**Membrane Processes**

In the living world, membranes keep things separated. They pass materials selectively. Discrimination is often very acute, permitting substances having very similar composition and structure to be either passed or excluded. They facilitate active separations with exquisite precision.

 Downstream separations needs may exceed the capabilities of conventional membrane processing. Membrane separation processes use perm selective membranes, which are man-made structures fabricated to be selective in the passage of components. Membrane effective pore size covers a huge range.

In a downstream processing of microbial products membrane processes can be performed by using various techniques :

1. **Ultrafiltration and Reverse osmosis**
2. **Liquid membrane**
3. **Ultrafiltration and Reverse osmosis**

Both processes utilize semi-permeable membranes to separate molecules of different sizes and therefore act in a similar manner to conventional filters.

1. **Ultrafiltration**

Ultrafiltration can be described as a process in which solutes of high molecular weight are retained when the solvent and low molecular weight solutes are forced under hydraulic pressure (around 7 atmospheres) through a membrane of a very fine pore size. It is therefore used for product concentration and purification.

A range of membranes made from a variety of polymeric materials, with different molecular weight cut-offs (500 to 500,000), are available which makes possible the separation of macro-molecules such as tlr()tellns, enzymes, hormones and viruses

When considering the feasibility of ultrafiltration it is important to remember that factors other than the molecular weight of the solute affect the passage of molecules through the membranes. There may be concentration polarization caused by accumulation of solute at the membrane surface which can be reduced by increasing the shear forces at the membrane surface either by conventional agitation or by the use of a cross-flow system.

Secondly a slurry of protein may accumulate on the membrane surface forming a gel layer which is not easily removed by agitation. Formation of the gel layer may be partially controlled by careful choice of conditions such as pH.

Finally, equipment and energy costs may be considerable because of the high pressures necessary; this also limits the life of ultrafiltration membranes.

**B. Reverse osmosis**

Reverse osmosis is a separation process where the solvent molecules are forced by an applied pressure to flow through a semi-permeable membrane in the opposite direction to that dictated by osmotic forces, and hence is termed reverse osmosis.

It is used for the concentration of smaller molecules than is possible by ultrafiltration. Concentration polarization is again a problem and must be controlled by increased turbulence at the membrane surface.

1. **Liquid Membrane**

Liquid membranes are insoluble liquids (e.g. an organic solvent) which are selective for a given solute and separate two other liquid phases. Extraction takes place by the transport of solute from one liquid to the other. They are of great interest in the extraction and purification of biologicals for the following reasons:

(a) Large area for extraction.

(b) Separation and concentration are achieved in one step.

(c) Scale-up is relatively easy.

Their use has been reported in the extraction of lactic acid. Liquid membranes may also be used in cell and enzyme immobilization, and thus provide the opportunity for combined production and isolation/extraction in a single unit. The potential use of liquid membranes has also been described for the production of alcohol reduced beer as having little effect on flavour or the physico-chemical properties of the product.

Reference

1. Stanbury, The recovery and purification of fermentation product. Principle of fermentation technology. Second edition. Butterworth-Heinemann