KOHLER®

Diesel Generator Maintenance

Feasibility and benefits of no-load exercising.

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INTRODUCTION:

Diesel generator operators are all too familiar with the problem of engine slobber or wet stacking, a buildup of unburned fuel in the exhaust system that can lead to decreased engine performance and premature failure.

Wet stacking typically occurs when generators frequently run with little or no load because the generator is improperly sized or because adequate load is not available during the exercising period. Often times applications require added time and cost to connect external load banks to apply sufficient load to complete an exercise, which results in higher emissions and extra fuel costs.

EXPLANATION OF WET STACKING

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When generators run at less than 30% of capacity for extended periods of time, their engines are unable to sustain the optimal operating temperatures needed to burn fuel completely. Pressure inside the combustion chamber falls below crankcase pressure, and piston rings can't expand enough to seal the space between the pistons and cylinder walls.

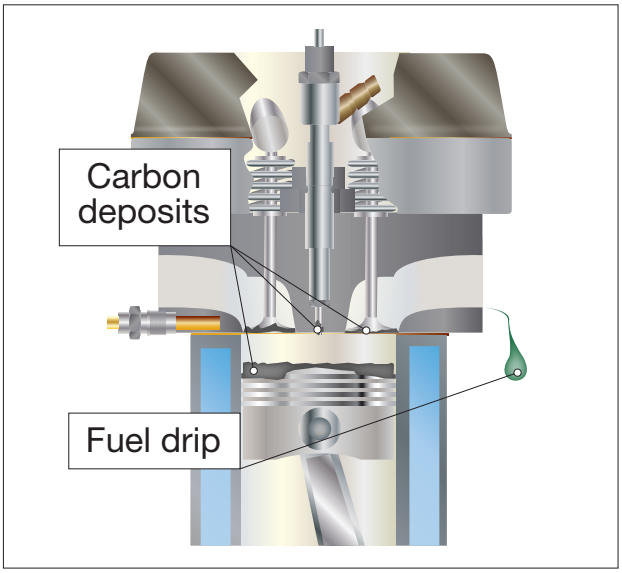
WHAT WET STACKING CAN LEAD TO

As depicted in Figure 1, wet stacking fouls fuel injectors, causes excessive valve guide wear, and can lead to damaged pistons, piston liners, and rings.

EMISSION CONSIDERATIONS

In addition to shortened engine life and higher maintenance costs, operators may also run afoul of emissions regulations, which have grown tighter in recent years.

Figure 1



WET STACKING: A CRITICAL ISSUE

IMPACT OF NEW EMISSIONS TECHNOLOGY

Wet stacking has become a more critical issue in recent years as diesel generator manufacturers have incorporated new emissions control technologies into their products. These include diesel oxidation catalysts (DOC), selective catalytic reduction (SCR) components, and diesel particulate filters (DPF). See Figure 2.

Such aftertreatment technologies are all negatively affected by low-load operation, which can cause emissions targets to be missed. SCR and DPF components, in particular, must operate within a specific exhaust temperature range.

