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AUTOMOTIVE INDUSTRY SOLUTIONS IN RESPONSE TO EUROPEAN LEGISLATIVE EMISSION REGULATION CHALLENGE

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Abstract. EU regulation related to the Automotive Industry focuses on strengthening the competitiveness of the European automotive industry by implementing an effective internal market regulatory framework of technical requirements, as well as enhancing co-ordination of policy areas affecting the sector. In order to make recommendations for better regulation 'enhancing global competitiveness and employment, while sustaining further progress in safety and environmental performance at a price affordable for the consumer', a high-level group called CARS 21 was set up in 2005. The article gives an overview of the latest European legislative instructions, their effect on the automotive industry and features the solution options ranging from vehicle-level technologies to energy resources.

Keywords: EU legislation, automotive industry, vehicle, engine, alternative fuels.

Regulation of the automotive industry in the EU

Automotive industry-related EU regulation is focused on competitiveness fortification of the European automotive industry by implementing an effective internal market regulatory framework of technical requirements, as well as enhancing co-ordination of policy areas affecting the sector. In order to make recommendations for better regulation 'enhancing global competitiveness and employment, while sustaining further progress in safety and environmental performance at a price affordable for the consumer', a high-level group called CARS 21 was set up in 2005.

Technical requirements are formulated in the European Directives. These directives require third party approval – testing, certification and production conformity assessment by an independent body. The European Whole Vehicle Type-Approval System allows manufacturers to have a vehicle 'type' approved in one Member State and, then, to market the vehicle in all other Member States without further tests. The system became mandatory for all passenger cars in January 1998 and for two- and three-wheeled motor vehicles – in June 2003. Similarly, in July 2005, it also became mandatory for all new tractors, whilst the process of introducing such a system for trucks and buses is currently underway.

The 2001/77/EC Renewable Energy Directive (REN) focuses on the blend of biofuels obtained from different sources. It contains the approved Green House Gas saving threshold of eligible biofuels.

The 1998/70/EC Fuel Quality Directive (FQD), setting the most important technical and environmental specification for fuels, is under review by the EU. The FQD and the EN standards elaborated on the bases of this directive guarantee that consumers can get the appropriate fuel for their cars in the whole EU. Car manufacturers guarantee a problem-free operation of cars if these fuels are used.

In order to limit pollution caused by road vehicles, the EU provides standards for the automotive industry. The new common requirements for emissions from motor vehicles and their specific replacement parts are described in Euro 5 and Euro 6 standards (2007/715 Regulation). They also outline measures improving access to information on vehicle repairs and promoting the rapid production of vehicles in compliance with the provisions of the Regulation. These are verified parallel to the Fuel Directive and norms. It urges the automotive and oil industries to harmonize their developments. The car manufacturers are improving more composite engines, in accordance with treatment systems and vehicles that need high-level additised fuels.

Proposal for a Regulation of the European Parliament and of the Council setting emission performance standards for new passenger cars as part of the Community's integrated approach to reducing CO_2 emissions from light-duty vehicles regulates the CO_2 emission levels for new passenger cars (Tanczos and Torok 2007) which were sold.

The latest EU standards and policies

The goals of 2001/77/EC Renewable Energy Directive (REN) are to reach minimal 10% energy of biofuels by 2020 in all means of transport. Biofuels from waste and not eatable materials will count double towards the 10% national target and company obligations. The minimum level of green-house-gas saving is expected to reach 50% by 2017. Under the continuous review of REN, the CEN TC19 workgroup is working continuously on specifications for B7/B10 biodiesel and E10/E85 ethanol blends. The new CEN TC383 for biofuel certification awaits the EU mandate.

The current version of 1998/70/EC Fuel Quality Directive (FQD) prescribes in Article 7a: 6% as mandatory, additional 2% for other fuels like CCS and an extra 2% as voluntary. The baseline year will be 2010, but the already blended biofuels are not taken into account. It will probably result in two gasoline grades (E5/E10): E10 specification is already in the Directive, while CEN is going to update gasoline standard. It is required that suppliers maintain E5 at least until 2013. As concerns diesel fuel, the new goals of the FQD will cause the following: the Directive specifies B7 grade, while B10 is expected to be used since 2015. It is allowed to sell B7+ diesels on the market .

