Studies Of Rock Salt Microstructure In Three Areas Of Russia

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When analyzing the current status of research into rock salt microstructure, it becomes obvious that such studies are fragmental to date and are mainly focused on its implications for rock strength and deformation parameters. At the same time, information is still missing on microstructure relation to rock salt dissolution and permeability. Only a single paper has addressed microporosity impacts on dissolution rate so far.[1]

These reasons attach topical importance to detailed, and systematic, studies of rock salt microstructure in various areas. In this study an attempt was made to generalize and order rock salt microstructure elements and defects in three salt areas – Romanov, Rossoshin and Tereklinsk.

Neophot-2 microscope was employed for sample observations using bright and dark-field photomicrography, and magnification was in the 100X – 250X range in the majority of cases.

It was shown that all studied areas feature basically similar salt elements and defects. Besides, it was found that various microstructure implications were virtually independent of a particular lithological group to which salt samples apply.

We focused attention in this study on morphological features of rock salt microstructure, bearing in mind to provide, at a later phase, the quantitative assessment of microstructure defect implications for physical and chemical properties of salt – addressed as a construction material (bedrock environment). For this reason hereinafter we provide main microstructure characteristics which can be evaluated using microscope, as well as parameters useful for estimates in quantity terms such as:

– natural and technology-caused (technogenic) cracks (their length and opening are measured together with their presence per unit of surface – as attribute of effective porosity); – mutual grain texturing that could be easily identified from etched image (notably, sub-grains, unlike grains, feature similar patterns); – inter-grain contact planes (they could be observed for transparent grains, easily identifiable at contact boundaries for different grains, and can be addressed in connection with grain cohesion); – opacity zones observed in transparent grains (opacity origins are of definite theoretical interest); – mineral impurities (of special interest is comparison of different rock salt samples where impurities are uniformly dispersed in salt volume and do not lead to emergence of individual mineral forms and samples, where their own mineral skeleton comprising insoluble or poorly soluble impurities is formed in rock salt; the same relates to samples where mineral inclusions are held in pores, caverns and within grain boundaries).

The all structural microdefects were identified and illustrated (fig.1 for example).

Special importance should be attached to study of rock salt micro-cracking as a parameter driving main salt characteristics – effective porosity (EP) and permeability – impacting losses of stored products kept in underground storage and its environmental performance.

To our opinion, growth of EP under load is consequence, rather than microcrack elongation and spreading, of numerous other factors:

– emergence of open "technology-caused" cracks extending into a sample from its surface;

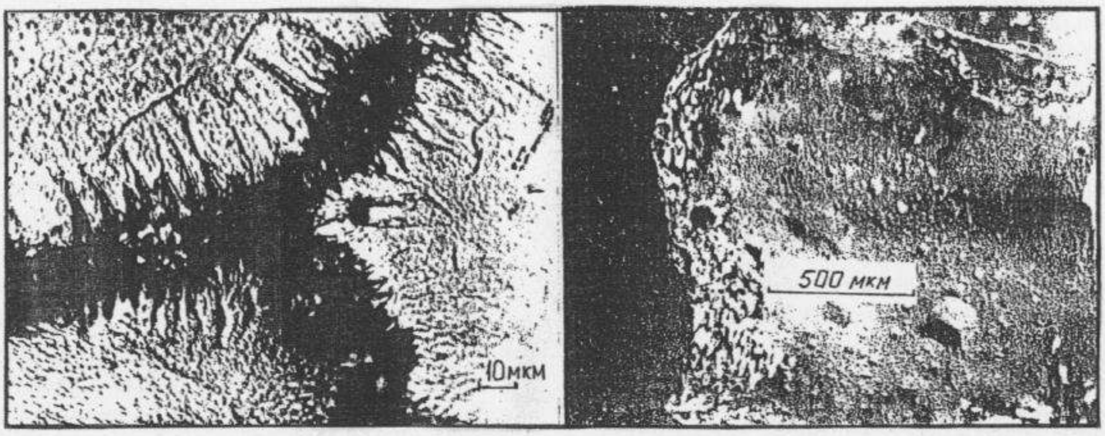
– opening up caverns and isolated pores when transversed by enlarging cracks;

– boundaries between grains (width and spread under load and after loading); – boundaries between sub-grains (longitudinal and transverse sub-grain sizes are measured to plot distribution bar charts); – micropores (pore diameters and depths are measured and then the total pore volume in predefined salt space is calculated to compare this total pore volume with dissolving rate); – caverns or hidden cavities (depth and transverse measurements, cavern volume should be also added to pore volume to evaluate total porosity);

– emergence of additional microcracks on halite grains (crystals) boundaries;

– expansion of intergrain intervals.

Comparisons made by us between experimental EP data for Rossoshin rock salt samples, both prior to and after loading, and surface microcrack measurements obtained, have led to conclusion that expansion of grain intervals appears to be the main contributor to open porosity increases.



a b

Fig.1.Microfotos of rock salt: a) rock salt - feather highly large-grained. Rossoshinskaya square. Depth 1212,6-1213,0 m. Boundaries of three grains, widened after one-dimensional load (σ = 23,8 Mpa during 2 hours) . You can see numerous microcracks on the grains periphery.
b) rock salt - feather large-grained. Rossoshinskaya square. Depth 1322,9-1323,1 m. Contact surface of three grains. On the left is the transparent grain without defects (black). On the right is the defect grain surface , covered with pores, crystals and impurities, observed through transparent halite grain (gray). Between these grains you can see contact surface at angle with respect to exposure plane. This surface is covered by white twisty figures (outcome of impurities on surface) on the black background of pure salt.

References

.Kazaryan V.A., Zybinov I.I., Kotov A.V. SMRI Spring Meet. Krakov, 1997, pp.271-277.