Corrosion in vegetable oils used for the production of bio-fuels

Fouad Andari, Jean Kittel, Joana Fernandes, Marion Fregonese, Nathalie Godin, François Ropital

Corrosion in vegetable oils used for the production of bio-fuels

Fouad ANDARI[1], Jean KITTEL[1], Joana FERNANDES[1], Benoît TER OVANESSIAN[2], Marion FREGONESE[2], Nathalie GODIN[2], François ROPITAL[1]

[1] IFP Energies Nouvelles, France
[2] University Lyon, INSA-LYON, MATEIS UMR CNRS 5510, France

Part of the ambitious objectives set out to reduce global greenhouse emissions (GHG), industrialists in the energy sector are hindering their reliance on conventional oils as sole fuel generators. Subsequently, alternative bio-sourced feedstock has been implemented in production cycles with already available technologies. Amongst those projects, the hydrotreatment of vegetable oils is used for the production of green transportation fuels (such as diesel, kerosene), which are quite similar in composition to the fossil derived fuels and are compatible with existing combustion engines. The process involves hydrogenating the unsaturated and oxygenated lipids, under high temperature and H_2 pressure, in order to generate high quality fuels. While the corrosiveness of conventional hydrocarbons is well documented, the reactivity of bio-oils lacks research from industrial feedback or laboratory investigations. A common mechanism encountered in oil refineries is naphthenic acid corrosion. Although bio-oils do not contain naphthenic acids, they are composed of fatty acids which are long chain aliphatic carboxylic acids. In addition, the presence of oxygen in the molecules may generate H_2O after reaction with H_2 which could further intensify corrosion mechanisms. Other impurities are also present, which may result in significant differences of corrosiveness compared to conventional oils. This communication examines the impact on corrosion of bio-oil composition with special focus on the free fatty acid concentration. The study of high temperature corrosion in biomass involves two complementary approaches: biomass characterization and corrosion monitoring. Biomass characterization involves the physical-chemical analyses of the products before and after exposure. Several techniques were used to measure the chemical evolution of the oil. Corrosion evaluation was made by weight-loss measurements and surface observations. A first set of experiments was conducted in model solutions made of rapeseed oil with controlled addition of oleic acid at different concentrations (total acid content of 0, 20, 40, 60, 80, 100 mg_{KOH}/g as per the standard NF EN ISO 660). A good correlation is found between the acidity and corrosion rate.

Keywords: Corrosion, Biomass, Bio-fuel, Hydrotreatment