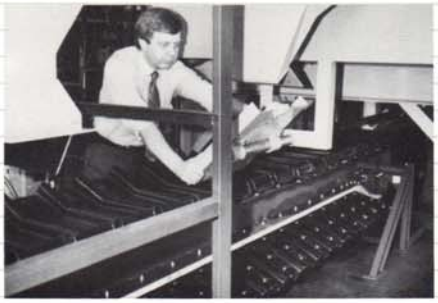

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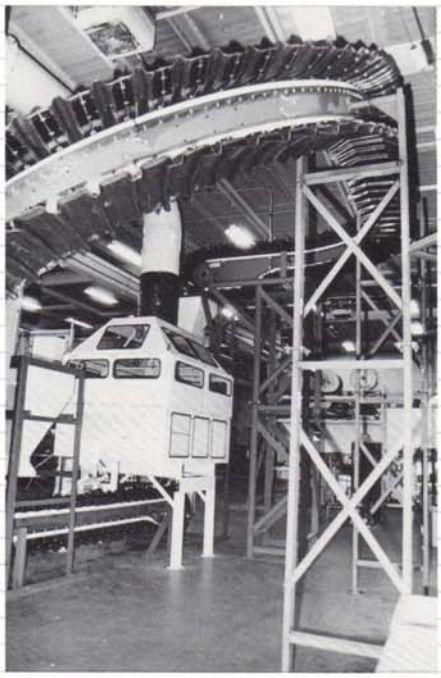
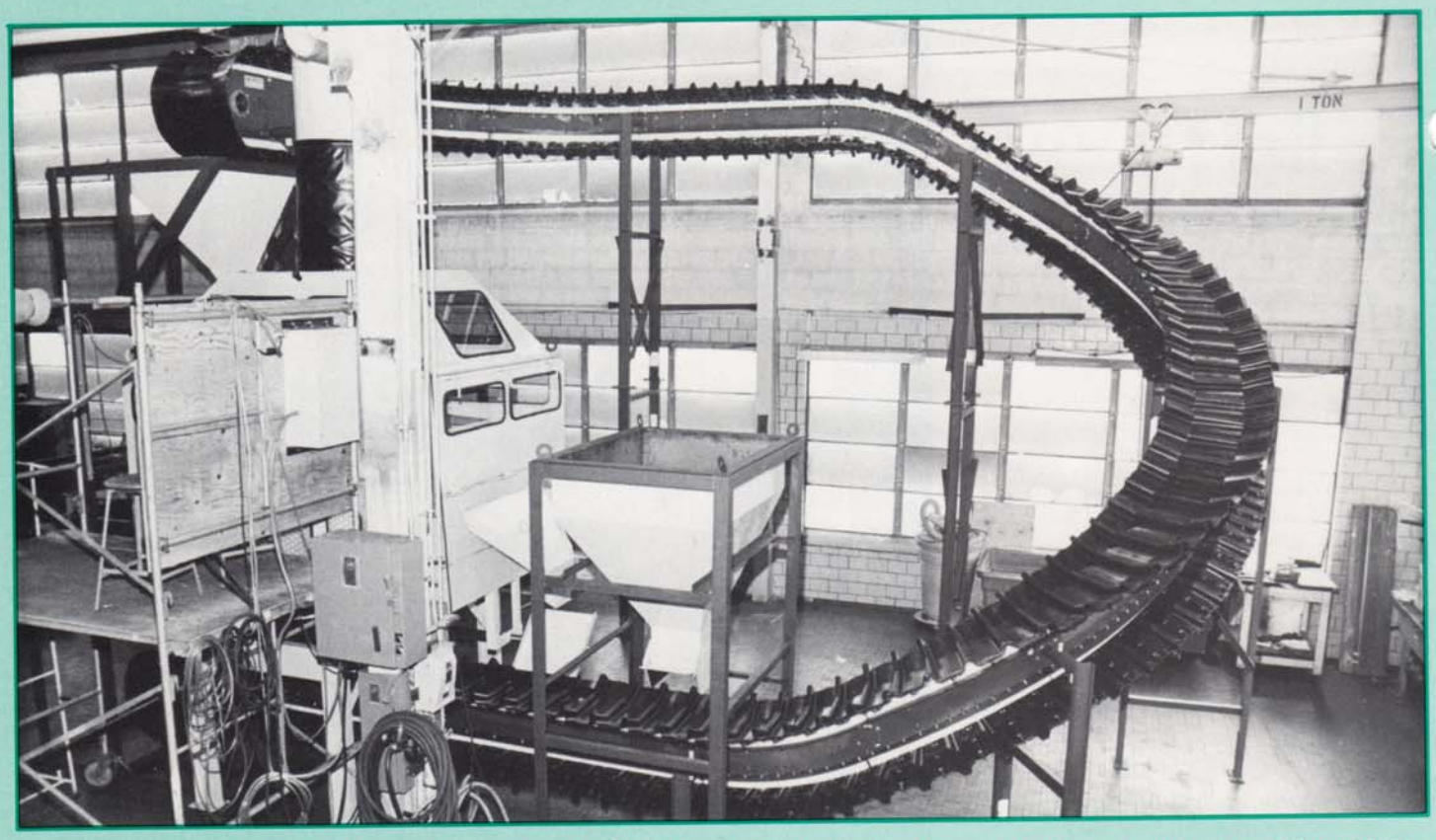


