Novel Binders and Methods for Agglomeration or Ore

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In agglomeration of iron ore to produce pellets for use in the blast furnace and in advanced ironmaking processes, it is important to determine the effects of water chemistry on the performance of bentonite clay binders and how this impacts the pellet quality. It was determined that the water that remains in the filter cake after filtration in iron ore concentrators can contain several hundred times greater concentrations of calcium ions and other cations, due to surface chemical effects carrying the ions along with the water. This is a serious concern for pellet quality, as calcium ions are known to degrade the performance of bentonite clay binders. Based on the theory of the electrical double layer, it was predicted that reducing the pH of the solution to near the isoelectric point (IEP) of the magnetite particles would cause the bulk of the positively-charged calcium and magnesium ions to be released. Carbon dioxide injection was found to be the best available method for reducing slurry pH to near the magnetite IEP so that calcium and magnesium ions would be removed during filtration. In both laboratory and plant studies, the carbon dioxide injection produced the significant additional benefit of increasing filtration rates by up to 23.7%.

In iron ore pelletization, filtration costs are in the range of $0.60 - $1.50/ton, much of which is for the energy to apply vacuum to the system. The energy-efficiency benefits of the 23% increase in filtration rate would be adequate justification for carbon dioxide injection, even in the absence of effects on pellet quality. Improved binder technology will also allow the adoption of advanced single-stage ironmaking technologies, which are approximately 13% more energy-efficient than the conventional pelletization-blast furnace technology. Assuming that 50% of the industry converts to single-stage ironmaking, this will save an estimated $6.51*10^{13}$BTU/year.