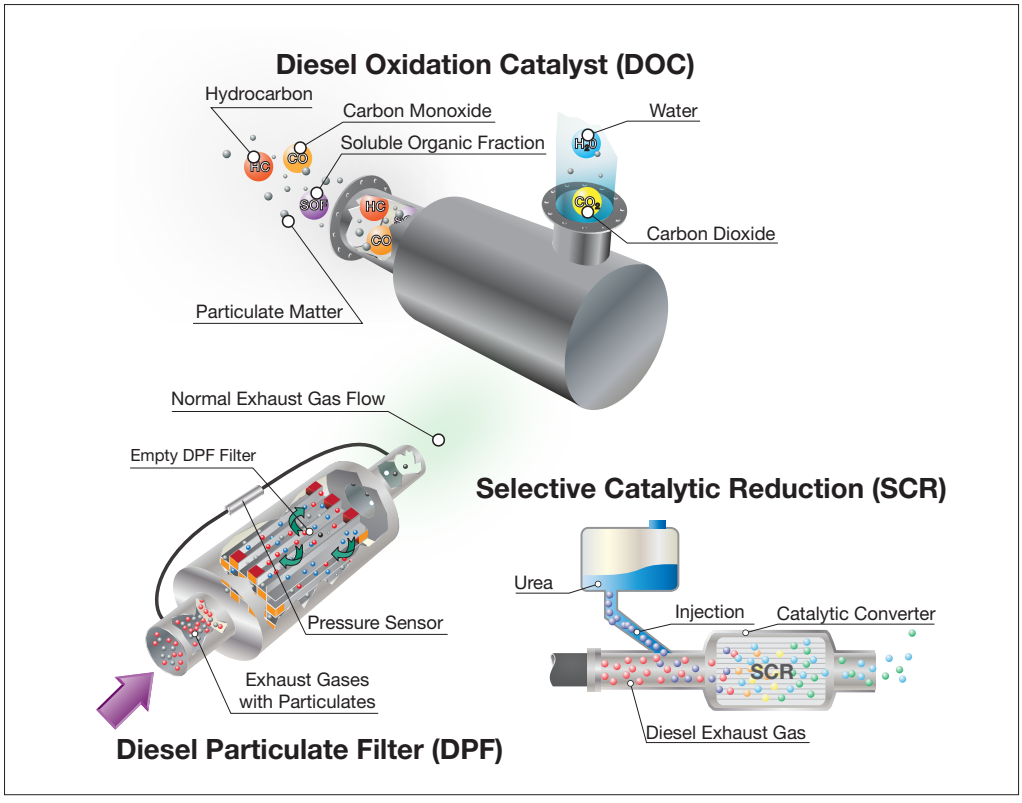
ADDRESSING WET STACKING

The solution for wet stacking for years has been to exercise the generators at 30% of the rated capacity once per month to burn off unused fuel or prevent buildup. However, advances in technology are making the need for this costly procedure less demanding. This paper asserts that some of today's diesel generators can be safely run at 30% of the rated capacity or higher as little as once per year to maintain optimal performance and stay within emissions guidelines.

WHY IT'S NECESSARY TO ADDRESS WET STACKING

Wet stacking doesn't damage the engine in the short term, but over time it can lead to poor performance and reduced engine life. In extreme cases the exhaust stream can combust under rapid application of the high exhaust temperatures.

Figure 2



LOAD-BANK TESTING

LOADING TO MINIMUM LOAD

The simplest way to avoid wet stacking during monthly exercise is to run the generator at the manufacturer's recommended minimum loading. Because many operators do not wish to transition to building load, the monthly exercise requires use of a load bank, which can be used to supplement or perform loaded maintenance activities.

This load-bank testing artificially boosts the load placed on the generator to burn the accumulated buildup. Most generator manufacturers recommend that load-bank testing be done monthly for a minimum runtime of 30 minutes.

In addition to runtime, operators also need to consider the time it takes to set up the load bank, which can add up to a significant time commitment by operations personnel as well as fuel consumption for facilities that manage multiple generators.

REVISITING LOAD-BANK TESTING PROCEDURES

Many facilities conduct load banking according to maintenance procedures that were drawn up years ago and have never been revised. Technology improvements can now simplify this monthly procedure. In an industry that has historically moved rather slowly, the news has probably not reached many operators.

