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ACARP MATTERS

INDUSTRY INVESTS $900,000 IN DRAGLINE MACHINE HOUSE COOLING AND DUST CONTROL

The Australian coal industry has invested almost $900,000 in a series of dragline machine house cooling and dust control projects since 2006.

Inefficient dust filtration systems and elevated temperatures within the machine house have been linked to an increased failure rate of DC motors in the primary drive systems and deterioration of other electrical and electronic equipment. A change in overburden removal practices is contributing to this situation. Shorter dig/swing/dump cycles and higher suspended loads are resulting in increased temperatures inside the machine house. In addition, the growing use of inpit benches needed to uncover deeper coal seams is exacerbating the hot, dusty conditions.

Dusty conditions

Fan Layout

Ventilation systems need to provide cooling air to all the right places and the filtration systems need to ensure that that air is clean. All dragline ventilation systems have filtration to remove dust from the air before it is discharged into the house. The effectiveness of the systems varies particularly in relation to their basic design and the level of maintenance/cleaning effort which mines are prepared to undertake. In addition to the requirement to supply clean air, a positive pressure differential must be maintained in the machine house to prevent dust from being drawn back in through the exhaust louvres.

ACARP engaged BMT WBM to complete three major projects to address these issues – dragline machine house cooling and dust control, dragline machine house dust control, and field testing of alternative cartridge technologies.

In the first project called Dragline Machine House Cooling and Dust Control, researchers looked at overheating of equipment within the machine house and how to predict it using computational fluid dynamics (CFD). Using site measurements to provide a basis for calibrating the analytical model, the necessary computational tools to predict cooling behaviour within a dragline machine house were developed and proven in this project. Towards the end of the first project, preliminary research into dust control was started.

This research into dust control continued in earnest in the second project. The researchers found that typical dust loads for the outside environments where the draglines were working varied between 3,000 and 30,000 mg/m2/day. Inside the dragline machine houses, dust fallout levels were generally found to be between five per cent and 20 per cent of the outside levels, depending on the effectiveness of the filtration system on the dragline at the time. These figures equate to a 95 per cent filtration efficiency for the better performing systems through to only 80 per cent for the majority off systems. This highlighted that there is a considerable opportunity to achieve improvements even with the existing systems.

In performing the research, draglines were selected so that a range of different dust filtration systems could be investigated in order to establish their benefits and disadvantages in relation to intake air configurations, fan and motor arrangements,

dust filtration elements and scavenge system layouts. System maintenance and cleaning were identified as significant issues in terms of their effect on filtration performance and a range of improvements to existing designs were proposed.

Moths were found to be a major problem. They clogged up intake screens and scavenge systems on the filtration units and reduced their performance. Some practical means of addressing this problem include not have lighting too close to the intakes of the filtration units because it attracts the moths and, when modifying ventilation systems, maintainers should make the intake screens as large as possible so the moths can't get trapped so easily onto the screen mesh.

Project Leader Bruce Manser said several design concepts involving alternative technologies were investigated with a view to establishing whether any particular technology could be expected to yield a dramatic improvement in overall dust filtration efficiency compared with the existing technologies.

"Primarily these assessments attempted to test the practicality for implementation on a dragline, taking into account the large volumes of air that need to be handled for cooling the machinery within the machine house of a dragline as well as the available 'real estate' on the roof of the dragline where air handling and dust control equipment need to be located," he said.

"We concluded that a cartridge style system had the greatest potential for achieving consistently improved air quality in the dragline machine house. To be viable on a dragline we felt that the normal operational pressure drop across the filters would need to be decreased somewhat from standard cartridge filter design practice in order to bring the fan power consumption requirements within acceptable limits."

Bruce said a third project was launched to identify whether an alternative cartridge filter design with improved flow and pressure drop characteristics, compared to those normally used in cartridge dust filtration systems could be developed and then tested on an operating shovel. With that objective in mind, a mine with an operating P&H shovel, fitted with an AirScrubPro™ system (which uses cartridges), was identified for site testing. Some conventional cartridge filters were also sent to Germany for laboratory testing.

"On completion of the first stage of laboratory testing, it became evident that a significant reduction in pressure drop across a clean filter was unlikely to be realised by simply attempting to develop an alternative filter cartridge design," he said.

"The focus of the third project then moved away from the attempt to design, manufacture and test an alternative cartridge filter design to the field testing of the existing cartridge filters already being used in the standard Air Scrub Pro™ system to establish how quickly the pressure drop across the filter changed with time as the filter elements tended to clog."

ACARP Project Monitor Tony Egan said the findings from the three BMT WBM projects had provided the Australian coal industry with a better understanding of dragline cooling and dust control issues and further provided operators with tools to assess the potential for improving the situation on a particular machine experiencing cooling or dust issues. This has particular relevant for operators planning an overhaul or replacement of the ventilation system on a dragline in order to get the most benefit from the works.

"In the second project, a variety of possible basic concepts for implementing a cartridge filtration system on a dragline was provided, with one of the preferred concepts proposed for a M8050 dragline being identified as the BMT WBM horizontal 'cartridge' concept," he said.

"In the third project, BMT WBM has provided a revised design concept depicting a simplification of the earlier concept that attempts to minimise the overall weight of the system as well as keep the implementation of the cartridge technology at the lowest possible level of complexity.

"ACARP should consider supporting a trial if a suitable site commits to the installation, making a project viable."

Tony said that apart from the original research focus of improving ventilation and filtration on draglines, the knowledge gained from the cartridge filter testing could now be used by sites to better maintain and operate their existing shovels and to guide any decisions they may make in modifying their existing shovel ventilation systems to enhance filtration performance.

Callide - Main Filter Fan

Callide - Roof Filter House

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