Behavior of B20 fuels in arctic conditions

K. Sirviö[†], S. Niemi, R. Help, S. Heikkilä, and E. Hiltunen

University of Vaasa, School of Technology and Innovations, PL 700, FIN-65101 Vaasa, Finland

[†]Corresponding author, e-mail: katriina.sirvio@univaasa.fi

Abstract.

Several renewable and sustainable liquid fuel alternatives are needed for different compression-ignition (CI) engine applications to reduce greenhouse gas (GHG) emissions and to ensure proper primary energy sources for the engines. One of the shortcomings of several biofuels has been their cold properties. Still, the need for alternative fuels is also present in arctic areas where the storing of the fuels may become problematic. The main aim of the current study was to determine how the storage related properties of fuel blends change if the fuels first freeze and then melt again. The samples were analyzed three times: as fresh, and after the first and second freezing-melting phase transitions.

The share of renewables within the blends was 20 vol-%. Rapeseed methyl ester (RME) and animal-fat based methyl ester (AFME) were blended with LFO in a ratio of 80 vol-% of LFO and 20-vol% of RME or AFME.

The investigated and compared properties were the FAME content of the neat FAMEs, and kinematic viscosity, density, oxidation stability index, and acid number of the blends. Cold filter plugging point was measured for AFME and its blends. According to the results, the quality of the FAMEs and their blends did not change significantly during the freezing over. The freezing-melting phase transition seems, thus, not to be as big a threat to the fuel quality as the high temperatures are.

Keywords. Alternative fuels, fuel blends, storage conditions, arctic conditions, fuel stability, medium-speed engines.

1. Introduction

The 2030 EU climate & energy framework sets three key targets. The first one is to cut greenhouse gas emissions at least 40% from the level of 1990. The second target is to have at least a 27% share for renewables in energy consumption by 2030. The third one is to reach at least a 27% improvement in the energy efficiency. (European Commission, 2017) All these actions are needed to delay the climate change. In marine industry, the need for cleaner fuels is the most urgent. The emission legislation in maritime is becoming stricter, first the limits of oxides of nitrogen, but now even the sulphur and particulate matter limits. For the EU inland waterways, the pollutant emissions must already be strongly reduced, also including the particulate number emissions. According to Third IMO GHG Study made in 2014, international shipping accounts for approximately 2.6% and 2.4% of $CO_2$and GHGs on a CO_2e basis,