Response to Reviewers

Dear Reviewers

Thank you for your comments and corrections to be made. The changes made to the manuscript are detailed below.

TITLE:

The title was changed to:

“Dissolution of Black Copper with the Use of Iron Crap - Part l”

There are currently equivalent data for the extraction of Cu from the same mineral. Also, we want to add a temperature analysis, as they indicated they would like.

As soon as the problems of COVID-19 are over, we will finalize the tests requested.

ABSTRACT:

The final part of the abstract was modified based on the modifications of the conclusions

“Finally, it was discovered that there is a higher kinetics of dissolution of Mn when working with Fe0 in short periods of time, although similar extractions are obtained in prolonged times. The pre-treatment process by adding NaCl resulted in increased Mn extraction, allowing to obtain highly concentrated solutions in short periods of time (30 min). Applying high concentrations of reducing agents, the effect of particle size has no significant significance on the dissolution rate of MnO2.”

EXPERIMENTAL DESIGN

This item was completely restructured, based on what was requested. Indicating the four experimental conditions, and separating by section to make it easier to understand. In addition, requested data was included.

“For the leaching tests, experiments were performed under 4 different conditions: a) Standard condition (without the addition of reducing agent, only H2SO4), b) With the addition of reducing agent (Fe), c) With a pre-treatment process and subsequently leaching adding reducing agent (Fe), d) With a pre-treatment process and later leaching adding two reducing agents (Fe and NaCl). In addition, the effect of particle size was subsequently evaluated. Details for each procedure are detailed below:

2.4.1 Pre-treatment

For the pre-treatment, we worked with 10 g of mineral, adding 20 kg of H2SO4/t (depending on the level to be studied) (0.1 cm3 of H2SO4) and 0.1 g of NaCl (i.e. 10 kg/t). The mineral sample and reactive agents were homogenized, followed by resting for 48 h in a Petri dish covered with plastic to avoid evaporation losses. The temperature during the resting time was controlled at 25 °C with the use of an air conditioner in the laboratory. At the end of the pre-treatment, the mineral is washed with distilled water, then it is homogenized again.

2.4.2 Leaching Tests

Next, leaching tests were carried out in a 100 mL glass reactor with a ratio of 0.01 S/L. It was worked with 10 g of black copper ore, which was added to the reactor with the use of of an analytical spatula. Stirring and suspension of the material was performed with the use of a 5-position magnetic stirrer (IKA ROS, CEP 13087-534, Campinas, Brazil) at a speed of 600 rpm, particle size of -75 + 53 µm, Fe0/MnO2 of 1/1 (condition b, c and d), 0.1 g of NaCl (condition d) and the temperature was controlled using an oil heated circulator (Julabo, St. Louis, MO, USA).

The tests had an operational time of 70 minutes.

2.4.3 Effect of particle size

These experiments were carried out under the same conditions previously described (4 conditions). However, previously the material was reduced in size through the use of a porcelain mortar, and then, it was passed through sieve meshes (Tyler) until reaching two size ranges: a) -90 + 75 µm and b) -173 + 147 µm. Which were compared in the experiments for two Fe reducing agents (Fe0 and Fe2+). The tests had an operational time of 30 minutes

The reactant used in all experiments was sulfuric acid at a concentration of 1 mol/L. The sulfuric acid used for the leaching tests was grade P.A., with 95–97% purity, a density of 1.84 kg/L, and a molecular weight of 98.80 g/mol. The temperature in all experiments was maintained at 25 °C. Also, the tests were performed in duplicates, and 5 cm3 undiluted samples were analyzed by using atomic absorption spectrometry (Agilent 240FS, Agilent Technologies, California, USA) with a coefficient of variation ≤ 5% and a relative error between 5 to 10%.

Please add how the Mn extraction percentage was calculated”

RESULTS AND DISCUSSION

For item 3.1, the following text was incorporated:

The results for conditions 3 and 4 are practically identical. This is beneficial from an industrial point of view, because Fe0 is a low-cost input that can be obtained from industrial waste. While adding NaCl in the leaching process, would imply an additional cost to the process.

For item 3.2, the following text was incorporated:

“When operating with high concentrations of reducing agent in the system, the particle size is not relevant to increase the dissolution rate of MnO2. It is also important to note that a time of only 30 minutes was evaluated due to the aggressive nature (rapid dissolution kinetics) of acid-reducing leaching”.

The minor changes requested were modified, and in addition, the error bars were included in the figures

CONCLUSIONS

Conclusions 3 and 4 were modified, as requested:

3. The pretreatment process by adding NaCl, resulted in the increase of Mn extraction in short periods of time (30 min).

4. Applying high concentrations of reducing agents, the effect of particle size has no significant significance on the dissolution rate of MnO2.

Regards