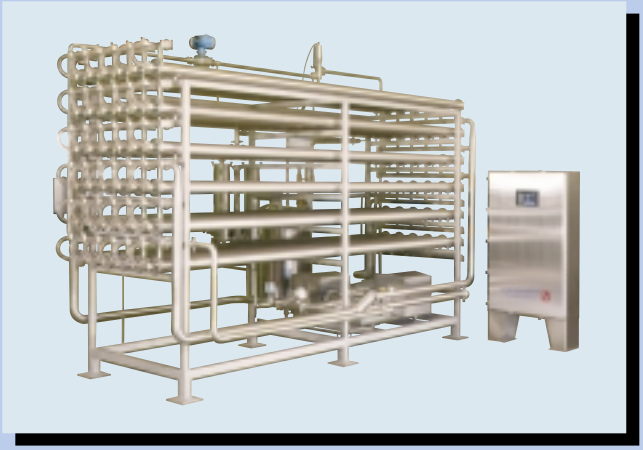
BIOTECHNOLOGY
Fermentation Broth Clarification
Lysozyme
Lactic Acid Production
Citric Acid Production
Enzymes

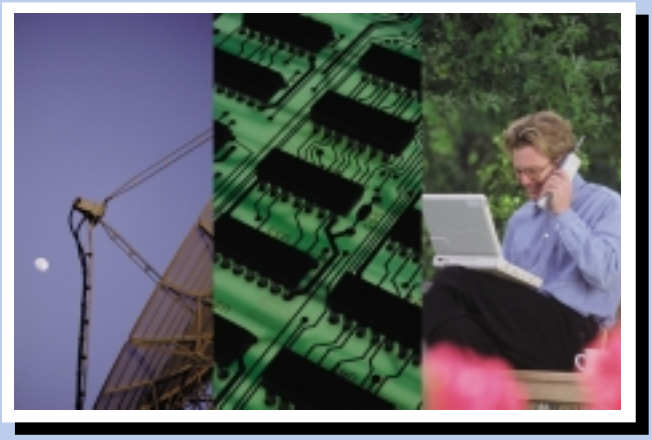
PHARMACEUTICAL
Ultrapure Water
Antibiotics
Proteins
Depyrogenation

Laboratory Testing: FES engineers analyze samples collected from process streams by carrying out experiments on a laboratory scale in order to select the best membrane for your separation requirements.

Pilot Testing: FES engineers perform all necessary tests for determining operating conditions that will provide the most economical membrane solution for a given process. Such tests may be carried out in our pilot test laboratory or in your facility.

System Design: FES engineers use data collected from the laboratory and pilot test work to design state-of-the-art membrane systems. They specify the operating and cleaning parameters required so that production systems will operate at maximum efficiency. FES will supply a complete turnkey system.





After-Sales Support: FES provides both on-site and off-site technical support for the purpose of maintaining the membrane system at maximum operating efficiency. Computers in FES offices may be connected to systems in any country of the world. This advanced technology provides a link for FES engineers and plant supervisors to monitor a process in real time.

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