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EMISSION TESTING USED BIOGAS AND VEGETABLE OILS AS FUELS

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ABSTRACT: We made some environmental tests on different kinds of vegetable oils and biogas in a few projects so in this paper we describe exhaust emission measurements, in fact this paper introduces environmental dimension of renewable energy systems (utilizing biogas and vegetable oils in internal combustion engines). We deal with the biogas and biodiesel because producing and utilization of biogas and biodiesel help realize the strategic purpose and objects in the energy policy and the environment policy, too. Namely the European Union focuses on the promotion of renewable energy sources through its energy policy. Actually, our environmental obligations and supported tasks of renewable energy production came into view after our joining to the European Union because in the European Union the share of renewable energy must reach 20% till 2020. So we have to take advantages opportunities more and more in the renewable energy.
KEYWORDS: Biogas, Vegetable oils, Internal combustion engine, Emission testing

INTRODUCTION

The studying of possible renewable liquid and gaseous fuels - derived from different kinds of biomass or wastes - is not a new theme. Although in recent years, sustainable development and sustainable survival became actual global problems because it is needed to increase the rate of renewable energy sources to solve together the environmental and energy problems. Numerous studies examine biodiesel and biogas fuels because their properties are similar to conventional fossil fuels so can be used in internal combustion engines without any special modifications. Actually, the idea of the bio-fuels is as old as the engine itself.

There are various solutions to utilize the biogas and the biodiesel, one of the possible options is utilizing of them in internal combustion engines. Our daily lives there can be no firing. However it can not be given up the energy from burning, but environment pollution is not necessary to accompany development. In the operation and facilities management of heat engines in addition to machinery and equipment design there is key role composition and quality of the used fuel. Most of the air pollutants come from the combustion. The importance of renewable fuels - between the biogas and the biodiesel - is justified by environmentally, EU requirements and economic considerations besides energetic aspects. Conservation of state of our environment and efficient, economical satisfying of energy demands can be solved by harmonized application of traditional and renewable energy sources.

Accordingly, the objective of our research task is: testing of utilization of biogases and biodiesel for energy in internal combustion engines particularly the emission.

THE ENVIRONMENTAL EFFECTS OF BIOGAS FUELLED

We made emission tests on 24.6 kW power, 4 cylinder Wiscon Total TM27 type gas engine with biogases. We represented the biogases as mixtures of methane and carbon-dioxide.

In Figure 1 it can be seen that in case of λ >1.1 air access ratios the cooling effect of the surplus air results lower NO_x emission, however, NO_x formation depends on the temperature. The engine operation with increasing carbon-dioxide content of gas mixture - by reason of drawing-off of combustion and cooling effect of carbon-dioxide - results further decreasing.

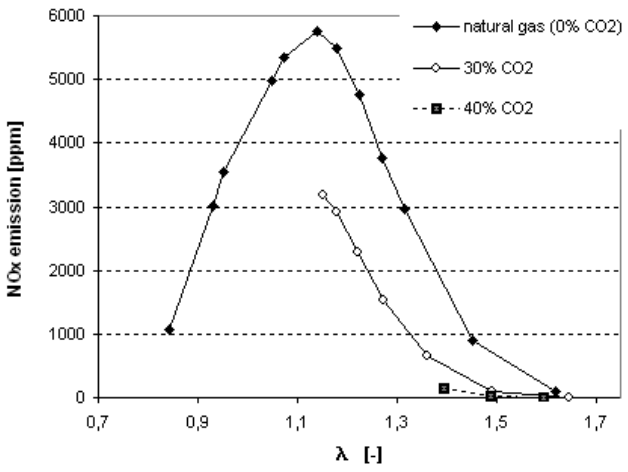

Figure 1. NO_x emission

With increasing of carbon-dioxide rate of the applied biogas, the circumstances of the combustion are getting worse.

Figure 2 illustrates the CO emission plotted against the air access coefficient. In case of λ<1.0 air access ratios CO emission increases by leaps and bounds, which can be explained by the increase of adiabatic flame temperature and production of getting rich mixture.

