DESIGN AND DEVELOPMENT OF MULTI-LAYER EXHAUST GAS FILTER ATTACHMENT IN HEAVY-DUTY DIESEL VEHICLE TO CONTROL AIR POLLUTION

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Abstract : In this work, the effect of using a Exhaust filter on the overall vehicle exhaust emissions was evaluated. A Exhaust filter is a South African patented diesel particulate filter designed to operate as a secondary diesel filter for the removal of particulate contaminants up to 0.5 microns in size in the fuel prior to injection. It is believed that removal of contaminants prior to injection may improve the fuel injection efficiency, there by promoting efficient combustion, and thus resulting in reduced emissions and fuel consumption.

Keywords: Exhaust Gas Filter ,emission , activated charcoal ,smoke ,pollutants.

1. INTRODUCTION :

In the last decades great improvements have been made in terms of model comprehensiveness and accuracy in diesel filter. To promote the development of effective filter the various model are viewed, their characteristics and application are discussed. The diesel filter are device that physically capture diesel particulates to prevent their release to the atmosphere.

The design filter is used as attachment that show filtration efficiency apart from the inbuilt filter in vehicle. This attached filter have multilayer filter layers to deposit most effectively solid fraction of diesel particulates that left from existing filter i.e. likely to incorporate additional functional components targeting more solid diesel particulates and related black surface emission to reduce Air pollution Diesel particulate filters capture particle emissions through a combination of surface-type and deep-bed filtration mechanisms, such as diffuse deposition, inertial deposition, or flow-line interception. Collected particulates are removed from the filter, continuously or periodically, through thermal regeneration.

Diesel filters are very effective in controlling the solid part of PM emission, but maybe ineffective in controlling non-solid particulate fractions. Filters have been commercialized for selected retrofit applications and are on the verge of commercialization for highway light- and heavy-duty diesel engines.

I. WORKING OF EXHAUST GAS FILTER

Engine generates lots of pulsating noise as its exhaust valves open up to release highly pressurized gas. These thousands of little sound bursts per minute travel quickly down the exhaust pipe, and the noise bounces around to add up into a loud and potentially very annoying sound. The key, then, is to find a way to minimize this sound level before it exits the exhaust system.

[1] ENGINE NOISE

Mufflers are mounted in line with your exhaust pipes, typically towards the very end before the exhaust tips. They feature a series of perforated tubes or baffled chambers which are designed to tune and minimize your engine's sound output. As noise comes into the muffler, the sound waves bounce around against the baffles, creating opposing sound waves that cancel each other out. And much like an acoustical engineer designing an instrument or a concert hall, muffler manufacturers know how to "tune" the baffles and chambers to create a desired sonic effect. So whether you want to cut as much sound as possible or get a focused sound with an amplified growl range, there's a performance muffler out there foryou.

[2] BACK PRESSURE

Engine exhaust *back pressure* is defined as the exhaust gas pressure that is produced by the engine to overcome the hydraulic resistance of the exhaust system in order to discharge the gases into the atmosphere. For this discussion, the exhaust back pressure is the gage pressure in the exhaust system at the outlet of the exhaust turbine in turbocharged engines or the pressure at the outlet of the exhaust manifold in naturally aspirated engines.

[1] BACK PRESSURE LIMITS

All engines have a maximum allowable engine back pressure specified by the engine manufacturer. Operating the engine at excessive back pressure might invalidate the engine warranty. To facilitate retrofitting of existing engines with DPFs, especially using passive filter systems, emission control manufacturers and engine users have been requesting that engine manufacturers increase the maximum allowed back pressure limits on their engines.

Maximum Recommended Exhaust Back Pressure.

EngineSize	Back PressureLimit
Less than50 hp	40kPa
50-500 hp	20kPa
500 hp and above	10kPa

Engine manufacturers are usually much more conservative on their back pressure limits. For example, diesel generator set engines from Caterpillar, Cummins, John Deere and DDC/MTU.

[2] EFFECT OF INCREASED BACK PRESSURE

At increased back pressure levels, the engine has to compress the exhaust gases to a higher pressure which involves additional mechanical work and/or less energy extracted by the exhaust turbine which can affect intake manifold boost pressure. This can lead to an increase in fuel consumption, PM and CO emissions and exhaust temperature. Increased backpressure may affect the performance of the turbocharger, causing changes in the air-to-fuel ratio-usually enrichment— which may be a source of emissions and engine performance problems. The magnitude of the effect depends on the type of the charge air systems. Increased exhaust pressure may also prevent some exhaust gases from leaving the cylinder (especially in naturally aspirated engines), creating an internal exhaust gas recirculation (EGR) responsible for some NOx reduction. Slight NOx reductions reported with some DPF system, usually limited to 2-3% percent, are possibly explained by this effect. Excessive exhaust pressures can increase the likelihood of failure of turbocharger seals, resulting in oil leak agent the exhaust system. In systems with catalytic DPFs or other catalysts, such oil leak can also result in the catalyst deactivation by phosphorus and/or other catalyst poisons present in the oil. All engines have a maximum allowable engine back pressure specified by the engine manufacturer. Operating the engine at excessive backpressure might invalidate the engine warranty. It is generally accepted by automotive engineers that for every inch of Hg of backpressure (that's Mercury – inches of Hg is a unit for measuring pressure) approximately 1-2 HP is lost depending on the displacement and efficiency of the engine, the combustion chamber designetc.

