REUSE WATER GENERATION FROM THE POX EFFLUENT USING MEMBRANE DISTILLATION

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EXTENDED ABSTRACT

The gold mining contributes to the development and maintenance of the population's life quality. In order to this metal recovery exceed 90%, it is necessary to adopt pre-treatments, such as oxidation under pressure (POX), which requires a large water volume and, consequently, generates a high effluents amount. These effluents are constituted by the high acids and metals concentration, which even after the neutralization and precipitation process can be solubilized, causing water contamination (RICCI, 2015). In this scenario, an alternative treatment is membrane distillation (MD), which can achieve 100 % theoretical retention of not volatile compounds (ASHOOR *et al.*, 2016), thus generating a permeate of high physical chemical quality. Today there are different configurations of membrane distillation, but due to the simplicity and the high mass transfer coefficient obtained, direct contact membrane distillation (DCMD) stands out. For this reason, this work has the objective of generating reuse water for industrial application from the POX effluent using direct contact membrane distillation.

Tests were carried out in a lab-scale using a DCMD flat sheet polytetrafluoroethylene (PFTE) with active area of 0.004209m². 2 L of industrial overflow gold oxidation process effluent in different temperatures (55, 60 and 65 ° C) was added to the feed tank. In the permeate tank, 1 L of distilled water was added and maintained at a constant temperature of 25° C with the aid of a Chiller. The feed and permeate flow rate were maintained at 0.55 liters per minute (LPM). The tests were conducted for 6 h, permeate flux and conductivity (μS/cm) were monitored at regular intervals of 2 min. After each test, a physical cleaning by recirculation of distilled water was performed. Moreover, a chemical cleaning was carried out with a solution of hydrochloric acid 2% for 20 min. A diagram of the system used is shown in Figure 1(a).

As can be seen in Figure 1(b), No flow decay was observed during the tests, demonstrating the robustness of the system in the treatment of the POX effluent. The mean fluxes were 2.79, 12.36 and 21.12 L/m^2.h for the temperatures of 55, 60 and 65 ° C respectively. By projecting the conductivity curve, we can infer that it will stabilize at around 40 µs/cm, which represents a conductivity rejection greater than 99.9%. Furthermore, when analyzing the metal concentrations in the permeates, a rejection greater than 99.86% can be observed for several ions such as Fe^{3+}, Ca^{2+}, Al^{3+}, Cu^{2+}, Mg^{2+}, Ni^{2+}, As^{5+}, As^{3+}, Mn^{2+}, Co^{2+} and SO_4^{2-}. Regarding recovery rate, the values found for 55, 60 and 65 °C were 3.81, 13.18 and 26.23 %, respectively. It can be observed that the higher the permeate flux, the higher the rate of recovery achieved. This was because no flow decay was observed.

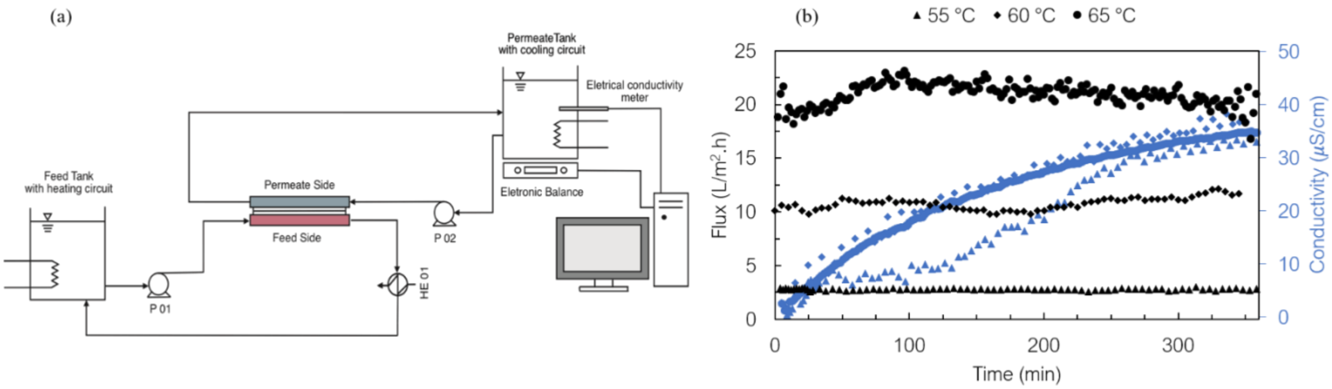

Table 1 - Different fluxes and cleaning efficiency (%) for each temperature. J_o: initial flux with effluent, J_f: final flux with effluent, J_{pc}: flux with distilled water after physical cleaning, J_{cc}: flux with distilled water after chemical cleaning and J_w: distilled water flux with clean membrane.

Temp. (°C)	J_o (L/m².h)	J_f (L/m².h)	J_{pc} (L/m².h)	J_{cc} (L/m².h)	J_w (L/m².h)	J_f/J_o	Physical cleaning (%)	Chemical cleaning (%)
55	2.89	2.88	9.42	10.0	10.76	1.00	87.5	93.3
60	11.99	11.71	15.60	17.9	18.31	0.98	85.1	97.8
65	20.96	20.62	20.93	21.5	21.62	0.98	96.7	99.4

With the data in Table 1 we can confirm that the variation of the flux was small, since the J_f/J_o ratio is close to 1. The physical cleaning was able to partially recover the permeability of the membrane, being the lower efficiency of 85.1%. On the other hand, the chemical cleaning met the expectations guaranteeing the recovery of more than 93.3% of the flux in relation to the initial one, conferring that most of the fouling was of a reversible nature. Overall, it can be seen that using only the DCMD is sufficient to guarantee the reuse water quality. In addition, no significant fouling occurrence was observed under the operating conditions in this study, which reinforces the robustness of the technology employed.

KEYWORDS: Membrane distillation; POX effluent; Water reuse.

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