# HOW DOES 10% ETHANOL COMPOSITION OF GASOLINE AFFECT CAR ENGINE PERFORMANCE

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***ABSTRACT:*** *Ethanol is a renewable, domestically produced alcohol fuel made from plant materials, such as corn, sugar cane, or grasses. Using ethanol we can reduce oil dependence and greenhouse gas emissions. Ethanol fuel used in the U.S. has increased dramatically from about 1.7 billion gallons in 2001 to about 13.4 billion in 2014. E10 is now the standard replacement for traditional unleaded. Over 90% of all unleaded sold today contains ethanol.*
*In this paper it has been examined the influence of the E10 fuel mixure on some car engine performance.*
***KEYWORDS****: ETHANOL, RENEWABLE FUEL, BIOFUEL, FUEL MIXURE, BIODIZEL, GREENHOUSE EFFECT.*

## *INTRODUCTION*

E10 is now the standard replacement for traditional unleaded [1-4]. E100 (pure ethanol) is widely used as fuel and for this purpose is needed special engine. It can be used as a supplement to regular engine. Over 90% of all unleaded sold today contains ethanol. Ethanol has higher octane than gasoline, and adds 2,5 - 3 points at the 10% level. E10 can be found at all octane levels from 87-93.

Bioethanol is a form of renewable energy that can be produced from agricultural raw materials [5]. It is commonly used maize, sugar beet, potatoes and cereals. According to the International Energy Agency, cellulosic ethanol could allow ethanol fuels to play a much larger role in the future than previously thought.

## *EXPERIMENTAL*

### *General characteristics of the object of our researches*

Details for the car: Brand: Opel Astra 1.6G; Engine: X16SZR; Displacement 1598 $cm^3$; Power: 55 (75)/5200 [kW(hp.)/$min^{-1}$] Torque: 128/2800 [Nm/$min^{-1}$]; Compression Ratio:1:9.6; Maximum pressure at the end of the compression stroke: 12-15Bar; Ignition system: Multec-Ze; Fuel system: Multec-Ze; MAP (Manifold absolute pressure); Combined control of ignition and fuel system; Axle: Front; Gearbox: manual 5-speed; Fuel consumption (urban): 9,7 L/100 km; Fuel consumption (outside city) 5,6 L /100 km.

### *Conditions in which the control trips were carried out*

In order to ensure comparability of the results during the control test with different fuels was provided: Adjustment of the engine; Regulation of the running part of the car; Thermal state of the engine - the same temperature of the coolant; Engine oil type - Repsol Elite Multivalvulas 10W40; Spark plugs Champion-RC10DMC; Oil filter Champion - G102/606; Air filter Filtron; Fuel OMV - H95; Ethanol is E100.

In order to cover the whole working area of the engine using fuel mixture E10 and to assess its technical and the car's engine performance were carried out the following inspection trips:

- Disassembly and assessment (after 3000 km) of the technical parameters of the engine and technical evaluation of the undercarriage of the car and connected elements of the passenger compartment with it;

-The fuel system is Multec-Mono with fuel pressure 3 bar. The fuel filter was replaced after 1000-1500km running as well as the engine oil 10W40 Repsol. The gearbox F13/5 was in good condition;

Trip distances for the entire period of the car test 25 771 km; 15 793 km with a fuel mixture E10 and 9918 km with H95 fuel;

### *Assessment of the state of the rubber static seals fuel system of the vehicle*

In order to examine and evaluate the influence of the fuel mixture E10 on the rubber elements which are directly in contact with fuel, rubber gaskets samples of the fuel system were taken, as well as rubber "O" rings of this system. Material: NBR(Nitril-butadiene rubber), Hardness Shore A: 40÷90; Temperature range: -30÷ +85$^oC$; tensile strength N/$mm^2$: 5-15; very good scrub resistance.

The examined samples were immersed into gasoline H95, E10 fuel mixture and E100 (pure ethanol). Testing was done according to ISO 1817: 1999 "Vulcanized Rubber-Determination of the effect of liquids [6].

Determination of resistance of different liquids was made of our samples ~3,5mg with thickness 2±0,2mm. The obtained results are shown in the following graphics.

