eISSN: 2229-3213 pISSN: 2229-3205
The Journal of Applied Science and Social Science
Volume 16,Issue 05 May, 2026

INFLUENCE OF FUEL WATER CONSISTENCE ON THE RELIABILITY OF FUEL APPARATURE WORK

Abdullayev Abdupatto Salimovich
Andijan State Technical Institute,
Associate professor of the department
abdupatto1966@mail.ru
Khabibullaev Mukhammadjon
4th-year student in Energy Mechanical Engineering

Abstract: The results of work on determining the content and causes of water appearance in the fuel of automobile engines during their operation in various climatic conditions are presented, and issues regarding the influence of watered fuel on the reliability of the engine's fuel equipment are considered.

Keywords: Car engine, fuel equipment, fuel, water, reliability, failure, high-pressure fuel pump.

Diesel fuel produced by domestic oil refineries meets the requirements of state and industry standards. However, the conditions for transporting, storing, and refueling fuel at the enterprises are characterized by high dust content and air humidity. At all stages of diesel fuel delivery from the manufacturer to the consumer, a continuous process of accumulation of impurities that reduce its quality occurs, the main ones being mechanical impurities and emulsion water.

The operation of automobile and tractor engines on fuels with high emulsion water content leads to the failure of mainly fuel equipment (TA). High-precision parts of high-pressure fuel pumps (HPF) and nozzles are most susceptible to this phenomenon, accounting for 50% to 90% of all diesel fuel equipment failures [1,2]. Along with this, operating a diesel engine on contaminated fuel deteriorates its efficiency and increases the toxicity of exhaust gases.

The quality of diesel fuel according to GOST 305-2013 is evaluated by a number of indicators, one of which is its water content, which, in accordance with the requirements of this standard, must not exceed 200 mg/kg.

However, water present in any amount in the fuel negatively affects the performance of high-precision parts of diesel fuel equipment (causing their corrosion and worsening the lubrication conditions of the contacting surfaces), leading to premature failure of expensive diesel engine power system units [1, 2,5].

Water in fuel can exist in dissolved and free states, determined by the physical and chemical properties of the fuel's hydrocarbons, its temperature, as well as atmospheric humidity and pressure.

Dissolved water is individual molecules associated with some large hydrocarbon molecules. A water molecule has a small molecular volume and possesses the ability to associate with other molecules through hydrogen bonds. Hydrocarbon molecules have a significantly larger volume, but they are non-polar, possess a small dipole moment, and are unable to form hydrogen bonds between themselves; therefore, the attraction forces between water molecules are insignificant and are mainly determined by the polarizability of water and hydrocarbon molecules. Since the polarizability of water and hydrocarbon molecules is small, the solubility of water in them is also insignificant and depends on their structure. Molecules of unsaturated and aromatic hydrocarbons, being an exception, enter into a chemical bond with water and form a compound.

Increasing air pressure, humidity, and temperature contribute to an increase in the water content in the fuel. If the conditions determining fuel saturation with water change sharply, excessive moisture saturation may occur. In this case, excess dissolved water will transition to a free state as a separate phase forming a water-fuel emulsion or sediment.

The amount of dissolved and free water in the fuel is the total water, i.e., the sum of the percentage content by mass. The presence of water can change the physical and chemical properties of the fuel and affect the failure-free operation of the TA.

Under routine operating conditions, diesel engines with high water content are encountered in the TA system. The table shows the water content in diesel fuel for vehicles in the middle and southern climatic zones of operation.

Table 1

Water content in auto-tractor fuels

Sampling site Middle zone Southern zone

Vehicle fuel tank: water settlement zone 0.0 5-0.08 0.25-0.18

fuel consumption level

(during vehicle movement) 0.005 -0.034 0.0 6—0.052

Fuel rough cleaning filter (settling) 0.02-12, 0 0.03—23.0

Fine fuel purification filter 0.005-0.035 0.04—1.83

After fine cleaning filter Traces 0.001–0.004

Assessment of the polydisperse composition of the water-fuel emulsion showed that the sizes of water droplets in the fuel can be approximated by a logarithmic normal distribution [5].

