

Recovery of valuable metals from copper tailings of the III and IV regions of Chile, through leaching processes and the use of surfactants

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INTRODUCTION & AIM

Chile is the world leader in the production of copper. Its mining exports accounted for 5.4 million tones in 2023, representing more than half of the national export value. Chile's national massive mine cadaster shows that the mining industry generated 758 tailing deposits from copper mining operations located in ten regions. They account for 28.2 billion of authorized tones of mine tailings. The primary goal of any remediation project for mining residues is the recovery of valuable metals, and in this case, Cu and Fe for the Chilean ores. In this work we propose to improve the leaching process using surfactant agents to improve the hydrophilicity of mineral and tailing surfaces, by using hydrophilic groups in the leaching of sulfide ores. This will improve the surface wettability of minerals, and enhance the leaching effects.

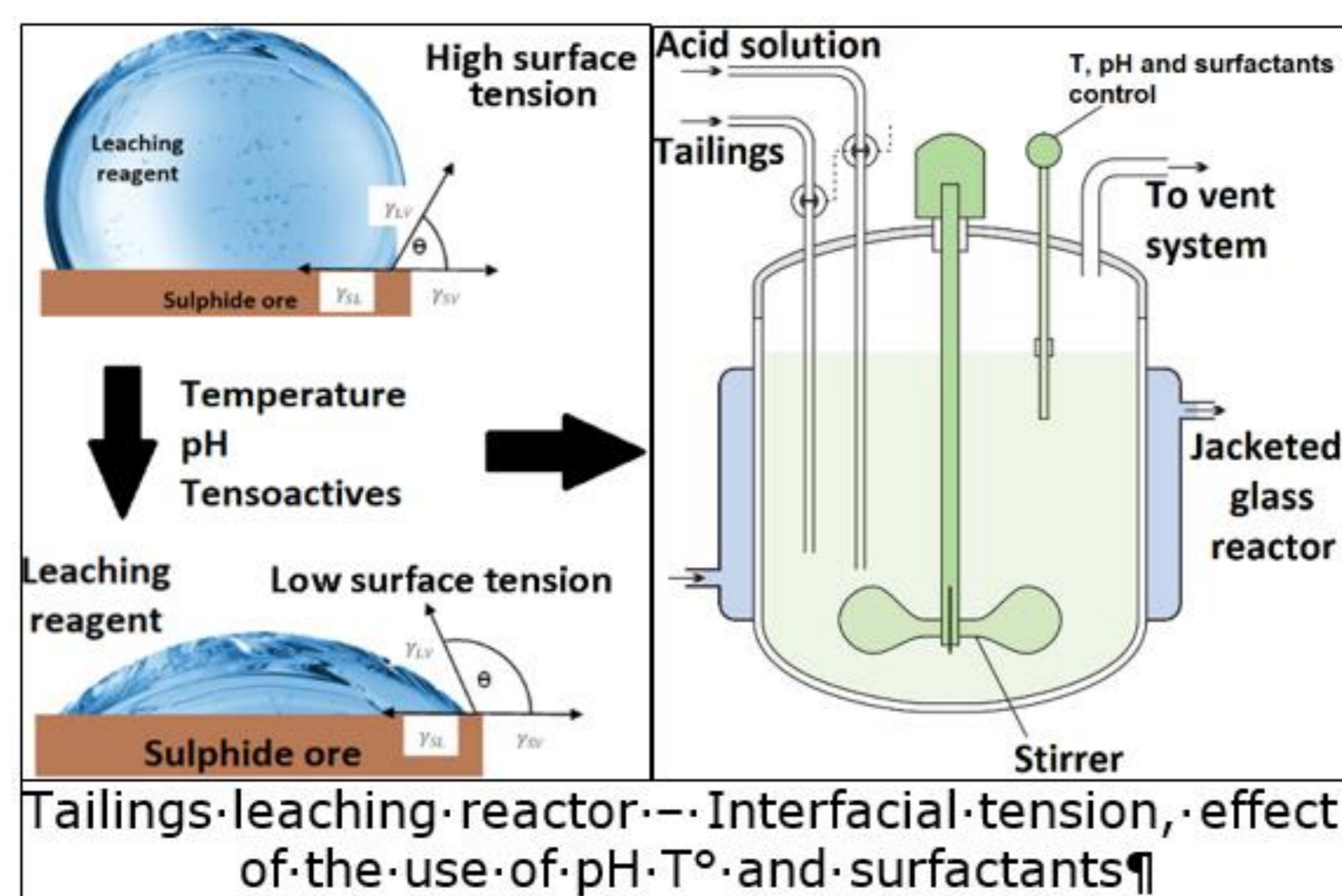
METHOD

The work methodology to be used for the processing of mining tailings was the following:



The tailings will be leached using a stirred reactor, which has an external temperature controller. Variables to analyze: pH, solid/liquid HCl leaching ratio, temperature and surfactant concentration.

