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**DIESEL FUEL WAYS AND THEIR ELIMINATION METHODS****Serhiy Burlaka**, Ph.D., Senior Lecturer  
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*The efficient operation of agricultural machinery depends on the purity of the oil products used in its operation. Purification of fuels and oils is mainly carried out by filtration through porous separators.*

*Currently, oil refineries (refineries) produce a thorough cleaning of the fuel. However, due to repeated resale and transportation, fuel contamination occurs. Due to poor flushing of the tank, other oil products and when filling the tank during precipitation, water and impurities can enter the fuel during its transportation. Water can enter the fuel tank in the form of condensation. Due to the long chain of transportation of petroleum products from refineries to consumers and non-compliance with transportation standards, customers receive low-quality fuel. Modern power systems for cars and tractors do not allow the presence of water and small impurities in the fuel. In this regard, in this paper, the problem of watered diesel fuel is considered. An assessment of the influence of such fuel on fuel equipment and engine operation is given. The data are given for the content of water in the fuel.*

*Consider the saturation of the market with filters that allow you to separate water and fine particles from fuel. The advantages and disadvantages of each existing filter and compared with the proposed membrane filter are considered. A technology has been introduced to separate water and fine impurities in diesel fuel by installing an additional fine filter in the tractor power system.*

*This article confirms the urgency of the problem of diesel fuel flooding. Data on the type of water contained in the fuel are given. An assessment of the effect of water in the fuel on fuel equipment and engine operation is given. The existing solutions to the problem of watering diesel fuel are presented and the effectiveness of the proposed filter is confirmed. A diagram of the proposed installation is presented, as well as plans for the modernization of the fuel cleaning.*

**Key words:** diesel fuel, watered fuel, filter, diesel engine, membrane, cleanliness of fuel.

**Fig. 4. Table 1. Ref. 10.**

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**1. Formulation of the problem**

The State Program for Agricultural Development and Regulation of Agricultural, Raw Materials and Food Markets for 2013-2021 is aimed at developing agricultural enterprises, increasing the availability of agricultural products, which will also address the issue of import substitution [1]. A special factor influencing the availability of agricultural products is the provision of agricultural enterprises with reliable agricultural machinery. When operating a diesel engine, about 50% of all failures are occupied by the fuel system, and more than half of these failures are caused by pollution of diesel fuel, including. water content of the fuel (the presence of water in diesel fuel) [2]. We will get acquainted with the latest developments in the direction of dehydration of diesel fuel in this article.

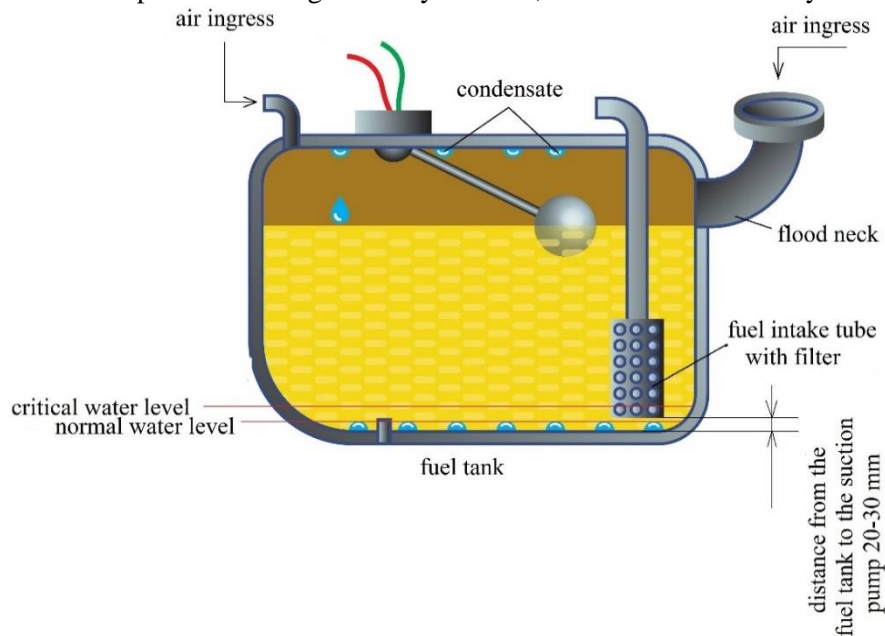
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**2. Analysis of recent research and publications**