All vehicles equipped with a diesel engine will be required to substantially reduce their emissions of nitrogen oxides as soon as the Euro 6 standard comes into force. For example, emissions from cars and other vehicles intended to be used for transport will be capped at 80 mg/km (the additional reduction is more than 50% compared to the Euro 5 standard). Combined emissions of hydrocarbons and nitrogen oxides from diesel vehicles will also be reduced. These will be capped at, for example, 170 mg/km for cars and other vehicles intended to be used for transport.

Recently, CO_2 emission has become the main concern to the automotive industry. The industry signed a voluntary agreement with the European Commission in 1998 to reduce CO_2 emissions rates of passenger vehicles sold in the European Union to a fleet average of 120 grams of CO_2 per kilometre (gCO_2/km) by 2012. This agreement reduced CO_2 emissions by cars by the average 12.4%, but this requirement will not be met in 2008. Although recent years have seen a significant improvement in vehicle technology, particularly, in fuel efficiency, which translates into lower CO_2 emissions, this has not been enough to neutralise the effect of increases in traffic and car size.

The car manufacturers have not met their own goals, thus the EU set the following limits in the Regulation 2007/297: until 2012 65% new cars will have to reach 130 gCO_2/km engine emission and a further reduction of 10 g CO_2/km should be obtained by the increased use of biofuels, and by other technological improvements, such as minimum efficiency requirements for air-conditioning systems, tyre pressure monitoring systems, setting maximum tyre rolling resistance limits, with the use of gear shift indicators and utilisation of biofuels. By 2015, EU27 100% new cars will have to reach an average 130 g CO_2/km and, by 2020, 95 g CO_2/km target, including hydrogen and fuel-cell vehicles.

What could be the solution of the automotive industry? The use of biofuels may be one of the easiest and cheapest options towards a low carbon car future. Some of the automotive industry players are advocating increasing biofuel blending, developing flex fuel vehicles and including biofuels in the emission regulations. It is hard to predict, which of the competing low carbon technologies and fuels will win in the long term, but many automotive industry experts view biofuels mainly as a bridge to more sustainable options such as fuel cells.

Car Industry Developments

Technical background

As mentioned above, the greatest challenge for the automobile industry at the 21st century is to find an optimal solution to decreasing crude oil reserves, rigid emission standards and higher power and satisfying better drivability demand of customers. Manufacturers try different technical ways to reach these goals. Different technical solutions can be divided into three major groups: vehicle-level technologies, engine-based technologies and fuel-pulled technologies. In the following chapters, we give a short overview of these major tendencies.

Vehicle-level technologies

Vehicle-level technologies contain the technical solutions involving more than engine development. They combine the engine development with drive, chassis and weight improvements and very often with new energy saving types. The three most important vehicle technologies improvements are given below.

Hybridization

Hybridization combines the benefits of the well-known and widely used internal combustion engine and an electric motor. Different car manufacturers developed different solutions to this problem. The most widely known type is the gasoline-hybrid. Hybrid vehicles were produced first by Anton Porsche in the early 1900. This vehicle had axle engines complemented by a 2 kW gasoline engine. Until late twenties, more other models were developed, but they were not comparable with rapidly developing gasoline engine.

The main and first investigator of these hybrids nowadays is Toyota from Japan. It is natural for a Japanese manufacturer to develop a gasoline hybrid because, in Japan, gasoline has a dominant market share. Toyota launched its first hybrid car named Prius in 1997. In ten years they sold more than 1 000 000 items. Honda and Ford were the first followers (Horváth A *et al.* 2007).

There are different ways to combine the internal combustion engine with electric motor. Fig. 1 gives a global overview of these methods based on different combinations as follows:

- overhead cable vehicle (trolley bus);
- replaceable accumulator;
- internal combustion engine;
- overhead cable combined with accumulator (for shorter distances, emergency cases);
- rechargeable accumulator;
- serial hybrid;
- parallel hybrid;
- overhead cable combined with internal combustion engine.

The main advantage of the combined use of electric and combustion engines is based on the idea that the high torque of the electric engine is usable in the loads where the combustion engine operates at low efficiency level. The two base combinations are shown in Fig. 2. These are the bases of all other combinations.

The essence of the parallel hybrid system is that both engines are in mechanical connection with the driven wheels. They contain two engines (one is a combustion engine and another – an electric motor), two pieces of energy storage equipment (fuel tank and accumulator) and a special clutch. The vehicle can be operated by one of the systems or by two systems. It means that smaller engines are sufficient to reach the same peak power level.