LOADING MODERN DIESEL ENGINES

TAKING ACCOUNT OF THE LATEST DIESEL TECHNOLOGY

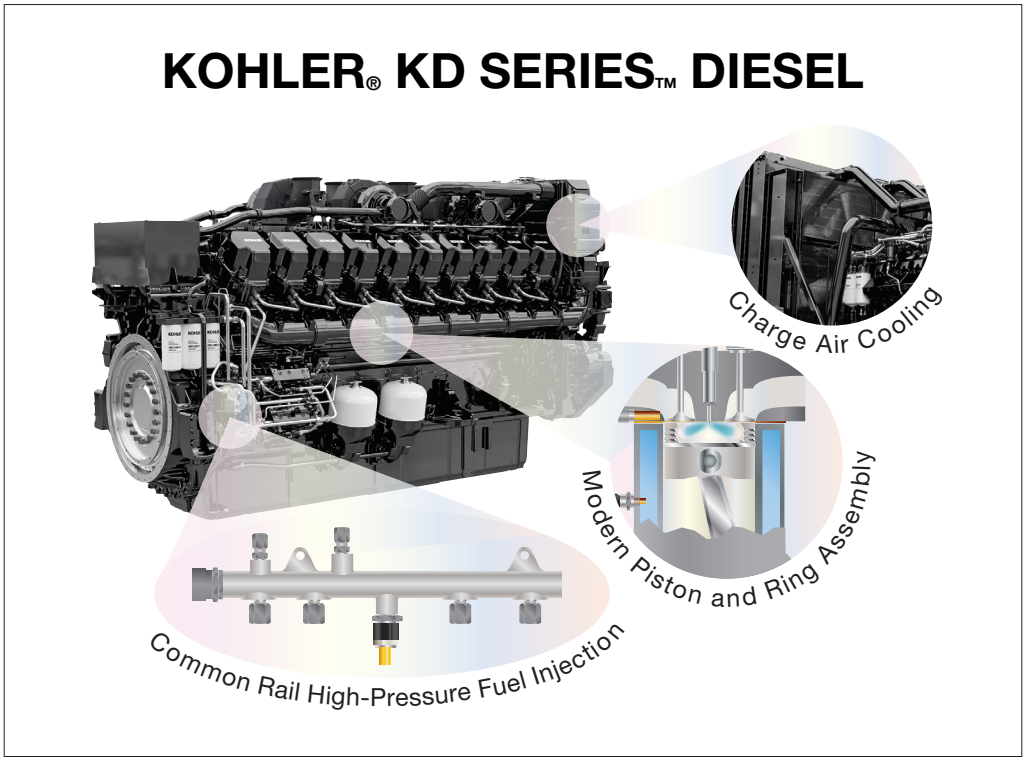
Modern diesel engine designs now incorporate several technologies that enhance operating efficiency and reduce the gaps between pistons and rings that allow unburnt fuel to escape. Other advances include:

- ✓ Common rail systems allow better atomization of fuel into the cylinder and the ability to have multiple injections per cycle. This allows the combustion process to be better tailored to the requirements of emissions and/or cylinder temperatures, a process called “fuel mapping.”
- ✓ Charge air cooling allows more air to be delivered to the cylinder at a lower temperature, which permits fuel to be combusted more completely.
- ✓ Modern piston and ring assemblies are engineered to a much finer degree of tolerance than those of older engines. This significantly reduces the blow-by that allows fuel to escape the combustion chamber. The result is that the engine burns more efficiently and the conditions that lead to wet stacking are significantly mitigated.

This combination of common rail systems and improved ring designs enables lower-exercise loading by containing combustion gases and enabling a shaped charge to be created. See Figure 3.

Increasing cylinder pressures also increases cylinder temperatures at lower loads.

Figure 3



REVISITING OLD MAINTENANCE ASSUMPTIONS

KOHLER® KD SERIES™ FIELD EXPERIENCE

These and other efficiency improvements should enable generator operators to reconsider old assumptions about maintenance schedules and significantly reduce the once-monthly load-banking requirements.

In fact, test and field experience with generators such as the KOHLER KD Series suggests that unloaded monthly exercise is allowable, as long as the generator is load bank-tested annually, which is standard practice for most operators.

SWITCHING TO ANNUAL LOAD TESTING

The savings from switching from monthly to annual loaded testing are compelling. For example, a 3250-kilowatt running a load-banking cycle for 30 minutes each month burns about 1,913 liters of diesel fuel and emits 57.7 kg of pollutants per year. In contrast, performing the same monthly exercise unloaded consumes less than 1,065 liters per year and total pollutant emissions are reduced by 40% on a kilograms per year basis. Considering one additional scenario, this same generator exercised at no load once every 4 months and one time per year at full load will only consume 550 liters of fuel and emit 70% less total pollutants when compared to a monthly loaded exercise. See Figures 4 & 5. There are also collateral on-site savings.

Switching the annual load testing method does not violate NFPA110 requirements. The regulation states that exercising of the unit is required to be performed monthly for 30 minutes at either 30% of rated load or at loads to maintain the minimum exhaust gas temperatures set by the manufacturer.

