TEKA. COMMISSION OF MOTORIZATION AND ENERGETICS IN AGRICULTURE – 2013, Vol. 13, No.3, 128-132

Methods of increase of operating properties of transport vehicles in the conditions of low temperatures

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Received May 23.2013: accepted July 04.2013

S u m m a r y. The methods of increase of operating properties of transport vehicles are described in the conditions of exploitation at the low temperatures of surrounding air. The results of researches of process of heatexchange are resulted in the bunches of finned tubes. Criterion dependences are got for the calculation of process of heatexchange. The rational construction of fuelpreheater of diesel transport vehicles is chosen.
K e y w o r d s. Temperature, fuel, coefficient of heat transfer, fuelpreheater.

INTRODUCTION

Viscosity and density fuel define the processes of the evaporation and formation of mixture in diesel. More Low density and viscosity provide best atomization fuel. At reduction of the temperature fuel that is accompanied increase to density and viscosity, increases the diameter of the drop (fig. 1) and falls the fullness of their combustion with the result that increases the specific consumption a fuel, grows the opacity of exhaust gases [5, 10, 18].

With reduction of the temperature viscosity diesel fuel increases, obstructing filling section pump of the high pressure; however, practically breach of the presenting fuel approaches only at the temperature below the temperature of its clouding (before 268K). The Clouding fuel is connected with formation in him when cooling microchip the paraffin, having high temperature of a hardening. At clouding crystals paraffin gradually ram the filters, and presenting fuel stops. The Fault in functioning the system of the feeding by fuel cause the reduction to powers and economy of the diesel, scale in the cylinder, sticking piston rings and other phenomena's. [1, 5, 6].

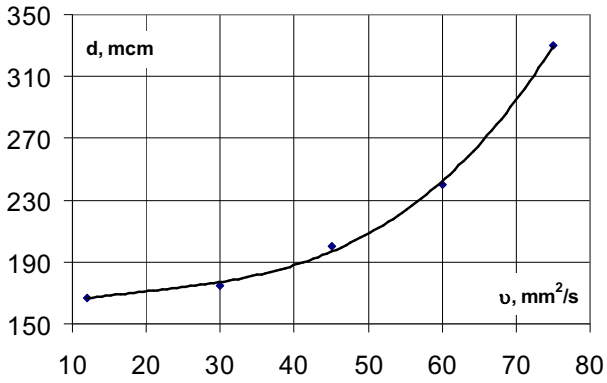

Fig. 1. The relationship between the subtleties spray fuel (average diameter of droplets d_p) on the viscosity

Viscosity fuel also influences upon filling the pump of the high pressure and on drains fuel through clearances plunger pair. With increase of viscosity fuel increases the resistance of the fuel system, decreases filling the pump of the high pressure that can bring about fault in its work. Raised viscosity promotes increasing an amount injected fuel in consequence of reduction drain it through clearances plunger pair in the course of нагнетания. Simultaneously increases the advance angle впрыска from kinematics of viscosity fuel.

With increasing of viscosity, because of spottiness of the sizes of the drop fuel, changes the depth of the penetration and corner of the cone of the fuel torchlight. Particularly sensitive to change of viscosity fuel to engines with indivisible camera of combustion, the form and sizes which are coordinated with the form and direction torchlight fuel [12].

Under constant moisture with increase the temperature fuel solubility water in he increases, and humid from air moves over to fuel. At reduction of the temperature fuel process goes in inverse direction: solubility water in fuel is lowered, and excess its partly falls out in the manner of emulsions and precipitation.

The Most amount of water falls into fuel at condensations it on cool surface of the tank fuel by autumn and in winter, when daytime fuel is warmed, but in the night is vastly coolled. At, the vapours of water condensing on wall fuel tank in the manner of drop of water or rime , which, haved in fuel, partly open in him, but partly settle on bottom of the tank. Than fuel less in tank, that more water in fuel system. Besides, presence of water in fuel is conditioned technology of the conversion to oils. Water in fuel may be free and emulsion.

