

A Compilation of Conventional Fuel Additives

A literature review of chemical additives in diesel and biodiesel fuels for improved combustion

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Abstract— With the rise of carbon emissions into the atmosphere on a worldly scale, there exists a need to improve the efficiency of the internal combustion engine. This research review seeks to answer that need through the use of chemical additives. Not only has published research shown that chemical additives can decrease carbon emissions and other particulates, but that they can also improve conductivity, modify friction, demulsify, dehaze, and other types of efficiency. Furthermore, research has also been conducted on mixtures of chemical additives with diesel and biodiesel fuel that will be discussed in this report to show even more possibilities of efficiency through the use of chemical additives. Therefore, the purpose of this research is to study the efficiency of chemical additives on internal combustion engines, as well as the plausibility of such a product to exist, in the hope of developing a device that can be brought to market in the near future.

Keywords— additives; diesel; biodiesel; combustion; flame temperature; emissions; power; torque; climate change

1. INTRODUCTION

Internal combustion engines (ICE) produce an average of 4.6 metric tons of carbon dioxide per year, according to the EPA. In turn, this grandiose amount of carbon dioxide has escalated to the point where the average temperature of the world is rising. This rise of temperature has devastating effects on not only health and ecosystems, but also the economy, as weather keeps getting more extreme to cause frequent destruction. Though the solution to stop using internal combustion engines seems simple, it is not easy to implement, as many individuals do not have the means to change their routines. That being said, a need exists to improve the efficiency of the internal combustion engine so that this climate crisis can be resolved.

It is believed that an engine utilizing chemical additives could be a solution to improving engine efficiency, as it would have the ability to handle the extreme conditions of heat, pressure, and possibly abrasion that combustion creates inside of a cylinder. Although this may seem like an easy improvement to the production of engines, the manufacturing of such a product can be quite difficult and expensive.

Research findings have been conclusive that various additives could indeed be utilized in diesel and biodiesel fuels to improve environmental emissions and engine performance. However, there has yet to be a standardized fuel substitute on the market. This indicates that further research and ultimately production still needs to be done. Therefore, this paper seeks to limit the potential additives that could be brought to market into a comprehensive list, while questioning other additives that have yet to be tested, in the hopes of bringing a product to market sooner to help the internal combustion engine, and ultimately the climate crisis.

II. BACKGROUND

Because combustion is the driving force of engines, there exists a need to better the process, while limiting the amount of fuel required and byproducts emitted. One way to do this is to decrease the ignition delay in the engine. Ignition delay is the amount of time between the injection of fuel and the beginning of combustion, consisting of a physical and chemical delay of the system. The time of the fuel to be ready for combustion via injection is the physical delay, while the chemical delay is due to the temperature of the system and the properties of the fuel. Therefore, if the physical delay is improved by bettering the combustion chamber, injector, and injection pressure, then the ignition delay could be improved. Likewise, the chemical delay could be improved by bettering the fuel properties to have a higher cetane number, perhaps lighter weight, lower viscosity, higher exhaust gas temperature, greater fuel atomization, lower heating value, etc. Therefore, if an additive were added to the fuel to enhance these types of properties, better combustion will occur (1).

The physical amount of fuel consumed also influences the amount of byproducts. The brake specific fuel consumption describes this parameter and is defined as the quantity of fuel used by an engine for each power output unit. By decreasing the amount of fuel required, there will be less harmful waste products emitted such as oxides of nitrogen (NO_x), oxides of carbon (CO_x), and hydrocarbons (HC). Furthermore, by decreasing the amount of fuel required, the natural resource can be conserved. It should be noted that a concern by many researchers is that biodiesel may in fact increase fuel consumption due to its low energy content, in turn having a negative environmental effect

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