

MODELLING OF GEOLOGICAL ENVIRONMENTAL EFFECT ON THE PIPELINE NATURE-TECHNICAL SYSTEMS IN THE DIFFERENT LANDSCAPE-CLIMATIC ZONES

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All pipelines are the Nature-technical systems. Their operation depends on geological conditions and geological environment.

The negative influence of the geological environment on trans-continental pipeline systems is well-known and obvious. Analyzing influence of the geological environment on the pipeline it is necessary to note that its destructive influence will substantially be neutralized at a stage of its design (an optimum choice of a line of the pipeline) and its construction (isolation, category of pipes, engineering modeling of slopes etc.). However at these stages it is impossible to assess the full influence (qualitative and quantitative) of these adverse natural factors. The extent and an orientation of influence of each of these factors can be determined only after complex prospecting and special engineering work.

In 'stationary' pipeline regimes the influence of the geological environment is minimized and has little impact on the safety and longevity of pipeline operation. However there is always the risk that the geological and landscape conditions behave in an un-controlled manner, with real threats of damage and destruction. Various additional works are carried out for research of these processes in trans-continental pipelines. They are: the diagnostic of their linear part, revealing of the negative processes, and inspection by complex technical analysis. These methods describe the serviceability of pipelines, their elements, the equipment and construction [1]. In most cases it helps to reveal the reasons for pipeline deformation, modelling extreme situations, by obtaining forecasts of the qualitative and quantitative characteristics of the geological environment and their influence on the pipeline. These forecasts are underpinned using mathematical models of stress and failure. An estimate of the influence of the geological environment, the factors and processes within that environment are made with reference to the dynamic balance of the nature-technical systems (NTS).

The main object of the research was to systemize these risks along the trans-continental pipelines in the different landscape-climatic zones.

The factors negatively influencing on the safe functioning of pipelines are:

- Presence of water-erosive processes within the limits of the pipelines connected with temporary and permanent streams.
- Presence of the perpetually frozen and seasonally frozen grounds and various cryogenic processes.
- Presence of the water-gravitational and gravitational processes connected with ruggedness of the relief.

- Tectonic processes in the different geological mediums.
- For this purpose the detailed analysis of landscape, climatic, geomorphological, lithological and geological factors of the pipeline area carried out [2]

Obtaining forecasts of the qualitative and quantitative characteristics of the geological environment and their influence on the pipeline are underpinned using mathematical models of stress and failure. An estimate of the influence of the geological environment, the factors and processes within that environment are made with reference to the dynamic balance of the nature-technical systems (NTS).

Numerical models were created to take into account the influence of streams, their effect on viscous and viscous-plastic mediums within geological environments, and subsequently on the pipeline. Estimation of the influence of various types of streams on pipelines, the program module calculates hydrodynamical load on its cross section, set within a stream of viscous and viscous-plastic mediums. Experimental and theoretical research have allowed solution of the levels hydrodynamical forces acting on a pipe, and determine the limiting critical loads.

One of the developed modules assumes an assessment of the influence of cryogenic processes on the pipeline complex. Estimation has been considered of the mechanical forces acting on the pipeline due to the freeze-thaw effects of the regime of grounds, especially the volumetric effects caused by these processes. From the research and the development of the program algorithm the main factors that result in loading on the pipeline are follows: a) the influence of gravitation forces on the pipeline (the weight of environment); b) the influence of the forces arising owing to volumetric expansion of the water-saturated environment during freezing; c) the influence of loads from pipeline warping; d) the influence of temperatures differences of the heated pipe and its environment; e) the influence of internal pressure of gas in a pipe.

Application of these modules integrated in pipeline GIS will allow to carry out operative calculations of the stress-strain state of the transpipeline system, to minimize the risks of non-controlled behavior of such systems. It also creates preconditions for predictive measures for the safe operation of pipelines.