CHEMISTRY ASSIGNMENT

NANOFILTRATION

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Nanofiltration:

Nanofiltration is a layer fluid division innovation imparting numerous qualities to switch assimilation. Not at all like RO which has high dismissal of for all intents and purposes generally broke down solutes gives high dismissal of multivalent particles, for example, calcium and low dismissal of monovalent particles like chlorides.

Nanofiltration is a layer filtration - based strategy that utilizes nanometer measured pores through which particles less than 10 nanometers go through the film. Nanofiltration layers have pore sizes from 1-10 nanometers, less than that utilized in microfiltration and ultrafiltration, however somewhat greater than that in switch assimilation. Layers utilized are overwhelmingly made from polymer slight films. Materials that are usually utilized incorporate polyethylene terephthalate or metals, for example, aluminum Pore aspects are constrained by their PH, temperature and time during advancement with pore densities going from 1 to 106 pores for every cm2. Layers produced using polyethylene terephthalate and other comparative materials, are alluded to as "track-draw" films, named after how the pores on the layers are made. "Following" includes barraging the polymer dainty film with high energy particles. This outcomes in making tracks that are artificially formed into the film, or "carved" into the layer, which are the pores. Films made from metal like alumina films, are made by electrochemically growing a slight layer of aluminum oxide from aluminum metal in an acidic medium.

Application of Nanofiltration in daily life:

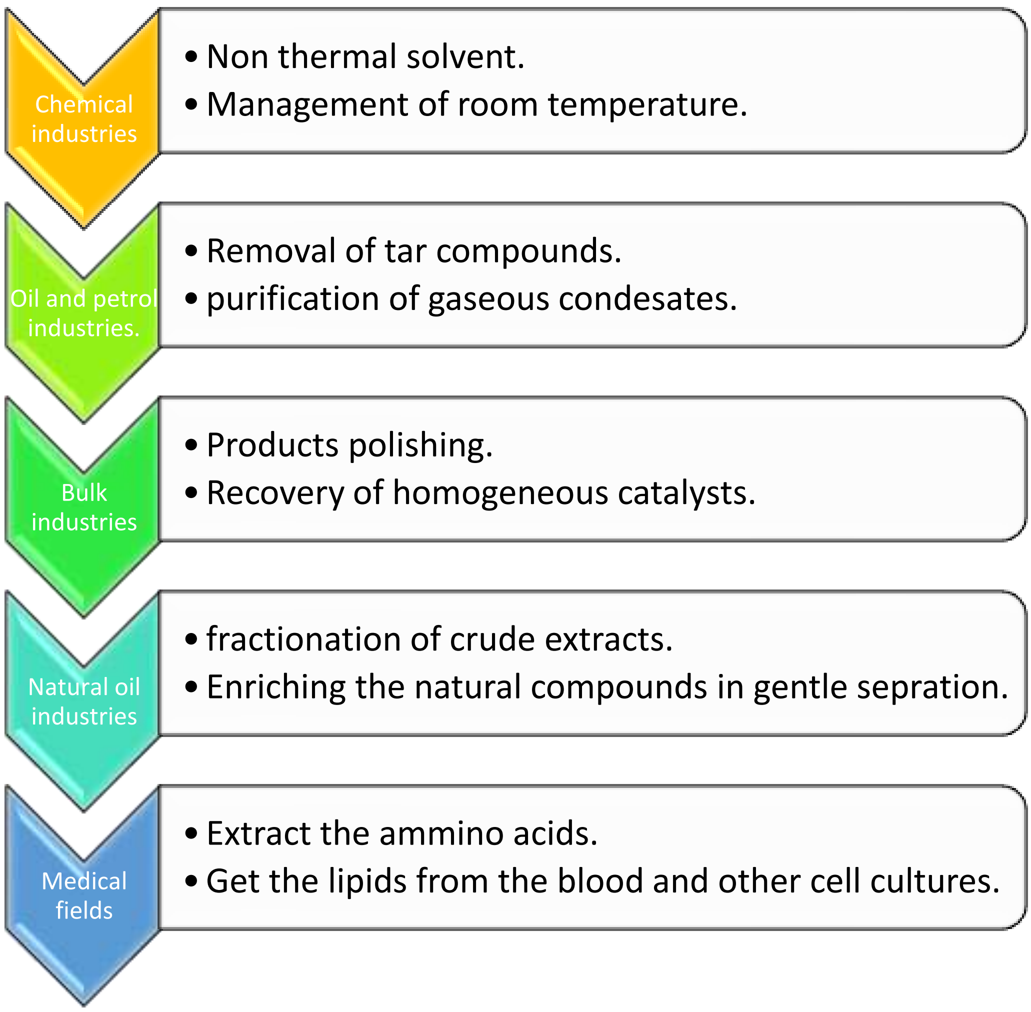
I. They are used in Fine chemical and Pharmaceuticals as non-thermal solvent recovery and management; it is also used in the management of exchanges in Room temperatures.