However, in range of λ=1.1-1.4 air access ratios CO emissions - independently of carbon-dioxide content of gas mixture-stabilized on lower values. In case of λ>1.4 air access ratios the dragging-on of combustion results increasing CO emission (and higher quantity of unburnt hydro-carbons). In terms of CO emission, unambiguously, it can be determined that the traditional gas engine is operated with gas mixture with low methane content, there is no effect on CO emission if the gas engine operates permanently in range of λ=1.1-14 air access ratios.

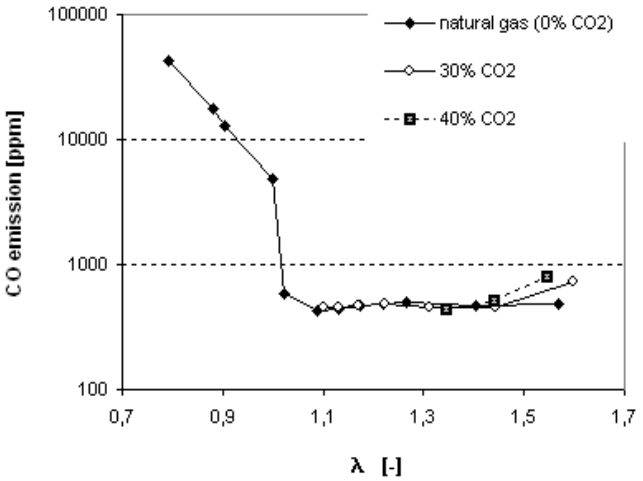

Figure 2. CO emission

Measuring of the methane content in the exhaust gas can give points of reference on the goodness of combustion process. Increasing the air absence and dragging-on of the combustion result similar tendencies considering the unburned hydrocarbons emission, too.

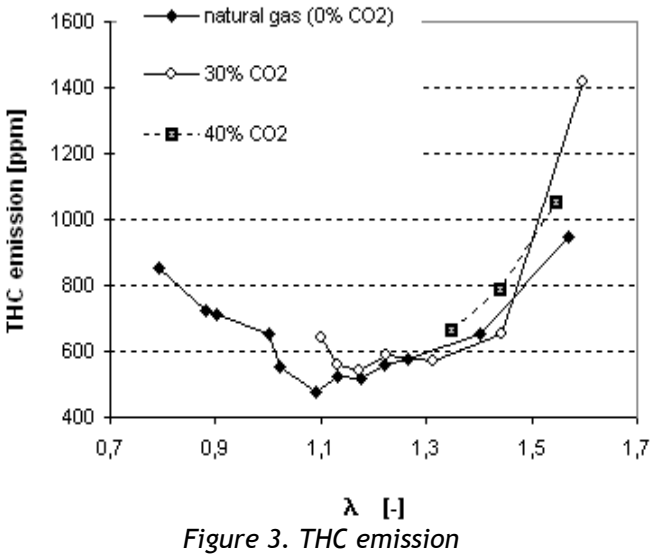

Figure 3. THC emission

In Figure 3 it can be discovered that considering the incombustible hydrocarbon content of the exhausted gases there is no significant deviation present between the operation of natural gas and gas mixtures with a higher carbon-dioxide content in the range of λ=1.2-1.4 air access ratio.

ENVIRONMENTAL EFFECTS OF VEGETABLE OILS FUELLED

We could test 10 types of vegetable oils which are suitable for use as diesel engine fuels. We investigated emission components used with as well 5 kinds of sunflower oils (NR, NB, NA, NA82, NA04), 4 kinds of rape oils (RT, RB, RE, RP), RME and RME mixed with diesel oil (RME 10%).

Application of vegetable oils as fuels in the internal combustion engine resulted different power and torque values than diesel oil, it can be explained with different heat values and viscosity, cetane number of vegetable oils.

Our tests were performed by taking into account the requirements of EU 49 standards with PERKINS 1104C engine type. In the course of our we established the amount of CO, HC, NO_x, CO_2 and O_2 components of exhaust gases and determined the rate of smoking, too.