SERPENTIX CONVEYOR CORPORATION



A 360 DEGREE SPIRAL by the Serpentix conveyor (above) provides a true closed loop for testing the pre-combustion coal cleaning dry separator developed by American Davidson. Coal samples are fed into the hopper in front of the separator at floor level. Elevated 14 feet, the material is discharged into the hopper above the test unit and then into the separator. The loop is repeated after the material feeds through the separator and is discharged back onto the conveyor.

Serpentix Helps Prove Separator Can Clean Pyrite From Coal Before Burning

Great fuel cost reductions in generating electrical power, sharply reduced air pollution and the virtual elimination of sludge caused by contaminated utility/industrial wastewater, is anticipated from a new dry process for pre-combustion coal cleaning developed by American Davidson.

Testing of the process was performed in Dearborn, Michigan on a 10 ton hour (tph) production prototype — an Air-Fluidized Vibrating Bed Gravity Separator. It included a 63-foot three-dimensional Continuous Path Conveyor, designed by Serpentix Conveyor Corporation to provide a closed loop system for more reliable and accurate test data.

Testing and analytical work was completed in 1987, according to G. Borsattino of The Davidson Group, a company headquartered in London and parent company of American Davidson. Initial sales of the dry separator will be to electrical utilities, he said.

The burning of coal by electrical power generating stations releases sulfur dioxide fumes which are caused by pyrite, a mineral found in coal. At present, utilities have no way of removing pyrite from the coal prior to combustion, Borsattino explained.

Utilities currently purchase pre-washed coal from mines, depending on them to remove much of the shale. The utility must then rely on Flue Gas Desulfurization (FGD) to control the sulfur oxide emissions, and other types of stack gas cleaning to remove ash particulates caused by the shale not removed in pre-washing, Borsattino said. The FGD methods are normally wet processes, the only types presently efficient enough to meet sulfur oxide emission standards.

Preliminary testing of the separator on a wide variety of low and high sulfur coals at the Davidson Research Center (DRC) in Dearborn, resulted in removal of virtually all shale and more than 70 percent of the pyrite from the samples tested. A pyrite removal rate of 80 to 90 percent is possible, Borsattino said, depending on how fine the coal must be crushed to liberate the pyrite. Shale removal is quite simple since its libera-

tion size is greater than pyrite. The testing was under the joint supervision of DRC Director M. John Magill and Separator Project Manager Borsattino.

