

1. ABSTRACT

Poor cold-flow properties of biodiesel limit its utilization in temperate regions such as Montana. Crystallization during cold-weather operations may lead to clogging of filters and eventually fuel starvation and stalling of engine. This study aims to understand the crystallization behavior of biodiesel derived from different vegetable oils and animal fat. Cloud point (CP) and Cold filter plugging point (CFPP) of biodiesel samples were determined according to ASTM methodologies. Crystallization of biodiesel was also observed under Polarized Light Microscope (PLM). Lastly, the impact of commercial anti-gels on biodiesel, diesel fuel No.2 and biodiesel blends were evaluated.

2. EXPERIMENTAL

Preparation of biodiesel

Biodiesel samples were prepared in lab-scale via the conventional base-catalyzed transesterification with methanol.

Cold-flow property analysis

Cloud Point – ASTM D 2500
 Cold Filter Plugging Point– ASTM D 6371

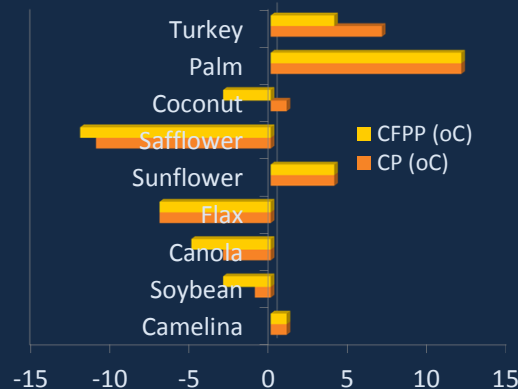
Microscopy at low temperatures

Microstructures were observed under Olympus BX 51 Polarized Light Microscope equipped with Linkam TMS 94 temperature control system at a cooling rate of 1°C/min.

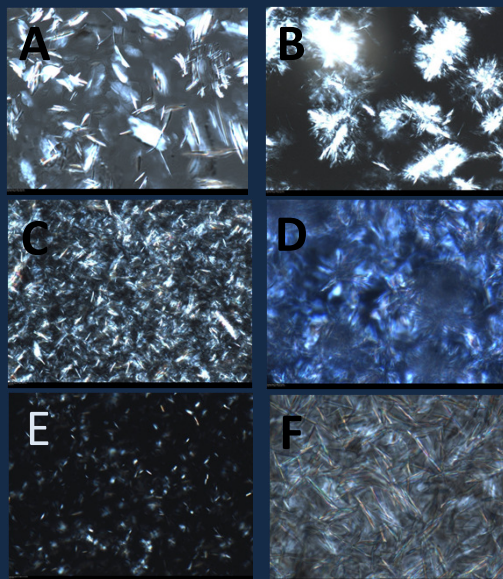


3. RESULTS

A. CP and CFPP of neat biodiesel



B. BIODIESEL CRYSTALS

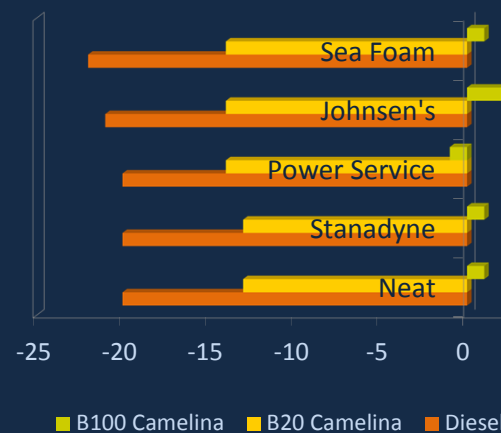


Biodiesel crystals observed at -10°C under PLM (200X) at a constant cooling rate of 1°C/min (A: Camelina; B: Flax; C: Soybean; D: Turkey; E: Canola and F: Coconut)

Biodiesel crystallization is mainly influenced by the fatty acid profile of the feedstock. Presence of a high amount of mono-unsaturated components in canola biodiesel impedes agglomeration attributed to their bent structure. Turkey fat and coconut biodiesel, developed a thicker layer of solidified materials. Surprisingly, flax which contains a high amount of poly-unsaturated components, exhibited agglomeration leading to the formation of larger crystals. Canola biodiesel developed the smallest crystal size among all the biodiesel samples tested.

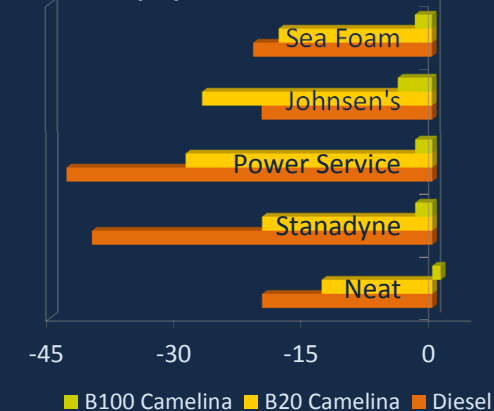
C. IMPACT OF ANTI-GEL ADDITIVES

a. CP (°C)

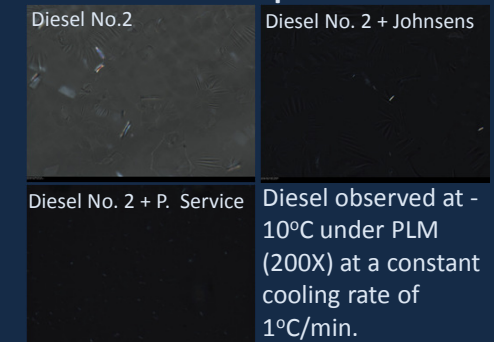


Cloud point analyzer

b. CFPP (°C)



c. PLM at low temperature



Diesel exhibited better cold-flow properties than biodiesel. B20 blend exhibited 35% increase in CP and CFPP compared to neat diesel. Diesel No. 2 had the tendency to develop film rather than crystals at low temperatures. Some commercial anti-gels exhibited no impact at all on cold flow properties of fuel. PLM also revealed that some anti-gels inhibited the film formation in diesel during cooling.