APPLICATION OF MEMBRANE PROCESSES IN WHEY TREATMENT

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Because of its intrinsic properties that well fit the requirements of process intensification strategy, membrane technology has well established applications in most of the industrial processes ranging from water desalination, wastewater treatments, agro-food, chemical and petrol chemical industry, etc. In particular, integrated membrane systems are today recognized as an interesting tool for a better rationalization of numerous industrial cycles.

Membrane processes are widely used in different fields of food industry. It is connected with a possibility to separate liquid substances at the molecular level using less energy. Therefore, these processes are increasingly becoming a preferable alternative to the more expensive traditional processes of fractionation. Moreover, membrane processes can also be used to treat a variety of aqueous wastes.

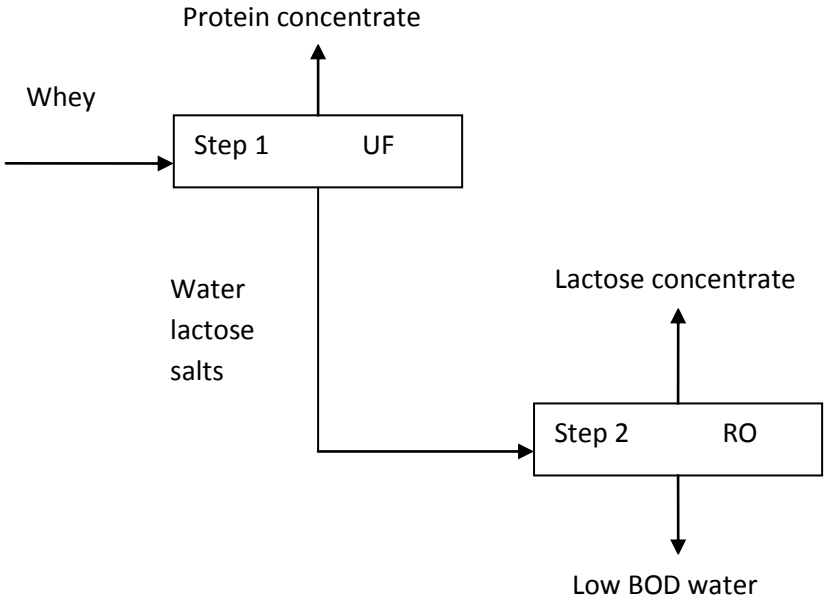
With the development of improved membranes, membrane processes have become major separation processes in the dairy industry. The largest areas of application are the pre-concentration of milk for cheese manufacture, the production of protein concentrates from whey, demineralization and concentration of whey. The last two refer to the methods of whey treatment.

The whey is essentially a dilute aqueous solution of lactose, mineral salts, a small amount of fat, vitamins and non-casein milk proteins (e.g. lactalbumins and lactoglobulins). Up to 1960's it was considered to be a problematic waste of cheese manufacture due to its high volume (often 90% of the mass of milk used) and its extremely high biological oxygen demand (BOD). The advance of whey treatment is caused by three main factors: an increase in costs of its release, the emergence of new technologies in extraction of whey protein and scientific researches, due to which valuable nutritional and biological properties of this product were found.

Well-known fractionation processes of whey are based on membrane separation, which include microfiltration (MF), ultrafiltration (UF), nanofiltration (NF) and reverse osmosis (RO). Separation takes place through semipermeable membranes, using a hydrostatic pressure gradient as the driving force. The separation mechanism is generally based on a sieving effect through thin filters of controlled pore size.

MF is used for the removal of bacteria and fat globules from whey and UF for the separation of whey proteins. NF is used to fractionate mixtures of smaller molecules, e.g. partial demineralization of whey products. NF can be applied as an alternative desalting process for electrodialysis. RO is applied to remove water against an osmotic pressure, and requires much higher pressures than the other membrane techniques.

In whey treatment simple removal is not much used. There usually used a combination of two or more membrane processes. Here is suggested the dual process of whey separation depicted in Figure 1. It includes UF, resulting in receiving whey protein concentrate as the retentate and a protein-free permeate containing mainly lactose and minerals, and RO, which enables to obtain lactose concentrate and water of low enough BOD for disposal without further treatment. The purified water produced by membrane treatment could be reused in the dairy factory as heating or cooling water, as boiler make-up water or for cleaning purposes.



Fiqure 1. Dual process for treating whey

In this way, it is possible to recover useful valuable nutritional products and produce water suitable for reuse and, of course, to alleviate the pollution problem due to application of membrane processes. There is no doubt that it contributes to create high technology and use completely raw material resources.

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