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ORIGINAL ARTICLE **OPEN ACCESS**

Models of Sealing elements of Improved Cranes with required properties

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ABSTRACT
The research work is devoted to the development of the necessary algorithm in predicting the destruction of the sealing elements of improved cranes during exploitation in the oil and gas industry. Including, in the article are given scientific basics of durability definition of seals in empirical criteria
Keywords: *seal, algorithm, mechanical systems, improved cranes, functional, potential energy*

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INTRODUCTION

Prediction of the equipment efficiency loss during exploitation and the development of a control system for reliability indicators is an actual problem of modern industry. Many important problems solved and have been resolved in this field. In conclusion, the degree of accuracy and correctness of solutions of this type of problem depends on an accurate prediction of the critical state of failure of all and details of the examined equipment.

In this research work, developed the scientific basics of the setting algorithms for predicting the critical state of sealing failure elements of cranes during exploitation

Existing cranes widely used in industry, being from one of the main units of the included in the complex of refinery equipment, as well as manifolds of Christmas trees for drilling, are designed to prevent and regulate fluid and gas flows.

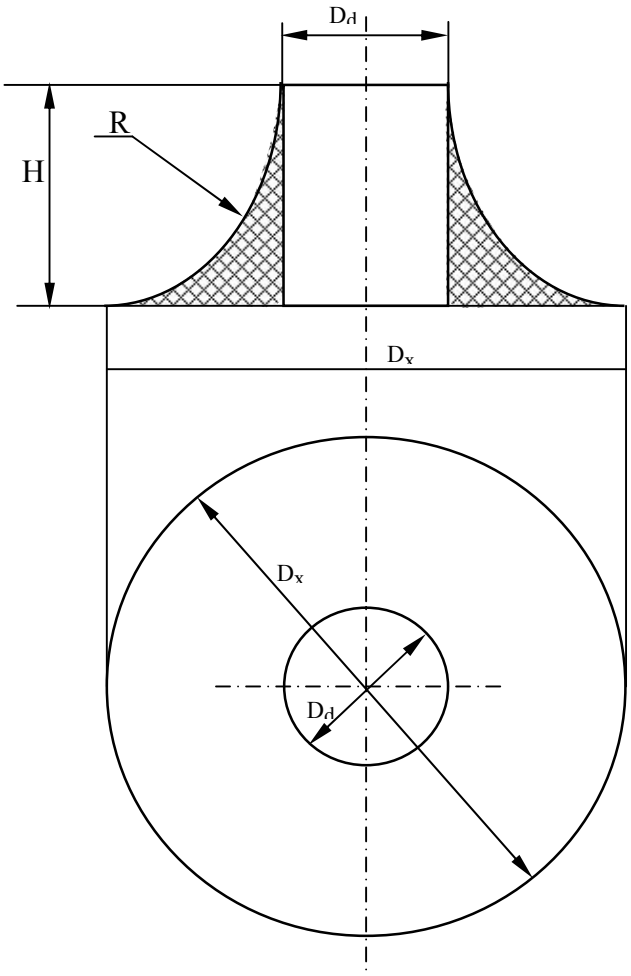
Plug valves used in the wellhead and Christmas tree equipment are working in very difficult conditions. Depending on the schemes of the Christmas tree and manifolds, they can make up a quantity in the Christmas tree 10 ÷ 12 pieces, and in the manifolds 15 ÷ 20 pieces and are considered from the most leading nodes [2,3,4,5,6].

For this reason, the efficiency of the Christmas tree and manifolds directly depends on the operability, durability and reliability of the plug valves.

In different types of plug valves, sealing elements are used for sealing between metal and metal surface, to prevent the contact between the plug and the hoops and to ensure the tightness of the plug in the socket. The listed conclusions prove that, sealing elements being one of the main elements of the cranes, has an irreplaceable role in ensuring its efficiency. Increasing the efficiency of the sealing elements will cause an increase in the efficiency of the whole plug crane.

Entering the class of cranes, plug cranes operating at low pressures (14-21MPa), easily manageable, their production by the technological reasons, a relatively cheaper costs, therefore using in the exploitation considered expedient.

But these cranes working at higher pressures 21MPa, riveted on the internal body of the socket and loses its efficiency. Provision of efficiency at higher pressures will increase the reliability of the design. Such a construction was introduced by us [1]. In this construction, the main task is to ensure the fit of the added V-shaped sealing element in the socket according to the required design parameters(pic.1).



Pic.1

There is also the important tasks are the inadmissibility of any "leakage" in the sealed zone, ensuring their durability, reliable operation, designing the required properties of the sealing element of the plug construction.

METHODOLOGY

In sealing systems, the main task is to determine the criteria, this choice of parameters that fulfill the required technical functions of the sealing parts. to obtain tightness of compounds, it is necessary to create a contact stress or deformation on the contact zone of the sealed two surroundings, from the metal zone, sealed by highly elastic materials. To create the required sealing characteristics (pressure, temperature, speed, etc.), it is necessary to create on the contact area between the elastic sealing materials such a level of deformation to keep the contact voltage at the required limit time and in the working process.