At the time of writing, the definition of water is given, which is classified in diesel fuel by the principle of hit (Fig. №1. Scheme of water in the fuel tank). Two types are defined: free and emulsified water. Depending on the type of water in diesel fuel, the options for fuel dehydration used today are considered. Free water, we call the water that enters the fuel tank during refueling or is a product of condensation with a sharp drop in temperature [3]. As the temperature difference outside and inside the fuel tank increases (especially if it is not completely filled), the process of air condensation occurs with the formation of water droplets flowing to the bottom of the tank (free water) mixed with fuel (emulsified water). It was found that water droplets larger than 180  $\mu\text{m}$  flow to the bottom of the tank, and droplets smaller than 180  $\mu\text{m}$  are in the fuel in a suspended state [4]. Currently, to minimize and prevent malfunctions of diesel engines from water applied to the fuel system, use various developed solutions to temporarily or partially deal with the problem of fuel water: chemical

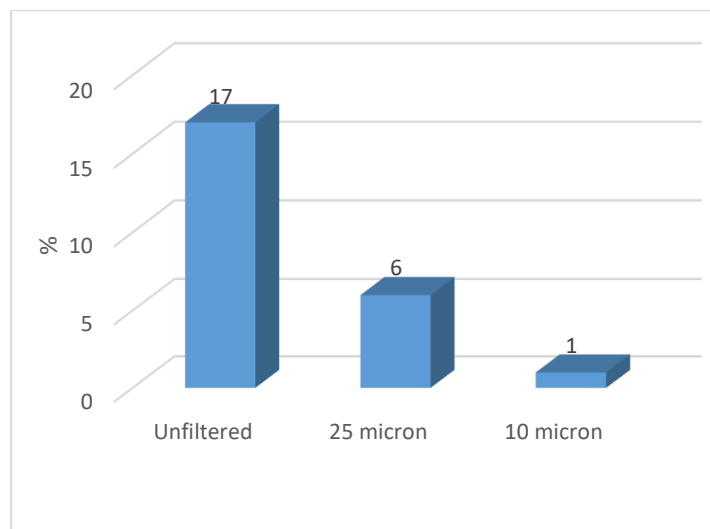


additives to fuel, separate filters. Chemical additives to the fuel, provide the rise of free water from the bottom of the tank in the thickness of the fuel layers (the volume of water raised depends on the capabilities of the additive, as well as the ratio of the filled substance and the volume of gasoline in the tank). Positive reductions in the amount of free water in the fuel clean the elements of the fuel system [5]. Negative qualities: high cost of solving the problem of flooding of diesel fuel for agricultural machinery of agricultural enterprises. Water remains in the fuel and enters the combustion chamber in the form of emulsified, fine droplets, the proportion of which in relation to the "pure" fuel is significantly reduced, is removed from the system by combustion.



**Fig. 1. Scheme of water in the fuel tank**

Separate filters: The principle of operation of separate filters is that the emulsified water is broken down to a fine state and evenly distributed throughout the fuel. During engine operation, it enters the combustion chamber together with the fuel and is removed with the exhaust gases. The positive qualities of the use of separate filters is solved with drops of water at the bottom of the fuel tank [6]. The American company is known as: Fleetguard has developed an innovative material for StrataPore separator filters that allows you to purify diesel fuel from water up to 95%. Efficiency is certainly high, an innovative solution that allows to achieve this effect, not all manufacturers of the automotive market can afford, not to mention Ukrainian manufacturers.