The combustion engine is not in direct contact with the driven wheels – only through the electric motor. The engine runs a generator for the electric motor or for the accumulator. The vehicle cannot operate with the engine alone, but can be operated with the motor only. In addition, the double energy conversion causes additional energy losses.

The fuel consumption and emission level of gasoline hybrids can be reached by the newest diesel technologies for lower price. On this basis the European manufacturers started to develop diesel-hybrid systems. These can combine the combustion benefits of the latest diesel engines with the advantages of the hybrid systems in urban areas.

From the perspective of fuel consumption, hybrid systems use the same amounts of fuel as traditional engines, and electricity is mostly produced on board. It is expected that the number of hybrid vehicles will increase in the future along with the improvement of the internal combustion engine. The two main ways will be the increase of drivability (for example, Lexus) and the fuel consumption optimization (minimal hybrid).

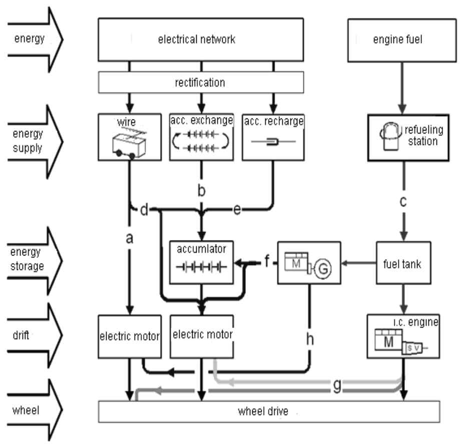

Fig. 1. The frame of the vehicle's drives (Emőd *et al.* 2006)

1 pav. Transporto priemonės pavaros struktūra

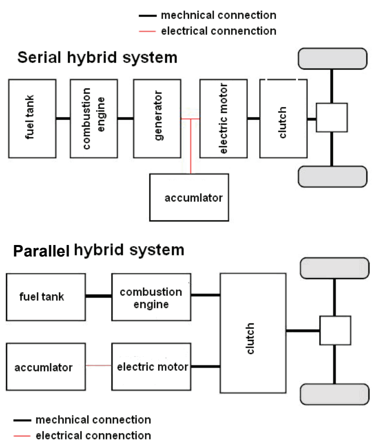

Fig. 2. Serial and parallel hybrid systems (Emőd *et al.* 2006)

2 pav. Nuoseklioji ir lygiagrečioji hibridinė sistema

Fuel cell

Fuel cells are another well investigated area. It could be the second step after the development of hybrid vehicles, leaving alone the internal combustion engine, and it is utilized with the electric motor only. It needs different forms of energy storage; the most applicable of which being the fuel cell. It will replace the fuel system and the combustion engine. It has quite a few drawbacks, the main being low energy density of the fuel cells (power cells today offer only 20 Wh/kg, with the potential of 60 Wh/kg in the next few years and the goal of 200 Wh/kg). The chemical limit of the storage capacity is approximately 1500 Wh/kg, but it will be reached only in 2020. Then, the energy stored in 100 kg battery would be enough for 400 km, with an additional 300 kg drive chain[4] (a modern combustion engine of app. 150 kg with the fuel tank containing 50kg of fuel would be enough for 750 km). An alternative for energy storage could be the use of compressed hydrogen by the vehicles. There could be more H_2 stored on board. Unfortunately, power is needed for hydrogen production (Murphy 2008).

If energy is stored in cells, recharging facilities are needed. In some cases, the power system could be used for this purpose. If energy is stored in hydrogen, then, hydrogen refueling stations are required.

Engine-based technologies

The internal combustion engine can be developed based on the results obtained from using the newest production technologies. These help to reach higher injection pressures, better combustion, lower weight, etc. In the next part, some of these new technologies are described.

HSDI – high speed diesel injection

High-speed diesel injection covers all the technical solutions that are used to reach higher injection pressures for diesel engines. Increasing injection pressures are essential to fit the even sharper emission standards. The main trend of development is associated with the common rail system with increased hydraulic pressure. The common rail technique has been available on the automotive market since 1995. Peak pressure of the system has increased since then. Now, it exceeds 2000 bar. These systems need very clean, ultra-low sulphur diesel fuels that are very stable at these pressures.

Advanced combustion technologies – HCCI / CCS / DiesOtto

There are more investigations which aim to combine Otto and Diesel burning. In order to meet tightening emissions standards and ever higher demands for fuel efficiency, car producers recognised that they have to abandon conventional petrol and diesel engines in favour of a new type of motor. HCCI and CCS are different attempts made in this direction.