About 80 percent of all coal burned in the United States today goes into the coal-fired boilers of electrical generating stations and 10 percent is used in industrial processes.

Current domestic coal production is projected to reach 1.1 billion tons annually, according to the U.S. Department of Energy. Approximately one third will come from the predominately low sulfur coal reserves in the western states with the remainder — mostly high sulfur coal — coming from the eastern and mid-western states. Those totals could change significantly, Borsattino predicted, with American Davidson's dry coal-cleaning separator.

Present wet FGD methods cannot remove sufficient inorganic (mineral) sulfur to permit many eastern and midwestern coals to meet existing air quality standards for removal of sulfur dioxides. However, the American Davidson dry process would provide sufficient cleaning to meet those standards by removing pyrite from coal before combustion.

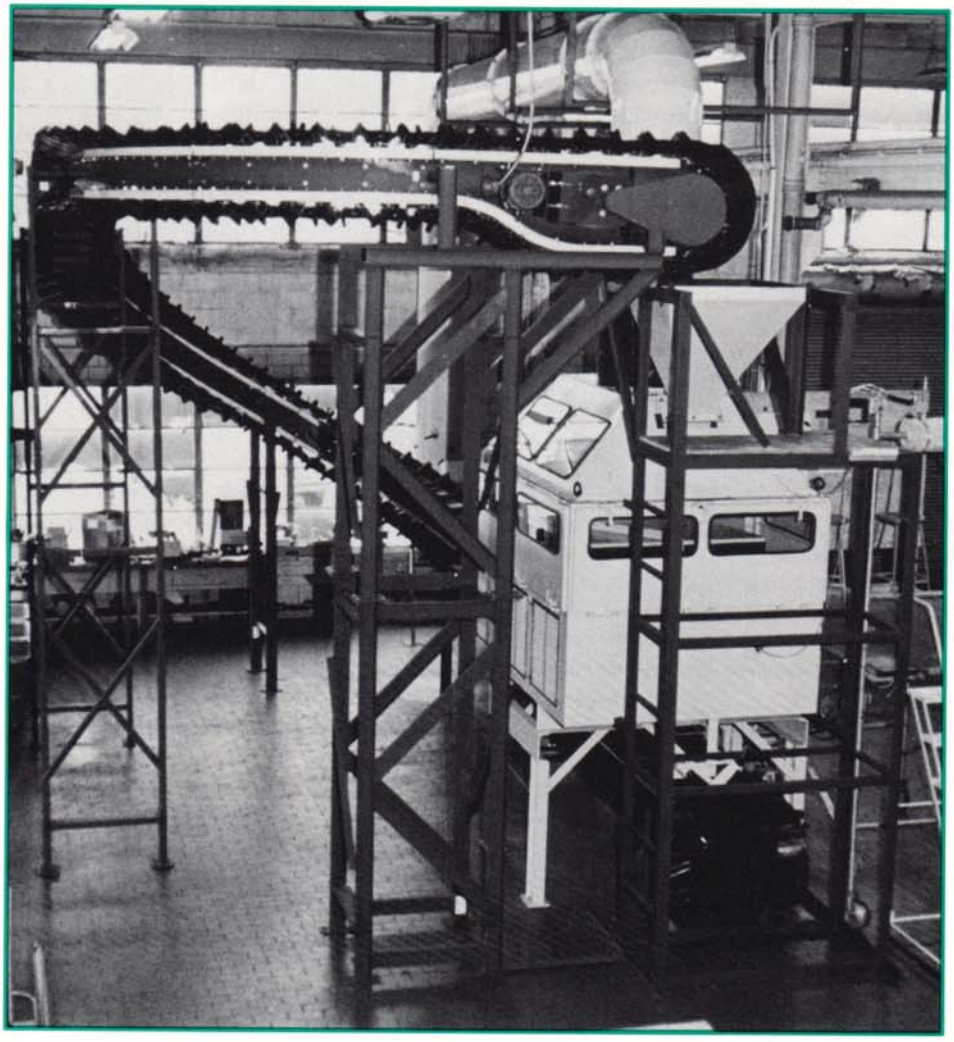
Neither dry nor wet methods can deal adequately with the organic sulfur in coal because it does not occur as a separate material. Organic sulfur is bound to the carbon atoms in the coal, making it much more difficult to remove than pyrite.

