CHEMICAL CLEANING OF MEMBRANES

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The chemical cleaning of the ceramic and/or hollow fiber membranes after a filtration stage must receive the attention it deserves.

> Having defined an effective cleaning protocol is just as important as having optimized filtration conditions when dealing with a tangential flow filtration process in your downstream. Moreover, I would dare to say, the latter is even more important.

If after filtering we do not clean properly, the permeability of the membranes will go down batch after batch, resulting in changes to the membranes prematurely and thereby increasing the cost. The "permeability" is the reference parameter to assess the effectiveness of a chemical cleaning, and this is defined by the following equation:

$$Permeability\left(\frac{L}{h \cdot m^2 \cdot bar}\right) = \frac{Permeate\ flow\left(\frac{L}{h}\right) \cdot K_t}{TMP\ (bar) \cdot Filter\ area\ (m^2)}$$

The term "Kt" is a normalization parameter dependent on temperature. If the permeability is measured at 25ºC, this term acquires value equal to 1, whereas if the temperature is above or below this temperature it will take values lower or higher than 1, respectively. All new membranes have a reference permeability indicated by the manufacturer. When the end user receives the membrane, permeability must be validated prior to the first use. It is very frequent that the measured value differs from that indicated by the manufacturer, which is mainly due to the quality of the water used during the validation process. Each time we clean the membrane we should try to approach the value of our reference target in a range of ± 20%. If the permeability is not within this margin it is advisable to repeat the cleaning again. There are some basic recommendations regarding chemical products, conditions (concentration and temperature) and contact times. These recommendations must be adapted to each type of process. Depending on the type of fouling (organic or inorganic), some products will be more advisable than others. In addition to the basic products such as NaOH, HNO_3 or H_3PO_4, there are other commercial product alternatives that include a mixture of chemicals that can attack different types of fouling at the same time. After all the key is to find the process and the product that best eliminates fouling. When I talk about membrane cleaning, I'd like to emphasize the term "efficiency". This is because the time it takes to perform this type of cleaning as well as the associated water consumption can have a significant an impact on a production cycle. So it's not just about leaving the membranes clean, but trying to do it at the optimum time with the most optimal water management. We therefore have a double task when developing and performing tangential flow filtration processes: to optimize our filtration process without leaving behind the optimization of subsequent cleaning.

Our M_1 (show in the below picture) and M_2 filtration equipment can integrate both ceramic and hollow fiber membranes. The conditions to clean each of them are different, but both have a common strategy:

1) Rinsing with water with closed permeate.

2) Recirculation of a basic solution via the circuit and through the membrane (with permeate outlets closed).

3) Rinsing with water (with closed permeate outlets).

4) Recirculation of a basic solution with open permeate outlet. This step can also be combined with the addition of NaOCl.

5) Rinsing with water with open permeate outlet, until achieving neutrality.

6) Recirculation with an acid solution with open permeate outlet.

7) Rinsing with water with open permeate outlet, until achieving neutrality.

The stage with acid is not always necessary. In order to assess this necessity, we recommend that at the end of the basic cleaning a measurement of permeability is performed. If permeability has been recovered, it will not be necessary to proceed with the acid stage. Oppositely, in the case that the membranes have not been recovered it will be the final user who decides whether to proceed with the acid phase or, on the contrary, repeats the basic one again.

When we develop tangential flow filtration processes at BIONET, we seek to select both the most appropriate filtration technology (type of membrane and conditions) and an adequate cleaning protocol adapted to each type of filtered product.