Treating black coal to remove its mineral matter.

contributes to the low cost of the process is the ease with which the working solutions can be regenerated. Dissolved minerals build up in the solutions, but simply adding lime precipitates the minerals as insoluble calcium salts, and prepares the caustic soda for re-use.

The calcium-rich sediment can be safely disposed of, or it could be useful in the making of Portland cement.

Footnote: Scientists from the CSIRO Division of Energy Technology have recently tested a coal–oil mixture in a medium-speed diesel engine using demineralized brown coal. The test results show that stretching out oil this way still has some way to go before it becomes economical .

Andrew Bell

The preparation of clean coal. A.B. Waugh and K. McG. Bowling. *Proceedings, Australian Coal Science Conference, Churchill, Vic., December 1984.*

Preparation and performance of brown coal/oil mixtures as a fuel for diesel engines. P.C. Bandopadhayay, R.J. Downie, W.R. Read, and J.J. Kowalczewski. *CSIRO Division of Energy Technology, Technical Report* No. 5, 1985.

Improvements in the baghouse

Passing a smoky stream of exhaust gas through a filter appears a simple way of controlling pollution. It works in a similar way to the household vacuum cleaner, where the dirty air-stream is forced through a fabric bag to filter out the dust.

But scientists at the CSIRO Division of Textile Physics are finding that there's more to the process than meets the eye, as they continue several years of research into improving the performance of the filters used in industrial installations.

Fabric filters are commonly used for pollution control and product recovery in a number of Australian mining and metallurgical industries, such as lead, zinc, copper, and aluminium smelting, and in iron and steel production. The food, chemical, and vehicle-building industries also make widespread use of them.

Stricter emission standards have encouraged their adoption. Filter bags are very efficient, typically trapping 99·9% of the particles in an exhaust stream. This is a better figure than can be obtained with gas scrubbers and cyclones. Electrostatic precipitators can match this performance under optimum conditions, but the fly ash from the combustion of certain Australian coals, particularly some in Queensland and New South Wales, has shown a reluctance to be caught this way.

For this reason, the Electricity Commission of New South Wales has installed the largest fabric filter set in the world at its Eraring power station north of Sydney. The 'baghouse', costing $50 million, contains 200 000 filter bags each 5·5 m long and 16 cm in diameter. Some 4000 cu. m of gas pass through the filters each second. Fabric filters will also be employed at the Commission's new Bayswater and Mount Piper power stations, and the Queensland Electricity Generating Board has recently installed fabric filters at three of its power stations.

Effective though they are, fabric filters are not yet trouble-free, and this is where the Division of Textile Physics comes in.

Like a clogged-up vacuum cleaner, a clogged filter bag performs woefully, and effective ways of cleaning the bags are of particular interest to Dr Bill Humphries and his Divisional colleagues.

Normally, fabric filters first capture dust particles at the surface of the cloth. Then particles agglomerate to form a porous dust cake, which itself acts as the filter and captures more particles. The cake builds up until the pressure drop across the filter becomes intolerable. Cleaning is needed.

A common cleaning method is pneumatic shaking, in which a short pulse of compressed air is injected into the filter bag. This rapidly accelerates the cloth, causing the dust cake to be thrown off.

If the cleaning is incomplete, a considerable pressure drop remains across the filter. This creates a need for extra power to force the gases through; but, more importantly, it limits the total flow rate of the exhaust stream. In turn, the production capacity of the system creating the gas flow is itself constrained. The plant manager is faced with a real bottleneck.

To examine the cleaning process in detail, the CSIRO researchers have developed instruments for measuring how strongly dust adheres to the fabric and devised apparatus that measures the rapid accelerations imparted

The baghouse at Eraring power station. With 200 000 filter bags, it's the largest in the world.

by the air blast during cleaning.

The latter — a non-contact system — uses an infra-red beam aimed at the bag. The reflected radiation is detected and, since the strength of the beam falls off with distance, its intensity provides a measure of the position of the bag.

A digital oscilloscope and computer complete the system, which can measure the very high accelerations (about 100 times that of gravity) that the bag undergoes in the first 10 milliseconds of the compressed air impulse. Knowing the acceleration, the scientists can then simply calculate the force acting to dislodge the dust cake.

They are using the information to develop a mathematical model that describes the complex relation beween the dust build-up on the fabric and the pressure drop across it. This will help process engineers to maximize production rates, and also choose the most efficient cleaning regimen compatible with low wear on the filter fabric.

Fly ashes produced from the burning of coal are chemically reactive, and if left on the fabric can bond together into a solid mass that permanently clogs the filter. In this case, it is therefore beneficial to make sure that the filter is as free as possible of adhering particles when it is periodically cleaned (usually every half hour or so).

Although the extra beating the filter bag then gets tends to shorten its life (a bag typically costs $30 and lasts 15 000 hours), this is much preferred to a cemented-up filter.

The researchers have found another way of increasing gas flow through the filters. If the dust particles are electrostatically charged before they enter the filter, then the filter's resistance to flow falls substantially, they have found. Apparently charged particles form a more porous dust cake than uncharged ones.

This finding has been put to good use at Mt Isa, where Mt Isa Mines Ltd operates a large baghouse installation that filters hot gases from the sinter plant and blast furnace of the lead smelter. In collaboration with the company, the scientists installed a test rig that showed that a corona discharge (produced by a 50 000-volt electrode within the gas stream) could increase flow rates through the filters by at least 40%.

The company has now begun to apply the method to its baghouse, and is finding that capacity there has been increased, which in turn is helping to increase lead production.

Another outcome of installing the corona discharge equipment is that accumulated dust can be removed from the filter bags more easily. This may well result in longer life for the filter bag.

Dr Humphries is also using the Division's textile production facilities to investigate the performance of new filter cloth materials.

An industrial partner is collaborating in work under way to develop a seamless filter bag made with a fibre that can withstand higher temperatures. Early results suggest that the new filters would perform well in power station installations. The bags are easier and cheaper to produce, and lead to reduced pressure drops.

Andrew Bell

Fabric filtration for coal-fired boilers: dust dislodgement in pulse-jet filters. W. Humphries and J.J. Madden. *Filtration and Separation*, 1983, **20**, 40–3.

The effect of particle precharging on the performance of a fabric filter collecting lead smelter dust. W. Humphries, J.J. Madden, and M. Miceli. *Aerosol Science and Technology*, 1984, **3**, 381–95.