**Fig. 2. Diagram of the dependence of fuel equipment wear on the quality of diesel fuel filtration**

In addition to Fleetguard, separator filters from other companies are also known, and a summary table of the main characteristics of their efficiency is given below:

Table 1

Comparative characteristics of some separator filters of different brands

Filter brand	Fleetguard Fuel ProFh330		Separ2000/10		Racor1000FG		Racor900FG	
Throughput, l/h	681		600		681		341	
Filter element	FS 19727	FS 19728	01010	01030	2020 TM-OR	2020 TM-OR	2020 TM-OR	2020 TM-OR
Capacity, g	78	62	1,3	5,6	18	168	13,7	72
Maintenance:								
- particles of 5 microns, (%)	83				83		83	
- particles of 10 microns, (%)	98,7	75	55		97	83	97	83
- particles of 25 microns, (%)		98,7	93					
- particles of 30 microns, (%)	100			36		73,1		73,1
- particles of 40 microns, (%)		100	98,7					
- particles of 45 microns, (%)				54		88,7		88,7
- free water, (%)	95	95	19,2	85	74	28	99	99
- free water, (%)	95	95	0	4	20	7	11	0

Thus, the search for a solution for dehydration of diesel fuel demonstrates that minimizing the content of "free water" in the fuel is much easier than removing emulsified (bound) water from diesel fuel [7,8]. When searching for a domestic solution for dehydration of diesel fuel for use in agricultural machinery, the design of a filter that dehydrates diesel fuel based on the use of membrane technologies is proposed [9]. The results of previous studies of the filter that dehydrates diesel fuel, predict that in the near future the issue of improving the resource efficiency of parts and mechanisms of Ukrainian tractor construction will be resolved.

### 3. The aim of the study

Analyze the process of formation and entry of water into the power supply system of a diesel engine. Find ways to remove and remove water from the fuel.

### 4. Presenting main material

To minimize the ingress of watered fuel into the engine, it is necessary to use a new device - a filter that dehydrates diesel fuel, containing ceramic cartridges sprayed with hydrophobic membrane and hydrophilic membrane, changing the filtration system.

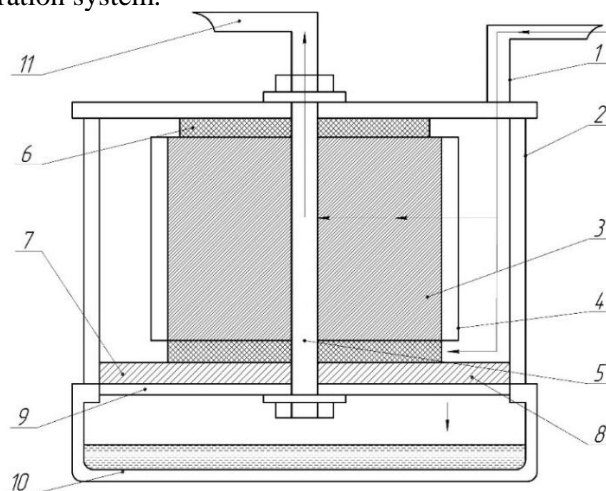


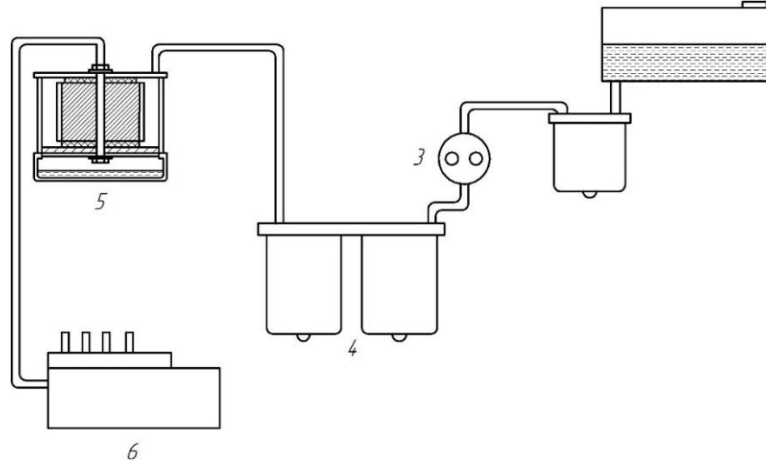
Fig. 3. The design scheme of the filter for dehydration of diesel fuel

Ceramic filter cartridge 3 with hydrophobic membrane (porous nano-complex-composite coating) 4 applied to its outer surface, 4 in the center of the cartridge is an internal channel for collecting and removing



dehydrated fuel 5, a sealing ring made of oil-resistant rubber 6 with applied hydrophilic membrane spraying) 8, metal washer with through holes 9, polymer transparent cover 10, outlet 11. The filter cartridge 3, on the surface of which is applied a membrane type MFKM (microfiltration fluoroplastic composite membranes) 4, have the shape of a vertical cylindrical element with numerous protruding vertical faces, which can significantly increase the filtration area. In the center of the cartridge 3 is a vertical channel 5, which passes into the outlet 11.

