CAVITATION PROCESSES IN WELL DRILLING

FEMIAK Yaroslav[1] & FEDYK Ostap[2]
[1]Ivano-Frankivsk National Technical University of Oil and Gas, Ivano-Frankivsk, Ukraine
[2]Drohobych College of Oil and Gas, Drohobych, Ukraine

Purpose. Studies of energy distribution at different frequency ranges in the process of propagation of cavitation-pulsation action on an array of rocks found that the maximum value of energy is realized at the pulse repetition frequency and the more pronounced the more cavitation bubbles.

Methodology. We have formalized the general problem, which is reduced to the choice of technological solutions to intensify the destruction of rock, taking into account the frequency distribution of energy from the peeling of cavitation bubbles at the bottom of the well.

Findings. In addition, as the number of bubbles in the cavitation pulp increases, there is some shift in the resonant frequency of the maximum energy transmitted to the rock mass in the direction of decreasing the frequency. The established pattern is observed at other distances from the source of cavitation perturbation of the flow.

The optimal sizes of cavitation bubbles as the main optimization parameter were experimentally established. Graphical dependences are constructed, which allow to estimate the growth of the sizes of cavitation bubbles from the change of pressure difference and the density of the washing liquid, as well as the ratio of the sizes of the cavitator nozzles. It is determined that the optimal pressure drop for flushing fluids is the limit from 4 to 4.5 MPa, the ratio of the diameters of the nozzles of the cavitator should not exceed 1.67, because there will be a rupture of fluid flows with internal hydraulic shock. The possibility of cavitation destruction has been experimentally confirmed on the example of such rock samples as sandstone, limestone, dolomite and marble. The obtained results have a clear practical significance, which lay in the development of methods for practical calculation of cavitation-pulsation optimization, which is to substantiate the influence of design parameters of pulsating devices on the formation of cavitation processes during drilling and recommendations for improving the drilling tool.

They contain the researches, which were conducted within program IFNTUNG “Scientific and organizational principles of building domestic oil and gas production and diversification of energy supply resources to increase energy Security of Ukraine”.

Key words: drilling tool, cavitation-pulsation mode, cavitation bubble

References

1. Femyak, Y.M., Fedoriv, V.V., & Marynchak, R.O. (2020). Petrophysical determination model of the collector points by the gamma-gamma-density results and gama-spetkrometric // International Scientific Conference “Geoinformatics 2020”. 11– 14 May 2020, Kyiv, Ukraine.

2. Fedoriv, V., Bagriy, S., Piatkovska, I., Femyak, Y., Trubenko, A. (2019). Petrophysic model for determin clayness of rocks by the results of complex geophysical researches. Geoinformatics – 13-16 May 2019. – Ukraine. – Kyiv.

3. Фем'як, Я.М., Фем'як, В.Я. (2016). Буріння свердловин з використанням кавітаційно-пульсаційного промивання їх вибоїв. Сборник научных трудов SWorld: международное периодическое научное издание, 2(2(5)), 36-40.

4. Фем'як, Я.М. (2018). Кавітаційно-пульсаційні процеси в інструментах для буріння свердловин. International periodic scientific journal: Modern engineering and innovative technoloies (Germany). 3(1), 135-138.

5. Фем'як, Я.М. (2020). Прогнозування кавітаційних режимів течії бурового розчину на основі нелінійних коливань кавітаційного пухирця. Organization of scientific research in modern conditions '2020: conference proceedings. – Seattle: (May 14-15): KindleDP, 649 p.

6. Grydzhuk, J., Chudyk, I., Velychkovych, A., & Andrusyak, A. (2019). Analytical estimation of inertial properties of the curved rotating section in a drill string. Eastern-European Journal of Enterprise Technologies, 1(7 (97)), 6–14. https://doi.org/10.15587/1729-4061.2019.154827

7. Vytyaz, O., Chudyk, I., & Mykhailiuk, V. (2015). Study of the effects of drilling string eccentricity in the borehole on the quality of its cleaning. New Developments in Mining Engineering 2015, 591-595. https://doi.org/10.1201/b19901-102

8. Chudyk, I., Poberezhny, L., Hrysanchuk, A., & Poberezhna, L. (2019). Corrosion of drill pipes in high mineralized produced waters. Procedia Structural Integrity, (16), 260-264. https://doi.org/10.1016/j.prostr.2019.07.050

9. Poberezhny, L., Chudyk, I., Hrytsanchuk, A., Mandryk, O., Kalyn, T., Hrytsuliak, H., Yakymechko, Y. (2020). Influence of Hydrate Formation and Concentration of Salts on the Corrosion of Steel 20 Pipelines // Management Systems in Production Engineering, 28(3), 141-147.

