Shahrood University of Technology

Journal of Mining and Environment (JME)

Journal homepage: www.jme.shahroodut.ac.ir

Iranian Society of Mining Engineering (IRSME)

Investigation of the relationship between texture coefficient and abrasivity properties of granite building stones

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Article Info

Received 16 October 2024
Received in Revised form 18 March 2025
Accepted 29 March 2025
Published online 29 March 2025

DOI: 10.22044/jme.2025.15208.2912

Keywords

Granite building stones
Abrasivity
Texture coefficient (TC)
Regression analysis

Abstract

In this study, a comprehensive investigation has been done on 10 different types of granite building stones from various mines in Iran. The study aims to investigate the relationship between the texture coefficient (TC) and abrasivity properties of the studied stones. Abrasivity of stones was quantified through six indices, including equivalent quartz content (EQC), rock abrasivity index (RAI), Schimazek abrasivity factor (F), Cerchar abrasivity index (CAI), building stone abrasivity index (BSAI), and the Taber wear index (Iw). Bi-variate regression analysis was applied to develop the predictive equations for relationship between TC and abrasivity indices. The investigations demonstrated that there is a direct relationship between TC and all abrasivity indices. Furthermore, TC has moderate to high relationship with abrasivity indices. After developing the equations, their accuracy was evaluated by performance criteria including determination coefficient (R2), the normalized root mean square error (NRMSE), the variance account for (VAF), and the performance index (PI). The strongest relationship was found between TC and RAI (with R2, VAF, NRMSE, and PI value of 0.850, 0.074, 85.386, and 1.630, respectively), while the weakest relationship was observed between TC and F (with R2, NRMSE, VAF, and PI value of 0.491, 0.532, 47.605, and 0.435, respectively). This research demonstrates importance of the textural characteristics of stones, especially TC as a reliable index, on the abrasivity properties of granite building stones. Thus, the equations developed herein can be practically used for estimating the stone abrasivity in building stone quarrying and processing projects.

1. Introduction

Granite building stones have always been utilized as one of the most commonly used construction materials for both interior and exterior facades of buildings. These stones are known as abrasive stones due to the presence of quartz mineral within their compositions. So, the quarrying and processing of granite stones lead to accelerated tool wear and increased tool consumption, therefor significant cost escalation. Thus, awareness about the abrasivity properties of these is crucial for estimating expenses and choosing the appropriate drilling, cutting and polishing systems [1-4]. The physico-mechanical and petrographical properties of stones can significantly affect their abrasivity properties. Among stone properties, textural characteristics are major factors for determining the mechanical behavior and abrasivity of stones [5]. Williams et al. [6] defined the stone texture as the degree of crystallinity, grain size or granularity and the fabric or geometrical relationship between the constituents of a stone. In rock mechanics and geological engineering, various parameters are quantified for assessing textural properties of stones. Table 1 shows some of the common textural properties of stones. The required

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