CCS combines the most favourable characteristics of both petrol and diesel technology to make one low-emission, high-efficiency power unit that runs on synthetic biofuel. The main investigator of this technology is the VW AG. Their engine was designed to meld the homogeneous combustion and low nitrous oxide emissions of a typical small capacity petrol power plant with the self ignition and low fuel consumption properties of a modern diesel. Fig. 3 shows the differences and similarities between Diesel (TDI), CCS and Otto (FSI) burning.

The engine uses the latest piezo injector. CCS engine is able to begin the combustion process within each cylinder much earlier than in existing diesels, which tend to start shortly after the piston reaches top dead centre. As the fuel is ignited for a longer period of time, the CCS engine proves to be more economical. To ensure that the CCS process will be possible to achieve, the manufacturer has worked closely with oil industry companies to develop a new synthetic Fischer Troops fuel. This fuel is a CO_2-neutral biomass mixture containing no petrol or diesel, but rather created to use forest or industrial waste as well as bio-degradable rubbish, animal waste and specially planted crops. It does not require any dramatic alteration of the existing infrastructure.

HCCI (Homogeneous Charge Compression Ignition) is a relatively new combustion technology for low emissions and high efficiency. It covers a broad range of advanced combustion concepts that combine the benefits of the compression ignition and spark ignition technologies. Different from the traditional ignition engines, HCCI combustion takes place spontaneously and homogeneously without flame propagation. It is based on the effective fuel-air mixing that results in more complete combustion of fuel charge followed by decreasing of NO_x and particulate emission. An extra benefit of HCCI met-

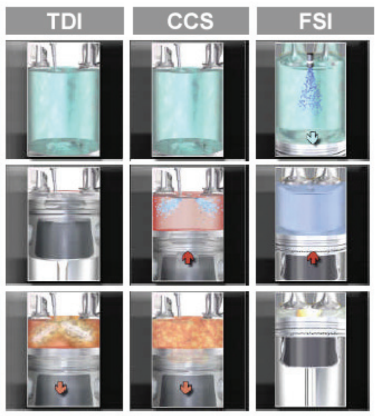

Fig. 3. CCS combustion (Drescher 2008)
3 pav. *CCS* degimas

hods is that they enable a bride range of fuels, and their fuel optimum is between gasoline and diesel characteristics. It shows an opportunity to use different fuels from diverse resources in the same engine. The first stage of using these type of advanced combustion will be a partial operation – part-time HCCI, which later will be extended to full-time HCCI operation (Advanced combustion for low... 2008).

DiesOtto powertrain is a further development of spark-ignition engine that includes features such as direct gasoline injection, turbo charging, variable valve timing and variable compression. It will be used in conjunction with a hybrid integrated starter/generator module. A controlled auto-ignition makes its core, allowing a highly efficient combustion process similar to that of a diesel to be achieved

Downsizing

Reducing the engine-swept volume, i.e. downsizing, offers the potential to meet the reduced CO_2 vehicle emission standards in Europe, as well as reducing fuel consumption. In downsizing the gasoline engine a key challenge is controlling octane requirement without sacrificing fuel economy. There are five common alternative approaches to the operation of turbocharged direct injection gasoline engine:

- Conventional λ=1 operation with reduced compression ratio (CR).
- Lean Boost Direct Injection (LBDI) with lean operation at full load to control octane requirement while maintaining a high CR.
- EGR Boost with cooled EGR dilution rather than excess air to control octane requirement.
- Miller cycle concept, where valve-timing strategies are employed to reduce the effective compression at high load.
- Dual spark strategies.

Higher octane number fuels are very useful in downsized gasoline engines, since they enable the use of the above technical solutions without any enrichment (Horváth *et al*. 2007).

After-treatment technologies

During the selective catalytic reduction (SCR), nitrogen oxides are removed through chemical reaction between the exhaust gases, a reactive agent (additive), and a catalyst. A gaseous or liquid agent (most commonly ammonia) is added to a stream of flue or exhaust gas and is absorbed onto a catalyst. It reacts with NO_x in the exhaust gas to form harmless H_2O (water vapour) and N_2 (nitrogen gas).