II. FILTER SELECTION

The exhaust filter to remove diesel particulate matter or soot from exhaust gas of a diesel engine thereby preventing the emission of exhaust gas pollution into the atmosphere.
Portable to install commercial and heavy duty truck.
For reducing the pollutants from the exhaust gas up to 0.3 microns.

The first category covers sources that produce mainly low-frequency noise, yet can typically tolerate relatively high-pressure drops. Engines, rotary positive blowers, reciprocating compressors, and rotary screw compressors are types of these sources. It is simply the nature of these machines to produce low-frequency noise and have pressure-volume relationships that are quite tolerant of system pressure drop. These machines are perfectly suited for reactive (chambered) silencers.

The second category of noise sources are those that produce mainly high-frequency noise and have performance that is very sensitive to system pressure losses. These sources are almost always moving or compressing a fluid with spinning blades. Examples include centrifugal fans, compressors, and turbines. By definition, this type of equipment is best treated with absorptive silencers for both low and higher temperature applications.

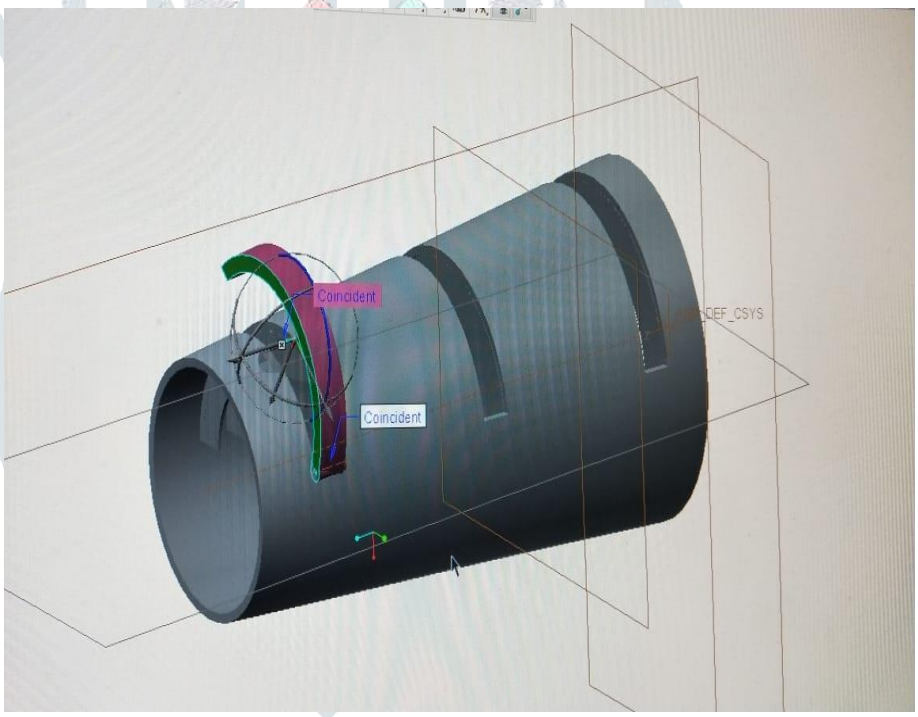
Resonators can be used to remove tones from the exhaust spectrum.

There are two major industrial facility applications that fall outside these categories, and are best silenced with specific combination reactive-absorptive mufflers. These sources are high-speed rotary positive blowers and high-pressure vents. Both sources have substantial high and low frequency noise content, and can tolerate moderate pressure drop. As a general rule, reciprocating or positive displacement machines should be attenuated with reactive silencers, and centrifugal equipment should use absorptive silencers. For all remaining major noise sources, combined reactive-absorptive silencers are appropriate with many designs available to choose from.

III. DESIGN AND FABRICATION OF PARTS

A filter have been designed which is of supercritical grade type and includes all the three attenuation principles i.e., reactive, followed by absorptive type muffler, and a side branch resonator. The interesting events of thedesign are continuous volume reduction of chambers in the reactive part, the flow pipe cross-sectional area is maintained constant throughout, a layer of insulation outside the reactive part, the placing of side branch resonator compactly, option for tuning the resonator using a screw and cylinder.

Demo Picture



CAD Design

Fig. Inside covering of Filter paper

Fig. Outside covering

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