What is Ceramic Tangential Flow Filtration and how it works

Tangential Flow Filtration

Tangential Flow Filtration (TFF), also known as Crossflow Filtration, is a physical separation technology based on the difference of size between the particles contained in a liquid and the pores of the membrane. In TFF, the feed solution moves parallel to the surface of the membrane. The particles contained in the feed solution that are larger than the pores of the membrane are concentrated as the filtration continues.

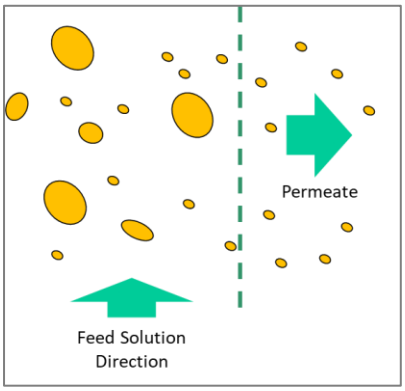

Figure 1: Tangential Flow Filtration.

The concentrated feed solution is referred to as the retentate. The portion of the feed solution that passes through the membrane is referred to as the permeate.

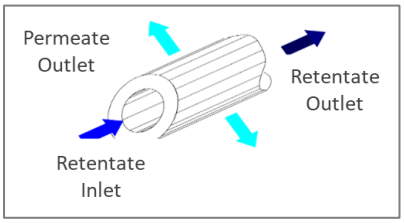

Figure 2: TFF in a single-channel tubular membrane

The constant movement of the feed solution parallel to the surface of the membrane limits the build-up of solids, allowing it to remain in operation for longer than in Frontal Flow Filtration (FFF), also known as Dead-end Filtration.

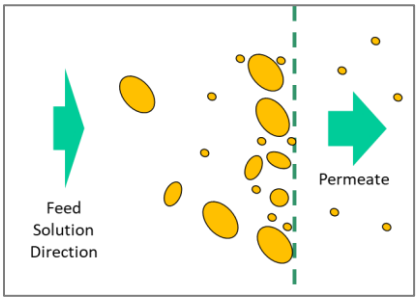

Figure 3: Frontal Flow Filtration.

In FFF, the feed solution is pushed frontally onto the surface of the membrane and solids bigger than the pores accumulate on the membrane. This layer of solids, known as filter cake, becomes thicker as the filtration continues and artificially reduces the size of the pores and the filtration flow. For this reason, FFF cannot handle high solid concentrations and presents limitations in continuous operation.

Ceramic vs. Polymeric

Among the different materials used in the manufacturing of membranes for TFF, a major division is made between ceramic (inorganic) and polymeric (organic) materials.

Polymeric membranes are made with materials such as polysulfone (PS), polyether sulfone (PES) and polyacrylonitrile (PAN). Each of these materials present different physicochemical properties, however, they also share similar limitations such as low resistance to abrasion, low operating temperatures and pH restrictions.

Ceramic membranes were developed in the '80s to overcome the limitations of polymeric membranes, making the use of TFF possible in more applications. This gave birth to Ceramic Tangential Flow Filtration (CTFF), a separation technology that takes full advantage of the physicochemical properties of ceramic material.

TAMI Industries, a global reference in R&D and innovation in ceramic membranes, uses two different materials in the manufacturing of its ceramic membranes: titanium dioxide (TiO_2) and zirconium dioxide (ZrO_2). The combination of these two materials, the know-how and the ownership of multiple patents allows TAMI Industries to offer the widest range of membrane lengths, external diameters, hydraulic diameters and pore sizes in the market. Some of the advantages of TAMI Industries' ceramic membranes are:

- **Temperature**: up to 300°C;
- **pH**: there is no pH limitation, from 0 to 14;
- **Solvents**: TiO_2 and ZrO_2 are among the most inert and unreactive materials in industry, allowing the operation with numerous non-aqueous solutions;
- **Abrasion**: average lifetime of 5 years, can achieve the double or more.

Do you have a question? Want to learn more about Ceramic Tangential Flow Filtration? Contact us!!

www.tami-industries.com / tami-info@tami-industries.com

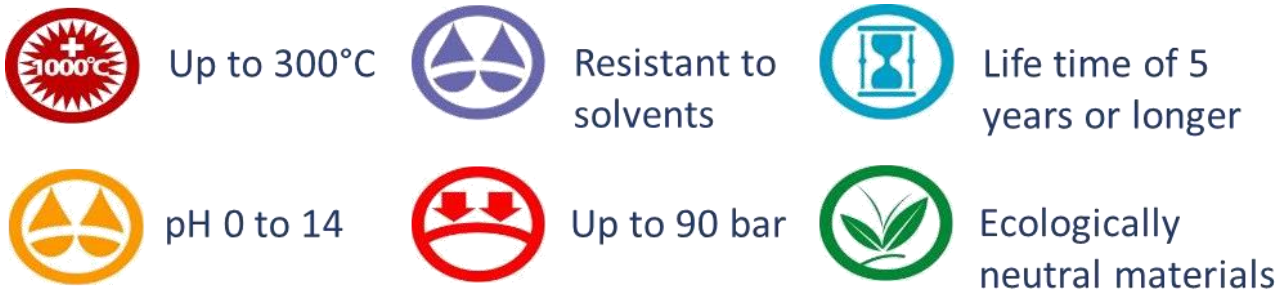

Figure 4: Summary of the key properties of ceramic membranes.

Figure 5: Ceramic membranes produced by TAMI Industries.

Where are ceramic membranes used today?

Initially developed to allow the use of TFF under extreme conditions, CTFF is today a tested and proved separation technology in multiple applications.

In the environmental industry, CTFF is widely used in the tertiary treatment of effluents as the pre-filtration step to nanofiltration (NF) and reserve osmosis (RO), protecting both NF and RO from abrasive particles and reducing the overall concentration of solids to allow their operation under optimal conditions. In environmental applications, CTFF is also used in external MBRs, reuse of degreasing baths and the treatment of biogas digestates.

The robustness of the ceramic material allied to the possibility of reliably regenerating the membrane and the performance by cleaning with strong chemicals makes ceramic membranes the best and often the only option for a vast number of environmental applications.

In the Food & Beverage industry, CTFF is a well-known solution in the clarification of beverages such as wines, ciders and fruit juices. It is also commonly found in dairy, sugar, pro-biotics and vinegar production plants. Just as ceramic dishes are preferred by most to plastic dishes on a dinner table, CTFF is the preferred choice when durability, hygiene and environmental protection are taken into consideration.

In the Biopharma industry, CTFF is one of the main separation technologies in Downstream Processing (DSP). It allows the concentration of microorganisms such as bacteria and yeasts and the purification of enzymes, proteins and amino acids. Different from TFF units equipped with polymeric membranes, CTFF units can be cleaned at high temperatures, extreme pHs and can be sterilized with steam. In addition, only the ceramic materials can present the high level of chemical inertness needed in the pharmaceutical industry.

The Oil & Gas, Petrochemical, Chemical, Electronics and Mining are some other examples of industries in which CTFF is used. The list of applications is unlimited and growing by the day.

Related articles:

- Non-circular channel ceramic membranes: Are they worth it?
- Ceramic Tangential Flow Filtration design
- Ceramic Membrane Cleaning and Regeneration

Do you have a question? Want to learn more about Ceramic Tangential Flow Filtration? Contact us!!

www.tami-industries.com / tami-info@tami-industries.com