Multi-fuel vehicles

To prepare the vehicles for the differentiated fuels automotive manufacturers have constructed cars that can be run by more types of fuels. Flexible fuel vehicles (FFVs) are designed to run on gasoline or a blend of up to 85% ethanol (E85). Except for a few engine and fuel system modifications, they are identical to gasoline-only models. FFV's were produced first for the Brazilian market in the mid 90's. More and more OEM are producing FFV's, while the first producers were Ford/Volvo and GM/Saab.

Volvo produced a vehicle, called Multi-Fuel (Fig. 4). It is optimized for running on five different fuel types: hythane (10% hydrogen and 90% methane), biomethane, natural gas, E85 and gasoline. The Multi-Fuel vehicle contains one large and two smaller tanks of totally 98 litres for gaseous fuels (hythane, biomethane and CNG), and one 29 litres tank for liquid fuels (E85 and petrol). The small gaseous fuel tanks are made of steel. The large tank has a durable, gas-tight aluminium liner, reinforced with high-performance carbon-fibre composite and an exterior layer of hardened fibre-glass composite. The fuel tanks are fitted neatly under the luggage compartment floor, which means that full loading capacity is preserved. The engine automatically adjusts itself to the right blend of gaseous or liquid fuels. To switch between fuel types, the driver simply needs to press the button.

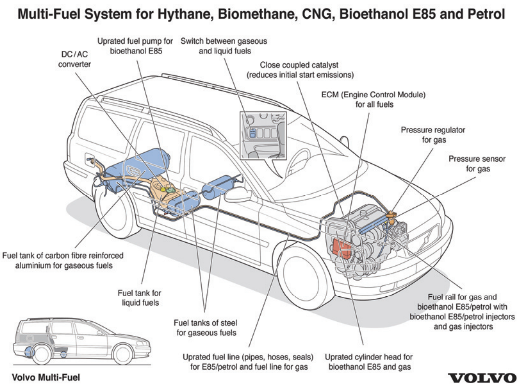

Fig. 4. Volvo Multi-Fuel vehicle
4 pav. Automobilis *Volvo Multi-Fuel*

New fuels, new resources

New engine technologies recommend new fuel qualities, at the same time, decreasing fossil resources, while rigid emission standards also aspirate to look for new energy sources. This section describes new types of fuels and resources.

Now, there is an urgency to improve the accuracy of predicting climate change impact (Tanczos and Torok 2007) on crop yields because the balance between food supply and demand is shifting abruptly from surplus to deficit. This reversal is being driven by a rapid rise in petroleum prices and, in response, a massive global expansion of biofuel production from maize, oilseed, and sugar crops. Soon, the price of these commodities will be determined by their value as feedstock for biofuel, rather than their importance as human food or livestock feed. In contrast, the urban and rural poor in food-importing countries will pay much higher prices for basic food staples and there will be less grain available for humanitarian aid. Food security will also depend on accelerating the rate of gain in crop yields and food production capacity on both local and global scales.

Utilisation of biofuels could show the following general advantages:

- lower dependence on crude oil;
- renewable fuel;
- favourable energy balance;
- reduction in greenhouse gas emission;
- lower harmful emission;
- biodegradable and non-toxic materials;
- option to the use of agricultural surplus.

Biodiesel

Biodiesel refers to a diesel substitutable fuel, produced by an etherification process from vegetable oils. It is a processed fuel to use in compression ignition engines, which feature differentiates biodiesel from the straight vegetable oils and waste vegetable oils utilized as fuels in some modified diesel vehicles. The resource quality parameters (irrigation, manuring, number of sunlit hours, etc.) have an excessive impact on the vegetable oil and, through that, on the biodiesel. It is a light to dark yellow liquid. It is practically immiscible with water, has a high boiling point and low vapour pressure. Biodiesel has the viscosity similar to that of diesel oil, the industry term for diesel produced from petroleum. It can be used as an additive in formulations of diesel to increase the lubricity of pure ultra-low sulfur diesel fuel. Much of the world uses a system known as the 'B' factor to state the amount of biodiesel in any fuel mix, in contrast to the 'E' system used for bioalcohol mixtures. For example, fuel containing 20 vol% biodiesel is labelled B20. Pure biodiesel is referred to as B100. It has a very high cetane number, up to 56 CN.

Biodiesel is often used as a blend, up to the maximum B20 (20 vol% biodiesel and 80 vol% conventional diesel), rather than as B100. In Europe, the diesel standard EN590 allows the blending of biodiesel up to 5 vol%, and the tendencies show that it will increase up to 7 vol% in the next few years.

