Analysis of losses in the storage of pure oil products stored in agrocluster oil warehouses and devices for their disposal

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Abstract. In the article, a comprehensive analysis of the losses that occur during the storage of clear oil products is conducted, highlighting the significant economic implications associated with these losses. Various factors contributing to the deterioration of product quality and quantity are examined, including evaporation, oxidation, and leakage. The article offers detailed insights into innovative devices designed to mitigate these losses, presenting a thorough analysis of their effectiveness. Each device is evaluated, revealing its advantages, such as enhanced efficiency and improved safety features, while also considering potential drawbacks, including cost and maintenance requirements. Furthermore, the article introduces a new generation device specifically engineered to address the challenges associated with storing clear oil products. It delves into the structure and operational principles of this device, showcasing its potential to revolutionize storage practices within the industry and reduce overall losses, thereby optimizing resource utilization and enhancing profitability for stakeholders involved in oil product management.

1 Introduction

In the decision of the Cabinet of Ministers of the Republic of Uzbekistan " On approval of the rules for the use of oil refining products", it is necessary to ensure the quality of the oil product - the ability of the oil product to meet certain needs in accordance with the specified purpose; Storage tanks for oil products must comply with the requirements of GOST 17032-2010 "Horizontal steel tanks for oil products", departmental technical norms and regulations, have a valid graduation table and have been compared in the prescribed manner; provision of pouring devices with steam release devices; development and implementation of measures to reduce the loss of oil products due to evaporation [1]

Agroclusters oil farms include engineering facilities and technical means. Engineering facilities consist of posts and points that provide oil storages and machines with oil products.

Various types of fuels and lubricants are used in agriculture. Each type of oil product has its own characteristics [13].

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2 Materials and methods

An oil farm is a complex of facilities, consisting of an operating room for oil products and an oil warehouse, equipped with devices for receiving, storing and distributing all types of oil products. 40, 80, 150, 300, 600 and1200 м^3 typical projects of oil depots consisting of a reservoir park with a volume and an operator's room with an oil depot have been developed. Typical projects two in option underground and top in options offer done [2].

Reservoir park - clear oil products to keep intended for 3, 5, 25, 50, 75 and 100 m^3 to volume have has been horizontal cylindrical steel from reservoirs organize found Tanks OZ-23802 breath get valves with equipped [7]. breath get valves inside the tank pressure harvest to do in return from evaporation dead to be reduces but indestructibility can't stop

Village economy in enterprises oil products losses different is a district. Come exit reasons according to them use period and to those in emergency situations separate can Usage period losses own in turn three to the group is divided.

- Quantitative losses;
- Qualitative losses;
- A mix losses.

Quantitative losses are caused by leaks, overflows, and failure to fill reservoirs. Such losses occur as a result of perforation of tank walls and bottoms, failure of injection and discharge pipes, non-compliance with maintenance technologies and failure to adjust malfunctions in time.

The main reason for the leakage of oil products is the poor technical condition of the oil storage equipment, violation of the rules of use, and low technical knowledge of the oil storage service personnel.

Quality losses are caused by mixing of different types of oil products, water addition, pollution and oxidation.

Mixed losses - The process of evaporation of clear oil products is a complex non-stationary process, which depends on the physical and chemical properties of oil products, storage conditions, the speed of filling and filling the reservoirs, and the technical condition of the reservoirs. Unfortunately, losses from evaporation of refined oil products are considered only quantitatively, but for some reason quality losses are not taken into account. Evaporation of light fractions of gasoline reduces the number of octane and reduces its detonation type. Heavy fraction composition leads to an increase in the actual amount of tar, increasing the formation of soot in valves, pistons and other engine parts.

