The paper describes the induction welding method of thin shaped disks with using of ring inductors by application of heat and electromagnetic screens. Developed a mathematical model that describes the energy consumption during the induction welding of thin steel disks.

Induction welding, steel disc, electromagnetic screen, thermal field, energy, mathematical model.

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FEATURES OF HARMFUL COMPONENTS Combustion gases forest technology ENGINES And farm tractor

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The basic harmful components of exhaust gases of modern engines silsko- and forestry tractors, analyzes the mechanisms, causes and conditions of their formation and ways to minimize harmful emissions.

Ecology, engine, diesel, toxicity, opacity, exhaust gases emissions rule *Standard, Stage, Euro, Tier.*

Formulation of the problem. The problem of protecting the environment from harmful emissions of heat engines is no less urgent than saving energy. All industrialized countries are intensive search for ways to reduce toxicity and smoke SH (exhaust gas) heat engines, especially transport. Now the world has a system of international, intergovernmental, governmental and industry standards that apply to gasoline engines of cars and trucks as well as buses and cars, tractors and combines diesel.

Analysis of recent research. Obviously, the urgency of finding solutions to the problem of reducing the burden on the environment will only be strengthened over time [1, 2]. No exception in this respect is the field of forest technology and agricultural production, which involves a large number of cars equipped typically diesel engines. The latter is known to be one of the biggest polluters of the environment and, in practice, not exhausted its potential improvement. The introduction of the legislation rigid standards toxicity and smoke SH railroads and intense competition - two factors that stimulate lately dvyhunobudivni leading corporations and firms drastically improve engines, using innovative new technologies. This also promotes the rapid development of microprocessor technology, digital technology, sensors and actuators, which are integral components of modern engines and their systems [3]. It should be noted that the limits and methods for determination of toxic substances are constantly improved and changed as towards setting new acceptable standards and improving test methods, and to develop new requirements to limit toxic substances such as lead, sulfur oxides, carcinogenic and others [1].

The purpose of research- Compile information on basic harmful components of modern engines SH silsko- and forestry machines, proanalizovavshy mechanisms, causes and conditions of their formation, and establish ways to minimize harmful emissions.

Results. Appointment ICE (internal combustion engines) - to transform the chemical energy of fuel into heat, and it - into mechanical work. The goal is achieved by the implementation of several successive processes can be reduced to three consolidated: preparing a combustible fuel mixture of certain outside or inside of the cylinder (mixing); ignition; combustion (oxidation). And the fundamental difference between ICE, working for Otto and Diesel cycles, is only a way of working ignition charge: ignition from an external source (spark flared) or spontaneous combustion caused by heat, obtained as a result of air compression. This is understandable: if the previously separate groups of isolated carburetor, gas and other types of engines, after the creation of gasoline internal combustion engines with direct fuel injection, alcohol and other models differences workflows in the environmental aspect can be considered insignificant and therefore have the right to analyze them position of general laws of thermodynamics and chemical kinetics with some amendments. For example, the nature of occurrence of hot flame that spreads homo- or heterogeneous charges in engines with spark ignition and diesel engines are different, because in the first case the source is one or more high, fixed by location spark in the second - the result of uncertain origin the place and time of initial outbreaks of low flame samorozhonom reactions and accumulation of active intermediates spent in later stages, but leading eventually to too hot flame. It is in its narrow front or directly adjacent layer combustion products basically completed the oxidation and the formation of toxic components VG. From these positions and consider the formation of environmentally harmful substances in the combustion chambers of engines. Let's start with the engine running on traditional internal combustion engines for liquid fuels of petroleum origin, which are known to be mixtures of hydrocarbons paraffin (alkane), olefin (alkenes), naphthenic (tsyklany) and aromatic (aromatics) series with the number of carbon atoms in the molecule of 5 and 30. The least stable, including conditions in the combustion chamber, alkanes with a chain of molecular structure (from S5N12 to S13N28). They are oxidized at temperatures more than 573 K (300 ° C) to form peroxides. The least stable aromatics of the benzene ring structure and core with high octane and, consequently, low cetane numbers. Unfortunately, to say that the mechanisms and patterns of exothermic oxidation of these substances fully understood until you can.

