J. Civil Eng. Mater.App. 2021 (June); 5(2): 47-55

Journal of Civil Engineering and Materials Application

Journal home page: https://jcema.com

Received: 22 February 2021 • Accepted: 09 May 2021

Research

doi: 10.22034/jcema.2021.256604.1044

Investigation of the Relationship between Schimazek's F-Abrasiveness Factor and Current Consumption in Rock Cutting Process

Reza Mikaeil [1]*, Akbar Esmaeilzade [1], Sina Shaffiee Haghshenas [2]

[1]Department of Mining and Engineering, Faculty of Environment, Urmia University of Technology, Urmia, Iran.

[2]Department of Civil Engineering, University of Calabria, 87036 Rende, Italy.

*Correspondence should be addressed to Reza Mikaeil, Department of Mining and Engineering, Faculty of Environment, Urmia University of Technology, Urmia, Iran. Tel: +9804433679607; Fax: +9804433679607; Email: reza.mikaeil@uut.ac.ir .

ABSTRACT

Predicting the current consumption of cutting machines in cutting building stones can be one of the most fundamental steps to achieve optimal conditions from energy consumption in the building stone cutting industry. Therefore, it is necessary to study the relationship between the operational characteristics of the machine and the work piece with the amount of consumed energy by the machine. In this paper, an attempt has been made to provide a precise model for predicting the current consumption of cutting machines using statistical studies. For this purpose, laboratory studies were performed under different operational conditions such as different depths of cut (15, 22, 30, and 35 mm) and different feed rates (100, 200, 300, and 400 cm/min). During the sawing process, 12 samples of soft and hard rock were studied by using a cutting machine on a laboratory scale (with the ability to change machining parameters and equipped with measuring current consumption). Following laboratory studies, rock samples were transferred to the rock mechanics laboratory to determine Schimazek's F-abrasiveness factor. After determining the abrasion of the samples, statistical studies were performed by using the SPSS software. Thus, the new statistical models were presented to predict the current consumption of the cutting machine based on the abrasion of the building stone sample, cutting depth, and the progress rate of the workpiece as an independent variable. The proposed statistical models can be used with high reliability to estimate the current consumption in the cutting process.

Keywords: **Current consumption, Machine parameters, Schimazek's F-abrasiveness factor, Statistical models**

1. INTRODUCTION

Observing the inefficiency and failure of technical management of energy consumption in some industrial processes and the resulting adverse environmental impacts reveal that optimization of energy consumption in industries and to carry out many projects in this connection are needed. Achieving this goal requires an accurate study of industries to reduce production costs while finding solutions to optimize energy consumption. Complete knowledge of building stones and evaluation of the performance capability of cutting machines in processing factories will lead to improve processing speed and increase production by designers and production planners. Proper application of these tools on the one hand and knowing and carefully investigating their performance, on the other hand, can significantly contribute to increased efficiency and quality of processed building stones. Relatively good studies have been conducted at various industrial and laboratory scales in the field of building stone cutting capabilities. Tutmez et al. developed a multifactorial fuzzy classification to evaluate the salability of building stones [1]. Mikaeil et al. developed the statistical models to predict the production rate of diamond wire saws in carbonate rock cutting [2]. Mikaeil et al. evaluated the saw ability ranking of