- "Small respirations" occur due to daily changes in environment and reservoir temperature when clear oil products are stored in reservoirs. In sharply changing climatic conditions (in the regions of Central Asia and Kazakhstan), losses from "small breathing" are much higher;
- When the reservoirs are filled with clear oil products, "big breathing" occurs due to the compression of the mixture of air-clear oil product vapors into the atmosphere;
- When a small amount of clear oil products are placed in empty reservoirs, as a result of the saturation of its gaseous surface, the pressure in the reservoir exceeds the norm, and the saturated steam overcomes the resistance of the valve due to atmospheric release.
- Due to the fact that vapors of thin oil products on the gas surface of the reservoir fly out into the atmosphere even from the small non-condensed areas of the reservoir devices [3.4,11,12,14,15].

Devices that reduce evaporation losses during storage in oil warehouses:

High-pressure reservoirs (rezervuary povyshennogo davleniya RPD) - reservoirs that completely eliminate evaporation losses, due to the fact that much more metal is used than existing reservoirs, the cost of storing gasoline increases. The use of such reservoirs in agricultural production is economically inappropriate [18].

Floating caps, liquids and microspheres (ponton iz polyethylene nizkogo davleniya PEND) - technologies that reduce the evaporation loss of petroleum products, the main goal of which is to reduce the amount of metals used. "TsNIL GOSkomnefteprodukt RF" offered floating liquid PEND for storage of oil products (A.S. USSR #635003 1978). This reduced evaporative losses by 94.7% in "small breaths" and 89.5% in "large breaths" when using a liquid that reduces the evaporative surface [19, 20,21].

As oil production increases, the production of refined petroleum products increases. Because of this, the size of the reservoir park is increasing significantly. But due to the lack of improvement in the storage systems of refined petroleum products, it leads to evaporation losses. Evaporation losses of stored clear oil products are significant: they account for 75% of all losses during storage [22].

The devices and devices for preventing evaporative losses mentioned above are economical when used in vertical cylindrical tanks. Because the evaporation surface of vertical cylindrical reservoirs is constant. It is not economical if these devices and devices are used in horizontal cylindrical reservoirs used in agricultural production. The reason for this is the variability of the evaporation surfaces of horizontal cylindrical reservoirs.

A number of practical and innovative works on reducing losses during storage, transportation and distribution of oil products have been carried out for many years at GOSNITI (Gosudarstvennyy Nauchno issledovatelskii tekhnologicheskiy institut remonta, vostanovleniya i ekspluatsii selskohozyaystvennyx mashin) for horizontal cylindrical reservoirs. Vapor condensing devices that offer them are powered by electricity. In terms of fire safety, it is not possible to use electricity in the reservoir park. "Reservoir gas return system" was created for horizontal cylindrical reservoirs and was not widely used in agricultural production due to the large amount of metal used for these devices [7,8,9].

The proposed " reservoir gas return system for storing volatile liquids" uses solar energy to generate cold (Uz patent #IAP 03301 28.02.2007).

Evaporation losses occur during storage of refined petroleum products. The higher the ambient temperature, the higher the evaporation loss of refined petroleum products. Analysis of clear oil products loss and prevention devices showed them to have some disadvantages. [2,3,4] the authors of scientific works did not take into account the physico-chemical properties of petroleum products when preventing the loss of clear oil products. we have chosen the method of reducing condensing losses. Of course, to condense oil vapors, it is necessary to produce cold. We get this coldness with the help of an absorption-diffusion cooler that takes power from solar energy. "Gas return system for reservoirs storing light volatile liquids" at Andijan Institute of Agriculture and Agrotechnologies A.S. UZ№IAP 03301. The device was created on 16.06.2004.

The proposed device can be used in the chemical industry, oil refining industry or agricultural enterprises during the storage period of oil products.

3 Results and discussion

The problem can be solved as follows: Gas return system for tanks storing light volatile liquids consists of a cylindrical condenser interconnected with the tank, a heat exchanger, a solar heater, a second heat exchanger in the form of a zmeevik, and the cylindrical condenser is made of internal and external walls. There is a gap between the walls. The first heat exchanger in the form of a zmeevik is located in this gap (Figure. 1), the lower end of which is connected to the ammonia vapor generator through the second heat exchanger, the upper end of which is connected to the first end of the absorber, the outlet end of the absorber is connected to the ammonia vapor inlet end, the ammonia vapor generator the inlet end is connected to the outlet end of the absorber, the outlet end of the ammonia vapor generator is connected to the second inlet end of the absorber, the outer wall of the condenser is made of non-heat-conducting material, and the inner wall is made of heat-conducting material.