II. It is also used in Oli and Petroleum chemical industries for the removal of tar components in the feed and also applied in the purification of gas condensates.

III. In the bulk industries they are used in polishing the products and empowered in the continuous recovery of homogeneous catalysts.

IV. It is also used in the fractionation of crude extracts and in enriching the natural compounds gentle separation in the Natural essentials Oil and similar Products.

V. In Medical fields, we are able to extract amino acids and lipids from blood and other cell cultures.



Advantages and Disadvantages of Nanofiltration:

Advantages:

I. One of main advantage of nanofiltration is as a method of softening the hard water during the process of retaining calcium and magnesium ions while passing smaller hydrated monovalent ions

II. Many separations process does not operate at room temperature like the distillation process in which we greatly increase the cost of the process when continuous heating or the cooling is applied

III. Performing gentle molecular separation is linked with nanofiltration that is often not include with other forms of separation process.

Disadvantages:

I. A main disadvantage associated with nano filtration as with all membrane filter technology is the cost and maintenance of the membrane used. Nanofiltration membranes are an expensive part of the process.

II. Repairs and replacements of membranes is totally depended on the total dissolved solids or we can also term them as salts, Flowrates, only an estimations of replacement frequency can be used.

III. With nanofiltration being used across various industries, only an estimation of replacement frequency can be used. This causes Nano filters to be replaced a short time before or after their prime usage is complete.

Process of Nanofiltration in Real life:

Design and operation

Industrial applications of membranes require hundreds to thousands of square meters of membranes and therefore an efficient way to reduce the footprint by packing them is required. Membranes first became commercially viable when low-cost methods of housing in 'modules' were achieved. Membranes are not self-supporting. They need to be stayed by a porous support that can withstand the pressures required to operate the NF membrane without hindering the performance of the membrane. To do this effectively, the module needs to provide a channel to remove the membrane permeation and provide appropriate flow condition that reduces the phenomena of concentration polarisation. A good design minimises pressure losses on both the feed side and permeate side and thus energy requirements.

Concentration polarisation

Concentration polarization describes the accumulation of the species being retained close to the surface of the membrane which reduces separation capabilities. It occurs because the particles are convicted towards the membrane with the solvent and its magnitude is the balance between this convection caused by solvent flux and the particle transport away from the membrane due to the concentration gradient (predominantly caused by diffusion) Although concentration polarization is easily reversible, it can lead to fouling of the membrane.

Spiral wound module

Spiral wound modules are the most commonly used style of module and are 'standardized' design, available in a range of standard diameters (2.5", 4" and 8") to fit standard pressure vessel that can hold several modules in series connected by O-rings. The module uses flat sheets wrapped around a central tube. The membranes are glued along three edges over a permeate spacer to form 'leaves'. The permeate spacer supports the membrane and conducts the permeate to the central permeate tube. Between each leaf, a mesh like feed spacer is inserted. The reason for the mesh like dimension of the spacer is to provide a hydrodynamics environment near the surface of the membrane that discourages concentration polarisation. Once the leaves have been wound around the central tube, the module is wrapped in a casing layer and caps placed on the end of the cylinder to prevent 'telescoping' that can occur in high flow rate and pressure conditions.

