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Dirty Fuel Damages Engines

"Repair statistics show that the majority of diesel engine problems stem from contaminated fuel."

Bosch Common Rail Injectors

Potential Failures and Causes

Robert Bosch LLC, USA 2012

Hard Particulates Damage Engines

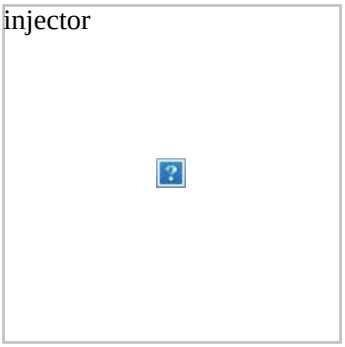
Dirty fuel will cause premature parts failure in equipment of any age. Because of the extremely high pressures, this damage is even more pronounced in newer equipment with HPCR fuel systems. Hard particulate is commonly referred to as "dirt", but is in fact made up of a wide variety of materials found at job sites (coal, iron, salt, etc.), generated by fuel tanks and lines (rust, corrosion, etc.) and inside engines (carbonatious materials and wear particles).

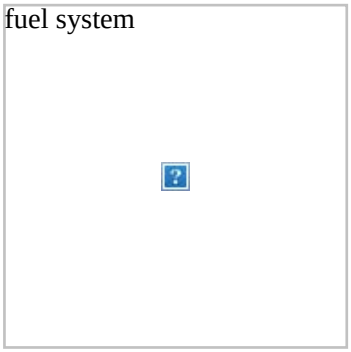
DAMAGE CAUSED BY HARD PARTICULATE

Hard particulate causes problems with moving parts in the fuel system. This can lead to starting problems, poor engine performance, idling issues and potentially complete engine failure.

The spray pattern generated by the HPCR injector is critical for proper combustion and overall fuel system performance. It must be extremely precise in terms of quantity, distribution and timing. Ball seat valves are sealed with balls that are only 1mm in diameter. A good seal is absolutely necessary for proper injection. Damage from erosive wear, such as shown below, will cause over fueling, leading to decreased fuel efficiency and eventually shut you down altogether.

Pump performance can also be compromised by scoring and abrasive wear. These issues are magnified by the tighter tolerances and extreme pressures in HPCR engines. In these circumstances, it is the smallest particles (1-5 microns in size)
that cause the most damage, virtually sand blasting part surfaces.





ALLOWABLE LEVELS OF HARD PARTICULATE

In some parts of the world, 10,000 gallons (38,000 liters) of “typical” diesel contains 1-1/2 lbs (700 grams) of hard particulate; this is 1000 times more than the 1/4 oz. (0.7 grams) per 10,000 gallons (38,000 liters) that is allowed by the cleanliness requirements of high pressure common rail fuel systems. In reality, there is no "OK" level of hard particulate. Injector manufacturers are very clear that damage caused by hard particulate reaching the engine is not a factory defect, but rather the result of dirty diesel that is not fit for use in HPCR fuel systems. At the end of the day, the end user is responsible for the fuel he puts into his equipment, and the consequences thereof.

HOW DOES DIRT GET INTO FUEL?

Dust and dirt are all around us, especially on job sites. Diesel fuel is fairly clean when it leaves the refinery, but becomes contaminated each time it is transferred or stored. Below you will find some of the key contributors of fuel contamination:

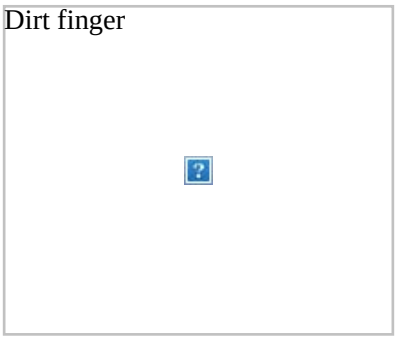
Pipelines: Most pipelines are not new, and certainly not in pristine condition. Corrosion inhibitors are added at most refineries to help protect pipelines, but rust and other hard particulate is nevertheless picked up by the fuel that flows though them.

Barges and rail cars: How often are they drained and scrubbed out? What was in the last load? Where did it come from? How much of it was still in the tank when your load was picked up? How long was it in transit? Is the tank hermetically sealed? There are lots of opportunities for contaminants to make their way into the fuel.

Terminal tanks: Terminal tanks usually see a high rate of turnover, so there is not much time for the fuel to

pick-up contamination from outside ingress. Has the tank ever received a "bad load" from a pipeline or a barge? Has larger dirt had a chance to settle on the bottom of the tank? How often has it been cleaned out? Was it just filled? Did the bottom get churned up in the process? How full was the tank when your fuel was loaded into the delivery truck? There are many variables that can affect fuel cleanliness.

Delivery trucks: All the same issues that apply to stationary tanks also apply to tanker trucks, except that truck tanks never get a chance to settle. In addition, have you ever considered how much dirt gets into that tanker while it is delivering fuel to a customer, potentially a customer in an extremely dusty environment? As fuel flows out, air is sucked in to displace it. Is there anything protecting the inside of the tank from all the dust in the air? Generally not. Venting is typically completely unprotected, as seen in the image to the right.


Dirt finger

Storage tanks: Onsite bulk storage tanks typically see less rapid turn-over than terminal tanks. In addition to those issues, yard and jobsite tanks can also develop serious problems with other sources of contamination, such as the ingress of dirt and water, condensation, rust, corrosion, microbial growth, glycerin fall-out and additive instability. Time and temperature become big factors affecting fuel quality.

Dispensing process: How far does your diesel need to travel between the bulk tank and the dispenser? The more pipe it runs though, the more potential there is for contamination. Are your dispenser nozzles kept clean? Are they ever dropped on the ground? Then what? What about the vehicles' fuel tank inlets, are they clean? Think about the extremely tight tolerances in your fuel system, then take another look at housekeeping issues. You will see them through new eyes.

Onboard fuel tanks: Contamination continues even after the fuel is in the equipment. What has that tank seen in the past? Has it been left stagnant for long periods? What kind of protection is there on the equipment's air intake vents? Heavy equipment does hard, dirty work.

Engines: Unfortunately, even if the fuel in your tank could be perfect, additional contamination is generated by the fuel system itself. Wear particles are created by mechanical friction. High heat and extreme pressure generated inside the modern engine, lead to coking and the creation of carbon products at the injector. Much of this internally produced particulate is returned to the fuel tank along with the unburned diesel.

Clean Diesel

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