Our measuring system realized the certification cycle which contains operating conditions like speed (idle speed, maximum torque speed, maximum power speed), load (10, 25, 50, 75, 100%) and load factors. R49 regulation requires a thirteen-step engine brake bench test in steady operation.

The emissions are measured step by step, and they are registered as a specific mass emission (g/kWh) per performance. The issue is an average number that is calculated per polluting components and also per operation modes. Among the thirteen measuring points (operation modes) the sixth and the eights measuring points are high load working points. This means high average exhaust temperature.

During the application of the 10 kinds of vegetable oil-diesel oil mixed fuel we measured higher NO_x values only on two cases than that of near diesel oil (Figure 4).

The samples with sunflower oil were slightly more favourable, than rape oil samples. Nine samples remained below the diesel fuel by 6.94% - 13.61%. Our further remark is that the values of pure RME exceeded the NO_x limit of diesel oil with 6.54% and the mixed fuel containing 10% RME also exceeded by 10.72%.

After the emission tests it was stated that among the 5 kinds of sunflower oil mixed with diesel oil the effect of 4 kinds of fuel fell back by 6.93%-24.94% compared to the CO value of diesel oil (Figure 5). Among 4 kinds of rape oil we noticed substantial falling (65% and 39.61%) in two cases and rising (9.52% and 4.56% twice).

The pure RME showed 26.42% less CO emission the mixed fuel containing 10% RME decreased by 73.57%.