First, reliably can be described only combustion fuels whose molecules have a membership of not more than two carbon atoms; model combustion of propane and butane are under intensive development, and octane combustion mechanism can be presented only in hypothetical form. Second, the combustion of hydrocarbon mixtures with air, the content of which is less stoichiometric formed soot, the mechanism of which is still not enough clear. Regarding the formation mechanism of environmentally harmful products of combustion are still many unclear. Standing only mechanism of nitrogen oxide high-temperature combustion, but very poorly understood mechanism of oxide fuel molecules that contain nitrogen, or by radical reactions containing hydrocarbons with nitrogen molecule. It is also unclear how the reverse process of converting nitrogen oxides formed in molecular nitrogen within the main zone of the flame. While still very low level of understanding of the chemistry of sulfur compounds in the flame. In view of the computing power of modern PCs have to make a strong simplification gas dynamic or kinetic aspects. In other words, there is no reliable theoretical framework that allows qualitatively perform quantitative analysis of chemical transformation of fuel into its combustion products with the formation of toxic substances. A full set of basic chain reactions, called mechanism of chemical transformation, seen usually at the macroscopic level, that many elementary acts replaced by one or more basic, determining the course of the entire reaction. So we act. The validity of the approach have postulyuyemyh patterns adequacy of the results of experiments repeatedly put on different types and models of engines.

First, note the general direction of the impact of changing some settings workflow for creation of two specific groups by nature occurrence of harmful substances. The first group includes products of incomplete combustion, carbon monoxide, hydrocarbons, aldehydes, carbon black; the second consists of complete oxidation of substances of chemical elements that are part of the energy as well as air - sulfur oxides and nitrogen. As is known from chemical kinetics according to Arrhenius equation rate of any reaction depends linearly on the concentration of the reacting components (in relation to the combustion of fuel in internal combustion engines - from hydrocarbons and oxygen concentrations in the working charge) and exponentially - on temperature. It follows that any change in the working process towards the reduction of toxic compounds one group necessarily lead to an increase in the presence of VG other substances. For example, raising the temperature of combustion and depletion mix causing a reduction in carbon monoxide emissions while increasing excretion of nitrogen oxides. This factor showed his time in California, USA, hard limit emissions of motor vehicles and carbon monoxide in the implementation of one-way antitoxic measures not only improve the hygienic quality of the atmosphere, but rather making it unfit for human nitrogen oxides. I had to change technical policy in the engine and manual cars.

Therefore, you must optimally organize the workflow in environmental terms, taking into account each individual harm harmful substance that is released in the process of implementation. To do this, set patterns formation in the cylinders pollutants and develop a complex criterion or criteria for assessing the total harm VG engines and vehicles (the latter subject performed useful work for carriage). Consider a modern interpretation of the mechanisms of formation of toxic compounds. The basic of standardized components currently VG engines with spark ignition is carbon monoxide - CO (carbon monoxide). Formation of it in a cylinder usually associated with poor combustion mixtures, explaining the reason for lack of oxidizer reactions to complete mixing and imperfection, which limits the access of oxygen to hydrocarbon molecules. Kvazihlobalna scheme of chemical transformations in this case is: SnNm 0.5·n·O2$\rightarrow$n·CO 0.5·m·H2O. In fact, a chain reaction with a set of basic acts conventionally represented as follows: RH$\rightarrow$R$\rightarrow$RO2$\rightarrow$RCHO$\rightarrow$RCO$\rightarrow$CO, where R - radical is a group of atoms in reactions transitional unchanged from one compound to another. Even for the simplest of the hydrocarbons methane CH4 under the scheme academician NN Semenov it is poorly branched chain consists of 11 reaction involving active radicals CH3, HO2, OH, HCO and less active but chemically unstable intermediates NSNO (formaldehyde) and H2O2 (hydrogen peroxide). Carbon monoxide formed, dookyslyuyetsya to the final product in the course as a chain reaction: CO + OH$\rightarrow$CO 2 + H; H + O2$\rightarrow$OH + O; CO + O$\rightarrow$CO2 occurs only in the presence of water vapor or hydrogen. The oxidation of heavy hydrocarbons carried out on a much more complex schemes.