The reliability of fuel apparatus (TA) operation is primarily determined by the condition of the precision parts. The largest number of failures and costs for their elimination in the technical maintenance of auto-tractor engines are attributed to nozzles, sprayers, and TNVD. The condition of these units largely depends on the purity of the fuel passing through them. The water content in the fuel, like mechanical impurities, negatively affects the reliability of the TA's operation [1, 2,5]. First of all, it worsens the operating conditions of both rough and fine-cleaning fuel filters, i.e., the surface of the element's filter curtain is saturated with water, resulting in its mechanical strength being compromised and hydraulic resistance increasing; therefore, up to 20% of tractor filter elements are damaged by water during operation.

At negative temperatures, the presence of water-fuel emulsion leads to the formation of ice crystals in the fuel, resulting in partial, and often complete, cessation of fuel supply and deterioration of its purification.

Fuel waterlogging—one of the causes of TA precision parts failure—causes the dissociation of corrosive components: naphthenic, sulfurous acids, and hydrogen sulfide on the parts' surfaces. As a result, short-circuited galvanic elements form between precision pairs, causing electrochemical corrosion. This phenomenon can primarily occur in the sprayer unit or plunger pair.

TNVD. During chemical and electrochemical corrosion, oxide, hydroxide, or salt films form on metal surfaces, which under high pressure at the contact points of the surfaces break down and contribute to the intensification of corrosion processes.

To determine the degree of influence of water passed through filters on the reliability of TA precision parts, motor-stand tests were conducted on the YAMZ-238 engine. The average cyclic feed and unevenness of feed to sections at the TNVD were determined; the quality of fuel spraying, lifting pressure, and the mobility of the sprayer needle at the working sets of nozzles. Additionally, the diametral gaps of plunger pairs and injection valves, the valve stroke, the diametral gap and sprayer needle stroke, as well as fuel consumption, were determined. Cyclic feed and non-uniform feed have insignificant and identical changes across all sets, meaning the influence of water on these parameters is insignificant. Deviations were noted on the parts that operated in an aqueous fuel environment. When the nozzle operated on fuel with a water content of 200 mg/kg, the quality of fuel spraying deteriorated due to the disruption of sprayer needle mobility. On the guide surfaces of the sprayer needles, changes in surface cleanliness occurred, and wear and tear traces increased proportionally to the water content. Computer profiling of the

sprayer's transverse axis in the section of the needle's guide surface showed that as the water content in the fuel increases, the wear of the housing increases.

Literature

1. Abramov, S.V. Cleaning of diesel fuel from water during the operation of agricultural machinery [Text] / S.V. Abramov, B. P. Zagorodskich, D. S. Mayakov // Works of GOSNITI. MOSCOW, 2014. - Vol. 115, - P. 38-41.
2. Zagorodskyich, B.P. Influence of diesel fuel water content on the performance of precision parts of fuel equipment. Volgograd: Volgograd State Agrarian University, 2015. - Vol. 2. - P. 27-30.
3. Karimkhodzhaev N., Almataev T.O., Odilov Kh.R. The main causes causing the wear and tear of vehicle parts operating in various natural and climatic conditions //Universum: Technical Sciences: Electronic Scientific Journal. 2020. No. 5 (74). URL: http://7universum.com/ru/tech/archive/item/9435.
4. Kramarenko G.V., Salimov A.U., Karimkhodzhaev N.T., Kayumov K.K. Fuel quality and reliability of tractor engines. - Tashkent. Fan. 992. – 126 p.
5. Kovalenko, V. P. Ensuring the industrial purity of petroleum products is one of the priority tasks of chemotology [Text] / V. P. Kovalenko, N. E. Siroedov // Oil and Gas Technologies. - 2014. - No. 5 (94). - P. 24-30.