10. Ratov B.T., Fedorov B.V., Sudakov A.K., Taibergenova I., Kozbakarova S.M. (2021). Specific features of drilling mode with extendable working elements. E3S Web of Conferences 230, 01013. https://doi.org/10.1051/e3sconf/202123001013

11. Kozhevnykov, A. O., Dreus, A. Y., Baochang, L., & Sudakov, A. K. (2018). Drilling fluid circulation rate influence on the contact temperature during borehole drilling. Scientific Bulletin of National Mining University, 1, 35-42. https://doi.org/10.29202/nvngu/2018-1/14

12. Davydenko, A. N., Kamyshatsky, A. F., & Sudakov, A. K. (2015). Innovative Technology for Preparing Washing Liquid in the Course of Drilling. Science and Innovation, 11(5), 5-13. https://doi.org/10.15407/scine11.05.005

13. Судаков, А.К., Ратов, Б.Т., Хоменко, В.Л., Муратова, С.К., Судакова, Д.А., Омирзакова, Э.Ж. (2019). Освоение, эксплуатация и ремонт буровых скважин на жидкие и газообразные полезные ископаемые. Монография. Министерства образования и науки Республики Казахстан, Каспийский общественный университет, 454 с.

14. Dreus, A., Kozhevnikov, A., Lysenko, K., & Sudakov, A. (2016). Investigation of heating of the drilling bits and definition of the energy efficient drilling modes. Eastern-European Journal of Enterprise Technologies, 3(7(81)), 41. https://doi.org/10.15587/1729-4061.2016.71995

15. Dreus A.J., Sudakov A.K., Kozhevnikov A.A., Vahalin J.M.(2016). Study on thermal strength reduction of rock formation in the diamond core drilling process using pulse flushing mode. Naukovyi Visnyk Natsionalnoho Hirnychoho Universytetu, (3), 5-9.

16. Dzyubyk, A., Sudakov, A., Dzyubyk, L., Sudakova, D. (2019). Ensuring the specified position of multisupport rotating units when dressing mineral resources / Mining of Mineral Deposits, 13(4), 91-98. https://doi.org/10.33271/mining13.04.091

17. Bulat, A., Blyuss, B., Dreus, A., Liu, B., Dziuba S. (2019) Modelling of deep wells thermal modes, Min. miner. depos., 13(1):58-65. . https://doi.org/10.33271/mining13.01.058

ANALYSIS OF MANGANESE DISTRIBUTION OF COAL SEAM C_5 OF "BLAHODATNA" MINE FIELD

ISHKOV Valerii[1]

[1]Dnipro University of Technology, Dnipro, Ukraine

Purpose. Study of the spatial distribution of manganese in the coal seam c_5 of the "Blagodatna" mine field and the establishment of relationship between its content and the main technological parameters of coal in the region.

Methodology. For the purpose of determine the composition of geochemical associations, correlation coefficients (r) between toxic and potentially toxic elements contents were calculated. Elements in which the relationship between the content is described by a correlation coefficient exceeding 0.5 with a significance level of at least 95% were combined into a single geochemical association. During the calculation of correlation coefficients, all values of manganese concentrations were normalized.

Findings. In the c_5 coal seam of the "Blagodatna" mine field the concentration of manganese changes in the range from 56.2 g / t to 157.3 g / t. The average value of the coal seam is 79.6 g / t. The accumulation of manganese does not depend on the depth, ash content and total sulfur content. Regionally the concentration of manganese in the coal seam c_5 increases in the northern, northeastern directions.

There is a high inverse correlation between the manganese content and the thickness of the coal seam (r = -0.764), a weak direct relationship with the ash content of coal (r = 0.45), a direct very weak relationship with the total sulfur content (r = 0.191) and inverse with the depth of the sole of the coal seam (r = -0.099). Linear regression equations:

$$Mn = 0,4473-0,4497 \times m; \qquad Mn = 0,123+0,3925 \times A^d;$$

$$Mn = 0,1796+0,1663 \times S_{total}; \qquad Mn = 0,252-0,0594 \times h$$

Based on the obtained results of statistical processing of geochemical information and analysis of constructed maps, as well as the conclusions of previous works, it can be assumed that the accumulation of the main part of manganese is primarily the demolition of its main part from the Ukrainian crystal shield in the central part of Donbas.

Key words: mine field, correlation, manganese, coal seam