In addition to these changes is a dissociation of carbon dioxide, which is described by 2SO2$\rightarrow$2CO + O2. In diesel engines, always working at total in the combustion chamber excess air ratioα> 1, the probability of these changes at the front have a hot flame, but their hats are additional sources of CO formation. These include low-temperature cold areas of the flame on the stage ignition of fuel; it drops that come with the injection in the amount of partially used for the oxidation of hydrocarbons with oxygen and burned diffusion;α~ 1.3) can create zones of its deficit and proceed reaction form C + 0,5·O2→2CO.

As a result cylinder engine with spark ignition at the beginning and end of the expansion stroke remain approximately constant volume concentration of carbon monoxide, at stoichiometric mixture - 5% when operating on lean mixtures - 1%. In early stroke diesel extensions are of the same order with these, but then quickly reduced and at the opening of the exhaust valves are up only tenths of a percent. Summarizing expressed, we can say that the determining factor in the presence of carbon monoxide in the VG engine with spark ignition is the mixture, and process temperature facet plays a minor role in diesel - on the contrary. Both parameters, in turn, are interrelated, since the transition to a rich mixture (heavy loads) always causes a rise in temperature process.

The second, also normalized component SH - group of hydrocarbons, which includes dozens of individual compounds that are conventionally denoted by the symbol SmHn (or SnHm or SHx). Additionally, there is a part of their emissions of fuel vapors. In the analysis of patterns of formation of hydrocarbons in the cylinder is used as described above kvazihlobalna model that considered both a model of formation of carbon monoxide. The analysis leads to the conclusion that, if well organized and constructive combustion waste heat from the combustion chambers terms of allocation of hydrocarbons can be quite small. Real, increased their emissions, as observed in the engines with spark ignition and diesel engines in related mainly to the suppression of cold combustion chamber walls oxidation reactions in near-boundary layer thickness of 0.05 ... 0.40 mm. "Frozen" as hydrocarbons in the gap between the piston and the cylinder wall below the first piston ring around the valve between the surface of the piston and the cylinder cover.

The third group consists of oxygen-containing hydrocarbons - aldehydes, which summarizes indicated by RCHO. In VG, basically, are formaldehyde and acrolein. The first one closes homologous series of saturated aldehydes, second - unsaturated. The release of aldehydes normalized until only diesel and only when their use in poorly ventilated volume (underground production, tunnels, quarries and so on. D.). The engine operating on the Otto cycle, they are formed in the wall surface layers and gaps in suppressing oxidation kinetic chain hydrocarbons. With very reactive, regardless of the mode of operation of the engine, they almost completely burn in the cylinders. Although, the detonation-like combustion emissions aldehydes according to calculations should increase, but the experimental confirmation of their results yet. In the presence of VG diesels analyzed oxygenated hydrocarbons in large quantities observed when working at low engine loads, and when they start, especially cold. This is due to the fact most of aldehyde formation during low ignition multi working charge. In particular, the cold flame glow explain the presence in it of optically excited molecules of formaldehyde. At high engine loads aldehydes time to burn in the cylinder on the expansion stroke, at low and at cold start of diesel are present in SH. The fourth component products of incomplete combustion are carbon black particles which consist mostly of solid carbon with the inclusion of 1 ... 3% physically and chemically bound hydrogen and sorbuyemyh their developed surface (1 g carbon black has a surface order 75 m2) Hazardous substances that stimulate cancer due to the presence of carcinogenic polycyclic aromatic hydrocarbons (PAHs). Soot, as any dust irritates the airways, causing a chronic disease, but its main danger is that the solid particles provide prolonged contact and absorption of carcinogens living tissues. Once in the body, PAHs accumulate it gradually nahromadzhuyuchys the critical concentration when the emergence of malignant tumors is inevitably fatal.

