Wet Stacking

Wet stacking is a condition that is caused by running an engine in an unloaded condition such as extended idle time or continual use at less than 50% of the rated output. It is most apparent in Diesel engines because of the variety of conditions the engines are subject to.

In Diesel driven generators the optimum running load to minimize Wet Stacking is 70-80% of the rated output.

The most common observation is wetness in the exhaust stack that looks like oil, thus the term wet stacking.

Continued use of the engine under wet stacking conditions can cause diminished engine performance, excessive fuel consumption, and even catastrophic engine failure because of the following conditions.

Collection of unburned combustion products on exhaust valves, turbocharger and exhaust manifold

- Poor cylinder wall lubrication and ring seating.
- Cylinder wall glazing.
- Excessive lubricating oil consumption.
- Excessive unburned fuel in the exhaust system.

All engines are designed to work within a specified load range and at specific temperatures. During combustion, the piston and liner are subject to extreme temperatures. The cylinder wall, fire rings and oil control rings and valve train are designed to work under these high temperature conditions. The fuel systems are calibrated to deliver the amount of fuel required to produce the rated horsepower. The cooling systems are designed to remove any excess heat created to keep the combustion temperatures at optimum levels.

When the engine is operated with insufficient load the following can occur. The high temperature created during compression ignites diesel fuel. At idle or light loads the cooling capacity of engine exceeds the amount of heat produced creating combustion temperatures that are insufficient to burn all of the fuel. Some of the unburned fuel is left in the combustion chamber while the remainder is pushed through the exhaust system. It then mixes with the normal exhaust soot to create an oily mixture. Some will turn to sludge and gather on the valve stems where there is enough heat to dry it out but not burn it while the remainder is pushed into the exhaust system.

In addition to gathering on the valve stems the unburned fuel creates a glaze on the cylinder wall and interferes with the seating of the rings to the liner. This glaze provides

excess lubrication on the rings and reduces their ability to keep the combustion above the rings and the oil below the rings. The glaze breaks the seal created when the rings seat to the liner. If the glaze is allowed to remain for too long loading the engine will not burn off the glaze and allow the rings to re-seal themselves. In severe cases the glaze can only be removed by disassembling the engine and re-honing the cylinder or liner.

Many Diesel generators are often subject to long periods of light loads. The most common complaint on these engines is that oil is dripping out the turbo or exhaust connections. Most of this is fuel mixed with soot. As the condition deteriorates from extended use under light load the fuel begins to glaze the cylinder wall and reduces the efficiency of the oil control rings causing oil to be added to the fuel soot mix. The oil control ring on a four cycle engine is located near the top of the piston just below the compression rings therefore any oil that passes will go directly out the exhaust.

Correcting a wet stacking condition can be as easy as applying a constant load (70-80% of rated output) to the engine to burn off the excess fuel and oil and reseat the rings.
If the engine can be loaded, it needs run with a sustained load until the wet stacking condition clears up. Often, this can take up to two hours of run time at minimum output of 80% rated power. The exhaust temperature should be closely monitored during this time. If the exhaust temperature is not elevated to the desired temperature it will have no positive effect.

Similarly Engine Glazing is cause by operating the generator under very light or no load conditions preventing the oil film on the cylinder wall from being scraped away by the expanding compression rings. The rings will instead “hydroplane” over the deposited oil film allowing it to be exposed to the cylinder combustion. The oil film will then partially burn on the cylinder leaving a residue that will build up and oxidize over time. Eventually this leaves a hard deposit on the cylinder wall that cannot be removed without honing the cylinders.

Oil glazing is a problem because it is typically not distributed evenly in the cylinder. Either the spaces that exist between the ring and cylinder wall are still there or new larger ones are created. Oil glazing is typically thicker towards the top of the cylinder where it builds up in the areas where heating is the greatest. The glaze has very smooth and friction free properties that do not allow it to be scraped away by the rings. This inhibits further metal-to-metal wear between the cylinder wall and rings preventing further mating of ring and cylinder.