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Research paper

The Pressure Quantity Prognosing at the Salts and Clay Disclosure on the Casing Column

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Abstract

The stages of the fastening interaction with the breed in time are considered, based on new ideas about the interaction of rigid fastening with a dissected inelastic deformed rock whose volume is limited to the reduced pressures region and which falls to the overlap under unbalanced conditions. The method of durability determination at single-compression compression depending on the seam is developed. On the basis of research on the rock salt creep at various stresses at the stage of established creep, a dependence of the density change as a function of the velocity of creep is obtained. The experimental results of determining the salt rocks strength, depending on the velocity of their inelastic deformation, are confirmed by the practical calculations of the casing interaction with the attachment of sections of bischofite, galite and haloperitone.

***Keywords**: pressure, casing, salt rock.*

1. Introduction

The quality of oil and gas deposits exploration is by the quality of drilling largely determined, development and oil and gas wells operation. In connection with the need for the development of deposits, the urgency of the problem is often ensured by studies inelastically deformed strains of salt rocks, which eventually change their physical properties and significantly affect on the breed roughness. Rocks stability maintenance with change in time and occurring in rocks processes investigation at the stage of established creep taking into various compressions with accounting dissolution, is a very actual task.

Based on new representations about the interaction of a rigid fixing with a dissected inelastic deformed rock, the volume of which is limited by reduced pressures region and which falls to the overlap in conditions of unbalanced state, the stages of fastening interaction with the breed in time are consider. The effect of hydrostatic pressure on the column in this work is not carried out.

2. Analysis of recent research and publications

To date, researchers, solving the contact problem of the interaction of the pipe with the rock, consider the properties of the rock unchanged and focus on possible load patterns. In the calculation of the uneven loading under contact interaction, the strength properties of the pipe and the rock in the state of elastic interaction are taken into account.

However, the experimental studies of inelastic-deformed salt rocks indicate the change in their physical properties. The question arises as to the effect of dissipation on power breed possibilities in contact interaction.

Methods of measuring the strength of solids in the process of inelastic deformation does not exist at all.

3. Formulating the goals of the article

The task of prognostication pressure on the column is to determine the rock pressure at any given time. The pressure and the time of it's change are unknown. But the experimental dependences tensile strength of uniaxial compression of the time resistance deformation rate are known σ_v = f(v) from density σ = f(p) and density from the deformation velocity p = f(v) and the salt rock density from the deformation rate, as well as the physical mechanism of processes and changing forces rock capabilities in the reduced stresses region created by the formation of reference pressure over the reduced pressures zone.

4. The main research material

Model of pressure development on inelastically deformed column of over-compacted around a well array of rocks (salts, clay) is shown on figure 1:

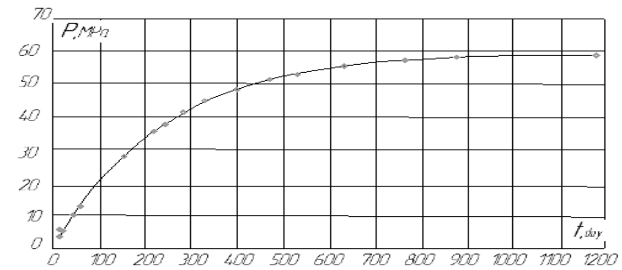
t_o-t_i - period of time, from the end of the column downhill to the WOC of the tamponal material in the tube space in the fluid rocks range;

t_1-t_2 - the time at which the decompressed rock volume is compressed to a volume with an initial density before the formation disclosure;

t_2 - time moment where the pressure on the column reaches σ_c temporary resistance of the uniaxial rock compression

t_2-t_3 - time of rock pressure change from σ_c by geostatic pressure P_g.

Based on the dependence $\sigma_v = f(v)$, the pressure on the column determine at the time moment t_1-t_2. Functional dependence of the pressure increase in period from 0 to t_1 to determine in the present



time there is no possibility, but insignificant also for the pressure restoration on the column dependence determining.

