Disposable Diesel Exhaust Filters Used In The Australian Underground Coal Mining Industry

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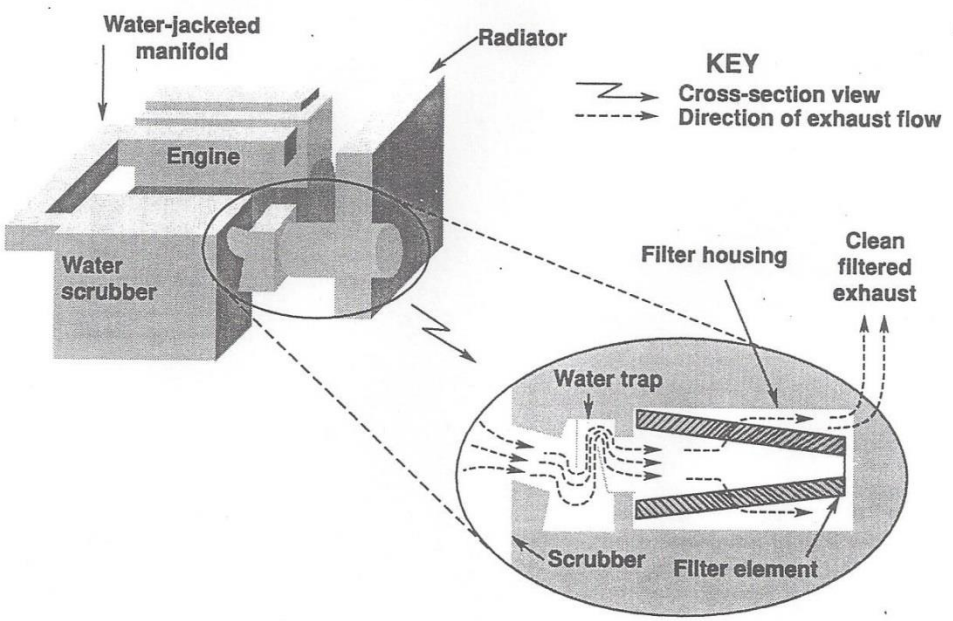
Disposable Diesel Exhaust Filters

- Developed by US BOM in 1991
- Based on Donaldson truck air filter element
- Initial trials on Ram Car at Skyline Mine (95% reduction in workplace DPM). Testing based on in-mine sampling using personal aerosol samplers with gravimetric analysis

Schematic of Original DDEFs



Source: US BOM 1992

DDEFs in Australia

- Microfresh Filters (now Freudenberg Filtration Technologies) co - developed first DDEF with BHP Steel Illawarra Coal
- Non flammable material (as distinct from initial material used in USA)
- A 85% reduction in workplace DPM exposure levels measured using simulated in-mine sampling
- Introduced into coal mines in 1995

DDEFs in Australia (cont)

- Filters last from 8 -50 hours depending on type
- Cost $100 - $250 AUD (€68 - €170)
- Not a statutory requirement

Current Filter Types

Media	Approximate Initial Particle Filtration Efficiency (at 25 nm)	Other Attributes
Electrostatically charged Polypropylene	95%	Low backpressure, good water pass-through, extended life
Paper (Cellulose) / fibreglass	50%	Low initial backpressure but then spikes quickly, Short life
Fibreglass matting	20%	Very long life due to inefficiency, high unit cost
Polyester	90%	Reasonable efficiency, moderate life, high unit cost
Electrostatically charged Co-polymer	95%	Low backpressure, good water pass-through, extended life (about double that of Polypropylene)

New & Used DDEF Media

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EIMCO Loader

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Personnel Transporter

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Twin Filter System

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Coal Tram

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Historical DDEF Issues

- In USA a build up of DPM lead to a fire in several vehicles (cellulose filters) due to loss of scrubber water
- Maintenance of seals and canisters important
- Change out of filters needs to be on performance not operator perceptions
- Significant ongoing cost but very effective in controlling DPM in coal mines

Current DDEF Issues

- Search for cost savings have resulted in numerous filter materials being used (are current evaluation procedures appropriate?)

