STRONG IRON ORE GREEN PELLETS. THEORY AND PRACTICE.

Seija Forsmo
LKAB R&D, SE-98381 Malmberget, Sweden

Abstract

Agglomeration of iron ore is commonly done in large balling drums or discs using water together with an external binder as a binding media. The mechanical strength of wet green pellets controls the productivity of the balling circuits and influences the productivity of the subsequent firing process, as well. A critical parameter in balling is to find a suitable moisture level. Too wet green pellets grow too fast and become highly plastic, too dry green pellets are fragile and break. The optimum moisture level in balling largely depends on the properties of the pellet feed. This has labelled balling as being “magic”: sometimes a certain moisture content is perfectly fine, other times it is too wet or dry.

To study the green pellet properties under different balling conditions, a new measuring instrument was developed and patented by LKAB. Compression strength is measured half-automatically and the compression curves are saved for numerical and graphical evaluation. Green pellets plasticity is calculated. A high-speed camera is used to record the breakage patterns. This way, visual information can be connected to the compression curves.

The agglomeration theory for wet green pellets has been dominated with the well-known capillary theory since the 1950’s. It claims that the main binding force is the capillary suction developed in capillary openings of the green pellet pore system. Capillary forces are as strongest with low porosity in green pellets and with small average particle size in the pellet feed, both leading to smaller capillaries. Capillary forces are easily completely lost if the particles are hydrophobic or if the surface tension in the pore liquid is low. Our results show that if only water is used as a binder, the capillary theory applies. However, viscous binders, like the bentonite clay, are used in industrial balling. In the presence of external binders, the main binding force originates from the binder, not from the capillary forces. Thinking in terms of the capillary theory results in misleading and incorrect process control measures.

By measuring the green pellets plasticity, the optimum moisture content in balling could be defined. This is very helpful when studying agglomeration of new materials. The optimum moisture content largely depends on the particle size distribution of the pellet feed.

Surface tension in the pore water and the wetting properties of the particles were found to influence the green pellet properties, but through different mechanisms than described by the capillary theory. In the presence of surface active agents, like for example a flotation collector reagent, air was bound in the green pellet structure making them weaker in both wet and dry states. Multi-breakage patterns were detected. Green pellet breakage to crumbs instead of a few distinct segments promotes the generation of dust and lowers the permeability of the pellet bed during firing.