ENVIRONMENTAL BENEFITS OF BIODIESEL

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Abstract. Since the beginning of the 1980s a number of studies on the energy and environmental efficiency of alternative fuels was carried out. Most of the studies caused hot discussions among proponents and opponents on an expert level but also in the public. Atmospheric and environmental deterioration due to large consumption of fossil fuels has become an environmental problem taken up on a global scale. Resolving this problem, together with global warming by CO2, has become one of the foremost issues in modern society. În recent years, in particular, attention has focused on diesel vehicle emissions as a major cause of atmospheric deterioration. Policies are being advanced to reduce the burden on the atmosphere and the environment both in terms of fuel and in terms of fuel-burning equipment.

Keywords:

1.INTRODUCTION

Biodiesel, an alternative diesel fuel, is made from renewable biological sources such as vegetable oils and animal fats. It is biodegradable and nontoxic, has low emission profiles and so is environmentally beneficial, [1]. Natural vegetable oils and animal fats are extracted or pressed to obtain crude oil or fat. These usually contain free fatty acids, phospholipids, sterols, water, odorants and other impurities [4].
Even refined oils and fats contain small amounts of free fatty acids and water. The free fatty acid and water contents have significant effects on the transesterification of glycerides with alcohols using alkaline or acid catalysts, [3]. They also interfere with the separation of fatty acid esters and glycerol, [3].

Table 1. Chemical properties of vegetable oil

Vegetable oil	Fatty acid composition, % by weight									Acid, value	Peroxide, value
	16	18	20	22	24	18	22	18	18		
Corn	11	1.8	0.2	0	0	25	0	60	0.4	0.11	18
Cottonseed	28	0.8	0	0	0	13	0	57	0	0.07	64
Crambe	2	0.7	2	0.8	1.12	18	58	9	6	0.36	26
Peanut	11	2	1	2.52	1.23	48	0	31	0.9	0.20	8
Rapeseed	3	0.8	0	0	0	64	0	22	8	1.14	30
Soybean	11	3	0	0	0	23	0	55	6	0.20	44
Sunfower	6	3	0	0	0	16	0	73	0	0.15	10

2. PRODUCTION OF BIODIESEL

Biodiesel fuels are produced through a process called transesterification, in which various oils (triglycerides) are converted into methyl ester through a chemical reaction with methanol in the presence of a catalyst, such as sodium or potassium hydroxide, [5]. The by-products of this chemical reaction are glycerols and water, [5]. Biodiesel fuels naturally contain oxygen, and while not inherently contained in the feedstock, sulphur may be present because of contamination during the transesterification process and in storage, [5]. Three basic routes to methyl ester production from oil and fats exist, and are well known, [8].
These are: base catalyst transesterification of the oil with methanol, directed acid catalyzed esterification of the oil with methanol, conversion of the oil to fatty acids, and then to methyl esters with acidic catalysts, [8]. The majority of the methyl esters produced today are done with the base catalyzed reaction because it is the most efficient for several reasons: low temperature (up to 150F) and pressure (20 psi), high conversion (98%) with minimal side reactions and reaction time, direct conversion to methyl ester with no intermediate steps, exotic materials of construction are not necessary, [8].

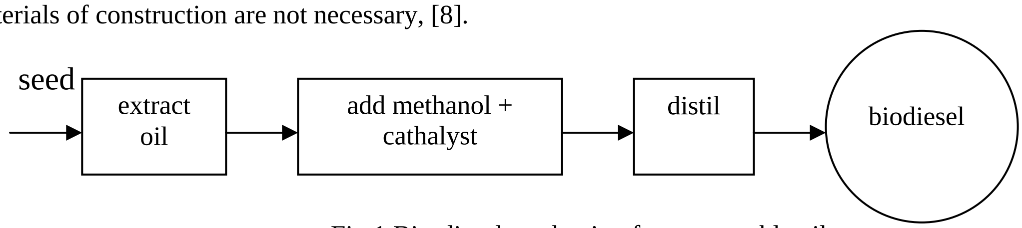

Fig.1 Bio-diesel production from vegetable oil

3. ENVIRONMENTAL BENEFITS

3.1 Emissions

Atmospheric and environmental deterioration due to large consumption of biodiesel has become an environmental problem taken up on a global scale [4]. The Kyoto Protocol came into force representing a global commitment by most of the world's industrialized countries to reduce carbon emissions [5], and Europe assumed the commitment to reduce CO_2 emissions between 2008 and 2012 by 8% [5].
From the results of emissions tests using these three fatty acid methyl esters, it was learned that the emissions from fatty acid methyl esters vary by carbon number [4]. The density of each ester was about the same, but the boiling point increased together with the carbon number. These differences in boiling point can be considered as one major factor behind the differences in emissions.
The major part of the tests performed by Aakko et al. [7] was carried out with a Euro 2 emission level Volvo bus

