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Ways to Save Water When Washing Cars

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Abstract

It is known that the maintenance of a machine consists of a large number of operations, which, by their nature and conditions of execution, can be combined into certain groups, covering the cycle of maintenance work.

The main task of the point of final washing of machines is the high quality of work performed with the least amount of water and the highest labor productivity. The article considers an approach to the economical use of water at the point of final washing of the fleet of automotive vehicles in military units.

The use of a washing machine brand KARCHER K7 1.168-502.0 in the maintenance of automotive equipment during the final washing of cars is justified.

Keywords: *washing machine, KARCHER, efficiency, water consumption, jet, pressure, head, kinetic energy of a water molecule.*

INTRODUCTION

Everyone knows that car maintenance consists of a large number of operations, which, by their nature and conditions of execution, can be combined into certain groups covering the cycle of maintenance work. In accordance with this, maintenance, regardless of its type, can be subdivided into the following main work: cleaning and washing and wiping (external care), fastening, diagnostic and adjusting, lubrication, tire and refueling work [1].

Regardless of the type of maintenance, the priority is cleaning and washing work, one of the tasks of which is to prepare the car for subsequent maintenance operations and give the car the proper appearance.

The bodywork, as well as the underside of the vehicle chassis, are particularly susceptible to contamination. Dirt interferes with maintenance on the underside of the vehicle.

METHODS

When washing cars, dust and dirt from the outer parts of the body and chassis of the car is usually removed with clean cold and warm (plus 25-30^{o}C) water. Sometimes water is used with the use of synthetic detergents: sulfonal or powder for washing a car (VTU No. 18/35 - 64).

When loosely bound dust-like contaminants are washed off with a jet of water, fine (30 microns) dust particles remain on the polished surfaces of the body, which are retained in a thin water film and when it dries and leave a matte gray coating on the surface of the body. A similar phenomenon occurs when dense mud deposits with impurities of organic origin are washed away, which have high cohesion forces.

This film is difficult to influence even when using a high-pressure jet and is destroyed only as a result of mechanical action (with a brush, sponge or chamois leather).

The final wash station is intended for internal cleaning and blowing of machines and their final washing. It consists of posts for internal cleaning and final car wash.

The main task of the final washing point of a military unit is the high quality of the work performed with the lowest water consumption and the highest labor productivity.

To date, in the military units at the point of the final washing of cars, washing machines of the M-600, TsKB-1112, MM-1000/8, MP-800 brands (hereinafter referred to as old-style washing machines) are used [2, 3].

RESULTS

Currently, KARCHER K7 1.168-502.0 washing machines have been developed, created and widely used for washing equipment, which significantly save water consumption and the time spent on washing due to the supply of water from a small nozzle at high pressure (up to 30 times higher pressure than in machines old model).

Time for washing a car with a Carcher washing machine K 7 1.168-502.0 t = 8-10 min. (1.5 times less time allotted for washing a car using an old-style washer).

And if we take into account that the volume of consumed water per minute "Karcher" K 7 1.168-502.0 is only 10 liters, then only 80-100 liters of water will be required for a T-shirt of one car by Karcher.

At the same time, washing one car with an old-style washing machine will take 15 minutes of time and from 750 to 2000 liters of water, as well as up to 10 times more electrical energy.

On average, every day, to ensure the life of the activities and combat training of units of military units, from 10 to 20 units of automotive equipment are used. There are 18-19 working days per month.

Let us determine the savings in water consumption per month V_E, when used in the military unit of the washing machine "Karcher" K 7 1.168-502.0, in relation to the old model washers. Let's assume the number of working days per month is 18, the number of operated machines per day is 20 units. Water consumption per day for one piece of equipment: when using an old-style washer V_C = 2000 l, and when using a washing machine "Carcher" K 7 1.168-502.0 V_K = 90 liters.

Let's determine the water consumption per month:

$V_C = T * L * V_1 = 18 * 20 * 2000 = 720\,000$ l.

$V_K = T * L * V_1 = 18 * 20 * 90 = 32\,400$ l.

Where, T is the number of working days per month;

L is the number of machines in operation per day, units;

The volume of saved water per month will be $V_E = V_C - V_K = 720000 - 32400 = 687600$ l., i.e. when using a Karcher-type washer, a military unit saves an average of 690 tons per month, usually of drinking water. Due to the decrease in the resources of suitable, especially drinking water, this is of great importance. In addition, a multiple reduction in electrical energy consumption and a 50% reduction in time consumption make the use of a Carcher-type washing machine obligatory at the points of clean washing of weapons and military equipment of a military unit.

