On Effective Porosity Diagnostics Of Rock Salt

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1. INTRODUCTION

The permeability is function of parameters, among which the efficient porosity (EP):

$K = (mr^2/K_f)\ (L/L_a)^2$, where m is the effective porosity

It is clear, that the definition of the EP is the actual task. As rock salt is an underground storage building material, the EP of rock salt samples was investigated and the methodical problems concerning samples preparation for testing were considered.

2. EXPERIMENTS

Saturation by kerosene was carried out in vacuurn and at air pressure.

The structure of crack-pore space was studied by impregnating samples with a saturated solution a dye "Nigrozine" in absolute ethanol. The microstructure of impregnated salt was studied with microscope at magnifications from 12x up to 42x. The amount of dye penetrated in salt depth was determined by taking salt samples on different distances from the centre of the specimens. After that extraction of dye from drilled salt was carried out using ethanol. The extracts were analysed on UV-VIS spectrophotometer, Specord, at frequency corresponding to the absorption maximum of the dye.

3. RESULTS AND DISCUSSION

The painted sites had intensive blue-violet colour. In common the observable picture of dye distribution in salt is reduced to the following:

- Not continuous, but fragmentary painting of samples takes place, and the main contact surfaces of grains are dyeing throughout, however channels, through which the dye solution moved to contact surfaces, are not observed;
- Maximal dyeing is observed near laterel areas of the samples;
- dyeing of isolated surfaces of grains contacts is frequently observed, as the adjacent contact surfaces and points where they meet, are not dyed throughout.

Table 1 : Data on Rossoshinskaya square rock salt samples

No sample	ρ, g/cm^3	m_{init}, %	m_σ %	Depth, m	Optic.density ethanol extract
60-1	2,150	0,361	0,200[a]	1201	0,060
13-2	2,130	0,793	0,707	1156	0,113
13-1	2,141	0,581	0,676 [b]	1156	0,125
142-2	2,134	0,373	0,697 [b]	1323	0,137
189-1	2,107	0,636	0,986 [b]	1367	0,200
247	2,077	0,868	1,443 [b]	1450	0,238
138-2	2,085	1,202	1,703 [b]	1319	0,324
141-1	2,140	1,202	1, 1 72[a]	1322	0,082
141-2	2,160	0,446	0,540[a]	1322	0,075
188-2	2,160	1,429	1,378[a]	1366	0,125

a - three dimensional compression
b ~ axial compression

Table 2: The influence the outer layer on the magnitude of the measured effective porosity

No sample	Initial diam, mm	EP %	Final diam, mm	EP %
7212	36,85	0,338	31,45	0,008
192	36,80	1,245	30,80	0,306
6912	36,80	0,166	29,75	0,006

In table 1, one can see that the optical densities of the ethanol extracts vary from sample to sample and corresponds to the measured earlier magnitudes EP. It is interesting to note that the observable correspondence does not depend on depth, from which the sample was taken nor its lithology.The evaluation of influence of a disturbed salt layer on magnitude of the calculated EP was carried out also by direct measurements of the amount absorbed hexadecane in vacuum of untreated rock salt samples and the same samples after removal of an exterior salt layer by means of dissolution. The outcomes of measurements and calculations are given in table 2.
Thus, supposition about the influence of a disturbed salt layer on outside of a sample on the EP magnitude is confirmed by direct experiments.
The influence of preliminary endurance of rock salt samples in a saturated NaCl solution on the measured optical density magnitude of ethanol extracts was investigated by light absorption comparison for identical specimens of the first and second series. The spectral absorption measurements have shown that in the samples from a NaCl saturated solution open pores and cracks are overgrown with salt crystals, though this effect is unequal for different samples. So, for specimens 189-1 and 13-1 the EP magnitude decreases with a factor two, but for the samples 142-2 and 13-2 these effects are noticeably smaller (a decrease by a factor 1.5 and 1.2 respectively).

4 . CONCLUSION

Thus, to our opinion, samples must have such a size (diameter) that the influence of the outer layer on the EP is negligible. Our experiments showed that the minimal diameter of rock salt samples must be more 50 mm.