Experimental investigation on the efficiency of zinc(II) recovery from waste streams by TBP liquid-liquid extraction

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Abstract

In many industrial processes the presence of zinc in the wastewater may represent an obstacle to its high efficient regeneration. This is the case of the treatment of spent pickling solutions aiming the recovery of hydrochloric acid via pyrohydrolysis techniques. Hydrochloric spent pickling solutions from steel processing contain relevant amount of metals such as iron (Fe) and zinc (Zn) that may significantly affect recovery of hydrochloric acid (HCl) through pyrohydrolysis. In fact, although Fe may be recovered as ferric oxide (Fe_2O_3) and does not have a substantial effect on pyrohydrolysis process, zinc chloride ($ZnCl_2$) evaporating can occlude nozzles and stick to the pyrohydrolysis reactor walls, thereby contaminating the iron oxide product. Thus, efficient removal Zn is needed. Of note, Zn recovery is economically affordable and can provide commercially valuable by-products such as zinc chloride or sulfate.
In this study, we present the results obtained within a laboratory experimental campaign to recover Zn and Fe from pickling liquors by means of liquid-liquid extraction adopting a suitable organic extractant, tributyl phosphate (TBP). In order to find out the best operative conditions leading to very high efficiencies, three main factors were investigated: the volume ratio between the organic extractant and the aqueous spent pickling liquor, the stirring time, and the percentage of TBP used (pure or variously diluted in kerosene). Furthermore, a parallel study was carried out for the analysis the efficiency of the stripping step, performed with the aim of regenerating TBP and recovering Zn and Fe by suitable aqueous stripping solutions. The results in terms of recovery yield and selectivity of Zn recovery over Fe ions were obtained and analyzed.

Keywords
Spent pickling liquor; zinc(II) removal; liquid-liquid extraction.

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