

Studies show that up to 25% of the volume of coal is lost as fine coal particles in the coal mining and handling process. These fines, considered to be nontransportable and useless may be concentrated as thick "deposits" in tailings ponds.

Actually, if the fines can be transported (as in the case of local slurry pipelines directly to the user), they are preferred, for most coal-burning electrical power plants inject the coal into their boilers as dust (-200 mesh). This allows for greater burning efficiency. Unfortunately, since fines are rarely available, utility companies must grind all coal received. Such grinding is very expensive, frequently costing as much as the coal itself.

At present, the concept of agglomeration of coal fines into coherent pellets strong and stable enough to allow transportation is being considered, and several pilot-scale operations have been undertaken. These have shown that while pelletization can be done with relative ease, the economics of the process is at best marginal. The binders considered to date include bentonite, various oils and asphalts, and organic waste. Obviously a binder which burns is preferable to one which contributes to the ash. Unfortunately, in each case, the coal pellets must be reground to dust to be injected into the furnace.

If, however, a binder is employed which is both combustible and contains a small amount of water, the expensive grinding stage can be eliminated. When a pellet held together by a water-soluble polymer or other water-based binder is introduced into a hot environment (a pre-heating chamber or the boiler itself), the vapor contained in the binder vaporizes and undergoes a rapid volume increase, causing a dramatic pressure increase inside the pellet. Meanwhile, the tensile strength of the pellet is being lowered by the degradation of the binder. Once the internal pressure exceeds the ability of the pellet to contain it, the pellet bursts. This "explosion" reduces the pellet once again to dust, since any pellet fragments would likewise burst. No grinding is necessary, and the economic picture of the process improves dramatically.

Application of this process finds breadth when one considers the potential sources of coal fines. As environmental regulations tighten, coal-cleaning standards rise. To effectively remove organic sulfur from coal, the coal must first be crushed, and conceivably large supplies of coal dust would be available. Pelletizing might also find application between the end of a slurry pipeline and the ultimate user. Another potential source is in-situ comminution of thin, deep coal seams, which reduces the coal to small fragments before pumping it to the surface.

To be sure, coal agglomeration will find widespread use in the near future, and the use of a water-based binder will make the process economically feasible. Indeed, the self-bursting concept may revolutionize the burning industry.

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Chemical Diagenesis of Pennsylvanian Brush Creek (Pennsylvania) Carbonate Components: Trace Elements

The various (low-Mg calcite, intermediate-Mg calcite, high-Mg calcite, and aragonite) carbonate components from the Pennsylvanian Brush Creek Formation of Pennsylvania are preserved in different stages of diagenetic alteration. In general, these components follow the predicted diagenetic changes in structure, mineralogy, and chemistry deduced from theoretical considerations for progressively altered carbonates.

The low-Mg calcite brachiopods show no signs of either structural or chemical alteration. The shell material is preserved as low-Mg calcite fibers with no apparent dissolution and/or infilling by diagenetic calcite. Also, the average Sr^{2+} content of the brachiopods is 820 ppm, which is in agreement with the chemical

content of their Holocene counterparts. In contrast, the intermediate-Mg calcite rugose corals show signs of structural aggrading neomorphism. The trabecular fibers are in part recrystallized to small mosaic calcite grains. This structural alteration is concomitant with chemical changes in the Brush Creek rugose corals. The least-altered components contain about 1,770 ppm Sr^{2+} , whereas the most altered components contain only about 1,030 ppm Sr^{2+} . For the high-Mg calcite crinoids, diagenetic alteration is mostly a cementation process with minor mineralogical alteration. The open meshwork structure typical of the Echinodermata is infilled in the Brush Creek crinoids by diagenetic cement. This infilling cement has decreased the average Sr^{2+} content of 2,140 ppm of unaltered crinoids to that of 1,090 ppm Sr^{2+} for the most-altered Brush Creek crinoids. Scanning electron microscope analysis of the originally aragonitic mollusks (gastropods, pelecypods, and cephalopods) shows a complete structural diagenetic transition series. The original and least-altered mollusk material is preserved as nacre, which is always aragonite. The second phase of the transition series in the mollusks is represented by the aggrading neomorphism of the nacreous tablets into small, coarse mosaic calcite crystals. The structural transition is completed by the replacement of the mosaic calcite by coarse calcite spar. Mineralogically, the mollusk material changes from aragonite to aragonite-calcite to calcite, relative to the least- and to the most-altered specimens, respectively. The structural and mineralogical changes of the originally aragonitic mollusks are also confirmed by changes in their overall chemical composition. Average Sr^{2+} values measured for the least-altered Brush Creek mollusk material is 4,470 ppm. Mollusk material of the second phase of the diagenetic transition series contains on average about 2,170 ppm Sr^{2+} . The most-altered mollusks, which are calcite, contain on average about 1,110 ppm Sr^{2+} . Similarly, the Na^+ values follow the diagenetic trend of strontium. The least-altered material contains 750 ppm Na^+ , the intermediate-altered material contains 420 ppm Na^+ , and the most-altered material contains 250 ppm Na^+ .

Thus the diagenetic alteration process and rate proceed in accordance with mineralogical stability. This sequence is aragonite, high-Mg calcite, intermediate-Mg calcite, and low-Mg calcite relative to fastest to slowest reaction, respectively. The diagenetic alteration and preservation process of the Brush Creek carbonate components is probably a two-stage event. The first stage occurs in the marine phreatic zone, and the second stage occurs in the meteoric phreatic zone.

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Age of Clay Diagenesis in Oligocene Frio Formation

The Rb-Sr isotopic dating method can be applied to sedimentary rocks to determine the time of formation of diagenetic illite. In the Pleasant Bayou 1 geothermal test well in Brazoria County on the Texas Gulf Coast, the interval from 9,300 to 16,500 ft (2,800 to 5,000 m) consists mainly of overpressured shale and sand of the upper Oligocene Frio Formation. Rb-Sr isotopic analyses of the less than 0.06 μ fraction indicate that clays within the zone of "hard" geopressure, which extends downward from 11,000 ft (3,400 m), formed in equilibrium with pore water and record an age of diagenesis at 23.6 ± 0.8 m.y. This sharply defined age is in contrast to the result that would be expected if burial diagenesis had been a gradual, continuing process, in which clays at different depths would have accumulated various amount of Rb at different times in the past. If this were true, the ages of diagenesis would have varied continuously from older in the deeply buried part of the stratigraphic section to younger in the upper part of the section.