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THERMAL STRESSING OF ULTRA-LOW SULFUR DIESEL AND LOW SULFUR F-76 DIESEL FUELS

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In recent years there has been an increased employment of high pressure common rail (HPCR) fuel injection systems in high speed marine diesel engines. This is largely due to their increased efficiency and reduced fuel consumption. The HPCR systems stress the fuel to a higher degree than conventional fuel injection systems, with some systems operating up to 1800 Bar, with fuel reportedly being exposed to temperatures up to 200 °C, and return fuel temperatures commonly exceeding 100 °C. Some HPCR systems utilise the fuel for hydraulic actuation of the injectors as well as cooling and lubrication of the injectors resulting in a significant proportion of the fuel being return to the bulk storage tank or day tank. This exposure to high temperatures and pressures can accelerate the formation of hydroperoxides aiding the auto-oxidation processes with the hydrocarbons in the fuel. Additionally, chemical processes that occur in stressed fuel can lead to poor water separability, increased filter blocking tendency, and formation of acidic species that can promote wear and corrosion of fuel system components potentially leading to catastrophic failures.

In order to investigate the effects of this thermal stressing on fuel properties, laboratory thermal stressing experiments have been carried out that involved exposing F-76 naval distillate and automotive diesel fuel (ADF) to temperatures of 165 °C and 186 Bar for short residence times (<10 Minutes). Initial investigations have demonstrated that peroxide values greater than 10 mg/kg can be achieved with short residence times. F-76 and ADF have both shown differing effects from the incorporation of fuel additives. ADF with biocide added obtained a peroxide value greater than 10 mg/kg with a residence time of 110 seconds compared to the equivalent F-76 sample that took 275 seconds to achieve a similar peroxide value. F-76 containing phenolic oxidation inhibitors achieved identical residence times (385 seconds) to un-additised F-76 in comparison to the amine derived additives for F-76 where peroxide values greater than 10 mg/kg were observed with a residence time of 275 seconds. We are currently investigating the effect this increased peroxide content has on water separability, filterability and gum formation.