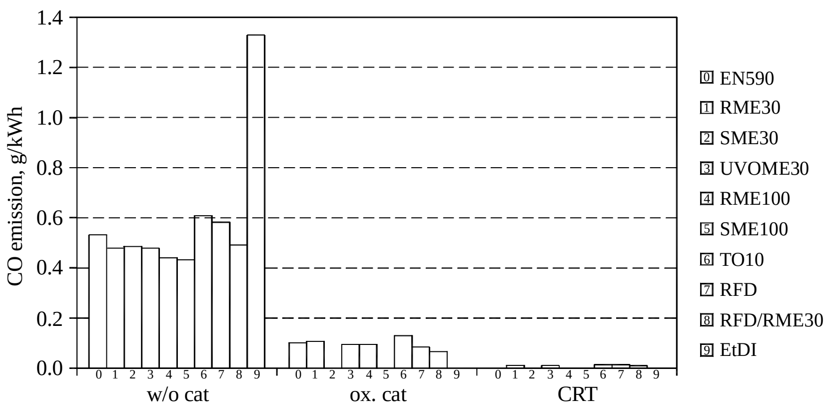

Fig. 2 CO emission with Volvo engine (w/o cat-without a catalyst; ox. cat-with an oxidation catalyst; CRT-CRT particulate trap.

engine. The vegetable oil esters studied were rapeseed methyl ester (RME), soy bean oil methyl ester (SME) and used vegetable oil methyl ester (UVOME). RME and SME were tested as 30% blends in European grade diesel fuel (EN590) and as neat esters. RME was also blended (30%) into Swedish Environmental Class 1 diesel fuel (RFD). The test fuel matrix also included Canadian diesel fuel blended with 10% hydrated tall oil (TO10) and an emulsion of Swedish Environmental Class 1 diesel and some 15% ethanol (EtDI). Compared to hydrocarbon fuels, the bioesters reduced CO emissions in most cases (Figure 2).Tests were conducted with biodiesel fuel blended in diesel fuel in concentrations of 20% and 40% by volume on a single cylinder version of a 3400 series Caterpillar D.I. diesel engine [7].

At high load using single injection, particulate and CO emissions decreased as the biodiesel concentration increased; a slight increase in NO, was observed for these cases. When a multiple injection strategy was utilized with the biodiesel blended fuels, a significant additional decrease in particulate emissions were observed with little or no effect on NO_x.

Compared to fossil fuels, the mutagenicity of RME emissions is much lower indicating a reduced health risk from cancer [8].

Testing different fuels, Krahl et al. [9] have found that all biodiesel blends led to better emissions than the diesel fuels and GTL. The use of all biodiesel qualities resulted in PM reduction and NO_x increase.

3.2 Evaluation of biofuels

The environmental benefits of biofuels appear during the combustion in the engine.The use of biofuels results in a closed carbon cycle, since the emitted amount of CO_2 is as much as the plant (rapeseed, corn, etc.) absorbed during its vegetation. Due to the low or zero content of pollutants such as sulfur in biofuels, the pollutant (SO_2 etc.) emission of biofuels is much lower than the emission of conventional
fuels. The use of biofuels, however, has some environmental drawbacks [10]. The raw materials of biofuels are plants produced by the agriculture having some negative impacts on the environment.

Table 2 summarizes the environmental impacts.

Table 2. Environmental Pros and Cons of biofuels

Pros	Cons
Closed carbon cycle, reduced CO2 emissions	The production of biofuels requires fossil energy
No sulfur content, no SO2 emission, very low NO*x* , CO, soot emission	Growing energy-plants bring about monocultures
Better energy balance than conventional fuels	The use of fertilizers and pesticides pollute the ground and groundwater

Biodiesel does not contain chemically hazardous materials. However, it does contain chemicals that do impart an oxygen loading on receiving environments. Therefore, long-term leakage or large spills into the environment can cause adverse impacts due to excessive oxygen utilization causing anaerobic (septic) conditions to become established.

Environmental release of biodiesel is considered much less of an environmental security issue than the release of petroleum diesel because of the ease of biodegradation associated with the biodiesel. Additionally, biodiesel is not considered a toxic compound due to its oil-base (not petroleum), [[11].

The US Biodiesel Board (2003) reports that studies show that the use of biodiesel reduces exotic (derived from outside of the biosphere) carbon dioxide flux into the biosphere by over 75% because of recycling of the carbon dioxide within the biosphere. Carbon monoxide production on a life cycle basis is reduced by approximately 35%. Measurements of particulate matter emissions from diesel-run buses indicate a reduction of particulates by over 60%. Soot (the black smoke released during rpm increases) within the same tests were reduced by over 80%. Sulfur dioxide and methane releases have been documented to be reduced by over 8% and 3%, respectively. Nitrogen oxide releases were approximately 9% higher than those measured from combustion of petroleum diesel fuel. Wastewater production and hazardous waste generation during processing of biodiesel over petroleum diesel is approximately 80% and 95%, respectively, lower.

4. CONCLUSION

In the Kyoto Protocol Europe assumed the commitment to reduce CO_2 emissions between 2008 and 2012 by 8%. The White Paper of the European Commission "Energy for the future: renewable sources of energy" considers it possible to double the production of energy from renewable sources until 2010. The strategies presented in the White Paper stress the role of biomass, attributing paramount importance to bioenergy as regards the mix of renewables.

In recent years, attention has focused on diesel vehicle emissions as a major cause of atmospheric deterioration. One main reason for introducing biodiesel as a fuel is to reduce the emissions of carbone dioxid from transport sector.

Numerous legislative measures have been developed în recent years and are now practiced to reduce the risks caused by exhaust emissions that may affect human helth and to determine climate change.

Since biodiesel is a renewable fuel that can be produced from plant and animal sources, an opportunity exists to reduce greenhouse gas emissions when compared to nonrenewable petroleum diesel. The carbone dioxid released from burning will be recaptured by crops growing.

Energy use is responsible for a large fraction of the emissions of air pollutants, resulting in local, regional and global environmental problems.

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