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Types of anti-detonation devices and the mechanism of their effect on automobile gasoline

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Annotation: Today, a cycle with external mixture formation (gas-diesel cycle) has been developed in which diesel engines are combined with natural gas. Almost all gasoline engines have switched to direct injection into the engine's combustion chamber.
Gasoline engines today use not only gasoline, but also natural compressed or compressed petroleum gases, alcohols and alcohol-gasoline mixtures.
Keywords: GMM(gasoline- methanol-mixture), combustion chamber, octane number, aromatic amines

INTRODUCTION: The purpose of anti-detonation devices is to increase the octane number of gasoline. Modern engines with a high compression ratio make serious demands on the detonation stability of automotive fuels. The use of gasoline that does not meet these requirements in cars - leads to detonation (explosive ignition without reaching the fuel-air combustible mixture in the combustion chamber with a spark flasher). The detonation process, in turn, leads to rapid damage and damage to engine components, incomplete combustion of fuel, and the appearance of a loud unpleasant sound in the engine. Cracked and damaged piston rings cause gases to flow into the crankcase and engine oil into the combustion chamber. In this case, there is an increase in smoke from the gases coming out of the engines, an increase in oil consumption, a decrease in the FIK of the engine and its resource.

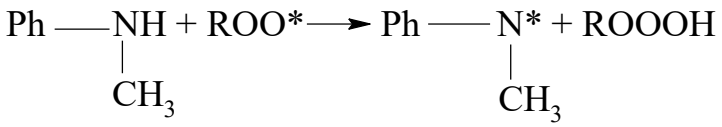
The mechanism of effect of antidetonators on the octane number of gasoline is aimed at preventing the oxidation of hydrocarbons before the normal combustion of fuels. During the compression of the combustible mixture in the combustion chamber, under the influence of high temperature, oxidation of hydrocarbons and the formation of a large amount of peroxides are observed. Because peroxides are not chemically stable, they decompose. Antidetonators destroy peroxides and prevent their accumulation. Although the mechanism of impact of antidetonators on the combustion process has not been fully studied, today the main directions of their influence on the mechanism of preventing detonation have been determined.

RESULT: When tetraethyllead is used as an anti-detonation agent, it forms ultradispersed lead oxides (size 1.5-30 μm) in the combustion chamber and reacts with peroxides.:

$$PbO_2 + RCH_2 - OOH \rightarrow RCOH + H_2O + PbO + ½O_2$$

Analogous to this reaction, it also happens with organic compounds of other types of metals.

Aromatic amines also destroy peroxide radicals in almost this way. Combustion reactions in the presence of aromatic amines are assumed to proceed as follows (in the case of N-methylaniline):



Although there are many other hypotheses about the effect of antidetonators on the combustion process, none of them has served as a theoretical basis for the development of effective antidetonators. All of them have been determined empirically.

Anti-knock compounds based on aromatic amines: Today, metalloorganic compounds are almost never used as antidetonators due to the limitations placed on basic installations. Therefore, we will not stop at organometallic installations. Currently, there are many types of aromatic amine-based compounds, and there are restrictions on their amount, and it is desirable to use them in gasoline in accordance with these restrictions. Aromatic amines have long been known in the art and are mainly used as propellants for rocket propellants. The octane number of some amines in the mixed state is given in table 1.1

The main disadvantage of aromatic amines is the high tendency to tar formation and corrosion of the details of the cylinder-piston group, due to which restrictions are placed on the amount of mixing to 1.0-

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1.3% for adding them to the composition of automobile gasoline. One of their main advantages is that amines mix well with other types of additives and in many cases show a synergistic effect. Therefore, several amine-based anti-knock compounds have been developed.

