Assessment of Chemical improvers for the oxidation of heavy fuels

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There is a renewed interest in the mode of propulsion by detonation within the framework of spatial applications. The most known devices are Pulsed Detonation Engine (PDE), Rotary Detonation Wave Engine (RDWE) and Oblique Detonation Wave Engine (ODWE) which are based on the repeated detonation of a periodically renewed reactive charge. The roadmap to the efficient utilization of these type of engines will rely on a better knowledge of the fuel combustion characteristics. A gas phase detonation can be initiated either directly by a strong shock wave such as that generated by powerful explosives driving the Shock-Detonation-Transition mechanism (SDT), or by a weak energy source that accelerates the flame for create detonation wave via the transition-deflagration-detonation mechanism (TDD). However, the basic mechanism of the detonation wave formation will be based on the possibility of creating, at a given location, a critical shock wave that would lead to a strong auto-ignition and subsequently the onset of the detonation. Since the cheapest solution regarding the fuel is to use commercial kerosene, it is important to increase its sensitivity using additives. Different additives are being considered such alkyl-nitrates (IPN: isopropyl nitrate), oxygenated species (ETBE: ethyl tert-butyl ether), nitromethane and nanoparticles. There are two kinds of promoters:

-Ignition promoters such as those used in compression ignition internal combustion engine, which improve the starting efficiency by increasing the cetane number.

-Flame speed improvers, in this case, only few studies are reported on hydrocarbons.

Kerosene used in the aeronautical sector is the subject of particular attention. An analysis of a sample of a kerosene type (TR0) by gas chromatography coupled with mass spectrometry shows that the latter contains mainly paraffinic or alkane type hydrocarbons. In this work, we aim to determine the effect of sensitizer achieved by the addition of promoters on the oxidation of hydrocarbons representative of kerosene. First, the addition of IPN to ethylene will be investigated. The work will focus on the transition from shock to detonation (TDD) in a 78mm diameter tube to reduce the distance and transition time associated the shock to detonation transition, over a given temperature and pressure range relevant to PDE application.