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When iron ore concentrate is pelletized to produce blast furnace feed, a key component of the pellets is the binder that holds them together until they can be fired to give them sufficient mechanical strength. The traditional binder used is bentonite clay, which is mixed with moist iron ore concentrate filter cake before pelletization. The bentonite bridges between the iron oxide particles in the pellet, so that when the pellets are dried they remain intact until they can be fired. The iron industry competes with other industries for high-grade bentonite, which has restricted bentonite availability and increased the cost, and so alternative binders would be valuable.

An alternative to bentonite binder, is binders based on coal fly ash. The chemical composition of fly ash is similar to that of bentonite, so their use will not disrupt the chemistry of the finished pellet. Fly-ash-based binders were found to give adequate pellet strength at dosages very similar to the dosages normally used for bentonite binders, although the binding mechanism was determined to be different. While bentonite binders produce a physical bond between iron ore concentrate grains in the pellet, the fly-ash-based binders undergo a “pozzolanic” reaction with water and alkali materials to form a cementitious bond between particles. It was demonstrated that, while fly-ash-based binders used alone had performance comparable to performance of bentonite binders, combinations of fly-ash-based binder and bentonite performed poorly. This was because of the significantly different binding mechanisms for the two types of binder. In particular, soluble calcium ions that were needed for the fly-ash-based binder severely degraded the performance of bentonite.

Fly-ash is much more available than bentonite, and since it is generally considered to be a waste product from coal combustion, it is much less expensive as well. One of the features of fly-ash is that it often has a high content of unburned carbon, and fly-ashes with more than 6% carbon cannot be used as concrete admixtures, which is the current dominant market for fly-ash. This project confirmed that a high carbon content did not harm the performance of fly-ash-based binders in producing iron ore pellets, and in fact the presence of carbon provided a supplemental fuel source that could reduce the quantity of fuel that would need to be provided to fire the pellets. Since the fly-ash used could be material that has no other market, the use of fly-ash-based binders for iron ore pellet production is significantly more economical than the use of high-grade bentonite.