Advanced technologies for highly efficient Clean Engines working with alternative fuels and lubes

Berichterstattung

Projektinformationen

CLEANENGINE

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Final Report Summary - CLEANENGINE (Advanced technologies for highly efficient Clean Engines working with alternative fuels and lubes)

The CLEANENGINE project evaluated the impacts on modern engines of:

- liquid biofuels coming from biomass (like biodiesel and bioethanol);
- environmentally friendly and ash-free lubes and / or lubrication concepts.

Effects of bio fuels and bio lubes usage on small (ships), medium (car) and large (ship) diesel and / or gasoline engine configurations are evaluated and compatible optimized solutions in materials, geometry and after-treatment are developed considering lifecycle assessment methodologies.

The CLEANENGINE project was organised into seven technical work packages (WPs): first two were 'input' work packages in which fuel, lubricant and additives developers focused their activities in designing and producing the engine alternative fluids according to end-users requirements. WP3 and WP4 were devoted at the evaluation of the compatibility of engine materials and sub-systems with the alternative fluids. In WP5, development and / or optimisation of post-treatment systems to reach emissions targets was performed for the three engine applications. In WP6, developed alternative fluids performances were finally assessed in engines. In WP7, a LCA study was carried out to study the environmental impacts in the production and usage phases of the alternative fluids.

In WP1 research activities were focused on the development of bio-fuels blends according to engine manufactures specifications, in particular: biodiesel + gasoil (diesel), gasoil (diesel) + bio-ethanol, petrol + bio-ethanol, bio-ethanol + biodiesel and mixtures of gasoil (diesel), biodiesel and bioethanol were considered in the project; to fulfil specifications multifunctional additive packages were formulated for all of the biofuel types.

The aim of WP2 was the development of 'compatible' lubricants with the abovementioned bio-fuels combining non-toxicity, bio-degradability characteristics and renewable resources with increased efficiency, reduced emissions and wear control. To achieve these aims the bio-lubricants were based either on ester- or vegetable oils or on polyglycols, with a high amount of renewable resources. The different CLENANENGINE engine technologies required the formulation of three different oils esterbased oil families: four-stroke oil for small and medium engines, four-stroke oil for large engines, two-stroke oil for small engines. The candidate base oils from the category of the polyglycols aimed at significantly reduce the viscosities at low temperatures in order to improve the fuel economy in city driving cycles. This was achieved by means of a high, intrinsic viscosity index of the base oils, eventually improved by VI improvers. To study the solubility of alcohol and biodiesels as well as to address the different oxidation and degradation reactions, polyglycols with three different backbone compositions, were considered. The newly developed alternative oils were characterised by biodegradability and toxicity tests proposed by OECD international organisation. The viscosity characteristics and the ageing stability in presence of bio-fuel dilution were also evaluated: results showed that the behaviour of the alternative engine oils is better than the conventional reference oils.

In WP3 tribological performances of alternatives lubes developed in WP2 and the effect of bio-fuels dilution on friction and wear of mating engine components were evaluated; alternative coatings were tested to counteract the negative effect of bio-fuel dilution. Also the corrosion effect of biofuels and alternative lubes on some engine components materials was evaluated. Different tests applied both to simple geometry specimens and real parts revealed a very good behaviour of the developed alternative oils and of the considered innovative coatings, especially in presence of fuel dilution, both in terms of friction and

wear results.

In WP4, the impact of usage of bio fuels in comparison with standard fuels on injection and combustion phases was evaluated by a numerical and experimental point of view. In general, it can be stated that adding biodiesel to fossil diesel does not principally change the behaviour of the engines. In some cases, emissions become better in some cases worse, depending on the configuration. In case of large engines various fuel blend, studies were tested and, based on the results, NOx removal was seen necessary to reach EPA 2007 in future applications.

WP5 activities were devoted to develop / optimise opportune after-treatment systems for engines working with bio-fuels; based on emission tests results coming from small, medium and large engines, different components were developed:
- for diesel passenger car application dedicated DOC+DPF solutions were prepared for Euro 4 and Euro 5 configurations;
- for small engine application a wire mesh catalyst to be assembled in the original muffler was prepared both for diesel and gasoline fuelled configurations;
- for diesel large engine an hypothesis was done for NOx reduction by SCR catalyst.

An assessment of the developed technologies (fuels, lubricants, modified injection and combustion parameters and post-treatment systems) was carried out by engine / vehicle tests in WP6. Shorter tests results showed that the current emission limits norms were fulfilled and endurance tests demonstrated that an optimisation of engine materials and the application of dedicated lubricant technologies are welcome to fight against bio-fuels specific deposits formation and the detrimental effects due to enhanced biogenic fuels oil dilution.

The LCA study performed in WP7 had the aim to evaluate by an environmental point of view the so called 'CLEANENGINE system' combining the application of biofuels and alternative lubes. Based on the available data and using two different evaluation methods it was concluded that the main environmental benefit of the proposed system is the reduced usage of fossil fuels resources.

Verwandte Dokumente

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