# STAND UNIT FOR INVESTIGATION OF HYDRO-ABRASIVE WEAR OF COMPOSITE POLYMER COATINGS

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***Abstract.*** *In this work, based on the analysis of existing installations, taking into account their advantages and disadvantages, a special installation was designed, and a technique was developed for experimental study of the hydroabrasive wear of samples from various composite polymer coatings, operating on the principle of periodic impact of samples with a hydroabrasive jet.*

***Keywords:*** *hydroabrasive jet, installation, hydroabrasive wear, cavitation, composite polymer material, coating, sample, wear resistance.*

## Introduction

Currently, to study the hydroabrasive wear of materials, installations are used that work according to the methods of "inserts", sample rotation, jet testing, centrifugal, etc. In the "inserts" method, the energy of the hydroabrasive mixture is communicated by a pump. Samples in the form of cylindrical rods are inserted into the pipeline and, as it were, penetrate the hydroabrasive flow.

## Methods

The sample rotation method was used in [1] to study the wear resistance of enamel coatings. The advantages of installations with rotating samples are small dimensions, low drive power, the ability to test several samples, the simplicity of the device, etc.

Testing materials for resistance against hydroabrasive wear a jet of a hydroabrasive mixture has also found distribution. Serious research using this method was performed in [2-4].

The most advanced technique and setup was proposed in [5]. A specific feature of this installation is the method of fixing and the shape of the samples. In the installation, a disk is fixedly fixed on the drive shaft, on which there are 6 holes for attaching sample holders. This design of the installation allows you to fix up to 6 cylindrical specimens, which increases the number of simultaneously tested specimens.

Considering the advantages and disadvantages of the known installations, it can be noted first that all of them are suitable for studying the relative wear resistance of materials under conditions of general hydroabrasive wear.

However, these facilities are unsuitable for studying the wear resistance of materials under conditions of joint cavitation and abrasive wear since none of them reproduces the cavitation component of wear. These settings, except for some, are also not suitable for determining the main wear patterns depending on such parameters as flow rate, abrasive saturation, particle size, etc., in addition, these machines do not consider such an important factor as mutual wear surface orientation and flow direction. We also add that these methods, except for the jet method, do not allow a clear study of the wear process depending on such an important indicator as the angle of attack.

Obviously, when designing test devices for hydroabrasive wear, it is also necessary to consider the presence of two types of wear: general and local, or rather, consider the phenomena that underlie these types of wear. General wear is based on wear by particles on the main sample due to friction and partly impact action of particles, while local wear, as a rule, is formed due to the local action of stationary vortices containing abrasive particles or the action of cavitation cavities.

In this case, the mutual orientation of the wear surface and the centrifugal forces of the flow, which occur in all rotary hydraulic machines, play an important role. In accordance with this, in the installation for testing for general hydroabrasive wear, it should be possible to install samples in relation to the abrasive flow and its centrifugal forces in accordance with typical surface layouts.

In addition, these facilities must have devices for measuring the flow velocity and saturation at the surface of each sample. In this case, it will be possible to study the wear patterns depending more reliably on the flow characteristics and the location of the samples.

Thus, based on the analysis of existing installations, considering their advantages and disadvantages, a special installation was designed and manufactured for the experimental study of the hydroabrasive wear of samples from various composite polymer coatings, which operates on the principle of periodic impact of samples with a hydroabrasive jet.

The jet-impact installation (Fig.) consists of a centrifugal pump 1 type 3K6, an electric motor 3 alternating current with a power of 8.0 kW, n = 2900 rpm, a shaft with holders of 10 samples fixed on it, a casing-tank 5, a V-belt transmission 2, pipelines and three-way valves.

**Results**

The centrifugal pump 1 takes the hydroabrasive mixture (pulp) or clean liquid through the suction pipe 14 from the tank 5 and delivers the pressure part of the pump. From here, part of the pulp through the three-way valve 4 is fed into the jet by the distributor 6, and part is transferred through the pipeline 12 to the tank. At the same time, the bypassed pulp keeps the abrasive particles in the tank all the time, in a suspended state. Valve 4 allows you to adjust the pressure of the pulp in the jet distributor and the amount of pulp bypassed. Next, the pulp from the distributor 6 enters the nozzles 7. Depending on the need, from one to four nozzles can work simultaneously. Nozzles are made of four diameters (6,8,10 and 12mm) from wear-resistant steel.

Hydroabrasive jets directly at the exit from the nozzle intersect with samples 8 fixed in the heads of the holders.

The upper part of the sample is free, which eliminates the possibility of the formation of a water cushion and provides an unhindered flow of the hydroabrasive mixture from the surface of the sample into the tank. The head can be rotated to the desired angle, there is a scale to fix the angle of rotation of the head. The distance between the centers of diametrically located samples is 350 mm; if necessary, this distance can be increased to 500 mm by replacing the holders.