Free water agglomerates in defender of the tank and pocket tube line, whence in fluid aggregation condition can be drainage easy, in crystalline aggregation condition disturbs the discharge отстоя and possible admixtures.

Emulsions water, freezing, forms the crystals rime, blocking fuel filters, but at hit in fuel equipment brings about freeze valve regulating unit and breakage of the drive of the pump.

At pumping fuel through filter occurs not only postponing weighted crystal ice on its surfaces, reducing (with miscellaneous by intensity, depending on amount of water) reception capacity filter, but also formation new crystal, being centre to crystallizations, around which occurs forming the hard phase.

Analysis of the influence of operating conditions of power systems of diesel vehicles led to the following conclusion: the performance of diesel engine vehicles in extremely low temperatures, typical of much of the territory of the CIS, largely depends on the efficiency of the power system operation which depends not only on the choice of the type of fuel, but mostly from fuel heater [2, 3, 11].

OBJECTS AND PROBLEMS

The Heaters oils (the heaters fluid fuel have a general name - a heaters of the viscous liquids) have found broad using in chemical, oil-processing, food industry, energy and on transport. On transport of the heaters fluid fuel have got broad spreading on court, diesel locomotive, to a lesser extent - on car transport.

Fuelpreheaters, as equipping the transport vehicle, being main by system element fuelpreheater, on the most typical particularity reasonable to classify as follows:

- a consumers to energy i.e. equipment, on operation which is spent efficient energy of the power installation [8, 21];
- utilizater energy i.e. equipment, using cast-off heat.

The electric heaters fuel pertain To the first group, to the second - gas and liquid. Moreover preferably organize the heating a fuel in pathway of the system of the power supply.

The Main action, reducing separation from fuel of the precipitation, is a heating fuel not in fuel tank, but in heatexchangers, disposable in system, which must:

- provide steady presenting a fuel in cylinders of the engine in given range of the temperature fuel regardless of the temperature surrounding ambiences;
- have a possible hydraulic resistances under minimum mass and size and high heat efficiency;
- be charaterized by required reliability and lifetime;
- have a minimum expenseses on fabrication and installation in system of the feeding, high maintainability and simplicity in service.

The Preceding studies теплообменных device has shown that the most efficient surfaces, sending heat, are formed from thick bunch finned tubes, made by method накатки on technologies VNIIMETMASH (the fig. 2). On result of the analysis result preceding studies and author data (the curve 6 on fig. 2) the most efficient are a bunch finned tubes with the following geometric parameter: diameter of the tube on rib d_r = 10,22 mm; the diameter of the tube, carrying rib d_{cr} = 5,8 mm; the internal diameter of the tube d_1 = 4,4 mm; the step rib t_r = 1,59 mm [7, 9, 17].

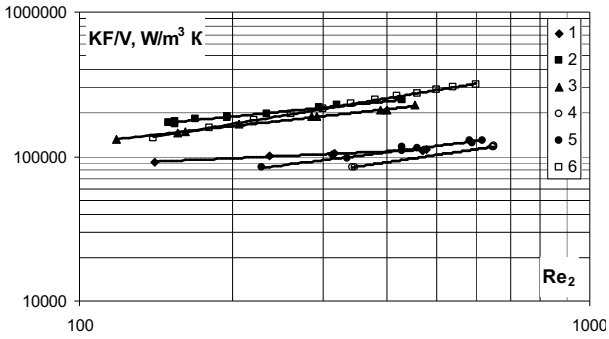

Fig. 2. Efficiency of use of fin tube bundles:
1 - the sheaf of smooth tubes, 2 - a dense beam of finned tubes, 3 - discharged beam fin indigenous tubes 4.5 - bundles small fin tube 6 - tube bundle with optimized the parameters of the fin (obtained by the authors)

