**Electrochemical Performance of Additively Manufactured 8620 Low-Alloy Steel: Effect of Acetic Acid**

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**INTRODUCTION**

The need for new alternative fossil fuels has been driven by the sharp rise of the cost of petroleum products, the unpredictability of fossil fuel supply, and the impact of greenhouse emissions. Additionally, the consumption of traditional fossil fuels is expected to contribute to climate change, which might occasionally lead to ecological calamity. Hence, finding technologies to decrease the emissions from burning fossil fuels and increase renewable energy resources to provide energy security are becoming active areas of scientific research. Compressed natural gas (CNG), liquefied natural gas (LNG), alcohols (ethanol and methanol), hydrogen, vegetable oils, and biodiesel are just a few of the alternative fuels that may be used in diesel engines [1]. Due to its similarities to diesel in terms of characteristics, biodiesel is an attractive alternative energy source and has the potential to have a carbon-neutral lifespan [2]. It may be used in all diesel engines with dependability and requires no major engine modifications. When used in a combustion engine, biodiesel emits much less hazardous pollutants than normal petroleum fuel [3], [4]. It can be produced from both edible and non-edible vegetable oils through a chemical process known as transesterification in the presence of a catalyst. Biodiesel is therefore recognized as one of the most feasible renewable substitutes for fuels generated from petroleum [5].

Automotive components e.g. crankshaft, camshaft, piston pin etc. are made of surface hardened 8620 steel for its enhanced hardness, wear, and fatigue properties [10]–[12]. For these parts to work as intended, lubrication is necessary. However, acidic substances present in engine oil can cause corrosive damage to these parts. In biodiesel-driven engines, the unburnt biodiesel can pass through the combustion chamber and mix with engine oil, which eventually dilutes it [8]. This diluted engine oil gives rise to acidic products such as acetic acid, formic acid, aldehydes, alcohols, and polymers through auto-oxidation [6], [7]. Higher engine oil temperature can accelerate this auto-oxidation process [9]. Auto-oxidation of biodiesel also occurs when it is stored for a long period. When such old biodiesel is used in diesel engines, the acids formed due to auto-oxidation can corrode fuel pumps, fuel injectors, filter components, etc. Hence, it is important to investigate the corrosion behavior of 8620 steel in acetic acid.

Corrosion properties of different grades of steel such as mild steel, stainless steel, and carbon steel in an acetic acid environment have been investigated by other researchers and increased corrosion rates have been reported [13]–[16]. However, the corrosion performance of 8620 steel in acetic acid environment has not been investigated yet. Furthermore, additive manufacturing technique, i.e., 3D printing, is becoming a promising fabrication method for automobile parts due to shorter lead time and higher dimensional precision. Thus, a thorough examination of the 8620 steel components fabricated using 3D printing technology is required.

In this research, electrochemical properties of 3D printed and conventionally manufactured (wrought) 8620 steels have been investigated. Potentiodynamic Polarization (PD) and Electrochemical Impedance Spectroscopy (EIS) experiments have been conducted in varying concentrations of acetic acid in presence of 3.5% NaCl solution. Microstructural investigations have been conducted via Scanning Electron Microscope (SEM).