Carcher-type washing machines, unlike old-style machines, are portable and this is another advantage, they can be used in the field after military exercises or other circumstances.

Let us analyze why Carcher-type washers have proven to be so beneficial in terms of saving water, time and energy.

An important factor in the washing process is the kinetic energy of the water molecule. The higher this energy, the more easily the water molecules break the bond between the dirt molecules. It is known from the course of hydraulics that the flow rate of water Q, through the free section of the nozzle, is determined by the formula

$$Q = \frac{60Fv}{1000} = \frac{3\pi d^2 v}{200}, \; l/min \qquad (1)$$

where F is the free cross-sectional area of the nozzle, mm^2;

v is the speed of water outflow from the nozzle, m/s;

d is the diameter of the nozzle outlet, mm.

In turn, the speed of the outflow of water from the nozzle

$$v = \mu\sqrt{2gh}, \; m/s \; (2)$$

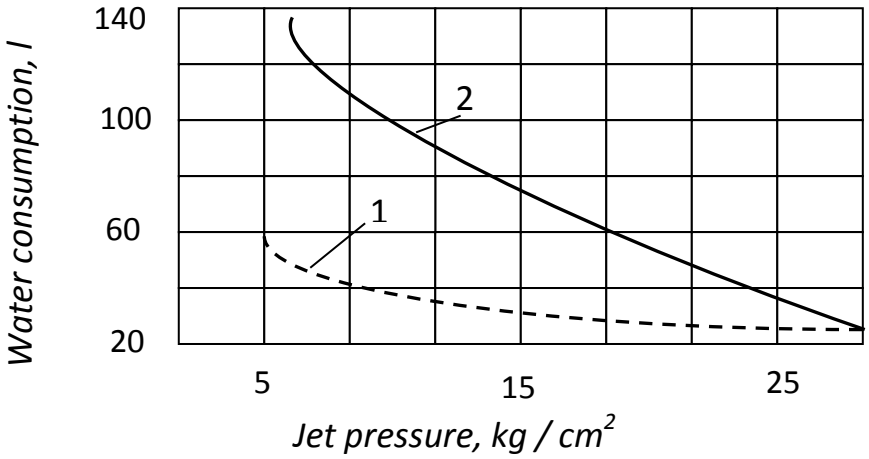
where $g = 9.81$ - acceleration of gravity, m/sec^2;

h - water pressure, m;

μ - coefficient of efflux taken for nozzles with nozzles equal to 0.5 – 0.55, and without nozzles - 0.7 – 0.75.

As can be seen from the above formulas, by decreasing the nozzle diameter and increasing the water pressure (i.e., increasing the water flow rate from the nozzle), it is possible, while maintaining a constant flow rate, to obtain a jet with higher kinetic energy and, consequently, higher efficiency.

With an increase in the jet pressure for nozzles of the same diameter, the total water consumption for the wash is noticeably reduced, because water with high kinetic energy with less volume washes away dirt faster. An even greater effect is given by reducing the nozzle cross-section. This dependence allows us to conclude that an increase in the pressure of the water jet with a simultaneous decrease in the nozzle cross-section (to a certain value) increases the washing efficiency. This effect is used by motorists when washing a car, they reduce the cross-section of the hose outlet by covering the outlet with a finger.



Picture. The relationship between the pressure of the jet and the flow rate of water when washing one piece of equipment: 1 - nozzle diameter 2.5 mm; 2 - nozzle diameter 3.5 mm.

DISCUSSION

From the experimental data [4] it also follows that the washing efficiency is characterized by the amount and speed of water supplied to the contaminated surface, or the power of the water jet. Water jet power.

$$N_C = Q\ h\ ,\ m\ /\ sec \qquad (3)$$

This expression shows that a jet of the same power can be obtained at different values of the flow rate and water pressure, i.e. with a small value of *Q* and a large value of *h*, or vice versa. This means that it is possible to regulate the kinetic energy flowing out of the water jet nozzle and by increasing the jet energy to increase the efficiency of cleaning dirty places.

Based on the above, the following conclusions can be drawn: the use of Karcher-type washing machines is an order of magnitude more economical compared to old-model washing machines and, in this regard, the use of Karcher-type machines in military units is mandatory;

Advantages of the Karcher type washing machine are based on increasing to a certain extent the kinetic energy of the water flowing out of the nozzle, which, possessing high energy, effectively breaks the sticky bonds of dirt, thereby easily washing it out and cleaning the surface. At the same time, reducing the nozzle diameter leads to a decrease in water consumption and an increase in the kinetic energy of water molecules.

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