Authors in the laboratory "Thermal energy vehicle systems" department "Cars" of the Volodymyr Dahl East-Ukrainian National University conducted research in order to get connected, the connections between the geometrical parameters describing the layout of the beams of small diameter tubes with rolling fin heatexchanger design apparatus (density layout of the tube bundle, the number of moves and the value of idle fuel leaks fuel in partitions) for thermal efficiency fuelpreheater. During the calculation of the energy system for heating fuel engine, namely during the thermal design of the fuelpreheater main difficulty is to determine the heat transfer coefficient k. This is mainly due to the complex structure of the surface heat transfer fuelpreheater and those with heat carrier. You also need to take into account the complex structure of the flow bathing the outer surface of the finned tube bundle [4, 13, 14, 19, 20].

Dependency is recommended On result of the studies for calculation of the factor heat exchanger:

$$k = \frac{1}{\left(\frac{\psi}{\alpha_1 \cdot} + \frac{d_{cr}}{2 \cdot \lambda_w} \cdot \ln\frac{d_{cr}}{d_1} + \frac{1}{\alpha_2}\right)}. \qquad (1)$$

The Methods of the calculation was elaborated by experimental studies, which results are submitted for fig. 3.

Equations were received On result of the processing experimental data for factor heatexchanger to parametric and criterion to form:

$$k = 973{,}84 \cdot v_2^{0{,}3632}; \quad k = 37{,}72 \cdot Re_2^{0{,}4262}. \qquad (2)$$

The equations are valid for v_2 = 0,4 ... 1,0 m/s and Re_2 = 750 ... 1000.

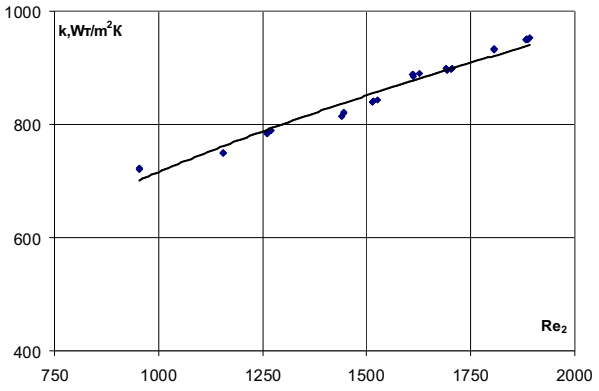

Fig. 3. The dependence of the heat transfer from the finned tube bundle Reynolds number of fuel

For revision result processing experimental data and methods of the calculation were organized special studies on determination physical characteristic winter diesel oil (refer to fig. 4, 5). The Results of these studies have confirmed the negative influence of the low temperature on characteristic fuel.