The presence of soot in VG determines their optical opacity (opacity), which is undesirable in terms of safety and in terms of subjective moral hazard assessment engines in environmental terms. Analysis of the mechanism of soot and stock it in VG to answer the question: why, being a product of incomplete combustion, it is manifested primarily in the emissions of diesel engines, the combustion process which occurs when the overall excess oxygen and only in small amounts - in engine, working on the Otto cycle, which is almost always the oxidant deficiency?

There are four phases of soot formation conglomerates that are in VG engines: creation of embryos; their growth to the primary particles are clusters of crystallites, which in turn consist of three- to five plates of graphite hexagons; Coagulation developed to conglomerates; burnout complex formations. The initial two acts of this chain of chemical and physical changes that lead to the appearance of primary particles aggregate result is the following processes: pyrolysis (cracking) - thermal decomposition (splitting) of hydrocarbon molecules; hydrogenation - high-temperature reactions of various compounds to hydrogen and its inverse process - dehydrogenation; polymerisation - reactions of compounds identical molecules of unsaturated compounds-monomers in an enlarged - polymer; condensation - reaction joining two or more molecules to the initial formation of a large particle of another species. Provide them with defining the conditions for the formation of soot impossible. At relatively low temperatures (less than 1500 K) polymerization reaction and condensation reactions prevail over dehydrogenation and embryos can be, especially aromatic hydrocarbons; High temperatures correspond pyrolysis and hydrogenation, and is dymamy almost any hydrocarbons. Concentration interval beginning soot formation is in excess air ratio α= 0.33 ... 0.70.

In the presence of spark ignition engines with working virtually homogeneous charge the likelihood of Zagrebahachenyh zones in the combustion chamber is small. There are also conditions for growth and coagulation of primary particles, but the high temperature working fluid after passing the hot flames burn promotes intensive small-sized entities soot. These factors explained little soot emissions engines working on the Otto cycle. In diesel engines, the formation of a local perezbahachenyh volumes, which ensured the flow of the above reactions leading to the formation of soot and primary structures of enlargement. This opinion is shared by all the theorists and experimentalists, but include the time of appearance of soot in the cylinder to different periods workflow. A representative of one of the schools, Z. Moyrer believes that the primary particles appear on stage ignition, when the progressive increase in ambient temperature exponentially increases the rate of reaction mechanism of peroxide and oxygen in the reaction zone behind the demand for it. In the diesel smoke formed by the disparity between the rates of cracking and oxygen, and carbon formed can be oxidized to the dioxide only in reaction with water vapor, whose presence near the likelihood krekinhuyuchyh molecules too small. On the other hand, according AZ Sokolika source fuming to be found in the distribution of hot turbulent flame in the combustion chamber. Both concepts apparently compatible, but soot formed during the period ignition time to burn in the cylinder, and that which was revealed during combustion in the WG. By the toxic end products of the reactions of combustion include oxides of nitrogen and sulfur. Nitrogen is present in the air and fuel, mostly in C5H5N pyridine and its derivatives, sulfur - only liquid fuel. In petroleum products containing up to 5% of nitrogen compounds by weight of pure nitrogen is 0.3 ... 0.6% sulfur content by weight until recently was limited to 0.12% for gasoline (A-72) and 0 2% for automotive diesel fuel, made from malosirkovyh types of oil (0.5% - in derived from sulfur). Due to the depletion of oil resources there has been a shift to energy sources with a high sulfur content.

Nitrogen gives five oxides, carbon monoxide or oxide - NO dioxide - NO2, its polymers - tetraoxide, antimony, pentoxide, designated summarily symbol NOX.