- Some operations have adopted the approach that DDEFs will solve all their DPM issues - not willing to invest in other control technologies like emissions based maintenance which would reduce employee exposures AND extend the life of filters

Development of DDEF Efficiency Test Procedures in Australia

- 1993: In – mine sampling using personal DPM samplers & gravimetric analysis
- 2000: Static test using a R & P 5100 EC analyser developed as part of filter pleat research
- 2000's: Supplier testing in field trials using laser light scattering instrumentation for EC
- >2012: Particle number & size investigations by at least one supplier & several researchers

Surface Test Tunnel (1993 -4)

Source: B Davies

Underground Test Tunnel (1994)

Source: B Davies

Historical Efficiency Testing in Australia

Source: B Davies

R&P Elemental Carbon Analyser

Source: B Davies

Initial Source of Emissions for Efficiency Testing (Cat 3304)

Source: B Davies

Current Testing Requirements

- % Efficiency using ISO 8 point cycle with EC analysis by laser light scattering & NIOSH method 5040

- Duration test over 6 hours minimum at load point 5 on ISO test cycle

Acceptance Criteria

- % Efficiency – no actual limit set. If compared to another "in use" filter the new filter must provide equivalent or better efficiency

- Duration test – filter must last a minimum of 6 hours as determined by breakthrough or backpressure

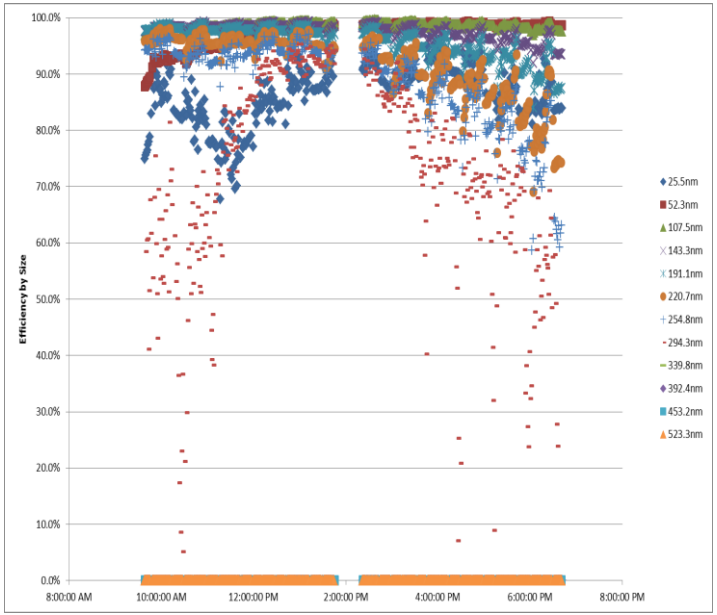
Current Workplace Exposure Limits for DPM in Coal Mines

- No statutory limit (ALARP)
- Guideline of 0.1mg/m^3 EC based on AIOH recommendation
- Some companies implementing lower standard
- No limit on particle number (but what is an appropriate health based limit for worker exposure in coal mines?)

Research in Past 5 years

- Focus in recent years has been on the longevity & cost reduction of DDEFs
- Some manufacturers looking at particle size & number
- Investigations into effectiveness of current testing procedures of respiratory protective equipment (RPE) used to control DPM

Australian vs Imported Filter



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% Efficiency at varying particle sizes over time

What is required

- A standard test procedure for the testing of all DDEFs in terms of downstream worker health protection
- Agreed acceptance limits based on health outcomes (EC and/or particle number?)
- Legislation by statutory authorities to ensure compliance

Current UoW Project

- Is it possible to have a stationary test procedure for DDEFs that can link the outcomes to downstream worker health protection as distinct from comparison testing?
- What is the best measurement metric for such a test (EC and/or particle number)?

Current UoW Project

- What are the appropriate health based acceptance limits for use in coal mines (EC and/or PN)?
- Can these limits be used for RPE?
- International partners – Is it possible to build on past experience?

Summary

- DDEFs have been very effective in controlling workplace exposures to diesel particulate in coal mines
- Very expensive on an hour usage/$ basis
- Need for a more appropriate assessment methods linked to worker health effects

Questions