Pressure on the column at the moment t_1 does not depend on geostatic pressure and by the uneven loading pattern was determined, where the salt pressure in contact with the pipe is equal to the strength σ_v decompressed inelastically deformed rock and dependence determined $\sigma_v = f(v)$

Dependence $\rho = f(v)$ allows to determine the salts dissolution degree.

In the period of time t_1-t_2 increase the rock pressure on the column in the interacting deformation mode, the above-occurring rocks compatible deformation (subsidence) and the consolidation of dissected rocks in a closed volume, with the at interaction of which creeping rocks create support, transferring part of the loading on the column.

We evaluate the pressure at time t_2. The pressure at full sealing and reaching the breed of the strength limit does not exceed 38-40% of the above-occurring rocks weight of, which falls on the thawing zone.

In the time period t_1-t_2 the connection of the depth with pressure on the column is in general irrelevant and is determined by the compression of the dissected zone under the action of a "given" load, the pressure on the mount, created by the weight of the rocks of some volume, located above the decomposed rock [2].

In the period of time t_2-t_3 goes further development of deformation processes the above lying rocks, and the pressure on the column is determined by an increase the transfer of rock weight to densified salt rocks. At this time, the speed of the growth of pressure significantly depends on the depth and properties of the above lying rocks and does not depend on the parameters and properties of creeping rocks.

Thus, the presence of strong layers, for example, sandstone, can increase the time t_2-t_3 in 3 times compared to soft rocks, for example, with clay and salts.

In the absence of direct instrumental pressure measurements on a column in salt rocks for prediction of pressure-time dependence, dynamometric measurements of pressure on a column in creeping clays were used.

The pressure was determined as an average of 11 pressure sensors [3]. Fig.2 – geostatic pressure 2,633 MPa, depth 142.6 m, average density of above lying rocks 1847 kg /m^3, time of experiment 658 days.

A similar dependence is found for mines. In Fig. 3 the results of the increase in pressure in the coal bed material are determined, by means of the reduction of the 17 pressure distribution curves. These measurements are taken from work [1]. Curve 1 is based on pressure measurements for 12 months at a pressure of 50.7 MPa, which is equivalent to a depth of 2024 m with a density of 2300 kg /m^3.

The impact of the consolidation of the array is clearly visible. The greater the seal, the greater the resistance is made by the breed, the faster the pressure drops. The breed works like a paddle mount.

With time the curve moves upward, taking into account pressure at time t_1, curve 2.

The type of dependencies in Fig. 2 and Fig. 3 coincides with the temporary model of pressure development in Fig. 1.

In the first approximation, to determine the pressure of the salt and clay deposits on the mount at any time, it is possible to use the approximating function

$$\frac{Pt}{Pg} = \alpha \exp(-\beta^{\exp(-kt^{\gamma})}), \qquad (1)$$

where Pt - pressure at the given time, MPa; Pg - geostatic pressure, MPa; t - time, days; α = 1.0, ß = 5, 855; k = 0.555; γ = 0.49696, established by extrapolation of the curve in Fig. 2 in relative units of pressure to the geostatic.

An example of the expected increase in pressure on a column for potassium-magnesium salt is given in Fig. 4.

On the basis of the laboratory of the department of technology building designs, products and materials of Poltava National Technical Yuri Kondratyuk University, laboratory studies were carried out on vibrations of soilcement. In laboratory studies of soilcement vibration there was used shallow loam and quartz small, uniform sand. There was used portland cement of PC-II / B-W-400 and hydro-carbonate-calcium, slightly alkaline water with pH = 8 the content of portland cement was 20% from the weight of dry soil. Shallow loam soilcement was prepared by parties of mix cement ratio W/C = 1,5; 1,75 and 2,1. Sandy soilcement had W/C = 1,75 and 2,1. Samples of soilcement were formed in special metal cubic forms with dimensions grane of 100 mm, then the forms with soilcement were weighed. To create a reserve of liquid soilcement added to form a nozzle height of 50 mm. Vibrate samples in the form of a nozzle were performed on standard laboratory vibration stand at a frequency of oscillation n = 50 Hz and amplitude fluctuations under load A = 0,5 mm. After vibrating the nozzle was removed, and the remains of soilcement were cut in such form (Figure 1).