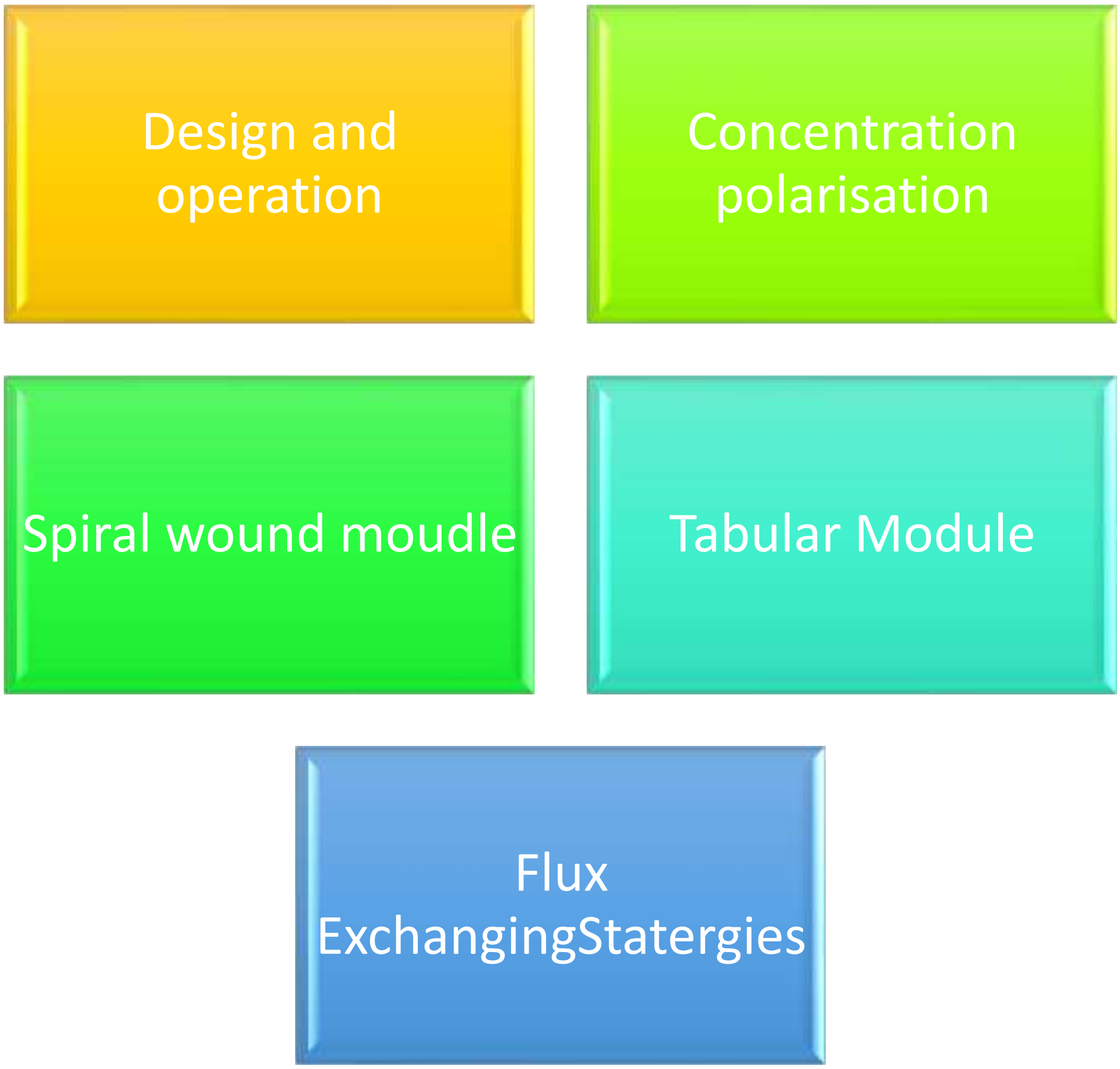
Tubular module

Tubular modules look similar to shell and tube heat exchangers with bundles of tubes with the active surface of the membrane on the inside. Flow through the tubes is normally turbulent ensuring low concentration polarisation but also increasing energy costs. The tubes can either be self-supporting or supported by insertion into perforated metal tubes. This module design is limited for nanofiltration by the pressure they can withstand before bursting, limiting the maximum flux possible. Due to both the high energy operating costs of turbulent flow and the limiting burst pressure, tubular modules are more suited to 'dirty' applications where feeds have particulates such as filtering raw water to gain potable water in the Fyne process. The membranes can be easily cleaned through a pigging technique with foam balls are squeezed through the tubes, scouring the caked deposits.