In addition, blinds are installed at a certain angle on the second side of the inner wall of the condenser, and a throttle nozzle is installed on the lower part of the inner wall of the system.

A gas recovery system for volatile liquid storage tanks works as follows:

An ammonia vapor generator inside the solar heater 5 evaporates ammonia from a saturated water-ammonia solution. The pressures in absorber 6, evaporator 4, and condenser 1 are the same. Since the ammonia vapor generator and the second condenser 7 are connected to each other, the pressure in them is equal. A water-ammonia solution with different concentrations circulates between the absorber 6 and the ammonia vapor generator.

The lean water-ammonia solution slowly moves from the ammonia vapor generator to the absorber 6. This solution absorbs ammonia vapors in the absorber and becomes a rich solution again, and the condenser 1 passes from the evaporator 4 to the absorber 6. The rich solution passes through the absorber 6 back to the ammonia vapor generator. As a result of the absorption of solar energy falling from the solar heater 5, the ammonia vapor generator evaporates a certain amount of ammonia. And again, this rich solution goes into the ammonia steam generator. And so the cycle repeats itself.

Air purified from light volatile liquid vapors is discharged to the outside environment through the manifold and discharge valve, the condensed liquid is returned to the tank 9.

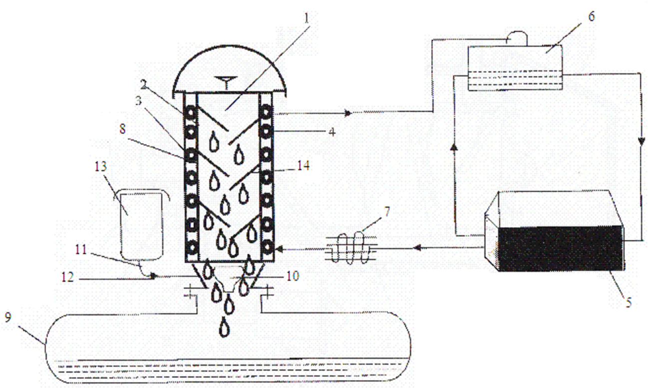

Fig. 1. Tank gas return system [16, 23]: 1. Condenser; 2. Two-layer wall of the condenser ; 3. Gap between two layers of walls ; 4. The first heat exchanger ; 5. Solar heater ; 6. Absorber; 7. The second heat exchanger ; 8. The inner surface of the condenser ; 9. Reservoir; 10. Throttle nozzle; 11. Patrubok; 12. discharge valve; 13. Air cleaner; 14. Blinds .

The main function of the condenser is to trap vapors of clear petroleum products. The operation and structure of the capacitor is shown in Figure. 2.

The process of heat exchange in an absorption device that condenses clear petroleum products.

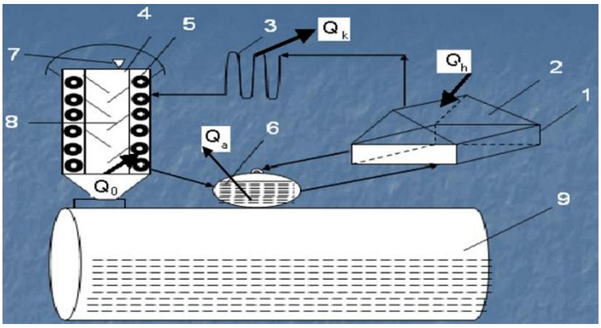

Fig. 2. The process of heat exchange in an absorption device that condenses clear petroleum products. Evaporator; 2. Solar heat exchanger; 3. Condenser; 4. Cooling department; 5. Zmeevik; 6. Absorber; 7. Valve; 8. Blinds; 9. Reservoir.