Raw material: Tailings with high iron concentration (>40% Fe₂O₃). Reagents: HCl (technical, 1.0 – 1.5M) - C₁₆H₃₁NO (disodium cocoamphodiacetate, surfactant). Solid/liquid ratio: 1/3. Temperature: 70 – 80°C. Dosage of surfactant : 0 – 1000 ppm.

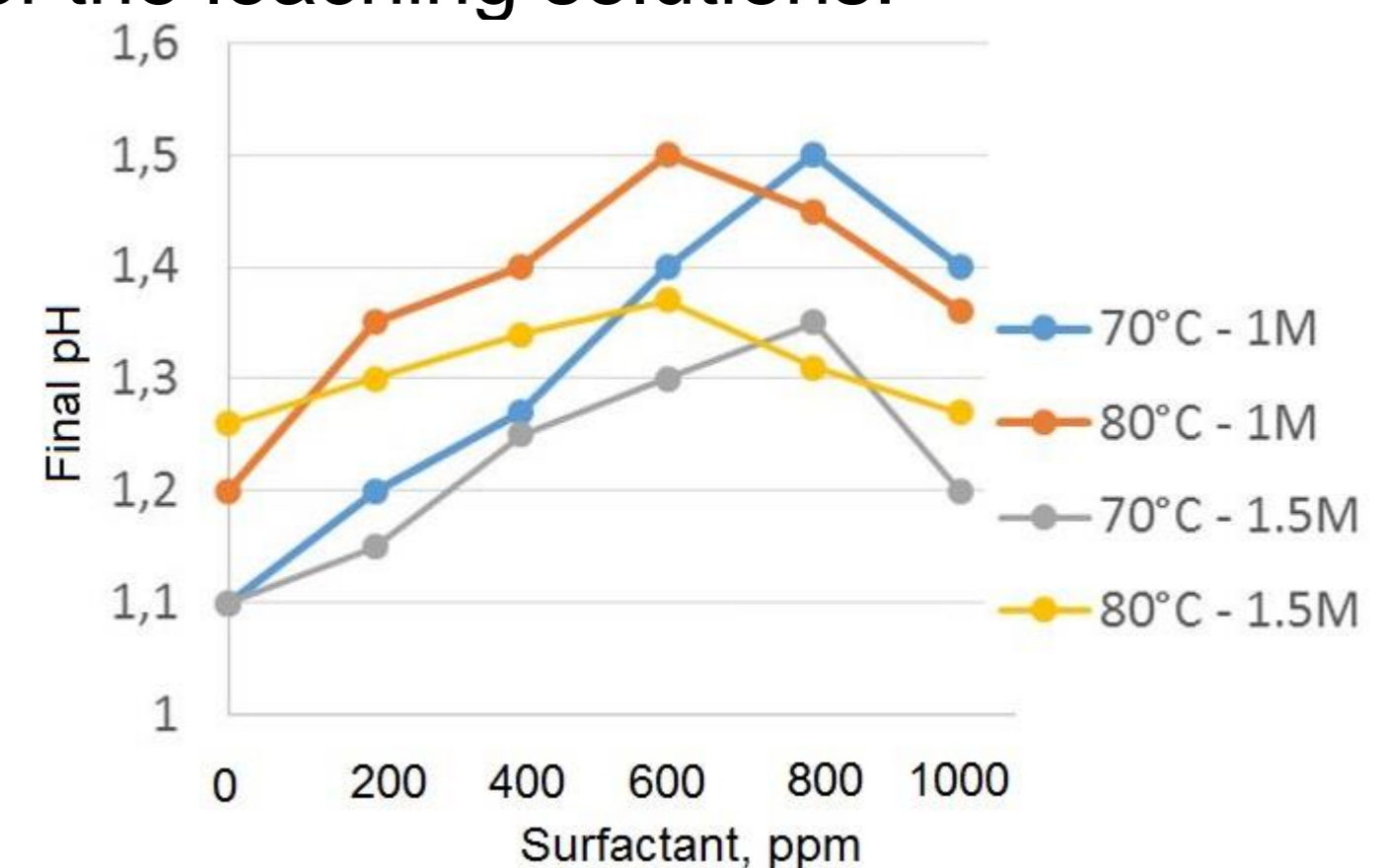


RESULTS & DISCUSSION

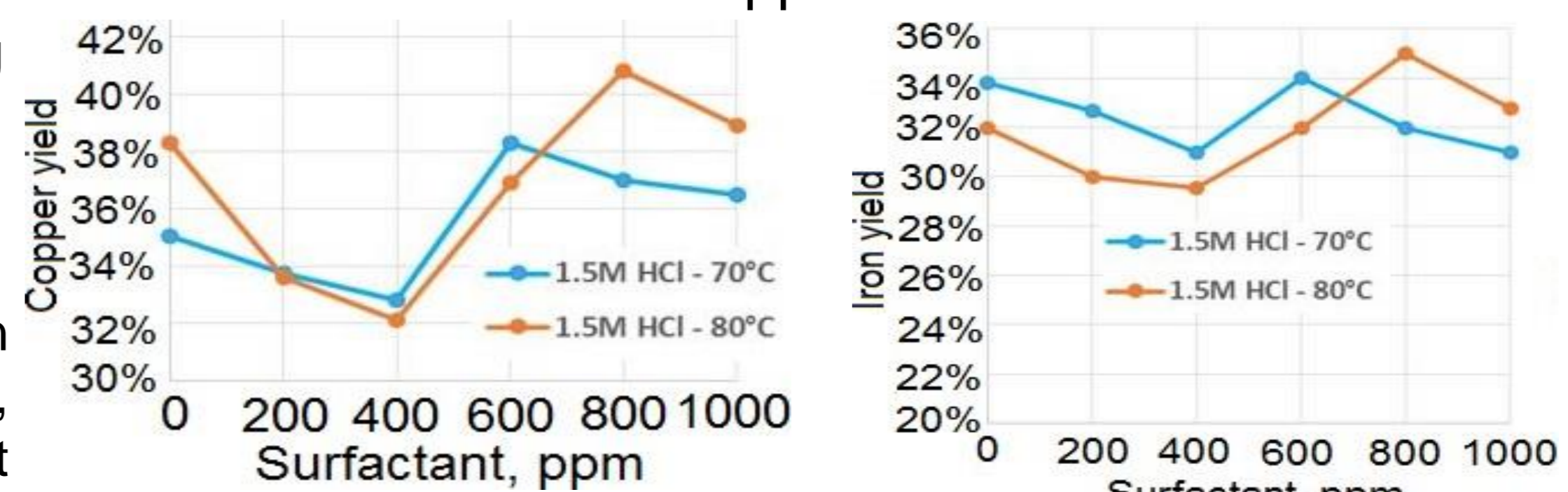
The table shows the tailings' chemical composition:

#	IDQ	Empresa	Sb (mg/kg)	W (mg/kg)	Cu > 300 (mg/kg)	As (mg/kg)	S Total (mg/kg)	Pb (mg/kg)	Zn (mg/kg)	SiO ₂ (%)	Al ₂ O ₃ (%)	Fe ₂ O ₃ >10 (%)
1	172	CARLOS GREGORIO ARAYA CAMPANA	10	10	1168	20	0,11	31	41	23,37	5,14	47,59

Final pH of the leaching solutions:



The final pH of the leaching solutions act as an indicator of reaction performance. In this case, the highest acid consumption, and therefore the best performance, were obtained for a temperature of 80°C and a surfactant concentration of 600 - 800 ppm.



Copper and iron recovery reached maximum values at 600 – 800 ppm of surfactant. Higher or lower values decrease the result.

CONCLUSION

- The use of surfactants improved the leaching process. However, after a certain dose threshold, the results decrease. The best results were given at concentrations between 600 and 800 ppm of surfactant in solution. Concentrations higher than this value will only decrease the recoveries of valuable elements.
- The best results were the following: iron recovery reached 35%, for 1.5M HCl, 80°C and 800 ppm of surfactants, while, for copper, it was 40.5%, for 1.5M HCl, 80°C and 800 ppm of surfactants.

FUTURE WORK / REFERENCES

In the future, we will develop custom electrodialysis cells to recover iron and copper from the leaching solutions. First, iron will be recovered using a cell that avoids the pitting corrosion and copper will be recovered using cells with bipolar electrodes to increase the copper production.