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Corrosion Behavior of Copper in Biodiesel-diesel-bioethanol (BDE)

S.K.Thangavelu[1, 3, a], C. Piraiarasi[1, b], A. S. Ahmed[2, c], F.N. Ani[3, d]

[1]Faculty of Engineering, Computing and Science, Swinburne University of Technology, Kuching, Sarawak, Malaysia

[2]Department of Mechanical and Manufacturing Engineering, Faculty of Engineering, Universiti Malaysia Sarawak, Sarawak, Malaysia

[3]Faculty of Mechanical Engineering, Universiti Teknologi Malaysia, Skudai, Johor D.T., Malaysia

[a]sthangavelu@swinburne.edu.my, [b]pchelladorai@swinburne.edu.my, [c]aasaleh@feng.unimas.my, [d]farid@fkm.utm.my

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Abstract. The present study aims to investigate the impact of biodiesel-diesel-bioethanol (BDE) fuel blend on the corrosion behavior of copper. Static immersion tests in B45D35E20 (45% biodiesel, 35% diesel and 20% bioethanol) were carried out at room temperature (25°C) and 50° for 408 hours. Mechanical, physical and chemical properties of copper were investigated before and after immersion tests. Investigations were carried out on the change in morphological properties using optical microscope; change in chemical structure using FTIR; change in mass and volume by weight loss measurement; and hardness changes using universal hardness tester. The changes of fuel properties of the blend such as total acid number (TAN) and color changes were also investigated. The results showed that the corrosion rate of copper in B45D35E20 at high temperature (50°C) is comparatively lower than the previous studies reported for pure biodiesel (B100).

Introduction

Biofuels (bioethanol and biodiesel) has gained progressive importance as alternative fuel for automobiles because they can significantly reduce environmental pollution and dependence on fossil fuel [1]. Biodiesel is produced by transesterification of vegetable oils or animal fats. It offers property close to that of diesel fuel and has no sulfur and no aromatics [2]. Bioethanol also represent an important renewable fuel which is produced form biomass and bioenergy crops to replace the usage of fossil fuels in both diesel and gasoline engine [3]. Biodiesel is miscible with alcohols and diesel; it can also be used as an emulsifier to blend alcohols and diesel and to be used as biodiesel–alcohol–diesel blends in diesel engines [4]. Studies regarding the mixing stability and fuel properties of biodiesel–ethanol–diesel fuels showed that the addition of biodiesel prevented phase separation and its high cetane number improved the low cetane number of diesel–ethanol blended fuels [5]. Ethanol blended fuels reduced NO emissions for all concentrations, unburned HC emissions depended not only on ethanol concentrations, but also operating conditions [6]. Labeckas et al. [5] suggested that ethanol up to 15% (vol%) blend could be efficiently used for diesel engine powering. Bioethanol and biodiesel represent an important renewable fuel for gasoline engines without any engine modification to replace the usage of fossil fuels. However, changes in the fuel composition and the introduction of alternative fuels often create material compatibility issues in terms of corrosion and the degradation of the automobile parts [7]. In diesel engines, fuel comes into contact with a wide variety of engine parts including fuel pump, gaskets, fuel injector, filters, fuel liners, bearing, piston, piston rings, etc. Among them, copper alloy based parts like fuel pump; bearing, bushing, etc. are mostly affected by the fuel [8-9]. These may give rise to potential problems such as interaction with metal surfaces and at the same time, degradation of fuel properties. It has been suggested that copper, aluminum, zinc, brass and bronze are not compatible with biodiesel [10-11] and bioethanol [13]. There are many literatures reported in the investigation for corrosion behavior of copper in biodiesel and diesel fuel [7-16]. Literatures showed a gap that there was no study reported in corrosion behavior

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