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*Dauletbekuly O., Baijumanov K.D.

Institute of Industrial Engineering,
Kazakh National Technical University KISatpayev,
Almaty, Kazakhstan
*e-mail: orkesha01@mail.ru

# Methods of increase of wear resistance and resource of operation of soil pumps

**Abstract.** Hydroabrasive wearout and cavitation of the soil pump are considered in the article. The essence and process of hydro abrasive wear. Improve the designs of pumps during their operation, and is also considered the main sources of problems. Also the analysis of ways for increase of wear resistance and energy efficiency of work during operation are made.
**Key words:** Groundwater pump, hydroabrasive deterioration, wear resistance, abrasive particle, cavitation, polyurethane, electrical insulators, frequency converters, microstructure.

## Introduction

Problems of the soil pump. Hydroabrasive wear – the process of gradual change of the sizes, forms or conditions of surface resulting from influence of the firm abrasive particles weighed in liquid and moving together with last rather worn out surface.

Hydroabrasive wear is the result of hydroabrasive wear of details. The essence of hydroabrasive wear consists in joint impact on the worn-out surface of firm particles and liquid which is shown in the form of friction and shock engagement of firm particles and the bearing liquid with working surfaces of pumps [1]. Process of hydroabrasive wear of pumps is a consequence of total action of all types of destruction: abrasive, cavitational, erosive and corrosion. Wear of pumps can be evenly distributed on all surface and arising only on certain sites. The greatest wear at course of an abrasive pulp takes place in those sections of flowing channels where the direction of a stream sharply changes. It is formed zones of local vortex formation. The stream moves with a high speed, owing to hydroabrasive wear driving wheels, bronedisk and cases (helix) of soil pumps are most often replaced. From total of spare parts approximately 30% are share of these details.

Ways of increase of service term of pumps are:

- Use of wearproof materials;
- Hardening of surface with firm alloys;
- Consolidation of pumps;
- Development wearproof hydraulic form of flowing part of soil pumps;

Increase of wear resistance by improvement of hydraulic forms of flowing channels influences on increase of service term than using of wearproof materials. Service term of details of pumps depends on a type of the transported materials, the mode of operation and speed of rotation of a wheel.

The glues on the basis of epoxies for fastening of protective rings and sealing hobs use for increasing service term of main equipment and also use surfacing of details of pumps. It will allow to cut down expenses on spare parts.

Improvement of pumps during operation provides the considerable between-repairs periods. Premature disbalance of the driving wheel is the reason of the short between-repairs periods.

In the soil pump it is offered to install system of washing gaps with clear water which comes to a gap between shielding disk and the driving wheel. Shielding disk on a half of diameter is supplied with a replaceable disk which working surface is reinforced by wearproof material that allows without replacing to restore shielding disk. The driving wheel is the main body of the pump in which there is a conversion of mechanical energy of the drive in hydraulic energy of liquid. As a result of influence of the driving wheel liquid leaves it with more pressure

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and speed, than at an entrance. The assembly drawing of a shielding disk is represented in figure 1. Application in this design of replaceable disks will allow to restore worn-out details [2].

The main problems

Perhaps, the main source of problems with pumps – cavitation. Physically this phenomenon is explained that there is always some dissolved gas in liquid. There can be depression zones at the movement of liquid in it. Bubbles are as a result allocated. Getting with a stream to a zone of more high pressures, bubbles collapse, emitting energy which destroys a surface of driving wheels, helix (fig. 1.), etc.

This energy also creates the shock waves causing the vibration extending on the driving wheel, a shaft, consolidations, bearings, increasing their wearout. Emergence of cavitation is caused by the different reasons. Any kind of cavitation is connected with not accounting of important rules of hydraulics and hydrodynamics [3].

The most widespread types of consolidations of pumps are:

- the unary and double stuffing;
- the unary and double face;
- the cuff;
- the slot-hole.

Solutions

The design, type, look, the concrete decision as consolidations, and all knot depend on type of the pump, conditions and requirements to its installation and operation. In all cases it is necessary to provide tightness leak in admissible limits, and also simplicity and ease of installation and dismantle of consolidation of the pump.

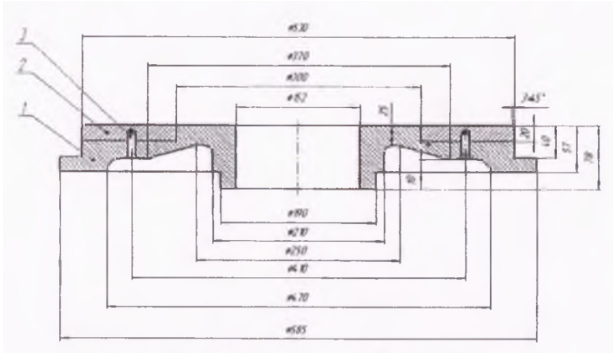
Polyurethane is the polymer with unique properties which is widely applied in production of details to supersevere conditions of operation.

Polyurethane is characterized by high physical and chemical and operational properties.

High abrasive stability. Thanks to this property polyurethane is known in equipment. Products from polyurethane are approximately up to 50 times more durable than rubbers, plastics, in some applications – non-ferrous and ferrous metals. This durability often means that polyurethane details can be made with smaller materials on weight and demand less costs of service, creating considerable economy.

