Waste Water – Available Reuse and Recycle Technologies

Conventional wastewater treatment technologies improve the quality of wastewater discharged into the environment and restrain polluted waters from contaminating other available clean water resources. However, these treatment technologies do not make wastewater fit for further beneficial uses in communities closer to the points of generation. Innovative and advanced technologies that can further improve the quality of wastewater are needed to overcome this limitation of conventional technologies, and to promote widespread adoption of recycle and reuse practices.

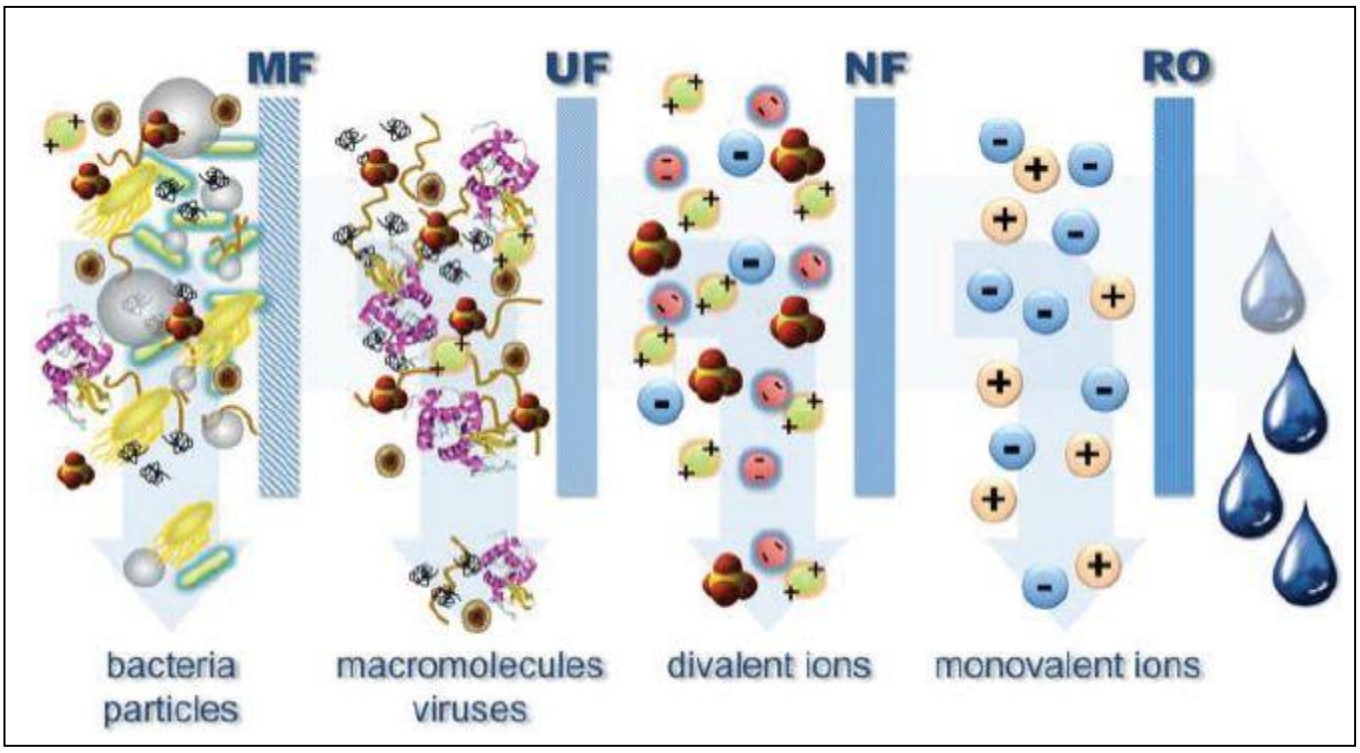
Advanced treatment processes can be biological processes, physicochemical processes, or a combination of both (hybrid processes). Biological processes to remove nutrient pollutants such as nitrogen and phosphorus provide the platform for further wastewater treatment to reusable quality.

Filtration Techniques:

Physicochemical processes such as deep-bed filtration, floating media filtration, and membrane filtration, play a major role among treatment technologies for water reuse. Membrane filtration has significant advantages over other processes since they produce high quality effluent that requires little or no disinfection with minimum sludge generation. The hybrid processes attempt to obtain the benefits of both biological and Physicochemical processes in one step.

Micro and Ultra Filtration:

Microfiltration and Ultra filtration MF and UF membrane processes can be configured using pressurized or submerged membrane modules. In the pressurized configuration, a pump is used to pressurize the feed water and circulate it through the membrane. Pressurized MF and UF units can be operated in two hydraulic flow regimes, either in cross-flow or dead-in filtration mode. In a submerged system, membrane elements are immersed in the feed water tank and permeate is withdrawn through the membrane by applying a vacuum. The key operational parameter that determines the efficiency of MF and UF membranes and operating costs is flux, which is the rate of water flow volume per membrane area. Factors affecting the flux rate include the applied pressure, fouling potential and reclaimed water characteristics. Flux can be maintained by appropriate cross-flow velocities, back flushing, air scouring, and chemical cleaning of membranes. Typically, MF and UF processes operate at flux rates ranging from 28 to 110 gal/ft2 per day (48 to 190 L/m2 per hour). MF and UF membranes are effective in removing microorganisms. It is generally believed that MF can remove 90 to 99.999 percent (1 to 5 logs) of bacteria and protozoa, and 0 to 99 percent (0 to 2 logs) of viruses. However, filtration efficiencies vary with the type of membrane and the physical and chemical characteristics of the wastewater, resulting in a wide range of removal efficiencies for pathogens.



Nano filtration or Reverse Osmosis

For reuse projects that require removal of dissolved solids and trace organic chemicals and where a consistent water quality is desired, the use of integrated membrane systems incorporating MF or UF followed by NF or RO may be required. RO and NF are pressure-driven membrane processes that separate dissolved constituents from a feed stream into a concentrate and permeate stream. Treating reclaimed water with RO and NF membranes usually results in product water recoveries of 70 to 85 percent. Thus, the use of NF or RO results in a net loss of water resources through disposal of the brine concentrate. RO applications in water reuse have been favoured in coastal settings where the RO concentrate can be conveniently discharged to the ocean.

Further Disinfection methods are used like chlorination, UV and Ozone to improve the quality of water for reuse.

Sources:

https://www.eolss.net/sample-chapters/C07/E2-14-01-01.pdf

https://www.nap.edu/read/13303/chapter/6#73

https://www.nap.edu/read/13303/chapter/6#75