Flux enhancing strategies

These strategies work to reduce the magnitude of concentration polarisation and fouling. There is a range of techniques available however the most common is feed channel spacers as described in spiral wound modules. All of the strategies work by increasing eddies and generating a high shear in the flow near the membrane surface. Some of these strategies include vibrating the membrane, rotating the membrane, having a rotor disk above the membrane, pulsing the feed flow rate and introducing gas bubbling close to the surface of the membrane.

PROCESS CYCLE INVOLVED IN THE STEPS OF NANOFILTRATION:



(Source: Wikipedia)

Alternative methods to produce the nanoparticle:

We can use the plant to produce the nanoparticles because foe us it is very difficult to produce the nano sized pores in the blades which cuts the metal in nano size but plants naturally have the stomata for the release of oxygen and excess water in the process of photosynthesis we can use these pores as they are similar to the nano size and while we pass the metals inside the plants body we get them in nano form in the stomata part of the plants which are usually situated in the bottom part of the leaves.

Usage of nanoparticles in real life:

(Source: Nanofiltration membranes -By Lau Woei Jye and Ahmad Fauzi Ismail)

Hazards due to the usage of Nanoparticles:

- The workers or mechanics who works in the nanoparticles manufacturing units especially who deals with nano particles in liquid media without adequate protection like gloves and face masks will get their skin exposed to it.

- Since the Nano particles are very small, they are usually in the powdered form only so the person starts to run the risk of Aerosolizatron.

- Not only the mechanics but also the cleaning authorities Will also gets affected. Those who clean dust collection system used to capture nano particles are at the risk of both skin and inhalation exposure.

- Nanoparticles used in cosmetics and sunscreens cause the health risks that are largely unknown and need further studies to explore their harmful effects over long term.

- Human and animal studies show that inhaled nanoparticle can deposit in the respiratory tract. Animal studies also show nanoparticles can enter the bloodstream and translocating other organs.

- Some studies have showed that some nanoparticles can penetrate through cells and tissues. These may tend to move throughout the body, reach vital organs like brain and cause biochemical damage and even cancer.

Ways to reduce the exposure towards Nanoparticles:

- ✓ Lab Protection and hygiene – Regularly laundered lab coats must be worn. Lab coats may not be taken to private homes and laundry. Arm sleeves are required very high levels of exposure or splashes of solutions containing nanoparticles are anticipated.

- ✓ In all labs, there must be facilities to wash their hands. Each time after the handling the nanoparticles.

- ✓ Standard and safety glasses are required when working in any lab where the peopling is handling with nanoparticles.

- ✓ Gloves must be worn when handling the nanoparticles.

- ✓ Always include the long pants and full sleeves shirt so your skin won't get exposed soon.

- ✓ Respirators and ventilators are needed to prevent inhalation problems.

- ✓ Aerosol producing activities such as sonication, vertexing, and centrifuging may not be conducted in open bench. It is preferred to perform them in fume hood, biological safety cabinet glove box or a vented filtered enclosure.

✓ Spills of dry nano particles must be cleaned with a HEPA vacuum. Dry sweeping must not be used. Large spills must be cleaned by EHRS.

✓ Lab pressurization must be negative to the hallway. Ventilation should be adequately managed.

✓ All solutions and solid materials must be disposed of as hazardous waste following established University guidelines.

Lab protection	•Hands must be washed •Safety glssses are mandatory
Cleaning	•Mask must be made mandatory. •Use long pants and full sleeved shirts
Aerosol producing activities	•Sonication, Vertexing must not be conducted in open space. •It is preferred to perform them in biological safety cabinetglove box.
Spills of Nanoparticles	•It must be cleaned with a HEPA Vaccum •Dry sweeping must not be used.
Lab Safety Protocols	•Pressurization must be negative to hallway. •VentilationShould be adequately managed

(Source: Nanofiltration membranes -By Lau Woei Jye and Ahmad Fauzi Ismail)