Table 1.1

The octane number of certain amines in the mixed state

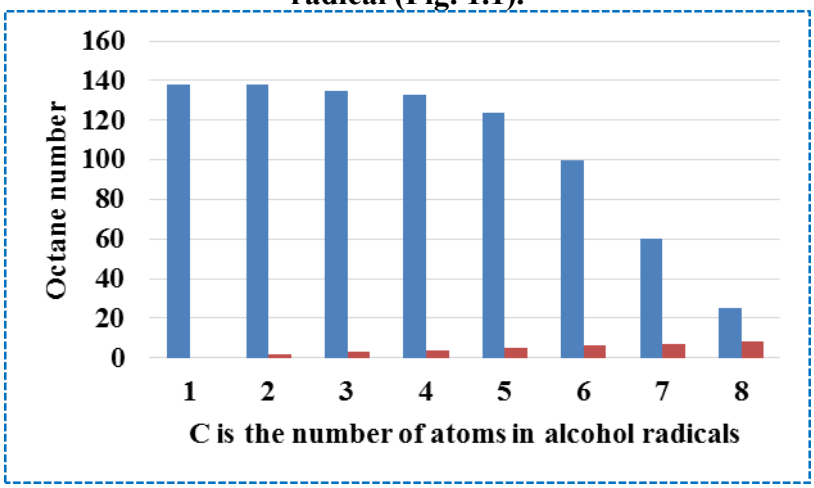
Compound	The octane number of the mixture	
	In the motor method	In research method
Aniline	290	310
n-Toluidine	305	340
n-Ethylaniline	300	320
n-Tertiary-Butylaniline	250	280
3,4-Xylidine	320	370
3,5-Xylidine	210	340
N-Methylaniline	250	280

Oxygenated compounds (oxygenates): Today, in the production of car gasoline that meets modern environmental requirements, the role of oxygen-containing devices is very important. By using oxygen-retaining devices, the octane number of gasoline is increased, and their resource is also increased due to renewable raw materials. while gasolines containing oxygenates show improved washability and flammability properties, the formation of carbon oxides and hydrocarbons as a result of combustion of these gasolines is significantly reduced.

The recommended concentration of oxygenates in gasoline is 3-15%. In this case, the amount of oxygen in gasoline should not exceed 2.7%. These amounts of oxygenates have been shown to have a significantly lower heat release rate compared to petroleum-derived gasolines, yet have no adverse effect on engine performance[1].

Performance index of oxygenates. Oxygenates exhibit the same octane number, saturated vapor pressure, and heat release capabilities as gasoline components. At the same time, oxygenates have a hygroscopic property, which is their ability to absorb moisture from the air. This feature can cause fuel clouding at low temperatures of oxygenated gasolines[2].

The octane number of the mixture of alcohols decreases with the elongation of the hydrocarbon radical (Fig. 1.1).



1.1 - picture. Octane number of alcohols in a mixture with gasoline: *1 - methanol, 2 - ethanol, 3 - isopropyl alcohol, 4 - secondary-butyl alcohol, 5 - amyl alcohol, 6 - hexyl alcohol, 7 - tertyl alcohol, 8 - nonyl alcohol*

Although methanol is a high-octane alcohol, it is not widely used as an oxygenate for gasoline. The main reason for this is the toxicity of methanol, poor solubility in hydrocarbons and high hygroscopicity. Methanol, like all alcohols, has a negative effect on the densification of materials and has an active corrosive property against non-ferrous metals. This leads to a decrease in engine resource and deterioration of fuel

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quality. It is desirable to add up to 5% methanol to gasoline, and in these proportions, the gasoline-methanol mixture (GMM) maintains a homogeneous state. When using GMM, it is necessary to solve the problem of its high sensitivity to moisture. GMM can dissolve no more than 0.1% water, at a higher concentration of water, the mixture separates into two layers. During the decrease in temperature, GMM first becomes cloudy and then separates into two layers. Therefore, in practice, there is an application temperature of GMM[3].

So that the gasoline-methanol mixture does not separate into two layers, higher alcohols are added to their composition as a stabilizer. For example, GMM can be stabilized by adding tert-butyl alcohol (a mixture of tert-butyl alcohol and methanol called oxynol) or isopropyl alcohol.

Ethanol is added to gasoline in large quantities as an oxygenate compared to methanol. Because ethanol dissolves well in hydrocarbons and is much less hygroscopic than methanol. Gasoline gasoline (gasoline containing 10-20% ethanol) is widely known today in North and South America. This can be explained by the fact that a large amount of ethyl alcohol is produced from sugarcane in these countries. In European countries, E-85 brand gasoline (gasoline containing up to 85% ethanol) is used[4].

Conclusion: The description of the components of high-octane automobile gasoline produced at oil refineries is presented, and the directions of their application in the production of high-octane gasoline are analyzed. The types and functions of anti-detonation devices used in modern automobile gasoline, the mechanisms of their influence on automobile gasoline, and the examples of various scientific researches were analyzed. The types of additives and additives used in petroleum fuels are presented, their types, tasks and prospects of application in the fuel industry are studied.

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