Fig. 1 shows a model of molecules and properties of various oxides of nitrogen. SH appears in engines, mainly oxide, which is then to subsequently dookyslyuyetsya dioxide. On the mechanism of formation of oxides during combustion distinguish three types: thermal, is obtained by high-temperature oxidation of atmospheric nitrogen; fuel, resulting from oxidation of nitrogen compounds low energy; fast, formed as a result of the collision hydrocarbon radicals with molecules of nitrogen in the combustion reaction zone. The main share falls on thermal nitrogen oxides.

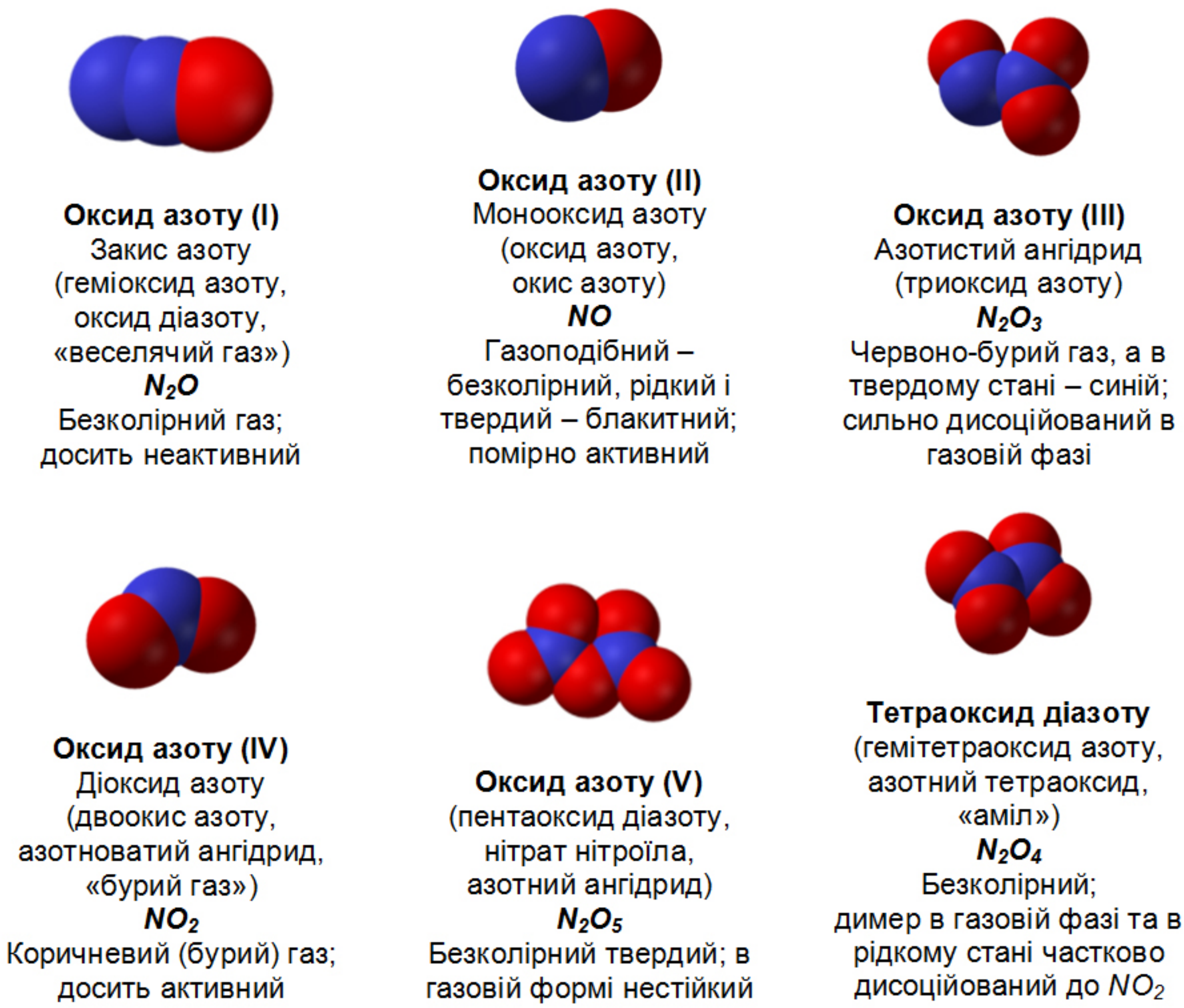

Fig. 1. Models and properties of molecules of nitrogen oxides.

