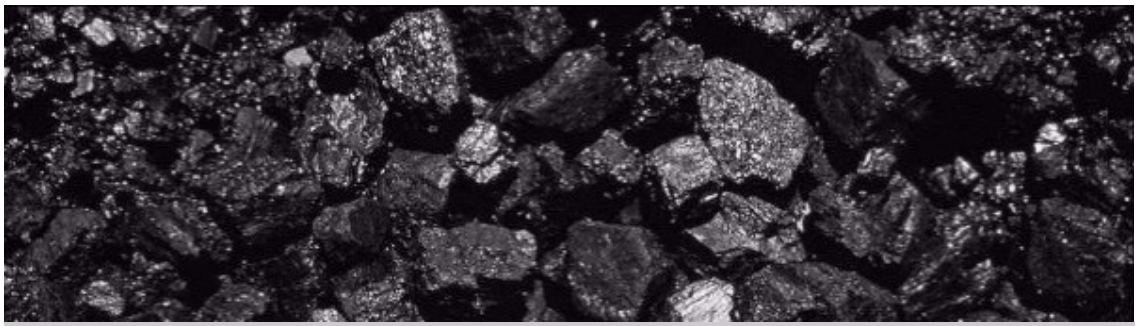
ACARP Matters



State-of-the-Art Diesel Vehicle Exhaust Filter System Ready For Commercialisation

Collaboration between researchers, the Australian coal industry, original equipment manufacturers and regulators has delivered a 'commercial-ready' exhaust filter system for underground diesel vehicles.

In Australian coal mines, diesel vehicles are the primary means of transporting workers and materials underground. However, diesel particulate matter (DPM) from vehicle exhaust is a potential health hazard, particularly given the confined conditions underground. To address this issue, disposable filter systems are installed on diesel vehicles. While these filters are efficient at removing DPM, they represent a significant operating cost (up to $164 million per annum in New South Wales alone) and can be difficult to install correctly.

The wall-flow diesel oxidation catalyst and filter system, developed by Orbital Australia, traps diesel particulate emissions using the porous structure of the filter element's ceramic substrate. Once trapped, the particulate components are oxidised through regular cycling of elevated temperature and/or catalytic reactions.

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The wall-flow DPF has two key advantages over disposable filter systems: its self generating filter is forecast to reduce operating costs by 80% over three years and its tamper proof design mitigates the risk of operating unfiltered diesel equipment in poorly ventilated areas. In addition, the system has the potential to be retrofitted onto existing equipment or incorporated into new OEM designs.

ACARP funded two consecutive projects to progress this technology: development of a proof-of-concept wall-flow DPF system and industrialisation of the system. In the first project, the proof-of-concept system demonstrated a reduction in DPM emissions and its robustness was proven on a load, haul, dump (LHD) machine. The industrialisation project built on the advances made in the preceding project. Researchers addressed design elements (DPF, pipework and monitoring), conducted on engine validation and durability testing, undertook field trials at Centennial Coal's Newstan operations and refined monitoring system software. Emissions compliance testing and safety system testing were also completed.

Two OEMs – PPK Group and Sandvik – made test engines available for the researchers to use and provided support at no cost to the project. PPK also supported the final site trial.

Orbital Australia General Manager – Engineering Services, Nick Coplin, said the second project demonstrated that the proof-of-concept wall-flow DPF system design could be industrialised to meet industry needs and satisfy regulatory and in-service requirements. "We demonstrated that emissions reduction efficiencies for diesel particulate matter could be carried forward from proof-of-concept to the industrialised unit and that the technical approach we took to predominantly insulate and only partly water cool the DPF design improved the system's thermal efficiency and performance," he said.

"The industrialised system demonstrated acceptable tolerance against soot build up, with no evidence of uncontrolled thermal runaway as a consequence of operations, and acceptable tolerance to infield operational issues, such as vibration, shock loading and general use.

"Other key outcomes included knowledge about NO2 formation and abatement (including the role of the wet scrubber), information about fuels compatibility, particulate speciation (including chemistry, size and distribution information), and industry specific drive cycles for the LHD machine, which can be used to characterise real world performance of the machine in underground coal mining operations."

