A way to pump lumps of coal

In the United States, a pipeline carries more than 4 million tonnes of pulverized coal a year from a mine in Arizona to a power station 439 km away.

In Tasmania, a pipeline carries finely crushed iron ore 85 km from a concentrator at Savage River to Port Latta on the north coast.

Around the world the number of pipelines for transporting solid materials is growing. A 1658-km coal pipeline, with a capacity of 25 million tonnes a year, is being planned in America. It will run from a mine in Wyoming to a power station in Arkansas.

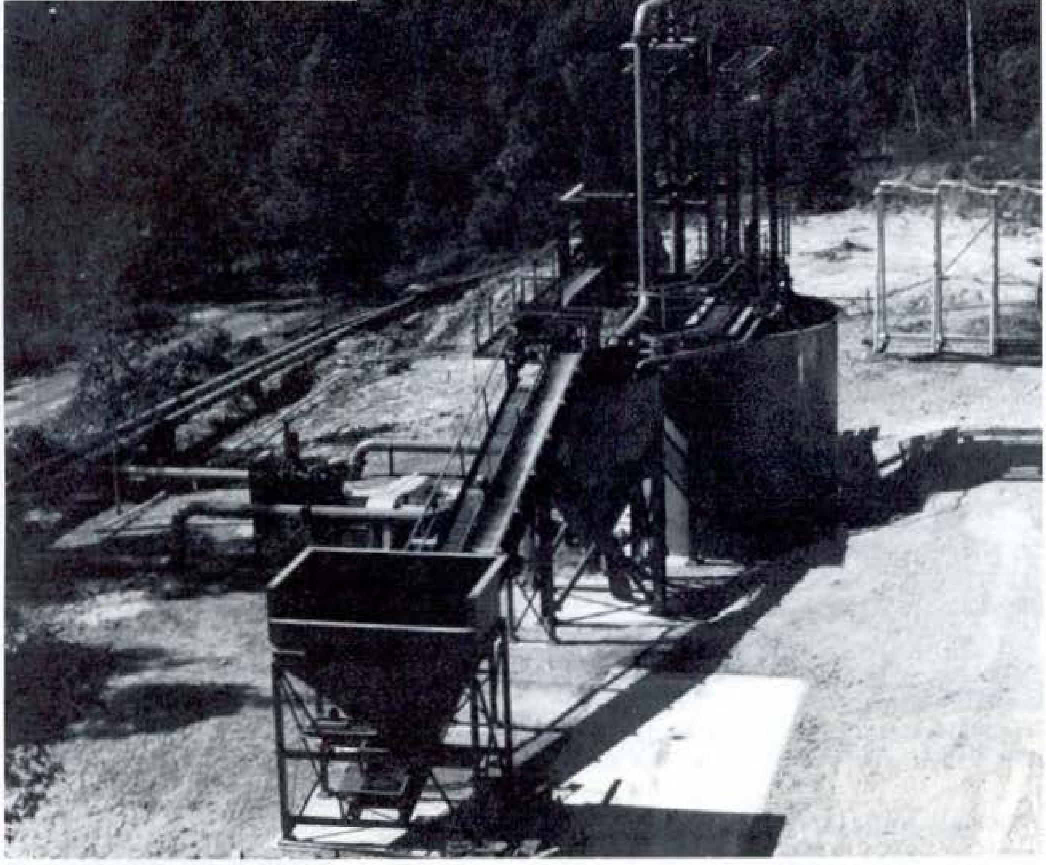
People are recognizing the advantages, economic and environmental, that a pipeline has over its alternatives. Railways cost more to build and operate. Road haulage increases noise levels, and a rise in the number of heavy vehicles increases the danger of traffic accidents. Conveyor belts are also noisy, and dusty.

A pipeline can be very inconspicuous: it isn't noisy and it can be buried underground.

The pipelines mentioned have one distinct disadvantage in common, however — the material carried needs to be finely divided and dispersed in a water carrier.

Coarse coal can be piped, but at a high penalty. Russia has built a 34-km pipeline that transports 10-cm lumps. But to prevent the coal sinking to the bottom, and blocking the pipe, it must operate at high speed (many metres per second) to maintain sufficient turbulence. This requires high pressure gradients, and therefore high energy losses. Wear of the pumps and of the pipe's interior is also a problem at those speeds.

And any interruption to the power supply creates a risk of blockage. A coal pipeline under the Thames became



The pilot plant near Newcastle. Its 300-mm-diameter pipeline forms a loop 2 km long.

blocked in this way in 1924 (and it's still in the same state today).

Finely ground coal less than 1 mm in diameter can be carried at low speed (1 m per sec.) and low energy requirements (about 0·05 kWh per tonne per km). However, fine coal has two drawbacks: it requires energy to grind it; and, more importantly, it creates difficulty at the other end of the pipeline in separating the coal from its water carrier. The latter's not so much of a problem when the coal is to be burnt in a power station where ample waste heat is available.

In Australia, however, most of the coal mined is for export, and has to be carried by sea. To ensure a stable cargo, shipping authorities require a moisture content of less than 10%, which would pose a serious dewatering problem with a fine coal.

Engineers at the CSIRO Division of Mineral Engineering have now demonstrated that coarse coal can be carried by pipeline under conditions usual for the transport of fine coal. Dewatering the coarse material simply calls for passing the material over a screen. Moreover, the pipeline can be shut down without any risk of blockage. They have halted the operation of an experimental pipeline at the Division and restarted it again with ease 3 months later.

A full-scale pilot plant has been operating since September 1984 at the Wallsend Borehole Colliery near Newcastle, N.S.W. This facility, funded by the National Energy Research Development and Demonstration Program, comprises a 2-km loop of 300-mm pipe, and is capable of carrying 300 tonnes of coal per hour.

The key to the success of the CSIRO approach is to suspend the coarse coal, not in water, but in a 'mayonnaise' of water mixed about 50:50 with powdered coal. The mixture will support, without settling, particles up to 20 mm in diameter.

The proportion of coarse coal (more than 1 mm in diameter) carried in the pipe can approach 40% of the total volume. This figure means that the pipeline has a carrying capacity the same as existing pipelines of the same diameter, but the dewatering of the product is far cheaper and faster.

Leader of the CSIRO group, Mr David McCarthy, believes the technique would be suitable for short-haul applications, such as off-shore loading of ships. The carrier fraction could be returned to shore for re-use.

For long-distance pipelines, recycling the carrier wouldn't be feasible, and so the carrier's energy content would need to be recovered by dewatering and briquetting, or by burning it, still wet, in a nearby power station. Alternatively, the carrier could be made up of the clay materials normally associated with the coal, rather than of coal itself, and washed out at the point of delivery.

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Prediction of pressure gradients for the transport of coarse coal in a fine coal carrier. C.F. Lockyear, L. Pullum, R.A. Duckworth, M.H. Littlejohn, and J.A. Lenard. *Proceedings, Transportation Conference, Institution of Engineers, Australia, Perth, October–November 1984.*

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