According to the conventional theory of atmospheric nitrogen oxidation proposed JB Zeldovich, PY Sadovnikov and DA Frank-Kamenetskiy, the reaction rate is not related to the chemical nature of the fuel is determined only by thermal factor, regardless of the way made local heating volume mix. Oxidized nitrogen in the flame front in the area of combustion products. Reactions occur on the chain mechanism that includes the following basic acts:

N+ O↔NO + N - 316 kJ / mol,

N+ O2↔NO + O + 136 kJ / mol,

and OH + N ↔NO + N and NH + + O2↔NO + OH.

Concentrations of oxides during combustion do not exceed the maximum temperature at equilibrium. Shvydkoprotikayuchi processes of heating and cooling the gas mixture can lead to uneven concentrations significantly, due to the fact that the reaction rate increases exponentially with temperature and decreases - from the energy of activation. Nitric oxide, which is formed in this case can exist indefinitely; This phenomenon is called quenching. When burning lean mixture significant impact on the output of nitric oxide reactions give uneven temperature field in the area of combustion products (called Mahe effect) and the presence of water vapor. The water in the chain reaction of nitrogen oxidation inhibitor is (a substance that slows the rate of flow of reactions, a kind of "antykatalizatorom").

Mechanisms of fuel and rapid nitrogen oxides only began to be studied. We can so far only state the fact that nitrogen enters the fuel easier to oxidation than nitrogen air.

Chemical associated with organic substances liquid petroleum fuels organic environment (in firm energy resources are present as pyrite and sulfate sulfur) gives the combustion of sulfur oxides, denoted conventionally symbol SOx present mainly in the form of di- and trioxide. Originally formed dioxide. At high temperatures and pressure in the presence of catalysts it easily turns into trioxide. In ICE catalysts are: present in the fuel vanadium pentoxide, iron oxides contained in a layer of soot on the bottom of the piston and combustion chamber walls. For this reason, the ratio between the content of SH di- and trioxide varies depending on the thermal state of the engine, its mode of operation. For example, at medium load diesel trioxide in its amount of dioxide is 30%, increasing to 70% in the transition to work in the nominal mode.

The presence of these air pollutants in VG engines and their emission cars normalized [3]. This limiting factor is the damaging effect of individual chemical compounds on the human body, which is limited to the value of average daily maximum allowable concentration in the air settlements (MPC). At the suggestion of academic and departmental institutes of the Russian Federation, are advised to take the following values of aggressiveness: carbon monoxide - 1; nitric oxide in terms dioxide - 41.1; oxides of sulfur dioxide in terms of - 16.5; hydrocarbons in terms of carbon - 1,26 for areas north of 45 ° north latitude and 2.16 for more southern areas; soot - 200 for areas with rainfall of at least400 mm per year and 240 for others.

It should be noted that these values are constantly adjusted as the accumulation of statistics, developed coefficients for other substances. In terms of depletion of world resources of oil and gas urgent search for alternative energy sources. Even more important is the issue for Ukraine, which imports most of traditional fuels. Due to several reasons (favorable climatic conditions, soils, etc.) Our country great interest are fuels of vegetable origin, such as ethyl alcohol, vegetable oils and their esters. In the analysis of the overall effectiveness of the use of an alternative fuel in internal combustion engines greater role played by environmental issues.

