

Research

A laboratory investigation for assessing the effectiveness of wastewater treatment using flocculation process in building stone processing industry on stone surface quality and abrasive tool wear

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Abstract

In this study, the effect of presence and concentration of two synthetic polymeric flocculants with different charging mechanisms (anionic and cationic) on surface quality and abrasive tool wear in polishing process of building stones was investigated. The polishing tests were performed in laboratory scale on two stone samples (granite and marble). An index, entitled improvement index (I) was defined for evaluating the effectiveness of flocculants on surface quality and abrasive tool wear. The results revealed that flocculation process had a noticeable effect on enhancement of surface quality and reduction of abrasive tool wear for both stone samples. The cationic flocculant was more effective for granite sample and anionic flocculant was more effective for marble sample. The granite particles mainly exhibit negative surface charge while the marble particles have positive surface charge in the pH range of wastewater used for polishing tests. Therefore, charge neutralization mechanism plays a major role in flocculation process of granite and marble samples. It was found that the use of flocculation process for treatment of wastewater in stone processing plants leads to increase of abrasive tool lifespan and more high-quality products.

Keywords Building stones · Polishing process · Flocculation · Roughness · Glossiness · Abrasive tool wear

1 Introduction

Polishing is one of the main stages in processing of building stones. Polishing is a finishing process that makes the stone more valuable due to the reduction of stone surface roughness, and increase of surface glossiness. In fact, stone polishing aims to improve the aesthetic characteristics that are highly valued by the consumers [3, 10, 20, 38, 46].

Polishing process is commonly performed by automatic polishing machine in stone processing plants [19, 21, 47]. The polishing machine is equipped with multiple polishing heads, each of which is equipped with six radially distributed abrasive blocks. The heads are mounted on a beam, and beneath the heads, a belt conveyor makes the tiles move forward. Stone tiles on the conveyor get through the polishing machine and the polishing heads rotate with high speed. Once the pressure is applied on the polishing heads for keeping the contact between stone tile and abrasive blocks, the polishing is implemented. In the other words, the surfaces of the stones are polished using a successive series of abrasive tools (blocks) with progressively finer abrasive particles, which have been installed at each polishing head under well-established operational parameters. It should be mentioned that the interaction of

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