Qa - the amount of heat transferred from the absorber to the environment;
Qk - the amount of heat transferred from the condenser to the environment;
Qh – solar heat received by the evaporator;
Qo – Ability to develop coldness, W;
The ability to develop coldness Q o is the main indicator, which is determined as follows:

$$Q_o = r \cdot G \tag{1}$$

where: r is the phase transition heat of clear oil products, (W sec) /kg [22];
G – Amount of clear oil products being condensed, kg.
If the ability to develop coldness Qo is determined by the condensation surface F, we get the following formula:

$$Q_0 = \frac{\lambda}{\delta} \cdot (t_1 - t_2) \cdot F \tag{2}$$

(1) and (2), we find the following accuracy :

$$r \cdot G = \frac{\lambda}{\delta} \cdot (t_1 - t_2) \cdot F \tag{3}$$

Amount of clear oil products being condensed we determine , kg.

$$G = \frac{\lambda}{r \cdot \delta} \cdot (t_1 - t_2) \cdot F \tag{4}$$

As can be seen from the formula (4), the amount of clear oil products being condensed is directly proportional to the condensation surface F. The condensation surface of the solution we offer is F determined by the following mathematical formula :

$$F = 2\pi \cdot R \cdot h + \frac{\pi \cdot R^2}{2} + d \cdot b - \frac{2\pi \cdot R}{\cos\alpha} \cdot b = 2\pi \cdot R\left(h + \frac{R}{4} - \frac{b}{\cos\alpha}\right) + d \cdot b \tag{5}$$

If we put the value of F into the formula (4) , we get the following formula.

$$G = \frac{\lambda}{r \cdot \delta} \cdot (t_1 - t_2) \cdot 2\pi \cdot R\left(h + \frac{R}{4} - \frac{b}{\cos\alpha}\right) + d \cdot b \tag{6}$$

the formula (6) that the amount of clear oil products being condensed is the proposed device parameters are directly proportional.

V.A. Sergienkov in his scientific work [17] determined the pressures of saturated vapors of clear petroleum products in the range of 200 to 700 mm.cm.us at temperatures from minus 40 to plus 400 C.

Analyzing the above, we learned that researching the process of "small breathing" has solved many problems. But the question of condensation of vapors of clear petroleum products remained open. More precisely, the amount of energy used for condensation of vapors of clear petroleum products has not been determined, so theoretical studies and their empirical confirmation are conducted in this direction.

Village economy in enterprises clear oil products storage for 3, 5, 10, 25, 50 and 100 m3 from reservoirs with is used. Oil in warehouses from reservoirs to DAST requirements in use according to which gasoline is stored reservoirs common capacity is filled to 90%. Because if the reservoir is filled to 100%, inside the reservoir temperature external temperature under the influence of increase in return, the amount of gasoline stored sharp to increase take will come. As a result, inside the reservoir pressure increased gone disaster in the situation to waste take comes [1].

Evaporation losses in horizontal cylindrical tanks account

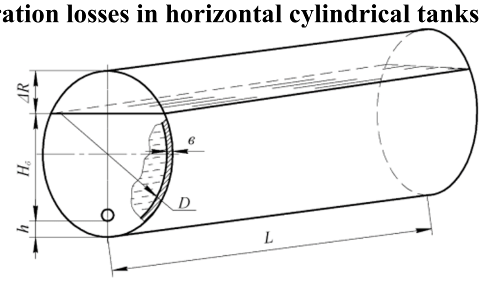

Fig. 3. Horizontal cylindrical tank parameters. L - reservoir length ; D - reservoir diameter ; h - pour-pour pipe installation height DR – in the reservoir gaseous space height H b - gasoline level height v - tank wall thickness.

