



COMBUSTION CHAMBER DEPOSITS IN LANDFILL GAS APPLICATIONS

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In traditional natural gas engine applications burning pipeline gas, most combustion chamber deposits are the result of ash build up from the metal-based additives in the natural gas engine oil (NGEO). These additives are calcium and/or magnesium-based detergents/dispersants used to neutralize acids along with zinc and/or phosphorus based anti-wear additives to protect the valve train. The reason NGEOs are categorized by ash content is because natural gas engines rely on these ash deposits to cushion the valves to prevent valve recession. However, too much ash in the oil can lead to excessive buildup on the valves resulting in poor seating and eventual failure. Elevated ash levels can also lead to other combustion chamber deposits as well as deposits in aftertreatment systems. The most common type of NGEO recommended for four-stroke stationary natural gas engines today is a low-ash engine oil which will contain around 0.5 wt% sulfated ash as measured by ASTM D874. This level of ash is the perfect balance to cushion valves, protect the valve train, and neutralize acids but not lead to excessive deposit formation. In applications where the gas being burned contains high amounts of sulfur such as in some wellhead gas applications, a mid-ash engine oil may be recommended which will contain around 1.0 wt% sulfated ash due to additional detergent/dispersant additives to help neutralize the sulfuric acid generated by the combustion process. Of course, additional ash will also lead to additional combustion chamber deposits which can lead to premature valve failure.

The ash deposits mentioned above are oxidized metal-based additives. In natural gas engine applications where the fuel is landfill gas, combustion chamber deposits are primarily comprised of silica. Unlike wellhead or pipeline natural gas, landfill gas contains siloxanes which can be found in a wide variety of consumer products that end up in the landfill.

These siloxanes, when introduced into the combustion process will be oxidized into silica which is very hard and abrasive. Typically, this build up of deposits occurs more rapidly than the ash build up in pipeline or wellhead gas fueled engines due to the relatively amount of siloxanes moving through the combustion chamber in relation to the additive metals.

In order to combat the build up of silica deposits in landfill gas applications, originally it was recommended to use a mid-ash engine oil product due to the elevated level of detergents/dispersant type additives. However, while the added detergency helped neutralize the extra acids generated it did little to reduce the amount of deposits occurring in the combustion chamber. Phillips 66 El Mar LF-D engine oil was specifically designed to have an elevated amount of dispersancy while at the same time remaining a low-ash engine oil. This elevated dispersancy greatly reduces the silica's ability to agglomerate and form deposits in the combustion chamber while the low-ash formulation contributes significantly less to ash formation than a mid-ash engine oil would. This combination leads to extended valve life and reduced maintenance of the top end components throughout the life of the engine.



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