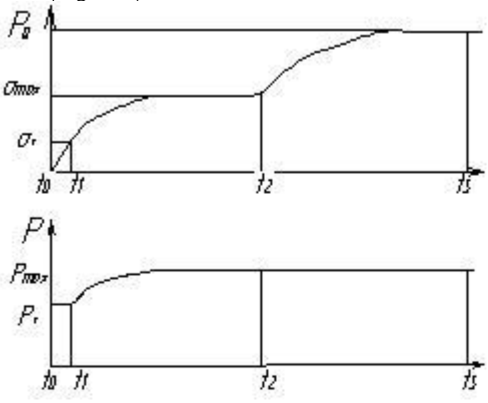


Fig. 1: Model of the development of pressure on the column of the casing-pipes inelastically deformed rozvedlennennom near stem rock mass

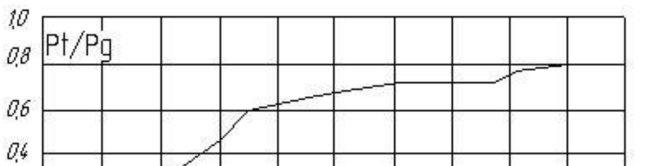
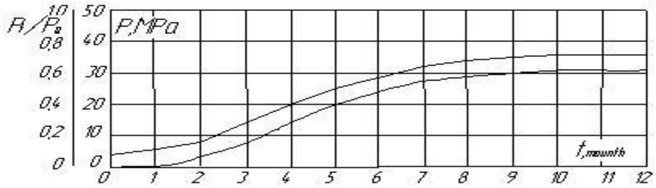


Fig. 2: Curve of creeping pressure of creeping clay on casing in time according to dynamometric measurements (pressure in relative units)



Upper curve - increase in mountain pressure;lower curve - increase ratio Pt / Pg.

Fig. 3: The curve of increasing pressure over time on a fluid reservoir in a closed volume after dissolution under geostatic pressure Pg = 50.7 MPa at a depth H = 2204 m

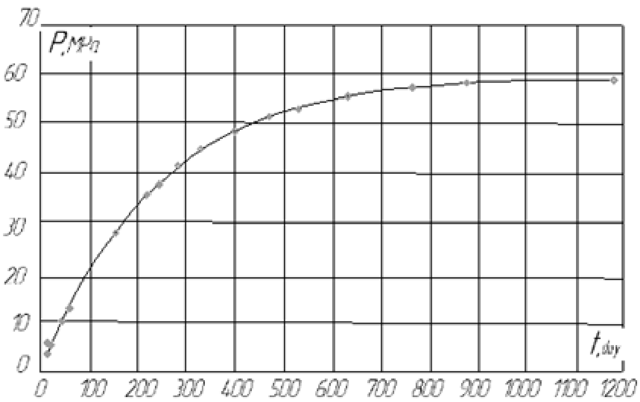


Fig. 4: Curve of the pressure of bischofite on the casing in time at a depth of 2600 m. Geostatic pressure Pg = 60 MPa

We have developed a method for determining the strength of a single-compression compression, depending on the velocity of inelastic deformation in the stage of established creep at different inelastic states, taking into account dissolution. As a result of numerous studies of rock salt creep at different voltages from 0.05 σs to 0.7 σs and measurements of it's density in the stage of established creep, the dependence of the density change as a function of the creep rate p = f (v) was obtained (Fig. 5).

Investigating the density at any given moment of the established creep at a given voltage, it was established that the density during the established creep is a constant value. When testing the samples on a uniaxial compression with a known density, the dependence of the strength was determined on a one-and-one compression as a function of density σ = f {p) (Fig. 6).

Having determined that there is no change in density at a steady rate of creep, they switched to the dependence $\sigma_v = f(v)$ (Fig. 7).

The dependence of $\sigma_v = f(v)$ correlates the strength and rheological parameters of the salt with the loading conditions and, obviously, is a passport characteristic of the rock strength at the inelastic deformation stage, depending on the deformation velocity.