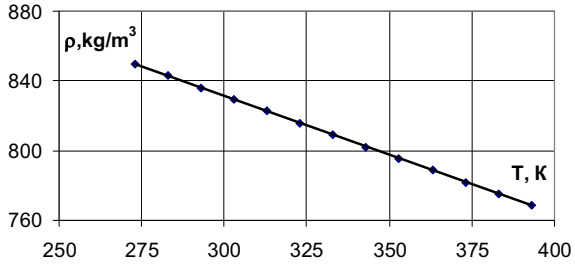

Fig. 4. The density of the winter diesel fuel, depending the temperature

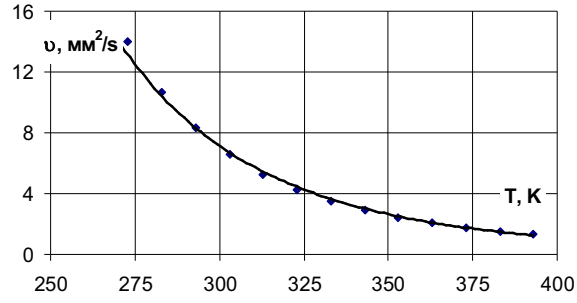

Fig. 5. Kinematic viscosity of diesel fuel Depending on the temperature

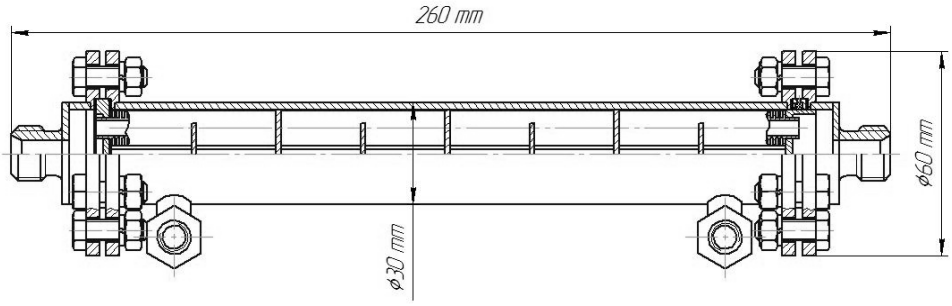

Fig. 6. Fuel heater for diesel engine

The Results of the studies have allowed to get the methods of the calculation heatexchanger device given type and systems with their use and design heatexchanger from finned tubes, made on technologies VNIIMETMASH, with optimized finned parameter (fig. 6) [15].

He is intended for cars with power of the engines from 240 before 320 h.p. and meets the demands usages of the engine at cool time of the year.

The Main element heatexchanger are a bunch of the tubes, trumpet lattices, body, lids, carbines. The End of the tubes bear up in trumpet lattice by expansion or soldering.

For increase the velocities of the motion heat carrier for the reason intensification of heat exchange are installed partitons in inter tubes space heatexchanger.

Fuelpreheaters has a triangular arrangement of the tubes with at a walk locations S = 13 mm (for the reason ensuring the optimum velocities of the motion fuel) and organization cross - opposite of the motion heat carrier (inwardly tubes - coolling liquid, in inter tubes - a fuel). Besides, appearing screw surface inwardly tubes at made finns promotes increasing to efficiency heat exchange. The Amount of the tubes in bunch is chosen from condition of the maximum filling the cross-section of the body fuelpreheater (3 tubes) [16].

The Comparative estimation experienced fuelpreheater with the best from the known analogue - PT 570 (SAINT PETERSBURG, RF) has shown [15]:

1. The Gabarit sizes less, than beside PT 570 in 1,5 times.

2. The General mass on 50% less, than beside PT 570.

3. Using the aluminum tubes will provide corrosive stability experienced fuelpreheater and will allow to cut down expenses non-ferrous metals in 2,5 3 times.

CONCLUSIONS

As a result of performing the work is solved important research problem, concluding in improvement fuelpreheater for transport for the reason ensuring the reliable usage of the diesel transport vehicle in condition of the low temperature surrounding air and formulate the following recommendations:

- a most perspective method of increasing to efficiency of the system of the heating fuel - an use special heatexchanger device;

- as executive element heatexchanger device, use the bunch finned tubes made on technologies VNIIMETMASH with the following parameter fin diameter tubes on rib d_r = 10,22 mm; the diameter of the tube, carrying rib d_{cr} = 5,8 mm; the internal diameter of the tube d_1 = 4,4 mm; the step rib t_r = 1,59 mm.

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МЕТОДЫ ПОВЫШЕНИЯ ЭКСПЛУАТАЦИОННЫХ СВОЙСТВ ТРАНСПОРТНЫХ СРЕДСТВ В УСЛОВИЯХ НИЗКИХ ТЕМПЕРАТУР

Юрий Куликов, Александр Ажиппо, Тарас Оробцов

Аннотация. Описаны методы повышения эксплуатационных свойств транспортных средств в условиях эксплуатации при низких температурах окружающего воздуха. Приведены результаты исследований процесса теплообмена и выбрана рациональная конструкция топливоподогревателя.

Ключевые слова. Температура, топливо, коэффициент теплопередачи, топливоподогреватель.