

The Effect of Geological Factor in Penetration Rate in Core Drilling

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Abstract

Core drilling is one of the most important processes in geotechnical and mining projects, and accurate of the factors affecting its efficiency is importance role in advancing the project. In this study, the effect of geological factors of Nakhlak mine samples has been investigated and their effect on drilling penetration rate has been evaluated. According to the researches on four rock types from Nakhlak mine, about 35 thousand meters of core drilling, it has been determined that by reducing sorting (well grading), unite weight and rock engineering properties (strength, durability, Seismic waves velocity ...) increase and the amount of porosity and water absorption decreases. This causes the decrease penetration rate of rocks. The amount of quartz mineral in the rock is also an important factor in reducing the penetration rate. Dolomitic matrix of rocks can increase porosity and penetration rate. One of the most important factors affecting on penetration rate in rock mass is the density of joints and RQD. The results show that the penetration rate increase as 160% in exchange RQD index from 60% to 80%.

Keywords: *Core drilling, Penetration rate, RQD, Sorting.*

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Extended Abstract:

1. Introduction

Core drilling in rocks for geotechnical engineering study is one of the most importance activity in project so that determination coasts of projects. Core drilling of jointed rocks are very challenge and expensive, so that study of geological condition such as texture, mineralogy and joint spacing are very important.

2. Materials and methods

Nakhlak mine in Isfahan province one of the oldest mines in central Iran. Geological condition such as mineralogy, texture and rock mass properties have very importance effect on drilling penetration rate (P.R). Physical and engineering properties of four type lithology (Lime sandstone, Dolomitic sandstone, Biopacstone and Micro conglomerate) are analysis in this study. This study shows that, lime sandstone has higher maturity (dense grain) and well grading and hither unite weigh and lower porosity therefore have higher uniaxial compression strength (UCS) and P wave velocity and other engineering properties.

Rock mass properties such as joint spacing and RQD have very important role in penetration rate. The Biopacstone because of higher RQD and lower hardness, have hither penetration rate (1.5-2.7 m/h).

3. Conclusion

Rock texture as a primary structure in intact rock have important role on unite weigh, porosity. As the same time mineralogy (Quartz and Dolomite content), have important rule in decrease of penetration rate. Well grading of rocks grain (textural factor) and high Quartz content and low cement (grain filling), cause lower penetration rate.

High joint spacing and RQD (Rock Quality Designation), cause higher penetration rate (P.R) because of discontinue impact is decrease and workability of drilling bitt is increase. Increase of RQD from 60% to 80%, increase P.R about 164%.

References:

- Adebayo, B., Adetula, B. O., 2013. Evaluation of physical and mechanical properties of rock for drilling condition classification, *World Journal of Engineering*, 10: 359-365.
- Akun, M. E., Karpuz, C., 2005. Drill ability studies of surface-set diamond drilling in Zonguldak region sandstones from Turkey, *International Journal of Rock Mechanic and Mining*, 42, 473–479.
- Bhalchavdra, V. G., 2009. Rotary drilling and blasting in large surface mines, CRC press: Balkema Book, 777 P.
- Babatunde, A., 2011. Effect of Textural Characteristics of Rock on Bit Wear, Federal University of Technology, Technical Report, 14: 299-307.
- Ersoy, A., Waller, M. D., 1995. Textural characteristic of rocks, *Engineering geology* 39: 123-136.

- Hayati, Y., 2019. Determination of drilling rate index based on rock strength using regression analysis, *Annals of the Brazilian Academy of Sciences*, 91: 1-10.
- Hegde, C., Daigle, H., Millwater, H., Gray, K., 2017. Analysis of Rate of Penetration (ROP) Prediction in Drilling Using Physics-Based and Data-Driven Models, *Journal of Petroleum Science and Engineering*, 159: 295-306.
- Hoseinie, S. H., Ataei, M., Aghababaie, A., 2014. A laboratory study of rock properties affecting the penetration rate of pneumatic top hammer drills, *Journal of mining and environment*, 1: 25-34.
- Inanloo, H., Sereshki, F., Ataei, M., Karamoozian, M., 2018. Prediction of rotary drilling penetration rate in iron ore oxides using rock engineering system, *International Journal of Mining Science and Technology*, 28: 407-413.
- Kahraman, S., 2018. Performance analysis of drilling machines using rock modulus ratio, *The Journal of The South African Institute of Mining and Metallurgy*, 23: 515-522.
- Kahraman, S., Balchi, C., Yazichi, S., Bilgin, N., 2000. Prediction of the penetration rate of rotary blast hole drills using a new drillability index, *International Journal of Rock Mechanic and Mining Science*, 37: 729-43.
- Wilbure, H. S., 1959. Laboratory Study of Rock Breakage by Rotary Drilling, *Society of Petroleum Engineers Office*, 216: 92-97.
- Niazi, B., 2011. Determination of drill ability of some natural stones and their association with rock properties, *Academic Journals, Scientific Research and Essays*, 6: 382-387.
- Su, O., Sakız, U., Akçın, N. A., 2016. Effect of elastic and strength properties of rocks during blasthole drilling, *Rock Mechanics and Rock Engineering*, 3: 217-221
- Kolapo, P., 2021. Investigating the Effects of Mechanical Properties of Rocks on Specific Energy and Penetration Rate of Borehole Drilling, *Geotechnical Geology Engineering*, 39: 1715-1726.
- Yarali, O., Soyer, E., 2013. Assessment of relationships between drilling rate index and mechanical properties of rocks, *Tunneling and Underground Space Technology*, 33: 46-53.
- Wang, Z. W., Huang, S. L., 1995. The mechanism of diamond core drilling of rocks, *International Journal of Rock Mechanic and Mining Science*, 34: 134-148.
- Wang, Z. W., 1995. The mechanics of diamond core drilling of rocks, PhD Thesis, University of Alaska, 250 P.