

# Selective solvometallurgical leaching of Pb from Jarosite residue of zinc hydrometallurgy processes

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The extractive metallurgy industrial process residues is complex because the relevant metals are in small concentrations, and often locked in complex matrices (sulphides, oxides, phosphates or silicates).[1] Consequently, it is difficult to recover the metals. On the one hand, the metal concentrations are too low to justify the high cost of pyrometallurgical leaching methods. On the other hand, most hydrometallurgical leaching processes suffers from substantial acid consumption and poor selectivity, resulting in high amounts of impurities in the leachates. If the aqueous phase in hydrometallurgy is replaced by organic solvents with dissolved reagents, then it would be another process called solvometallurgical leaching. Here, the metal ions are no longer hydrated, but solvated by organic molecules, which could give a higher selectivity, reactivity and affinity to bind to the metal ions.[1]

In this work, solvometallurgical leaching was carried out on jarosite residue from Boliden's zinc smelting plants at Kokkola, Finland. Presently, the residue is landfilled but due to its high rate of generation and presence of valuable metals, it is extremely interesting material for research as it can potentially be an important resource for valuable metals such as Pb and Zn.[2] The residue is produced as a by-product during purification and refining of zinc from its sulphide ore (ZnS, sphalerite). The elemental analysis showed the presence of Fe (175 g/kg), Pb (40 g/kg), Ca (25 g/kg), Zn (24 g/kg), As (8 g/kg), Cu (g/kg), Mn (0,64 g/kg) and Ni (0,113 g/kg). Other trace metals present were K, Si, Cr, Sr, Ag, Ba and Ir. Powder-XRD revealed that Pb is present in PbSO<sub>4</sub> and Zn in ZnS.

Solvometallurgical leaching of jarosite was investigated to leach Pb and Zn. A number of lixiviants were screened to find the best candidate. The lixiviants tested include organic acid, acidic, basic and neutral extractants, and HCl dissolved in alcohols and ionic liquids. The highest amount of Pb and Zn were leached by the two basic ionic liquids Aliquat<sup>®</sup> 336 ([A336][Cl]) and Cyphos<sup>®</sup>101 ([C101][Cl]) after their equilibrium with aqueous solutions of HCl. Next, the effect on the leaching, of different HCl concentrations used for equilibrating the [A336][Cl] and [C101][Cl] were investigated. The results showed that the leaching efficiency of Pb, Zn and Fe increases with increasing HCl concentration in the ionic liquid. The leaching efficiency of [C101][Cl] equilibrated with 0.5 M HCl were 68% Pb, 30% Zn and 11% Fe and they increased to 80%, 39% and 61% respectively when equilibrated with 6 M HCl concentration. Similarly for [A336][Cl], the leaching efficiency increased from 31% Pb, 25% Zn and 3% Fe to 74% Pb, 34% Zn and 66% Fe when the HCl concentration used for equilibration was increased from 0.5 M to 6M. Although

equilibrating ionic liquids with 6 M HCl leached more Pb and Zn, it also leached more Fe. Therefore, ionic liquid equilibrated with 0.5 M HCl was chosen for further investigation due its good selectivity against Fe.

Finally the leaching parameters: contact time, temperature, solid to liquid ratio and stirring speed were optimized and the final leaching efficiencies are shown in table 1.

Table 1: Leaching efficiencies after optimized conditions for jarosite (contact time 2 hrs, temperature 45 °C, Solid/liquid ratio 1:15, and stirring speed 1500 rpm)

Lixiviant	Pb [%]	Zn [%]	Fe [%]
[A336][Cl] eq. with 0.5M HCl	62	27	7
[C101][Cl] eq. with 0.5M HCl	73	31	10

In the near future, the experiment will be up-scaled using about 10 - 20 g of jarosite residue to check reproducibility of the results at larger scale. Recovery of the metals from the leachate will be investigated by non-aqueous solvent extraction or with non-aqueous ion exchange.

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## References

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