Microwave Pre-Treatment of Ores and Its Effect on the Flotation Process

Christopher Marion  
McGill University - Department of Mining and Materials Engineering

Supervisor: Prof. Kristian Waters

Introduction
Mineral processing is of great importance to our everyday lives. It involves the separation of metals and minerals from waste. The demand for metals is increasing as world economies grow, placing a strong emphasis on mineral recovery. In an uninterrupted year, Vale produces approximately 50,000 tonnes of nickel and 32,000 tonnes of copper. Nickel and copper prices are currently around 22,000 USD/tonne and 5,000 USD/tonne respectively.

Motivation
The comminution process is highly inefficient and energy intensive, and accounts for approximately 3% of the global electrical energy consumption. Microwave radiation has been shown to improve efficiency and reduce the energy need as a result.

Objective
Ensure that microwave pre-treatment does not have a negative effect on the separation of minerals.

Microwave Heating
Microwaves are a form of electromagnetic energy, with a wavelength ranging from one millimetre to one metre. They can heat any material provided it is not a perfect electrical conductor or insulator. Different minerals heat at different rates within an ore.

Microwave Heating of Ores
Different minerals heat at different rates within an ore.

Froth Flotation
Froth flotation is a separation process which takes advantage of the differences in hydrophobicity of valuable minerals and gangue (waste). Surfactants are used to increase the differences in hydrophobicity of the valuable minerals and the gangue. Hydrophobic materials attach to air bubbles, which rise to the surface, forming a froth. Froth is collected as it overflows, forming the valuable concentrate.

Results
Samples were treated in a 800W 2.45 GHz microwave for 30, 60, 90, 105 and 120 seconds. The ore was ground and floated with concentrates taken after 0.5, 1, 2, 5 and 12 minutes giving a cumulative grade and recovery.

Conclusion
Both recovery and grade of copper and nickel improved.

Future Work
Test the effect of different types of microwave (mono-modal and pulse microwaves).

Acknowledgements
Vale for providing the ore.
Pejman Nekoovaght for his assistance with the microwave

References