At the base of the housing under the vertical cartridge 3 with a separator - a seal ring of oil-resistant rubber 6, there is a flat ceramic cartridge 7 with a hydrophilic membrane type MFF-G (microfilter membranes through which water molecules pass) 8, which is pressed over the entire area from below with a metal washer with through holes 9 and tightened with a nut on the bolt. The bottom of the filter housing is closed with a transparent screw cap 10. Nano-complex-composite membranes are applied by spraying on ceramic cartridges.



**Fig. 4. Fuel system of the MTZ-80 tractor with the filter dehydrating diesel fuel included in the system**

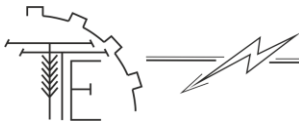
On the example of the diesel fuel supply scheme of the MTZ-80 tractor, which includes a developed new device - a filter that dehydrates diesel fuel, passing through the pump (3) enters the fine filter (4), then passes through the filter that dehydrates diesel fuel (5) where water is separated from the fuel by the use of a hydrophobic membrane and a hydrophilic membrane, and then the purified fuel enters the PNVТ (6) [10].

## 5. Conclusions

Pollution in diesel fuel affects the operation of fuel equipment and the engine, thereby reducing its reliability and service life. During the operation of diesels, about 50% of repairs are related to the fuel system, and more than half of these equipment failures were caused by contaminated diesel fuel. In addition, contaminated fuel particles entering the engine cylinders cause wear of the parts of the cylinder-piston group of the engine equipment. Use of the additional membrane filter will allow to prolong serviceability of the fuel equipment at small investments, thereby to save on repair of equipment.

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### ШЛЯХИ ОБВОДНЕННЯ ДИЗЕЛЬНОГО ПАЛИВА ТА ЇХ МЕТОДИ УСУНЕННЯ

*Ефективна робота сільськогосподарської техніки залежить від чистоти нафтопродуктів, які використовуються при її роботі. Очищення палив і олів в основному здійснюється шляхом фільтрації через пористі сепаратори.*

*Нині на нафтопереробних заводах (НПЗ) здійснюють ретельну очистку палива. Однак через неодноразовий перепродаж та транспортування виникає забруднення палива. Через погане промивання бака, іншими нафтопродуктами та при заповненні бака під час опадів вода та домішки можуть потрапляти в паливо при його транспортуванні. Вода також може потрапляти в паливний бак у вигляді конденсату. Через довгий ланцюг транспортування нафтопродуктів від заводів до споживачів та недотримання норм транспортування клієнти отримують паливо низької якості. Сучасні системи живлення автомобілів і тракторів не допускають наявності води і дрібних домішок у паливі. У зв'язку з цим в даній роботі розглядається проблема обводненого дизельного палива. Дано оцінку впливу такого палива на паливну апаратуру та роботу двигуна. Дані наведені для вмісту води в паливі.*

*Розглянемо насиченість ринку фільтрами, які дозволяють відокремлювати воду та дрібні частинки з палива. Розглянуто переваги та недоліки кожного існуючого фільтра та порівняно із запропонованим нами мембранним фільтром. Впроваджено технологію відділення води та дрібних домішок у дизельному паливі шляхом встановлення додаткового фільтра тонкого очищення в системі живлення трактора.*

*Ця стаття підтверджує актуальність проблеми обводнення дизельного палива. Наведено дані про тип води, що міститься в паливі. Дано оцінку впливу води у паливі на паливну апаратуру та роботу двигуна. Наведено існуючі рішення проблеми обводнення дизельного палива та підтверджено ефективність застосування запропонованого фільтра. Наведено схему запропонованої установки, а також плани модернізації паливоочищення.*

**Ключові слова:** дизельне паливо, обводнене паливо, фільтр, дизельний двигун, мембрана, чистота палива.

**Рис. 4. Табл. 1. Літ. 10.**

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