The project faced two regulatory challenges. The first was that part way through, the regulator advised that Orbital would not be allowed to self certify the DPF system and, as a consequence, the project scope was revised in consultation with the project industry monitors. ACARP accepted that Orbital had pre-certified the system and an OEM paid for a New South

Wales laboratory to complete the certification work. The DPF system passed the emissions and temperature tests.

The second challenge was obtaining approval for trials to be undertaken in outbye areas underground at an operational mine site. Gaining approval for this was stalled, so the project stakeholders worked together to find an alternate site where the project objectives could be verified under similar operational conditions.

Nick said the wall-flow DPF was an example of an ACARP research projects that had reached commercial readiness and it illustrated what was required to progress a project to that stage. The process generated a number of key learnings. “The number one learning is the importance of engaging with the regulator. If you are planning on making step change, the regulator needs to be aware of that from very early on in the project, so they can walk the road with you,” he said. “This is particularly important when there are question marks around new regulation that may not have been tested previously. Everybody goes into these things with the best of intentions but, at the end of the day, technology may tell you whether your perceived risks or perceived plan are actually correct.

“Another learning is around how to leverage partnerships and collaboration for the greater good or greater commercial benefit. This particular project was fortunate to have two OEMs – PPK and Sandvik – that contributed equipment, people support and effort in-kind. This meant we were able to avert additional costs to the project, such as acquiring the engine, design expertise and support like that.”

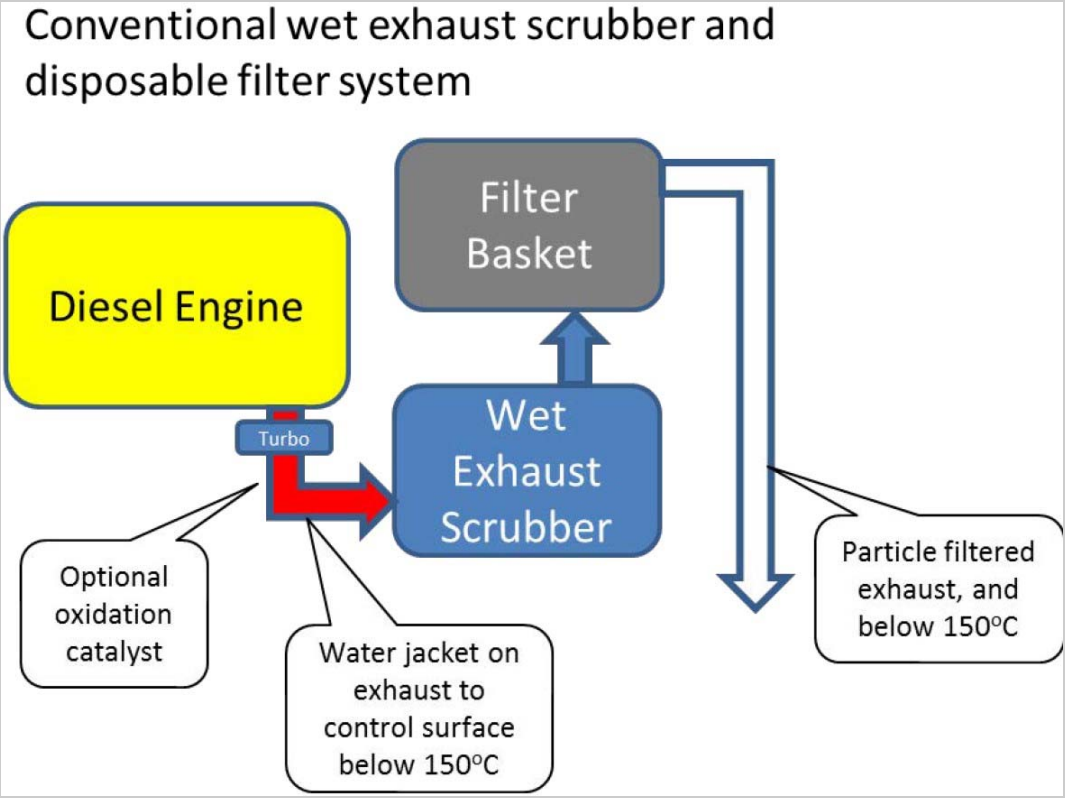
ACARP industry monitor and General Manager of Engineering for Centennial Coal, Greg Briggs, said a key impetus for the project was industry’s requirement for cleaner, more efficient engines to protect the health and welfare of workers. “Protection of workers required lower DPM. The wall-flow DPF removes people from handling fibre filters that are full of soot and potentially harmful contaminants,” he said. “The added benefit is the lower cost to run these machines as there is no need to change fibre filters and the engines run more efficiently throughout the whole duty cycle. This will mean lower overall costs and a machine that has less maintenance requirements.”