The environmental performance of diesel engines can be improved by the use of bio fuels (renewable energy), such as rapeseed oil (RO). This will keep the balance of carbon dioxide in the atmosphere, which reduces the likelihood of the greenhouse effect, because the combustion of biomass carbon emissions dioxane singing shutters with the quantity that is absorbed during photosynthesis in growing these raw materials. Because of the low sulfur content of RO SH diesel engines emitted small number of oxides that cause acid rain. However, the use of RO high-speed diesel engines with undivided combustion chamber and direct injection of fuel is limited due to an increase of 90 ... 140% emissions CO, CnHm, NOx and particulate emissions, and reducing the effective efficiency. This is due to the increase in the ignition delay period RO, which has a lower cetane number compared with standard diesel fuel, and changing conditions of cutting and mixing of fuel due to a higher viscosity PO. To avoid these major disadvantages through the use of two-phase power system fuel supply. However, this system requires a fundamental change in regular fuel equipment.

An effective method to reduce the toxicity of viral hepatitis, in particular emissions of nitrogen oxides and soot - the use of water in the fuel mixture formation. The used water can be supplied to the ICE (in liquid form) separately from the fuels or with him (in the form of water-fuel emulsions), as well as water-sprays or steam. When applying water directly into the cylinders ICE emulsion is formed on an exit line pressure. In the presence of water-fuel emulsions from 20 to 30% water (depending on mode) in diesel may reduce the opacity to 20% and - emissions of nitrogen oxides. In other cases, the specially prepared outside the cylinder ICE water-fuel emulsion. Its sustained combustion is provided at the boundary of water content in it ... 67 to 65% and reduce the concentration of soot particles - at 25 ... 30%. In this case, the quality of the preparation of such emulsions put forward stringent requirements for the implementation of which requires special hydraulic equipment. In particular, the injected fuel in a container of water under pressure 10 ... 12 MPa. Thus obtained water-emulsion should be periodically stir intensively using appropriate devices as emulsion stability characterized by low kinetic and kinetic state of calm after a while stratified weekend components. You also need to ensure the optimal particle size water 1 ... 5 microns; at a rate of more than 10 microns corrosion occurs and increases the intensity of wear of fuel equipment. Thus, in terms of the use of cars and self-propelled agricultural and forest technology machines humidification system goes relatively bulky and energy intensive.

Conclusion. All dvyhunobudivni leading companies and manufacturers of tractors, cars and other mobile machines gradually upgrade their products to comply with environmental standards Euro, EPA emission standards, Stage and Tier. Key advanced technology, systems and components to reduce harmful emissions from internal combustion engines SH following: EGR (Exhaust Gas Recirculation) - Screening (bypass) SH; SCR (Selective Catalyst Reduction) - selective (selective) catalytic SH (recovery using reagent - urea); DOC (Diesel Oxidation Catalist) - oxidation catalytic converter; DPF (Diesel Particulate Filter) - Particulate Filter (sazhovlovlyuvach); VGT (Variable Geometry Turbine) - turbocharger with variable geometry; HPCR (High-Pressure Common Rail) - Battery fuel supply system with high pressure fuel injection (120 (first generation) to 220 (fourth poklolinnya) MPa); ULSD (Ultra-Low Sulfur Diesel) - diesel with ultra low sulfur content; the use of intermediate cooling through the intercooler (radiator type "air-air"); improving the combustion process by developing efficient combustion chambers;

List of references

sovremennыh selsko- engines and lesohozyaystvennыh machines proanalyzyrovanы Mechanisms, Causes and terms s education, as well WAYS mynymyzatsyy vrednыh vыbrosov and opacity.

Ecology, engines, diesel, toxicity, opacity, spent hazы, vыbrosы, norms, standards, Stage, Euro, Tier.

The paper is devoted to the basic harmful components of modern agricultural and forest mobile machines engine emissions, analysed mechanisms, reasons and conditions of their formation and also way of minimization of the pollutants and exhaust smoke opacity.

Ecology, engine, diesel, emissions toxicity, exhaust smoke opacity, pollutants, norm, standard, Stage, Euro, Tier.