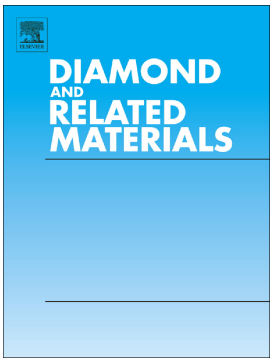

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A method to optimize the diamond wire cutting process

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Abstract

Stone are usually cut by diamond wire, that is frequently used to square stone blocks in marble companies and to pull blocks out of quarries. The diamond wire machines used for carrying out the former task are afflicted with a lot of technological troubles, such as poor surface finishing, low efficiency (in comparison with diamond wire machines used in quarries), process dangerousness and high cost of the cutting operation, due to the numerous breaking of the wire, that is expensive.

This paper deals with the analysis of cutting process of natural stones by means of diamond wire. In particular, the attention is focused on the analysis of cutting forces and on the optimization of diamond bead wear, that is influenced by pre-twisting and tensioning of the wire. This study is essential for a better design of cutting system and for a better use of existing machineries.

Keywords: *diamond wire, cutting force, bead wear, stone machining, process optimization*.

1 INTRODUCTION

Stone blocks are frequently extracted from quarries by means of diamond wire, and the same technology is used to square blocks in marble companies. In the former application the wire is installed on a machinery moving along a rail, while in the latter it is mounted on a stationary machinery. Machineries can be equipped with a single or multiple wires. Diamond wire is made by a steel cable equipped with 30-40 cylindrical diamond beads per metre, that remove the material to be cut. Furthermore, the wire is pre-twisted before cut process, in order to obtain its axial rotation during the process. This expedient ensures a uniform beads wear, avoiding asymmetries that could affect the surface quality of the finished slab. Moreover, the rotation ensures a longer bead life since the dressing process is homogeneous over its whole surface.

In literature there are some works on stone cutting. A mathematical method was applied by Jerro et al. to delineate the theoretic shape of chips, which was defined through chip dimensions. Then such parameters were related to tangential cutting force [1]. Brach et al. calculated the energy needed for cutting operation from cutting forces measured by a