Here the first problem is the research of elasticity, and the second is the research of the stress relaxation process. The main direction of our task is to research the functional of the structure potential providing the required tasks. This functional - is the deformation of the potential energy of sealing materials, the determining structures of the material the additional energies and the "mixed" potentials, which depend on the boundary conditions during the structure sealing. This functional with the potential energy of the microstructure of the sealing material must be determined by the principle of variation by the Euler minimization condition. This approach to solving the problem leads to optimization problems, and in its turn, of course, are considered the main tasks of mechanics.

In general, expediently considered three approaches to sealing elements by the laws of mechanics:

1. Creation of models and properties of materials self-management

2.Development of calculation methods giving premature information during one or another load change in the properties of materials self-management.

3. The problem of synthesis.

After creating the model, processing universal calculation methods explaining the self-management of the mechanical system, we have the ability to solve the most practical problems that are listed below:

1. Determination of the parameters of the required properties on the basis of the received calculation method. Here we are talking about the passive management of the properties. Usually, in such a process management, it is planned to study the influence change of one or another constructive parameter.

2. Using elastic and highly elastic materials in the construction design, by the varying way these design parameters to determine the hermetic criteria. The created design must create loading of durable seal with an answer to different characteristics and different directions. Here an important task is installing of synthesis of the courbe tension by the contact surface (Sealing surface).

In mechanics, the volume of tasks optimization in synthesis problems is growing. And this means that the design must have compatibility requirements. (example, a given surface bend, tension diagram, strength, etc.). Compatibility is chosen according to the optimization criteria (minimum volume or maximum working time indicators)

Optimization tasks can be implemented in the case that found their solution in it all the requirements in a set of designs (is meant sealing units)or a combination of parameters. This method will be differ from other searching procedures when the element will satisfy the requirement of the criterion of extreme sealing. Here we note some notes in the way of an exact research of the criteria for solving problems. In the beginning we accept the criteria of durability in the optimization of hermetic nodes.

But unfortunately, it should be noted that the criterion of durability is the most difficult predictable criterion. From the point of view of the description of models that determine the physical essence of the compaction process, there are certain approaches, for example. This is the energy of deformation collected in the sealant, some of it is realized in the cyclic period for seals, for creating temperature and for the expense of destruction from run-out. When the design is simplified, if it is possible to linearize potential functionals, the calculation accuracy increases. The installed (written) model makes it possible to predict the critical situation by using summation over all cycles of destruction of the seals.

İt is also possible in calculating for more complex situations, assuming that this energy is spent on creating temperature, durability can be determined by empirical criteria. A similar kind of criterion (kind) can be called self-burning (heating) from a stationary temperature.

Bearing in mind the above we can write:

1. The synthesis task and the synthesis of seals according to the bends stresses of the contact surfaces.

2. Solution algorithm of the problem.

We determine such a sealant with the elasticity potential of the form Ω, that during compressing the sealant between rigid plates on contact surfaces, a contact voltage σ0 was formed. In order to considered after compression sealant form Ω, is connected with the fitting site.

$$\sigma_{\text{К}} = \sigma^{0}_{\text{П.Н.}} \quad \Omega = \Omega_{i+1} \quad \text{when}$$

$$\sigma_c^{i+1} = \sigma_{g0}^{i} + (\sigma_{com}^{i+1} - \sigma_{com})$$

σ_c- contact voltage, $\sigma_{p.t.}$ - primary tension, $i+1$ - compression step

RESULT

In the research work, designed and determined the scientific basics for the setting algorithm by the prediction of critical state of the sealing elements cranes failure during the exploitation.

DISCUSSION

All fields of the developing industry devote special attention to the prediction of equipment failures during exploitation. Sealing elements performing special duties in equipment designs play an important role in ensuring the durability of equipment. Thus, in the event of failure of the sealing elements, the reliability indicators of the equipment will be reduced. From this point of view, the research work is devoted to predicting the situation of sealing elements required properties of cranes included in the closing devices groups. Below given the algorithm:

$$\sigma_{\text{К}} = \sigma^{0}_{\text{П.Н.}} \quad \Omega = \Omega_{i+1} \quad \text{when}$$

$$\sigma_c^{i+1} = \sigma_{g0}^{i} + (\sigma_{com}^{i+1} - \sigma_{com})$$

σ_c- contact voltage, $\sigma_{p.t.}$ - primary tension, $i+1$ - compression step

The article was accomplished at the "Oil and gas equipment" department (protocol 09 from 28.04.2017)

CONCLUSION

1. Taking into account the required properties of new seal constructions during designing to improve the durability of the seal.
2. Design of a new model providing a predictive critical state of seal failure

$$\sigma_{\text{к}} = \sigma^{0}_{\text{п.н.}} \quad \Omega = \Omega_{i+1} \quad \text{when}$$

$$\sigma_c^{i+1} = \sigma_{g0}^{i} + (\sigma_{com}^{i+1} - \sigma_{com})$$

σ_c- contact voltage, $\sigma_{p.t.}$ - primary tension, $i+1$ - compression must respond conditions

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