the applicability of the Weibull distribution is analyzed for the fracture of specimens of the final dimensions; and,

a comparison is made between the experimental results and theoretical fragment size distribution curves of a fractured specimen in the hydrodynamic theory of fracture.

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LITERATURE CITED


METHODS FOR PREVENTION OF FORMATION SILTING WITH FINELY DISPERSED CLAY PARTICLES DURING GEOTECHNICAL OPERATIONS

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Geotechnical processes are often complicated by solid-phase silting of the formation from migrating finely dispersed clay particle flows. They are generated in formation waters as a result of physical erosion of clay interlayers by the percolating flow and underground lixiviation of the rock that contains components insoluble in the leaching agent.

In the first case an effective method preventing solid-phase silting is to stabilize the clay interlayers by chemical agents. Solutions of organic cation polymers [1] or organo-silicic compounds [2] are recommended for this purpose.

However, this method is unusable when the geotechnical process involves decomposition of rocks by chemical agents and evolution of an insoluble finely dispersed residue. For example, an acid treatment of clay carbonate beds brings soluble carbonates into the filtration flow, while the insoluble residue silts the mass transfer surface. The amount of insoluble residue silting the bed was estimated from data on acid treatment of low-permeability sulfur rocks in Zagaipol authigenic sulfur deposit.

The sulfur ore of this formation consists mainly of sulfur, calcium carbonate, and insoluble clay inclusions. It was treated with a hydrochloric acid solution fed through injection wells. The productive solution was removed through drain wells. The carbonate component of the ore was decomposed in the course of the reaction. The calcium chloride formed as a result passed into the solution. A portion of the insoluble residue in a suspended state was removed by the filtration flow. The remainder settled in the bed, silting the mass transfer surfaces. The data from analysis of production solutions from acid treatment are plotted in Fig. 1, representing the relation C1 = f(C2) (where C1 is the concentration of calcium ions in the solution and C2 is the concentration of suspended ions). The C1/C2 ratio characterizes the proportion of suspended material brought out of the bed by the filtration flow. It should be independent of the degree of dilution of the production solutions by formation waters. This principle was tested by measuring the linearization of the relation plotted in Fig. 1. The calculations were performed with BMDPIR "Multiple Linear Regression" Sulfur Research Institute, Lvov. Translated from Fiziko-Tekhnicheskie Problemy Razrabotki Polezykh Iskopаемых, No. 1, pp. 57-61, January-February, 1991. Original article submitted March 20, 1990.

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OMI application software on an ES-1035 computer [3]. The sample correlation coefficient (0.9077) was less than the critical value at a significance level of 1% (0.684 [4]). Thus, the calculated linear regression coefficients (A = 0.369) could be used to estimate the percentage content of the insoluble residue remaining in the formation and silting the mass transfer surfaces according to:

\[ \langle n \rangle = \frac{\langle N_p \rangle - A \langle N_k \rangle}{\langle N_p \rangle}, \]

where \( \langle n \rangle \) is the percentage content of the insoluble residue remaining in the bed, \( \langle N_p \rangle \) is the average content of the insoluble residue in the one (according to [5] \( \langle N_p \rangle = 3.2\% \)); \( \langle N_k \rangle \) is C\( ^{2+} \) content in the ore (in \( \langle N_k \rangle = 26.8\% \) [5]); \( \langle N_k \rangle \) is the content of insoluble residue in suspended matter according to chemical analysis.

The value of \( \langle n \rangle \) calculated from this expression was 50.3%.

More than a half of all insoluble residue released by the chemical reactions is retained in the formation and silts the exchange surface. It can be removed from the bed by chemical and physicochemical techniques.

Chemical methods are commonly used to prevent this silting: Additives are introduced into the acids to dissolve the insoluble particles. These additives include hydrofluoric acid [6] or other HF carriers (ammonium bifluoride), which dissolve clay minerals and hydromica minerals. However, when HF is introduced to dissolve the material that silts the bed, hydrofluoric acid salts may be formed which are insoluble and precipitate as a solid residue.

A study of interactions of acid compositions with argillite - the main impurity that causes the silting of beds represented by monomineral (quartzose) sandstones [8] - has established that at a low hydrochloric acid concentration in the mud acid (HCl + HF mixture), the weight of secondary neomorph exceeds the weight of material brought into the solution after a certain period of time. When a mud acid with HCl > 10% is used, secondary sediment formation is contained while the high dissolving power of the solution is preserved.

To study the possible application of ammonium bifluoride (ABF) to decompose the insoluble residue of hydrochloric acid treatment of sulfur ore, experiments were organized according to the following procedure. The open surface of a core with an equal area in all tests (63.5 cm\(^2\)) was treated by acid compositions which consisted of 10% hydrochloric acid solution and ABF additives in amounts of 1, 3, and 5%. The reaction solutions were not agitated so as to reproduce the "acid bath" conditions - the acid treatment used in practice. The variation kinetics of Ca\( ^{2+} \) ion concentration in the solution at initial ABF concentrations is illustrated by Fig. 2: 0% - 1; 1% - 2; 3% - 3; 5% - and 4. The data indicate that for 10% hydrochloric acid solution and an acid composition with ABF content of 1%, a monotonic rise of Ca\( ^{2+} \) concentration is observed during the entire process, although in the second case this growth is less intense. For compositions with ABF content of 3-5%, Ca\( ^{2+} \) concentration increases in the solution to a certain maximum, after which it gradually declines. This behavior of the curves is explained by the formation of secondary insoluble substances that bind Ca\( ^{2+} \) ions. As the process advances, insoluble particles settle on mass transfer surfaces and