Gasoline is stored parameters of a horizontal cylindrical reservoir (Figure. 3). given . to DAST requirements according to which gasoline is stored reservoirs common when filled to 90% capacity gaseous space size to determine for (Figure 2) of the base of the cylinder from the diagram AB bow with limited part surface we find Of this for a is central on the surface of the angular sector D AOB is a triangle surface let 's subtract Sector surface with the following formula is found

$$S_{\Delta} = \frac{\pi \cdot \alpha \cdot R^2}{360} \tag{7}$$

DAOB is a triangle surface as follows let's find out

$$S_{AOB} = \frac{R^2 \cdot \sin \alpha}{2} \tag{8}$$

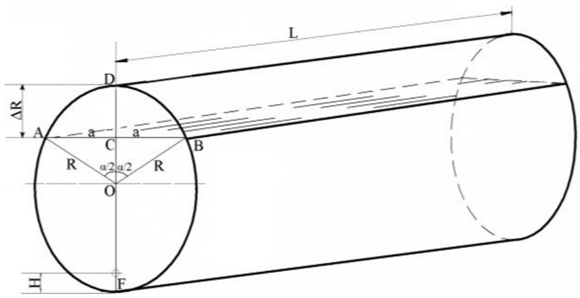

Fig. 4 . Empty the gas tank volume Determination of B scheme.

AVD segment surface to determine for the following from the formula we use

$$S_{AVD} = \frac{\alpha \cdot R^2}{2} - \frac{R^2 \cdot \sin\alpha}{2} \quad (9)$$

circle vatars property basically |CD |· |CF |= |AC |· |CB | equality in consideration take [23], (7) from formula the value of a we find

$$a^2 = (2R - \Delta R)\Delta R \quad (10)$$

D COB triangle D to triangle ACO equality in consideration take, and D from the triangle COB $Sin\frac{\alpha}{2} = \frac{a}{R}$ from equality using the value of a let's find out

$$a = Sin\frac{\alpha}{2} \cdot R = \sqrt{\frac{1-\cos\alpha}{2}} \cdot R \quad (11)$$

or

$$cos\alpha = 1 - \frac{2a^2}{R^2} \quad (12)$$

$$\alpha = \arccos\left(1 - \frac{2a^2}{R^2}\right) \quad (13)$$

(8) to formula (13). put the following the formula we can

$$\alpha = \arccos\left(1 - \frac{2\Delta R(2R - \Delta R)}{R^2}\right) \quad (14)$$

or

$$Sin\alpha = \sqrt{1 - \left(1 - \frac{2a^2}{R^2}\right)^2} = \sqrt{1 - \left(1 - \frac{2\Delta R(2R - \Delta R)}{R^2}\right)^2} \quad (15)$$

Expressions (14) and (15) into formula (9). let's say the following to the formula have we will be

$$S_{AVD} = F = \frac{R^2 \cdot \arccos\left(1 - \frac{2\Delta R(2R-\Delta R)}{R^2}\right) - R^2 \cdot \sqrt{1 - \left(1 - \frac{2\Delta R(2R-\Delta R)}{R^2}\right)^2}}{2} \quad (16)$$

where SAVD - AVD segment surface , m2 ;
F – in a cylindrical tank gaseous surface , m2 ;
R – reservoir radius , m;
DR - in the reservoir gaseous space height , m;
above (Figure 2) and gaseous surface F from formula (16) defining gaseous space volume We define V

$$V_{GB} = L \cdot F = L \cdot \frac{R^2 \cdot \arccos\left(1 - \frac{2\Delta R(2R - \Delta R)}{R^2}\right) - R^2 \cdot \sqrt{1 - \left(1 - \frac{2\Delta R(2R - \Delta R)}{R^2}\right)^2}}{2} \tag{17}$$

Expression (17). $\Delta R \leq R$ has been conditions for right $\Delta R > R$ has been conditions for the following from the formula use to the goal according to

$$V_{GB} = L \cdot \left(\pi R^2 - \left(\frac{R^2 \cdot \arccos\left(1 - \frac{2\Delta R(2R - \Delta R)}{R^2}\right) - R^2 \cdot \sqrt{1 - \left(1 - \frac{2\Delta R(2R - \Delta R)}{R^2}\right)^2}}{2} \right)\right) \tag{18}$$