In compliance with the diesel standard, biodiesel has a low heating value (10% lower than diesel) due to the presence of a substantial amount of oxygen in the fuel. Coupled with higher specific gravity (0.88) as compared to mineral diesel (0.85), the overall impact is approximately 10% lower energy content per unit volume (Jánosi *et al*. 2000).

Bioethanol

Nowadays, bioethanol is produced mainly using the 1st generation technologies, the feedstock being corn, maize and sugar cane. The 2nd generation production technologies are under development and they will enable us to produce ethanol from cellulose. It will result in a more bride feedstock range up to the wastes.

Ethanol has become an accepted blending component of gasoline in the world at the beginning of the 21st century. Low ethanol blending up to 5 vol% is allowed by the EN 228. Brazil utilizes gasohol with a minimal 25 vol% ethanol content. In the US and Sweden, E85 – containing minimum 70 vol% ethanol – is growing in importance. Traditional engines could run on ethanol up to maximal 22 vol%, but with ethanol content over 10%, car manufacturers recommend some component replacement. Flex-fuel vehicles (FFV-s) are constructed to be fuelled with free mixtures of ethanol and gasoline.

Bioethanol has less than two-thirds of the energy density of diesel oil, and has the same limitations as alcohol vehicles. The lower energy density implies that, with equivalent engine efficiency, a pure-alcohol-fueled vehicle would travel half to two-thirds as far as a diesel oil-fueled vehicle using the same size tank. The 1999 model flexible fueled vehicles using E-85 have a driving range of 200–300 miles. This range for the vehicles, using diesel oil, is 320–440 miles. The above energy density disadvantages can be compensated by certain improvements in efficiency, which can be carried out in spark ignition engines using alcohols, but not diesel oil. Pure ethanol can also cause starting problems in cold weather.

Ethanol has a cetane number 8, much lower than that of diesel oil which is 50–55. The air need is app. 9 kg air per 1 kg of ethanol (8.4 kg for the E93 ethanol and 7% water content fuel), and this rate is lower than that of diesel oil, which needs 14.5 kg of air. The lower air need means a possibility to increase the amount of ethanol without changing the value of the lambda, namely, the engine's optimization value (Lengyel *et al*. 2007).

Biogas

Biogas is high methane containing gaseous material that is produced by the biological breakdown of organic matter in the absence of oxygen. The methane content of the biogas is dependent on the feedstock, and the production process, being typically in the range of 55–80%.

Compared to other alternative fuels, biogas, used in the compressed gas (CNG) form, is associated with a considerable car manufacturer background: all of the big bus manufacturers and more and more car producers have their vehicles available with CNG system, which helps the future developments. If the quality level of fossil gas could be met, biogas would have a great potential (Kovács *et al*. 2008).

CNG tanks need a significant space, so one of the initial developments was to find the ideal and safe place for them. In the case of passenger cars, tanks are usually built into the floor (with boots remaining of the same size), while the tanks of buses are built over the roof. Besides, the weight of the tanks has been decreased significantly due to the use of new materials, such as carbon-fiberglass, which has a favourable affect on consumption and safety, as well (Horváth *et al*. 2007).

Hydrogenated Vegetable Oil

Hydrogenated vegetable oil (HVO) or hydrogenated plant oil (HPO) is produced by using a hydrogenation process from vegetable oils and converted animal fat oils. The reaction is similar to that found in the crude oil hydrogenation, but the differences in raw material do not allow the mixing of the two streams. The specific chemical structure of the paraffinic hydrocarbons produced by the hydrogenation of vegetable oils is determined by the natural oil source. Rapeseed oil feedstock, for example, produces mostly C16, C18 and C22 molecules (diesel fuel is a complex mixture of compounds, mostly paraffinic, naphthenic and aromatic hydrocarbons from C10 to C22).

The fuel, with vegetable oil as the feedstock, is produced using the existing equipment at the refinery and blended and transported with petroleum-based diesel. The hydrogenation of vegetable oils can be carried out by using the oils as feedstock to a refinery distillate hydrotreater. The product of vegetable oil hydrogenation is a liquid hydrocarbon mixture similar to diesel fuel components, and is free of high cetane, zero aromatic and sulphur. Vehicle test with 20 vol% HVO blend results in the decrease in THC, VO and particulates' emission and slight increase in NO_x. It could be explained by the high cetane number of HVO.

