Diesel Particulate Filter
Maintenance

Manufacturers of Emission Controls Association

Southeast Diesel Collaborative
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How a Diesel Particulate Filter (DPF) Works

• A DPF forces the diesel exhaust through a ceramic wall with micro pores
• Gases and vapors pass through…the particles are almost all trapped inside the filter
• In addition, the soot itself forms a "cake" layer that provide additional filtration
Applications of DPF

- DPFs are typically packaged in a round shroud and are designed to replace the muffler.

On-Road Application

Non-Road Application

DPFs Require “Cleaning”

- Regeneration: Carbonaceous PM (Soot) collected in the filter must be periodically combusted to avoid high backpressure or damage to the filter.
  - Passive regeneration: uses a combination of exhaust heat and a catalyst to combust the soot
  - Active regeneration: uses a heat source such as an electrical heater, a flame based burner, or a catalytic burner to combust the soot

- Cleaning: Inorganic ash, which is not combustible, will collect in the DPF over time and require cleaning
  - Comes primarily from lubricating oil
  - Must be physically removed periodically
Inorganic Ash Content

- Sources
  - Phosphates and metal oxides (including zinc) from lubricating oils
  - Wear metals from the engine
  - Contaminants from the refining of biodiesel
- Inorganic ash is a hazardous material in California:
  - Zinc concentrations from California Waste Extraction Test exceed total and soluble threshold concentration limits set by California regulations
  - Ash may not be a hazardous material in other states
- Anything removed from a DPF can be characterized as a potential health hazard

Filter Maintenance: Out of the Air and Into a Hazardous Waste Facility

Captured in tail pipe . . .

Collected in filter bag . . .

Sealed in containers . . .

and sent to hazardous waste facility.
Cleaning Event

• Failure to clean a filter when necessary can potentially lead to:
  – Engine performance problems
  – Damage or destruction of the filter
  – Voiding the manufacturer’s warranty
  – More complex and expensive ash removal processes

• Approved filter cleaning is required:
  – To assess the filter is still in good working order
  – To maintain warranty coverage
  – To ensure safe practices around worker exposure and disposal

Fleet Manager Checklist

- CARB or EPA verified DPFs have specific application requirements including:
  • Minimum average exhaust temperature (determined through data logging)
  • Engine Application: on or non-road
  • Engine model year and emissions class
  • Engine displacement and/or horsepower.
Fleet Manager Checklist (cont.)

- Vehicle Downtime for Filter Cleaning can vary significantly depending on many factors
  - Ease of removal and replacement of the filter system
  - Use of “swing” filters
  - Location of filter cleaner
    - In your own shop
    - Using a filter cleaning service
    - Shipping a filter to a remote site for cleaning

- Owning your own cleaning machine
  - You become a Hazardous Waste Generator in California
  - Look for a machine that meets OSHA standards
  - Look for a machine that verifies that the filter is completely clean
  - A cleaning machine is an air toxics SOURCE and may require an air permit from your local or state air agency

Filter Cleaning Processes

<table>
<thead>
<tr>
<th>Level</th>
<th>Process</th>
<th>Time</th>
<th>Estimated Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Use compressed air jet and/or pulsed air to backflow material out of the filter.</td>
<td>0.5 – 1 hr</td>
<td>90-95%</td>
</tr>
<tr>
<td>2</td>
<td>Heat the filter in an oven, kiln, or other device to combust sticky soot, fuel, or lube oil.</td>
<td>4-8 hours</td>
<td>5-10%</td>
</tr>
<tr>
<td>3</td>
<td>Intensive treatment (usually proprietary). Required if too much ash has been accumulated through engine issue or neglect.</td>
<td>unknown</td>
<td>&lt;5%</td>
</tr>
<tr>
<td>4</td>
<td>Discard the filters</td>
<td></td>
<td>&lt; 1%</td>
</tr>
</tbody>
</table>
Filter Cleaning Options

<table>
<thead>
<tr>
<th>Description</th>
<th>Fleet Operation</th>
<th>Distributor Operation</th>
<th>Reconditioning Service</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>The Fleet owns and operates filter cleaning practice</td>
<td>Cleaning machine owned and operated by authorized organization. In shop and mobile services</td>
<td>Drop off or send in a dirty filter and pick up or receive a clean one. “Recondition model”</td>
</tr>
<tr>
<td>Pros</td>
<td>Maximize cleaner availability to minimize downtime, Keep filters on site, Well suited for large fleets</td>
<td>Local expert handles all the aspects of cleaning</td>
<td>Minimum capital and resource investment (no swing filters, no</td>
</tr>
<tr>
<td>Cons</td>
<td>Fleet must be responsible for: Personnel training, Maintenance and repair, Filter assessment, Hazardous material storage and disposal, May not be able to clean all filters.</td>
<td>Engine may be ‘down’ while filter is being cleaned, Swing or spare filters may be required.</td>
<td>Not available in all areas</td>
</tr>
</tbody>
</table>

Other Diesel Retrofit Maintenance Items

- **DPFs**
  - Periodic inspections should include:
    - warning lights from backpressure monitor
    - mounting brackets & clamps
    - presence of soot in the tailpipe
    - condensation in tubing associated with pressure sensors/monitors

- **DOCs**
  - Generally maintenance free; periodic inspections recommended

- **Crankcase Filters**
  - Filter change generally required at normal oil change intervals