Below (Figure 5) from formulas (17) and (18). in the reservoir gaseous space height DR gaseous space volume V of to change dependence graph built

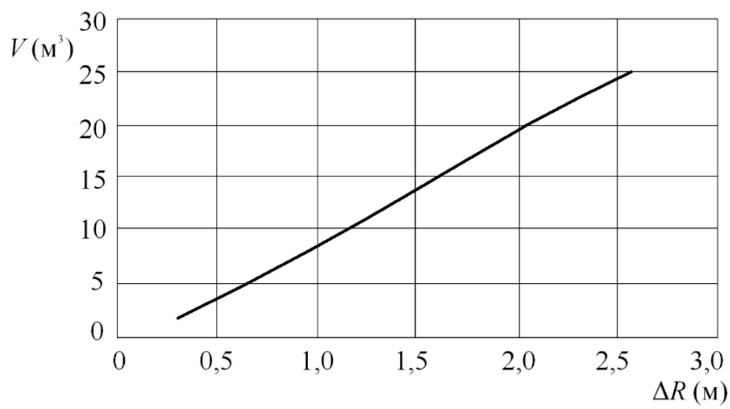

Fig. 5. In the reservoir gaseous space height DR the gaseous space volume V the to change dependence graph

Horizontal cylindrical from reservoirs « small breath in the period of " getting ". from the reservoir out going proposed a formula [2,3,22] that determines the volume of the vapor-air mixture in one breath .

$$G_{ur} = D_{ur} \cdot V \tag{19}$$

in this D ur - the average weight of vapors in the compressed steam-air mixture , kg ;

$$D_{ur} = \frac{P_{\min} + P_{\max}}{R \cdot (T_{2\min} + T_{2\max})} \tag{20}$$

Formulas (18) and (19) to formula (20). values put , « small breath get » largi gaseous space volume V the condensing gasoline quantity Go the to change dependence graph we can

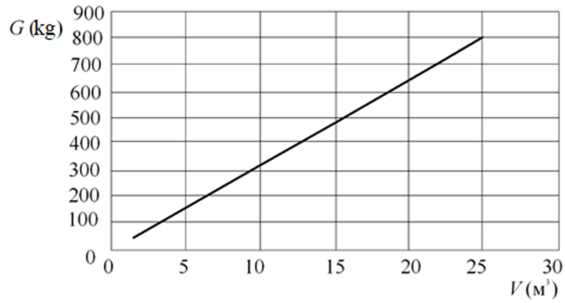

Fig. 6. Condensing gasoline quantity Gur gaseous space size V to dependence graph

4 Conclusion

- Village economy enterprises oil warehouses take being married, being kept and being distributed clear oil products one row to failures occurs.
- Mix failures basically from evaporations to the body come, quality and quantitative will be lost ;
- Mix failures on one row scientists scientific researches take went, but they quality losses account did not receive;
- We take went scientific in our study quality and amount losses too in consideration we got
- Cylindrical horizontal reservoirs gas cavity in consideration from evaporation losses quantity identified;
- Next our research evaporations prevention get not perhaps vapors holding to stay from the way take let's go

References

1. Gofurovich M. I. International Journal of Mechanical Engineering **7-3,** (March, 2022) pages 596-601.
2. Khudoyberdiev, T. S., Mirzayev, I. G., Abdimominov, I. I., & Abdullaev, A. O. (2022). Jundishapur Journal of Microbiology Research Article Published online 2022 **15-2,** (2022)
3. Zulunov Z.T., Mirzaev I.G. and etc. "New device ". Uzbekistan q/x magazine, **6,** 10 pages, 2004.
4. Zulunov Z.T. "Gasoline fumes condensed holding staying device account ". T.: " Uzbekistan Agrarian science Bulletin» **4(22),** 2005, pp. 92-95.
5. Z.T.Zulunov , I.A.Efimov, Mechanization and automation of technological processes v agropromyshlennom complex. Chast IV str. 106–107. 1989
6. Z.T.Zulunov , I.A.Efimov, Puti ekonomii toplivo energeticheskix resursov v APK. M., Trudy VIM, pp. 106–115, 1990.
7. Borzenkov V.A., Efimov I.A. i dr. "Osnovnye trebovaniya k otsenke tekhnicheskogo sostoyaniya reservoirov i oborudovaniya nefteskladov". M.: "GOSNITI", p. 16, 1987.