The precise value of energy input and therefore the greenhouse gas emissions will be dependent on the oil that is being processed and the set-up of the refinery unit. The results of the trials carried out using rape seed oil (RSO) as a feedstock to a high-pressure hydrotreating unit show that the hydrogenation of natural oil delivers a small reduction in GHG emissions compared to that obtained in the process of esterification and blending.

The proprieties of HVO are nearly the same as those of biodiesel. The density is slightly lower than that of a conventional diesel. Distillation behaviour and kinetic viscosity are in the same range. Oxidation stability of palm oil-based HVOs is superior, being at the level of a conventional diesel. Cold flow properties are worse than the FAME from the same feedstock. The cloud point of the hydrogenated palm oil is about 20°C. This poor low temperature performance is due to the fact that HVO is a straight chain hydrocarbon (normal paraffin) (Hideshy *et al*. 2006).

Biomass to liquid (BtL) fuel

Biomass to Liquid (BtL) fuel marks fuels, which are synthesized using the Fischer-Tropsch synthesis from biomass. Contrary to biodiesel, BtL fuel is usually obtained from firm biomass (e.g. firewood, straw, bio waste, animal flour, reed), made of cellulose and/or hemicellulose and not only from vegetable oil. Thus, the hectare yield is considerably higher.

In August 2005, one of the largest oil companies entered, in the context of the minority participation, into the business, thereby the technology and sales network will be in place. Some part of the premium diesel fuel is replaced with BtL. The portion is to be still increased, which will bring substantial emission advantages.

Fischer Tropsch fuels will have 7% smaller volumetric energy content compared with Diesel, and lower viscosity and a higher cetane number. BtL fuel is free from sulfur and aromatics. By controlling the process of synthesis, the fuel can purposefully be maintained at low nitrogen oxide content. The employment of BtL fuel does not require or requires only slight changes in the combustion engine and needs no special inlets. This represents an advantage compared to the employment of biodiesel.

Hydrogen

Hydrogen can be a long-term solution for the transportation sector to have a low-emission energy source. It can be used in vehicles in more ways, such as directly combusted in engines or by means of the fuel cells. Both solutions are well investigated. The use of hydrogen in external combustion engines have the benefit of the well-known engine technology combined with a new type of fuel. Some automotive manufacturers (Mazda and BMW) are going to produce these vehicles in series with the help of this technology. Fuel cell application is being investigated now by many manufacturers. Every year, more studies based on this technology are presented.

One benefit of using hydrogen is that it does not emit any CO_2, since it does not contain any carbon. The high burning temperature causes higher NO_x emission, but it can be controlled. The use of fuel cells is one of the ways which could help to eliminate this problem. High energy content is beneficial, but very low density causes storage difficulties. Because of this, it can be stored in vehicles only at high pressure and low temperature or gulped in metals. The problems of producing hydrogen effectively, as well as developing the infrastructure and decreasing the vehicle production costs still remain.

Conclusions

1. Regulations of the European Union on the reduction of transportation emission indicate the new developments in the automotive industry.
2. The legislative challenge could be handled in different ways: technological improvement of the internal combustion engine, implementation of new technologies and utilization of new fuels.
3. The advanced combustion process gives a real alternative: for the price of the engine reconstruction and fuel reformulation it gives a significant efficiency improvement and emission decrease.

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AUTOMOBILIŲ PRAMONĖS TECHNINIAI SPRENDIMAI, VERTINANT ES TEISINIO REGULIAVIMO NORMINIUS DOKUMENTUS AUTOMOBILIŲ GAMINTOJAMS

M. Zöldy

Santrauka

Trumpai aptariama automobilių gamintojams aktuali teisinė ES bazė. Aprašomi aktualiausi paskutinių metų ES standartai ir strategijos automobilių gamybos ir degalų naudojimo srityje. Pateikiami automobilių pramonės konkurencingumo didinimo ir plėtojimo kriterijai vertinant ES teisinę bazę. Taip pat aprašomi, analizuojami ir vaizdžiai iliustruojami naujausi techniniai sprendimai (gamybos technologijos, konstrukcijos elementai, degalų degimo technologijos, gaminio masės mažinimas, kelių degalų tipų transporto priemonės, energijos taupymas ir pan.) taikytini tam tikrose transporto priemonėse.

Reikšminiai žodžiai: automobilių pramonė, transporto priemonė, norminiai dokumentai, teisinis reguliavimas, techninis sprendimas.