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Metal Recovery by Ion-Exchange Resins from Municipal Incinerated Bottom Ash

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Abstract: Municipal waste incineration plants produce large amounts of bottom ashes, being higher year over year. In order to follow the circular economy scheme proposed by the EU, a recovery step is required to valorise the high added-value elements present in these ashes, such as copper (Cu), zinc (Zn) or even gold (Au). For this reason, the aim of this work is to recover these metal ions by means of ion-exchange resins at different pHs. Thus, different acid and base solutions were used to lixiviate bottom ashes from a municipal waste incineration plant in Barcelona (Spain) and two different ion-exchange resins (Purolite S940 and AuRIX 100) were tested to obtain the maximum Cu, Zn and Au recovery. Results indicate that it was possible to obtain Cu and Zn extraction percentages around 99 % at pH 5, whereas Au was extracted about 62.5 % at pH 9, after 24 h.

Keywords: Cu; Zn; Au.

INTRODUCTION Municipal incinerated bottom ash is the principal residue produced during the incineration of municipal solid wastes (Lynn et al., 2017). The composition of bottom ashes shows a combination of metallic and non-metallic elements with high added value (ISWA, 2015). For this reason, bottom ash could be a secondary source of heavy (e.g. Cu and Zn) and precious (e.g. Au and Ag) metals. Thus, the aim of this work is the valorisation of these high added-value metals in order to close a circular economy scheme.

MATERIALS AND METHODS Bottom ash was pre-treated with acid (1 M HCl and 1M H_2SO_4) and basic solutions (1 M $Na_2S_2O_3$) in order to obtain leaching solutions. Afterwards, Fe and Al elements were removed from these leaching solutions by precipitation using 35% H_2O_2 until pH=4.8 (adding 2 M NaOH). Then, ion-exchange experiments with Purolite S940 resin for Cu and Zn recovery and AuRIX 100 for Au recovery, were carried out in batch mode using a resin:liquid ratio of 1:10 (w/v). A range of acid pH (from 1 to 5) was tested for Cu and Zn recovery from hydrochloric and sulphuric lixiviates, whereas basic pH values (9, 10 and 11) were evaluated for Au recovery from the thiosulfate lixiviate during 24 h at room temperature.

RESULTS AND DISCUSSION Purolite S940 resin showed its maximum metal extraction (Cu and Zn) at the highest pH tested (pH=5). Results demonstrated that 98.4 % and 99.1 % of Cu extraction was possible using HCl and H_2SO_4-leaching

solution, respectively, whereas the Zn recovery was 99.1 % with HCl-leaching and 99.5 % using H_2SO_4-leaching solution. On the other hand, gold extraction by AuRIX 100 resin diminished when incrementing the leaching pH, obtaining 62.5 % of Au extraction with $Na_2S_2O_3$-leaching solution at pH=9.

CONCLUSIONS Overall, these promising results could allow (i) bottom ash valorization as a source of metals and (ii) the use of the ion-exchange resins as a suitable technology to recover and concentrate them.

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