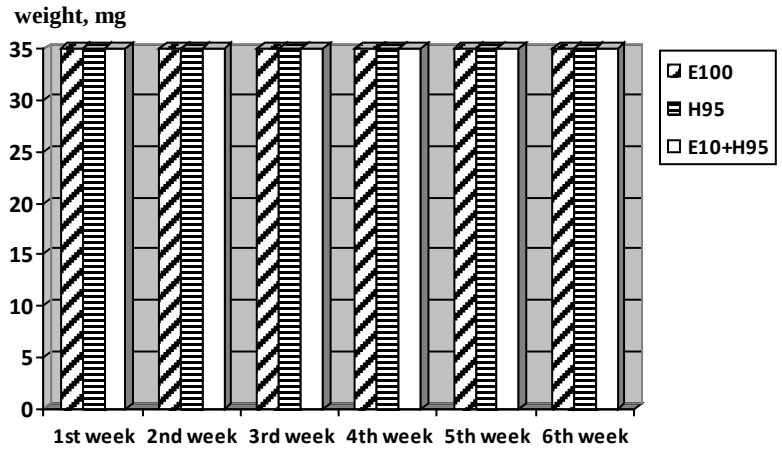


**Fig. 1.** *Weight-time dependence of our samples immersed into different fuels E100, H95 and E10+H95.*

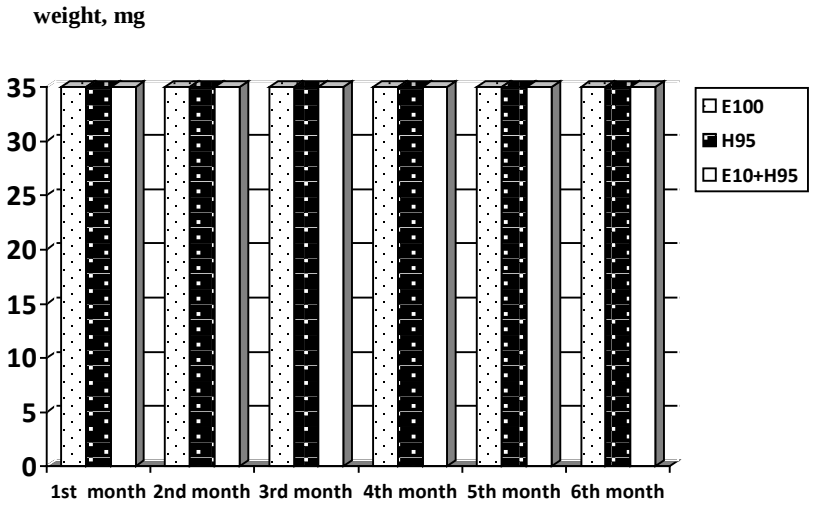


**Fig.2**. *Weight-time dependence of our samples immersed into different fuels E100, H95 and E10+H95 for the next six month.*

As a result of our researches was established that the used solvents - gasoline and ethanol do not cause change in mass of test samples. Vulcanizates are resistant to the action of such solvents for the whole period of our testing. There is no change in mass after being immersed into gasoline, pure ethanol and mixure E10+H95.

Ethanol has a lot of benefits - very high octane, which contributes to greater resilience to shock loads and the ability to optimize engine (compression ratio, pre-ignition)and with density close to that of gasoline;

- Presence of oxygen in the composition can provide a homogeneous fuel air mixing and as a result decreasing unburned or partially burned molecular emissions (hydrocarbons and carbon oxides);

- Ethanol has high latent heat of vapourisation allows "cooling effect" of air and thus improves the efficiency of the filling;

- Has a higher lubricant index compared to petro-diesel ones and this could lead to a longer life of the injection system. When ethanol is blended with conventional gasoline in small amounts (<10%), the improved burn of gasoline due to the oxidation by ethanol compensates for the lower energy content of ethanol itself;

Ethanol is characterized by high octane number RON. The special engine will be less sensitive to detonation combustion and the degree of compression can be increased in order to increase its effectiveness. This property is especially useful for reducing the carbon oxides emissions of spark-ignition engines. One promising approach is the reduction of conventional engines and distribution of gas turbine engines with smaller displacement. Having in mind that these engines can be highly sensitive to shock loads, significant improvement can be done by using of high octane fuels – Table1.

The typical ratio that is used for the compression ratio gives 1 point CR increase in 5 points octane. When ethanol is used for spark ignition engines (CR=RON95), the maximum pressure at the end of compression can reach 13-14 atmospheres and may induce heat for the efficiency increasing.

***Table 1.*** *Calorific values of the fuel oil*

| Fuel | RON | Calorific values of 1L, kJ/l | Calorific values of 1kg, kJ/l |
|---|---|---|---|
| Gasoline | 91-98 | 29,00 | 44,00 |
| Propane | 111 | 23,40 | 46,10 |
| Butane | 103 | 26,50 | 45,46 |
| Methane | 135 | | 39,82 |
| Ethanol | 129 | 19,59 | 26,40 |
| Methanol | 133 | 14,57 | 22,61 |
| Gasohol | 93-94 | 28,06 | 43,54 |
| Disel | | 40,90 | 42,47 |

## *CONCLUSION*

The results obtained give us information that solvents like gasoline and ethanol do not lead to the change in mass of the test samples. Vulcanizates are resistant to the action of such solvents.

Biodiesel improves engine performance, increases power, does not contain sulfur, reduces fuel consumption. The combustion of this fuel in the engine cylinder is not accompanied by the formation of sludge and the release of soot.

It has a higher octane rating and clean burn, so it supports a higher compression ratio and more aggressive ignition timing. Ethanol is considered also as renewable resource. Replacing gasoline with ethanol is aimed to reduce gasoline consumption for a reduction in greenhouse gases.

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