– Polyurethane – one of the most rigid, most abrasion and resistant elastomers which can not be break under loadings.

- High tensile strength and resistance to distribution of cuts, resistance to influence of the cutting blows. Products from polyurethane keep a form and mechanical properties after the appendix of cyclic loadings.



1-main disk, 2-shift disk, 3 - screw

**Figure 1** – Drawing of a combined shielding disk.

**Figure 2** – Cavitation of the helix after a year of operation of the pump.

**Figure 3** – Accessories from polyurethane.

- Temperature range of operation of products from-50 to +80 °C, about +100 °C are short-term. Polyurethane remains flexible at very low temperatures and possesses the outstanding resistance to a heatstroke.

- High elasticity and elasticity in the wide range of hardness, resistance to repeated deformations and bends without break. Lengthening to 450%.

- Good adhesion to the majority of materials. Possibility of production of the reinforced details.

- Good chemical resistance to oils, oil, organic solvents.

- The most of polyurethane – excellent electric insulators.

Polyurethane is completely synthetic polymer which properties can be changed for the solution of specific production and design objectives over a wide range.

Polyurethane details possess a number of unique properties and are completely deprived of rubber shortcomings. They perfectly maintain big sign-variable loadings under trying conditions of operation and don't lose the qualities for many years [4].

At the order of the pump equipment which operation is conducted at the changing working parameters (giving pressure), always there is a question of regulation of operation of the pump for the purpose of receiving the needful of giving and a pressure in these conditions .

Usually the standard size of the pump gets out on these manufacturer to the maximum values of giving and a pressure and on ranges of change of these parameters forming a working field.

**Figure 4** – PS75 Frequency converter.

I want to give an example of one companies in the field of control of pumps and frequency converters, the PumpSmart system, provides the advanced control of pumps, protects and optimizes their work, prevents refusals that provides increase of reliability of the pump and economic indicators of processes of transfer. PumpSmart opens the best ways of improvement of systems.

PumpSmart PS75 – is technologically advanced system which provides soft start, control of the pump, protection, calibration of power and production control.

The start-up / Stop sensors of vector control of the engine allows PumpSmart PS75 to operate the pump. Controlling rating pressure, preventing water hammers which are often connected with the moment of start-up and a stop of the pump.

PumpSmart PS200 offers management and protection of the pump for almost any productions with such parameters as pressure, a stream, and control of level. PS200 can measure: dry run, the minimum stream, or exit conditions from the nominal modes without installation of expensive external sensors. PS200 can control and react to excessive fluctuations of temperatures also.

The monitor of wear of the pump PumpSmart will periodically control operation of the pump and automatically warning about wear of the pump.

PS200 can be also easily introduced in any existing control system.

Calibration – allows to optimize an electric power expense by means of electronics – 20% reduction of speed can lead to 50% reduction power consumption [5].

Researchers from South Korea developed a new way of production of the alloyed steel of low density which can quite surpass the titan in durability and plasticity without increase in cost.

In materials science plasticity defines ability of substance to stretching and bends without deformation. This property is extremely important for the industry. Producers constantly look for ways of creation of easier steel alloys. But easier steel is more fragile.

The new steel alloy developed by team of South Korean experts under the direction of Hans of Kim (Hansoo Kim) from Pkhokhansky university of science and technologies possesses the best properties: material at the same time easier and more flexible. Specifics of production of such alloy are rather difficult, however this way led the alloyed steel existing currently to the material production significantly exceeding on qualities.

To make an alloy is easier, scientists added to it aluminum, less dense metal and in order that the alloy with aluminum was less fragile, added nickel. Thanks to it aluminum connects to iron in the nanometer.

Formation of aluminum clusters was confirmed by means of an electronic microscope. Then scientists held testing of metal and found out that it appeared less fragile, than ordinary steel.

Researchers reckon on that the new technology will quickly take the place in mass production and will be useful for industry, building and mechanical engineering [6].

The scientific article of group of Kim was published in the magazine "Nature".

## Conclusion

As we see, there are many ways of increase of wearout of details of the soil pump. But the most suitable method, I consider, it is using of polyurethane. Polyurethane is characterized by high physical, chemical and operational properties. Its feature that it is possible to pick up it on the environment of using soil pump. Using frequency converters, we improve operation of the soil pump, extending operation service term, thus we save electric power expenses.

As it was told above, progress doesn't stand still, the technology develops every year. Using these opportunities, it is necessary to be able to see prospects and to introduce them in further researches. Researches in this area will be always demanded and actual.

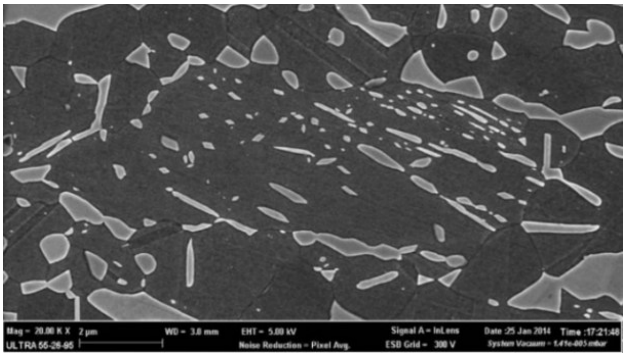


**Figure 5** – Microstructure of a new alloy.

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