Wet FGD cleaning to remove sulfur dioxides caused by pyrite, combined with shale removal efforts, causes great problems for any utility. The water used in stack (flue) gas emission con-

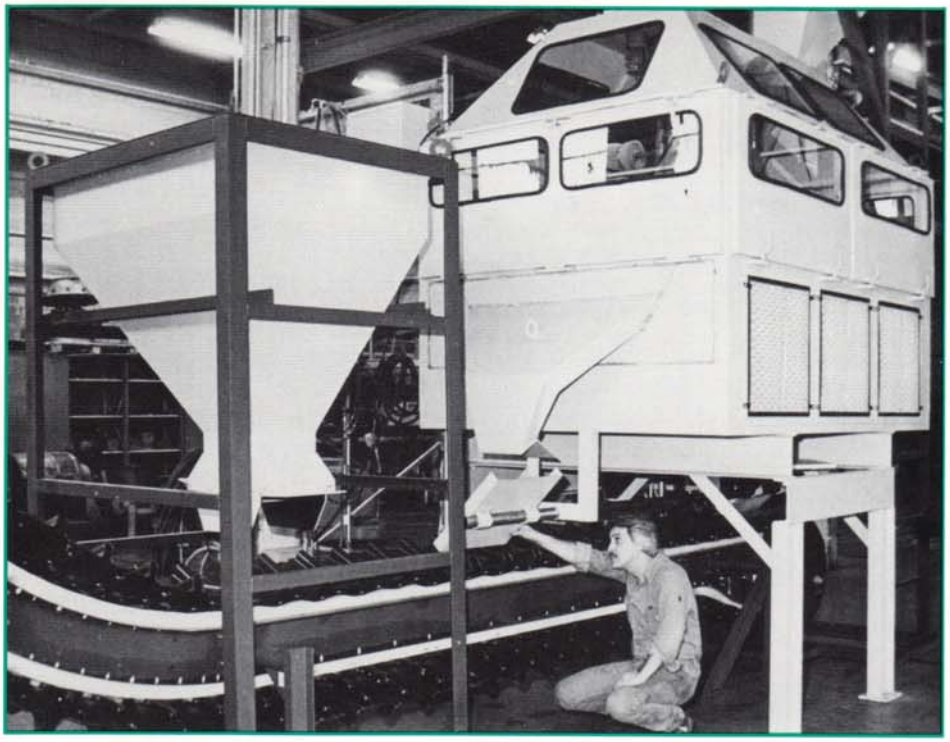
AN OVERVIEW

The purpose of burning any fuel in a steam boiler is to convert the heat of combustion into a different form of energy — pressurized steam. The steam then drives turbines to generate electrical power. As boilers became larger — in response to ever-increasing electrical demands — and, coal became the most abundant and economical form of fuel, the practice of burning pulverized coal resulted. There are now three basic techniques commonly used for burning coal in electric utility furnaces. The two techniques used generally at larger utilities include Pulverized-Coal Firing (PF) and, Cyclone Furnaces. The third technique — Mechanical Stokers — is used by smaller utilities. A fourth technique — Fluidized Bed Combustion — is now in the late stages of development. Common to each technique is the use of crushed coal.