Figure 4

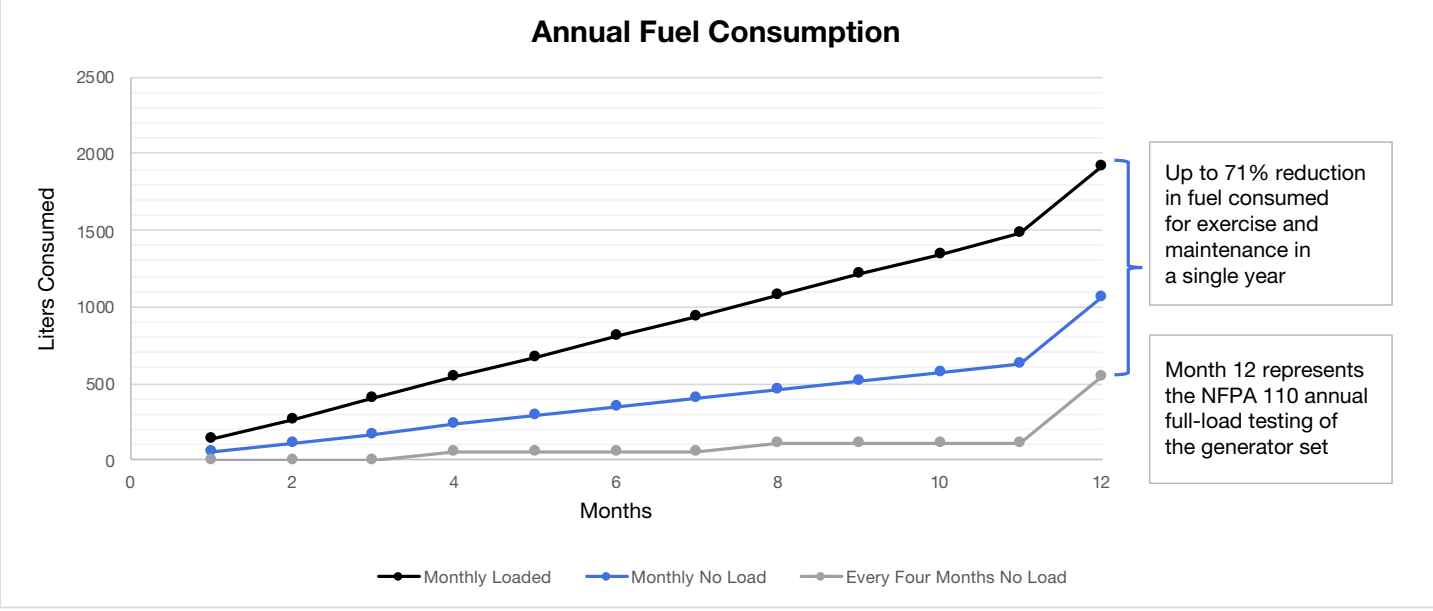
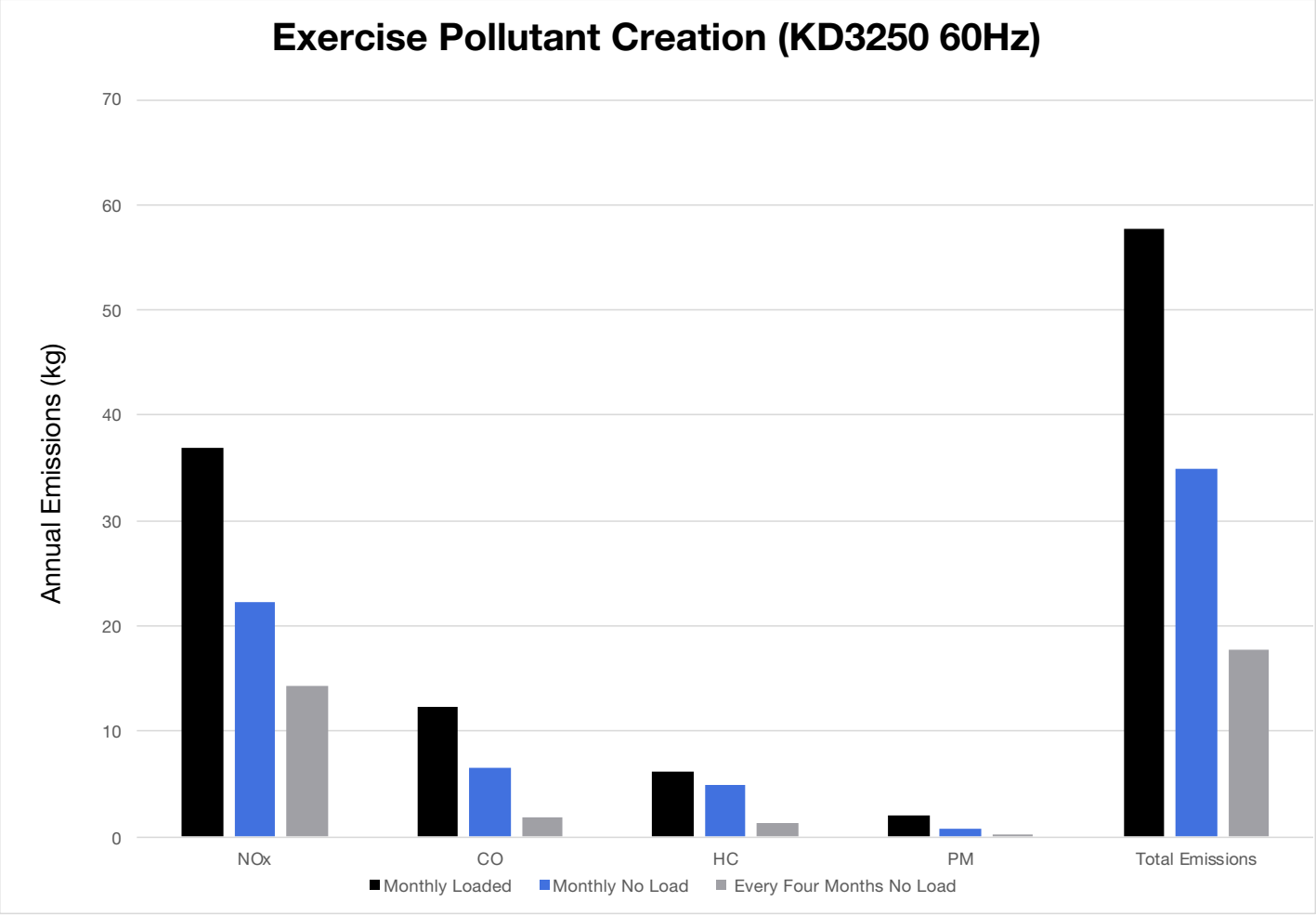


