ADDITIVE COMPOSITION FOR ETHANOL FUELS

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Introduction

Economical and environmental factors dictate the development of non-polluting fuels obtained from renewable sources in order to replace petroleum-based fuels. In Brazil, ethanol has been employed as an alternative fuel for more than 30 years. Ethanol is used in large scale in its hydrated form or in a blend with gasoline, and there are research interest and technology developments that aim to develop technologies where ethanol can be mixed with diesel fuel or, in a more challenging way, ethanol can be used directly in diesel cycle engines. [1].

However, the direct use of ethanol in Diesel engines is limited by its inherent low lubricity and low cetane number, which leads to problems such as wear and scarring that accelerate metal deterioration, as well as deposits in the fuel injection system, causing engine failure and shortening the life of some components. Furthermore, the low cetane number (CN) is a definite limitation for the direct use of ethanol in diesel engines. The development of additives that improve this property is a key topic for making any technology to apply this renewable ethanol fuel in diesel systems viable. Diesel has a great participation in fossil fuel consumption in Brazil and the world, and it is considered one of the main sources of air pollutants in large towns, with high emissions of hydrocarbons, nitrogen oxides, carbon monoxide and particulate material.

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Technological development in this field led to approaches in which mineral and vegetable oils are applied as lubricants, and chemical compounds that are dangerous and unstable are applied for improving the cetane number. These approaches are highly questioned since the lubrication is not appropriate for working engines with very frequent part replacement. The manipulation of such additives and correlated fuel offers additional risks to operations like preparation and all handling and transportation. Fuel instability can led to defects and engine interruptions, and, besides all these constraints, these approaches usually involve organic compounds with high numbers of linked nitrogen atoms that generate nitrogen oxides when burning.

In this paper, we describe the development of a new additive composition for hydrous ethanol that: i) improves the cetane number to the required level that allows the direct use of ethanol in regular diesel engines and without risks related to safety, handling and chemical stability; ii) improve the lubricity of fuels containing high percentages of ethanol by forming with them a stable solution and promoting an intimate mixture between the lubricant agent and the alcohol.

Materials and Methods

The additive composition was developed by combining an ignition promoter, made of a special configuration of polyalkylene glycols that are prone to promote the explosion of its mixtures with ethanol in diesel engine temperature and pressure conditions. A lubricant formed by one or more alkylamine derivatives, that are miscible compounds with ethanol in storage and use conditions, also confers the required lubricity to the fuel in contact with all parts of the tank and engine, and a solvent comprising a mixture of alkanols.

Briefly, the components filled a pilot reactor (10 L) and were mixed by vigorous agitation at ambient temperature, yielding a slightly yellowish and clean liquid as a final product. The stability of the solution was studied by adding an aliquot of 10 ml of the additive composition to 100 ml of hydrated ethanol. The solution rested without agitation for 2 months and was observed periodically. The ability of the additive composition in improving lubricity was verified using a High Frequency Reciprocating Rig test system (HFRR).

Results and Conclusions

As soon as the additive was added to ethanol, an emulsion was formed, which turned into a clean solution within 48 hours (without agitation). No phase separation was observed during the period of the experiment, demonstrating good stability of the solution.

The results of the lubricity test are shown in Table 1.

Table 1: Lubricity test results for ethanol containing additive (5%) using diesel as reference.

	ASTM 6079 WSD[3] [mm]	**ISO 12156 WS1.4[4] [µm]**
Reference (diesel, 60°C)	Max 0.52	Max 460
Sample	0.41±0.01	423.5±6.4

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The HFFR (High Frequency Reciprocating Rig) test was used to determine mixture lubrication qualities (ethanol containing additive). The test uses a steel ball that scrapes across a steel disc while immersed in a liquid. The amount of damage caused by the interaction of the ball and disk is called a scar rating. The higher the scar rating, the more damage that occurred. The results observed in Table 1 are smaller than upper limits according to ANP Resolution No. 42 showing good lubricity results.

The additive composition for ethanol fuel, which is applied to diesel cycle engines, was developed by combining an ignition promoter, a lubricant and a solvent comprising a mixture of alkanols.

Additive chemistry stability and lubricity were also evaluated showing outstanding results.

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References

1- A. C. Hansen et al., “Ethanol–diesel fuel blends - a review”, Bioresource Technology, 96, 277-285, 2005.

2- ASTM D 6079-99. Standard Test Method for Evaluating Lubricity of Diesel Fuel by High Frequency Reciprocating Rig.

3- ISO12156. Diesel Fuel. Assessment of lubricity using the high frequency reciprocating rig (HFRR).

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Publications by the Authors

Armelin N.A., Conde A.L., Gugliotti, M. Composição de aditivos para combustíveis, (20110005863), 2011.

Armelin N.A., Conde A.L., Tomassini C. R., Venceslau E.B., Rosa, F. Aplicações de Cetais preparados a partir de pólios e cetonas, (P107759)