TENTH MEDITERRANEAN COMBUSTION SYMPOSIUM

PARAMETRIC STUDY OF MICRO-EXPLOSION OCCURRENCE OF W/O EMULSIONS

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W/O emulsions seem to be an appropriate solution to replace classic hydrocarbon fuels regarding their pollutant emissions (CO, CO_2, NO_x…) [1]. Indeed, when heated, a W/O emulsion droplet is subject to a phenomena called micro-explosion, which rely on the boiling temperature difference between water and oil. Indeed, increasing water temperature leads to brutal phase change to vapour that bursts oil phase and engender a non-negligible amount of energy. However, micro-explosion is not a systematic process as other phenomena like puffing can take place. It appears that occurrence of micro-explosion is strongly related to the dispersed phase size distribution [2].

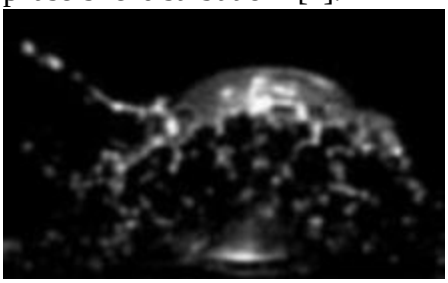

Figure 1: Micro explosion of W/O emulsion droplet

The aim of this work is to find a correlation between the occurrence of micro-explosion and the size distribution, heating temperature and emulsion composition. For this purpose, Water-in-Diesel emulsions are performed with micro-channels technique [3], under varying conditions (% surfactant, % water, flow rates…), in order to identify the effects of each of these parameters on the size distribution and micro-explosion occurrence.

Each emulsion is first observed under a microscope in order to determine the dispersed droplet's size. The second phase consists on heating the emulsion on a heat plate at 450°C. Depending on the size distribution, three different results are expected: micro-explosion, puffing and micro-explosion after puffing.

First results show a correlation between size average value (and distribution size) and micro-explosion rate: Indeed, micro-explosion seems to occur more often when the emulsion presents large droplets and/or large distribution in a "surfactant less" emulsion. This parametric configuration leads to higher rate of coalescence, and thus, even larger dispersed phase.

Keywords: emulsion, micro-explosion, size distribution, biofuel, puffing, surfactant, Leindefrost effect, coalescence, stability

References:

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