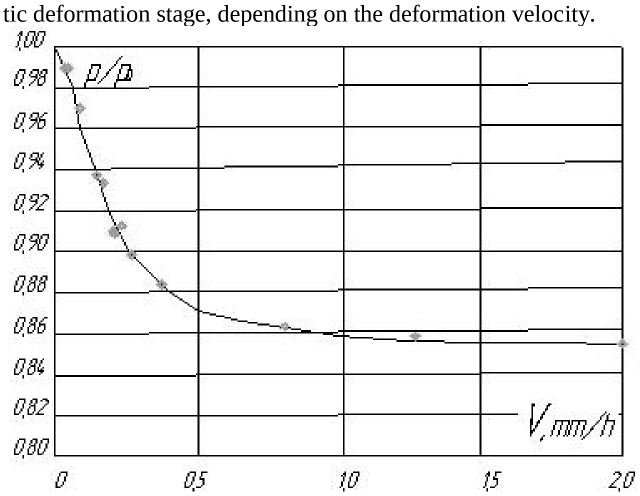


Fig. 5: The dependence of rock salt density from the deformation rate

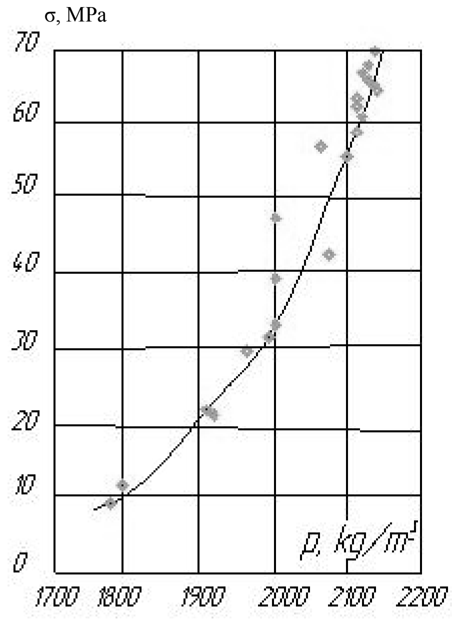


Fig. 6: Dependence of the strength limit of rock salt under one-piece compression from it's density

As can be seen from Fig. 7, the temporal resistance to uniaxial compression of rock salt at the rate of inelastic deformation, for example, 0.2 mm / h, is reduced by 40% from it's initial value in it's natural state.

That is, in the calculations of the problem of contact interaction of a pipe with a galite, instead of σ_c = 60-70 MPa, it is necessary to apply σ_c = 0,6 (60-70) MPa.

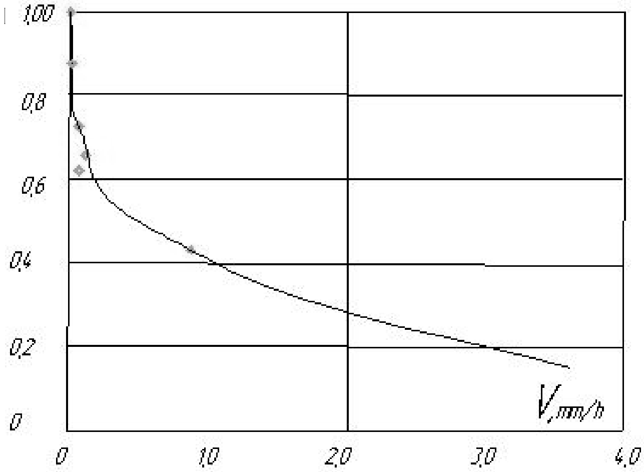


Fig. 7: Dependence of rock salt strength at uniaxial compression from the rate of deformation

The method is valid for other salt species, for example bischofite.

The results of salt rock strength determination, depending on the velocity of inelastic deformation, are confirmed by the practical calculations of the interaction of 245 mm casing columns when fastening sections of bischofite, galite and haloperite.

5. Conclusions

A method for determining the strength at a uniaxial compression is developed, depending on the velocity of inelastic deformation in the established creep stage at various stressed states, taking into account desealing.

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