Characterization of ceramics supports of titanium oxide for treatment of the radioactive liquid waste nuclear

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The membrane separation process (MSP) has been an important technology, applying in several areas to separate, concentrate or purify solutions. The ceramic membranes have superior properties to the polymer ones, mainly as the chemical resistance to solvents and extreme conditions of temperature (> 60º C) and pH (0-14). The MSP have advantages over traditional processes, mainly due to the separation occurring without phase change, avoiding energy costs [1]. Ceramic membranes are composed of a porous support, responsible for the mechanical resistance and covered by a thin layer, responsible for the selectivity. The oxides used in ceramic membranes are: silicon oxides (SiO_2), aluminum oxide (Al_2O_3), zirconia (ZrO_2) and titanium (TiO_2), or a combination of them. The titanium oxide has two crystalline forms, anatase and rutile, the last one being the most stable phase (980°C) [2]. The most important characteristic of a membrane is to have interconnected pores, which ensures the passage of the solvent and retain the desired solute. The porosity can be obtained by adding pore-forming materials or by controlling through the sintering temperature. The pores are responsible for retaining solid particles and thus directly influence the permeate flow, which consists of the volume of water permeated in a time interval at a given pressure, and it is possible to determine the permeability of the ceramic supports. The permeability can be understood as the measure of the largest or smallest facility that the membrane offers the passage of a given solvent. In samples containing 0, 15 and 30% of the starch sintered at 1100 and 1150ºC were determined the porosity and hydraulic permeability. The hydraulic permeability was calculated from the permeate flow with water (L m^{-2} h^{-1}) at pressures of 1 to 4 bar. The Table 1 shows that starch influenced porosity at both sintering temperatures and is more pronounced with increasing starch concentration. However, with increasing temperature, porosity drops for all starch concentrations.

Table 1 - Density and porosity values of TiO_2 supports sintered at 1100 and 1150 ° C.

Starch (%)	**Sintering (ºC)**	**Density (%)**	**Porosity (%)**
0	1100	57.81±0.02	42.19±0.02
15	1100	49.93±0.03	50.07±0.03
30	1100	32.25±0.05	67.75±0.05
0	1150	63.20±0.03	36.80±0.03
15	1150	56.37±0.03	43.63±0.03
30	1150	48.58±0.04	51.42±0.04

The porosity suggested for application as support is around 40%, being obtained in this study porosity of 42% with 0 and 15% of starch in both sintering temperatures.
Figure 1 shows the graph of permeate flow versus pressure. The permeability was determined for the condition 15% of starch at 1100 and 1150ºC, presenting values of 95 and 82 Lm^{-2} h^{-1} bar^{-1}, respectively. In the case of pure solvents and considering that it does not react with the support, the permeate flow will have a linear dependence with the pressure and the angular coefficient of the line will be the hydraulic permeability. These values correspond to the permeability of microfiltration membranes.

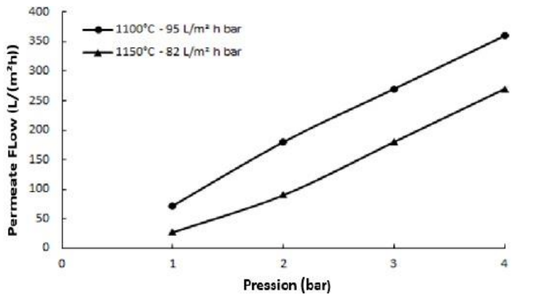

Figure 1. Graph of permeate flow as a function of the pressure of the TiO_2 supports with 15% starch and sintered at 1100 and 1150°C.

References

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