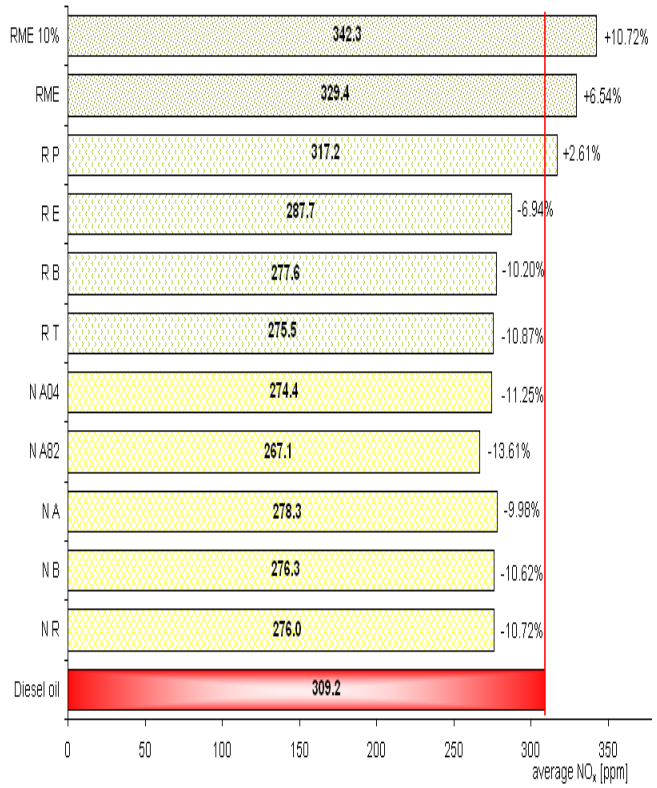

Figure 4. NO_x emission values

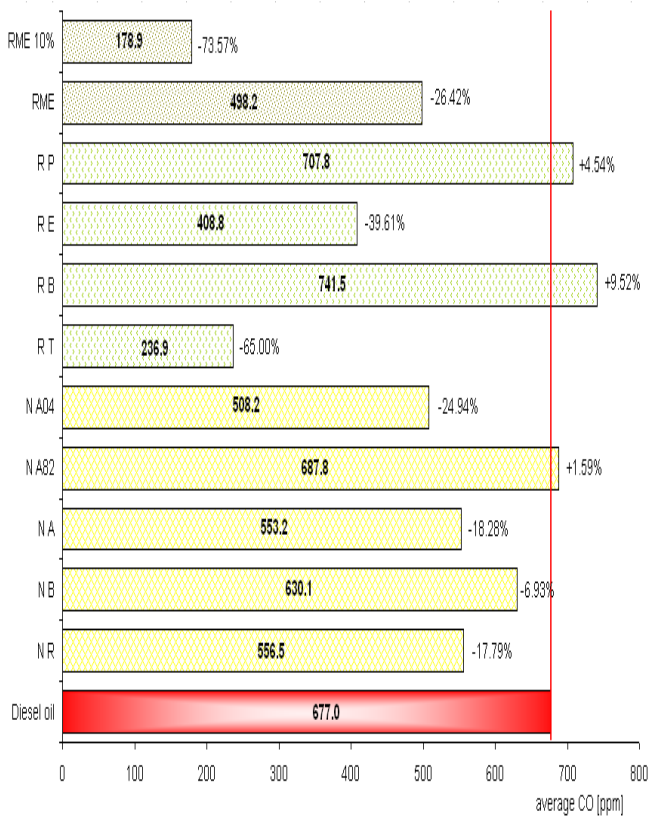

Figure 5. CO emission values

CH emissions of all the vegetable oils remained under CH values of diesel oil (Figure 6).

To compare the values of mixed fuel with sunflower oil that of there was diesel oil, drop of 18.6% - 34.88% and also a fall of 26.16% - 66.28% mixed fuel was used with rape oil. The pure RME resulted 5.23% less CH values, while the mixed fuel containing 10% RME dropped by 55.81%.

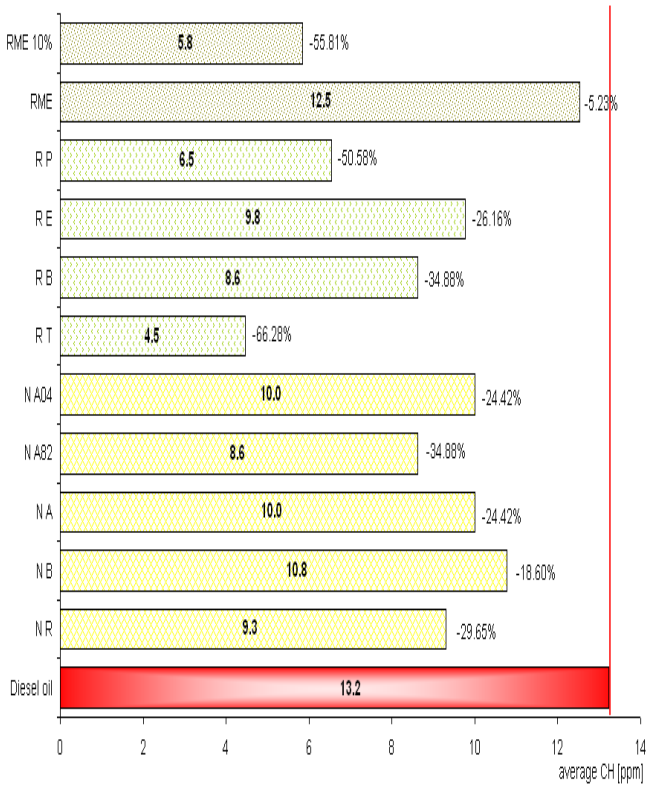

Figure 6. CH emission values

CONCLUSIONS

Today, all over the world, impacts of energy resources on the environment are global problem. The preservation of the environmental quality and providing of the necessary energy can be solved with the harmonized application of the traditional and renewable energy sources. Spread of energy carriers of biological origin can be promoted by continuous innovative activity. That is why nowadays the best perspectives are hidden in the utilization of biogas, biodiesel and vegetables oils for energy. They are universal energy sources, which have significant roles in the energy strategy.

Carbon-dioxide content of the biogas depends on the organic wastes or by-products and the production technology. The combustion takes longer time on the effect of carbon-dioxide, which can bring changes in emission.

It can be determined that that the 10 types of vegetable oil are suitable for use as diesel engine fuel but these promising results need to be completed by a more detailed study of the effect of parameters.

In conclusion, results of this study show that the biogas and vegetables oils have more and more important roles in the future.

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