Figure 5



REVISING MAINTENANCE SCHEDULES

KOHLER SERVICE PROVIDERS WILL ADVISE

Before revising maintenance schedules, consult with your dealer, service provider, or the manufacturer. Depending upon the types of aftertreatments you use, service schedules and capacities may differ.

For example, low-temperature operations in the presence of a combined DOC/SCR/DPF emissions control system may run the risk of oxidizing stored hydrocarbons and damaging the SCR catalyst when exhaust temperatures are later raised through higher loading or could plug the DPF.

Regional/local air emissions may also dictate the exercising requirements when using aftertreatment devices. Be sure to consider this during submissions for permitting of the facility. Manufacturers and their channel partners can help you choose the right aftertreatment technologies and match testing loads to permitted levels.

ABOUT THE AUTHOR

Justin Loritz, Product Manager–Large Diesel Generators, has more than 16 years of experience with Kohler in various roles within the organization. After graduating from Michigan Technological University with a B.S. in mechanical engineering, he began his career supporting the large diesel assembly team as process engineer and progressed through a variety of roles, including lead design engineer for the Kohler diesel marine product line, production manager for large generator assembly, and principal engineer of manufacturing systems. Justin has extensive knowledge of the KOHLER® KD Series™ products and the needs of customers within this product category.

ABOUT KOHLER ENERGY

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