Two to eight samples can be tested simultaneously. The linear speed of the samples is changed by changing the diameter of the circle of rotation or the number of revolutions of the driven shaft (by adjusting the gear ratio of the V-belt drive).

The sample shaft can be driven by an individual electric motor.

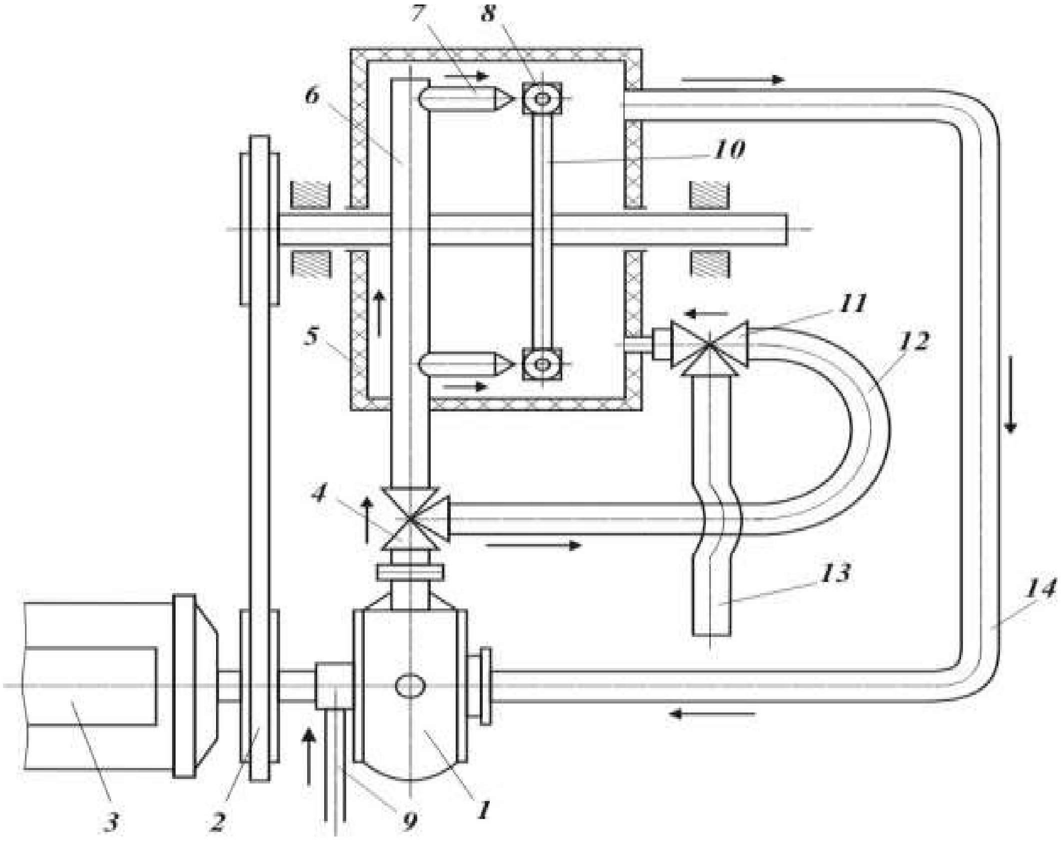


**Figure 1.** Scheme of the jet blower.
1 - pump; 2 - V-belt transmission; 3 - electric motor; 4 and 11 - three-way valves; 5 - casing-tank; 6 - jet distributor; 7 - nozzles; 8 - sample; 9 - drain pipeline; 10 - sample holders; 12 - bypass pipeline; 13 - pipeline for removal of the mixture; 14 - suction pipeline.

The jet of the hydroabrasive mixture, after hitting the surface of the sample, is sprayed and flows down the walls of the casing - tank 5, where it is mixed with the non-working mixture.

**Conclusion**

Pure water is supplied to the pump seal under pressure, protecting it from excessive wear. Water entering the system through the pump stuffing box plays the role of a cooling medium and keeps the temperature of the mixture constant. The spent hydroabrasive mixture is removed from the tank casing by the main pump through the pipeline 13 when the valve 11 is switched.

In addition, the design provides the ability to rotate the samples around the axis, which allows you to set the desired angle of attack. As samples, prisms with dimensions of 220x18x10 mm were used, made of Glass 3 coated with the investigated composite polymer material with a thickness of 0.5; 1; 1.5; 2mm. Before starting the test, the samples are weighed and mounted on the holders of the installation.

After each experiment, the samples are removed and weighed. To conduct a new experiment, the tank and the entire system are washed several times with clean water and then filled with clean water and fresh abrasive particles of the required size and quantity.

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