Greg said there was strong interest in the wall-flow DPF technology across the Australian coal industry. “There have been presentations done at mining forums and seminars, with a great deal of interest from mining companies, test houses and regulators. I think everyone could see the benefit of this technology, once it passed all the hurdles of testing and then onto commercialisation,” he said. “The next step is to complete independent regulatory testing, which we are all confident of passing, then a commercialisation trial, which we hope will occur this year.”

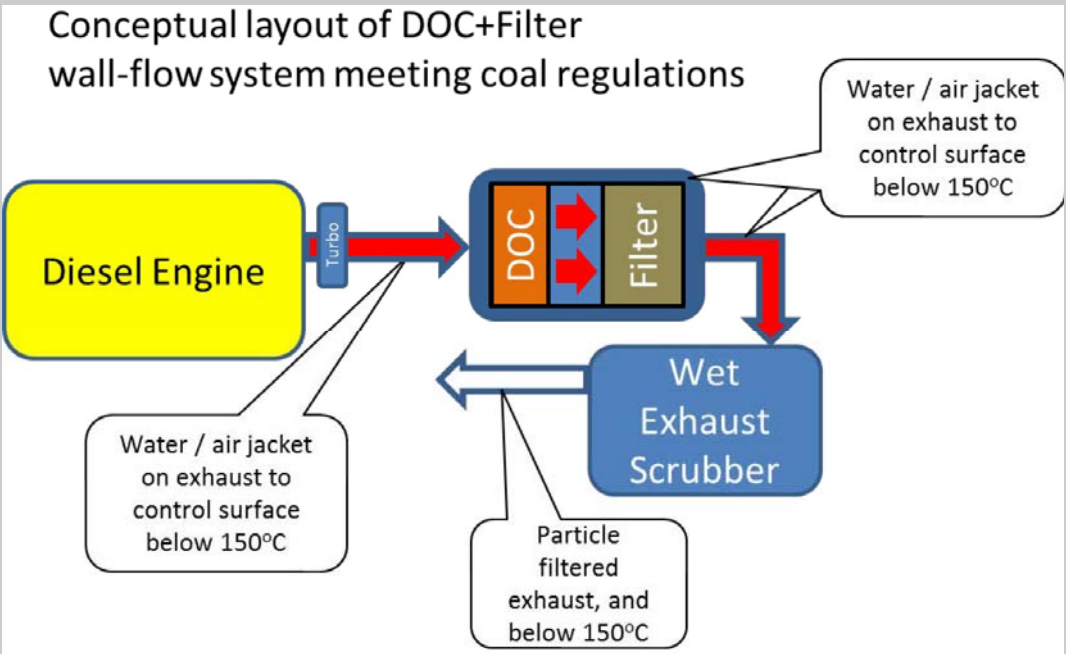
While there is strong interest in advancing battery vehicle technology in Australia, the wall-flow fitment offers a clean technology in the very near future which is easily retrofitted to any machine.

“I expect that this technology will operate for many years, until such time that a further technology – be it battery or an alternative – surpasses diesel engine systems.”

PPK COALTRAM LHD with NSW DES compliant disposable (wet element) system (and small oxidation catalyst) after treatment system



Conventional wet exhaust scrubber and disposable filter system



Proposed conceptual wall-flow DPF system

For further information:

The final report is available from the ACARP website. Report number C26070

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