Major pollutants resulting from burning coal include: ash from shale content; inorganic sulfur from the mineral, pyrite; organic sulfur; and, sludge from contaminants in the water caused by the use of wet Flue Gas Desulfurization (FGD) methods. As coal is burned, some of the ash is carried up the chimney as a finely divided fluffy dust which mixes with the other products of combustion. In the air currents, the ash flies. Hence the term "fly ash." In some boiler furnaces, about 50 percent of the ash in the coal goes up the stack (or flue). Up to 99% of the ash may have to be removed from the stack gas before discharge to the atmosphere to comply with emission standards for particulate matter. The 50 percent that does not go up the flue falls to the floor of the chamber for collection — a portion as molten slag and the rest as bottom ash. In a manner similar to fly ash, sulfur oxides are being vented into the atmosphere by coal burning plants. The Clean Air Act of 1970 established maximum levels for sulfur compounds and particulate matter (fly ash) in stack gases. This forced plants to use the more expensive low sulfur coals, and to seek methods of removing pyrite from coal prior to combustion so the more economical, high sulfur coals could be used.



SEVERITY OF THE CLIMB FROM under the separator and the twisting path taken by the Serpentix before discharging into the hopper above the separator is graphically shown, at right. Minimal plant space was required due to the conveyor's ability to climb sharply and, to make both horizontal and helical turns.



SAMPLES OF CRUSHED, UNCLEANED coal are fed onto the conveyor via the large hopper. Under the separator, a technician inspects the diverter shield and the larger outlet leading from the separator to the shield. Coal samples are fed through the separator continuously until testing of each sample is completed.

trol efforts becomes highly contaminated. The contaminants are removed as sludge which must be processed, treated then landfilled or incinerated.

Use of the American Davidson dry separator was expected to save utilities many of the expenses associated with FGD equipment, its operation and its maintenance, Borsattino said. Ash generation could be reduced greatly since shale not removed in the prewash could be removed almost entirely before the coal is burned. Also, in some cases, utilities could eliminate or sharply reduce their water contamination and sludge treatment/disposal problems.

Another significant benefit could be that utilities might use high sulfur coals which, in many cases, could eliminate high transportation costs of shipping low sulfur coals from remote locations. Production models of the American Davidson separators are expected to have cleaning capacities ranging up to 30 tph.

"A closed loop was necessary on the separator tested in Dearborn," Magill explained, "to ensure an extremely high degree of testing reliability and accuracy for a wide range of coal types without processing huge volumes of material. The Continuous Path Serpentix was the only conveyor that could give us a true closed loop within the plant space available."

The conveyor's 26″ wide convoluted belt, driven at 12 feet per minute by a three horsepower motor, delivered five tons of crushed coal per hour from floor level through a 360-degree climb. It discharged 14 feet above floor level into a hopper feeding the separator, Magill said.

After separation, the material cleaned from the coal is fed back onto the Serpentix conveyor under the separator. The material could then be diverted into bins alongside the conveyor for measuring or testing, he said. Or, it could be left on the conveyor for intermixing with the coal just cleaned and coal being fed onto the belt from the overhead hopper.

Without the Continuous Path Serpentix Conveyor, Magill explained, at least three conventional conveyors plus an elevator would have been necessary. The resulting transfer points would have made it impossible to control the dust and dirt, or to obtain any degree of accuracy and reliability in our tests due to degradation of the coal, he added.

The 10 tph dry separator in Dearborn is a refined version of a separator built by a French company, later acquired by The Davidson Group. The separator proved that a dry process for separating materials of different densities was possible. This process is based on a 50 year old patent owned by the company.

The French dry separator has been successfully used in numerous installations throughout Europe and Africa for separating such diverse materials as shale from coal, stones and shells from coffee beans, insulation from copper wire, metal from slag, metal ores from dirt and, for separating mixed materials into distinct products.

American Davidson is the world's largest manufacturer of heavy duty custom fans for the process industries, and one of the largest suppliers of industrial air pre-heaters and fluid couplings. Fifty percent of its products go to electrical utilities and 20 percent to the mining industry. The remainder goes to the steel industry, chemical plants, cement plants and foundries. ■