8. Bronstein I.S., Abuzova F.F. i dr. "Borba s poterami oil and oil production pri ix transportation and storage". M.: "Nedra", 1981.
9. Efimov I.A., Puchin E.A., Zulunov Z.T. "Snizhenie poter ot ispareniya svetlyx sortov nefteproduktov pri khranenii na nefteskladax APK". M.: Nauchno-teknicheskiy informatsionnyy sbornik, **2,** p. 24–27, 1990.
10. Zulunov Z.T. i dr. A.S. No. 1628434 "Gazootvodnaya sistema reservoirov dlya khranenia legkoisparyayushchikhsya jidkostey". 15.10.1990.
11. Zulunov Z.T. and others «Light the pilot liquids which keeps reservoirs hold the gas for remaining system". Andijan. Village economy from crops high and good quality harvest in getting agrotechnological problems and their solutions. Pages 167-169. 2006.
12. Sergeenkov V.A. "Issledovanie poter avtomobilnyx benzinov ot isparenia pri priemootpusknyx operatsiyax na nefteskladax kolkhozov i sovkhozov". M.: MIISP, 1970.
13. Rudenko A.I. Neftekhozyaystvo kolkhoz and state farm. M.: Kolos 1975.
14. Mirzaev I.G., Zulunov Z.T., Turdieva M.Yo., Zavisimost kolichestva kondensiruemyx legkoisparyayushchihsya jidkostey ot parameter kondensara. Russia. G.Samara magazine "Nauchnyy aspekt" RINTs (IF 0.03) , 2168...2172, 2020.
15. Mirzaev I., Zulunov Z.T., Tudieva M.Yo. Samara journal "Scientific aspect" RINTs (IF 0.03), 2173...2178, 2020.
16. Abdullaev D.A., Zulunov Z.T., Yuldashev R.R. Shkola Nauki **14(25)** December 2019.
17. Khudoyberdiev T.S., Zulunov Z.T., and dr. patent and isobreteniya №IAP 03301 Gazootvodnaya system reservoir dlya khranenia legkoisparyayushchikhsya jidkostey, 28.02.2007.
18. N.L. Levi, A.D. Prokhorov. O reservoir of elevated pressure: M: transport and storage of petroleum products and hydrocarbons. M.: 1982 **5, 198** pp. 6-8
19. N.A. Molchanov. G.K. Lebedev, V.G. Kolesnikov. Op yt promyshlennoy ekspluatsii pontonov iz PEND. M: transport and storage of petroleum products and hydrocarbons. M.: 1982 **5, 198** pp. 24-25
20. G.S. Choloyan, Development of a constructive form, technology of production and installation of filling devices, floating roofs, pontoons, oil tanks. M.: 1983.
21. Abuzova F, F., Bronstein I.S., Novoselov V.F., Rzhavsky E.L., Fokin M.N. Nedra, 1981.
22. M.G. Krayveychenko, L.A. Babin, V.I. Krasnov, G.B. Schneider. Means of sokrashcheniya poteri nefti ot isparenia iz reservoirov s plavuyushchimi kryshami. Obzornaya information. Ser.: "Transport i khranenie nefte i nefteproduktov" M.: VNIIOENG, (1984) **2(50)**
23. Mikheev M.A., Mikheeva I.M. "Osnovy teploperedachi". M. "Energy", 1977.
24. Mirzaev I.G., Zulunov Z.T., Turdieva M.Yo. Internauka **7 (183), issue 1,** 2021. 49-51.