Synopsis
The processing stages of the dimension stones industry use inputs mainly from petroleum-derived chemicals that can cause damages to the environment and to the human health. Therefore, there is a need to develop technologies more ecological and sustainable aiming to replace the conventional inputs actually used by less aggressive ones. From this, fickert made from polyurethane castor oil resin, Silicon Carbide (SiC), and silica from rice hull ash (RHA) and synthetic diamond is developed in order to compare them with the epoxy resin fickerts currently used in industry. Each half of an ornamental stone slab was polished with one type of fickert and the results obtained of the gloss measures were compared. It was found that the part that was polished with the abrasive made by polyurethane castor oil resin presented brightness about 10 Gloss Units (GU) greater than the other part that was polished with the conventional abrasives, in addition to presenting low values of mass loss. These results allow concluding that the ecological abrasive fickert is as a good alternative to the polishing of ornamental stones considering eco-efficiency and sustainability aspects.

Keywords
Abrasive, polishing, stones, ecological, RHA.

Introduction
A few decades ago, the generation of pollutants by companies was perceived as an inevitable consequence of industrial processes, causing a marked degree of environmental deterioration in many regions of the world (CIMM, 2016). The industrial processing of dimension stones embraces a succession of steps from the primary processing, where the sawing of the blocks from the quarries occurs, transforming them into rough slabs, until the secondary processing, in which the finishing phase takes place. In this step, these slabs pass through polishing machines with polishing heads where abrasive tools (fickerts) are arranged in sequence in the heads, from the coarsest to the finest grain. The fickerts perform a circular movement on the slab, with constant water flow for waste removal and surface cooling. This process aims to reduce the roughness of the material and increase its brightness values, configuring the polishing step that will produce ready-to-sell slabs. The types of fickerts used in the polishing of dimension stones can be divided into: Magnesians, in which the matrix is composed by Sorel cement, having as abrasive element the silicon carbide (SiC); resinoid, that are immersed either in epoxy resin or sintered metallic matrix, having diamond grains as the cutting elements. Among the above mentioned fickerts, the ones made from epoxy resin are the most used in the industry over the world. However, these tools are those that can present greater potential of environmental damages and risk to human health, since they contain toxic substances such as Bisphenol A and Epichlorohydrin in its composition (BESERRA et al., 2012). Based on this, it is sought to develop new technologies with a view to replace such inputs with others that are more ecological and pose minimum risk. Dorigo and Silveira (2016) performed abrasion tests with the aid of Taber Test machine in samples made using castor oil polyurethane resin and reinforced with silicon carbide (SiC) and silica from...
rice hull ash (RHA). The results of the abrasive tests were promising in relation to the abrasion resistance, which are lower than the minimum wear value proposed by the dimension stone fickert industries (0,5%).

From the works already developed, and seeking greater efficiency without losing the sustainable bias in the production of inputs for the processing of dimension stones, it was proposed to use the most resistant composition formula found in previous research (Dorigo and Silveira, 2016), and with the addition of synthetic diamond as cutting element, ecological fickerts were produced on industrial scale to be compared with conventional fickerts based on epoxy resin in order to analyze which one obtained the best final gloss result in the polishing of a granite slab.

**Objectives**

The objective of this work is to compare the gloss results on a sienogranite slab polished with the fickert made from polyurethane castor resin and with the conventional fickerts used in the industry, in order to verify the cutting efficiency and the performance of this input made with ecological matrix.

**Methodology**

**Materials**

For this research, it was polished a rock slab commercially known as Yellow Fiorite, which is classified as a porphyritic sienogranite composed by phenocrysts of potassium feldspar, quartz, biotite and little amount of plagioclase feldspar. In the preparation of the fickert, the polyurethane resin was used in the proportions of 1: 1.2 polyol and prepolymer, respectively. As an abrasive extenders, the formula corresponding to the sample represented by the proportions of 50% of Rice Hull Ash (RHA) and 45% of Silicon Carbide (SiC) in grain size 1200 mesh, and as a cutting element, 13.3g of synthetic diamond was added in the 600 mesh granulometry for each fickert produced (Figure 1). The polishing test was carried out in the Dimension Stones Processing Laboratory of the Federal Institute of Espírito Santo (IFES) in a semiautomatic polishing machine, which has one polishing head and capacity for 6 fickerts (Figure 2). The brightness measurements were performed using a micro-tri-gloss glossmeter.

![Fig. 1. Sample of the yellow sienogranite (A); Extenders of RHA and SiC (B) and synthetic diamond (C).](image)
Methods

The granulometry chosen to the fickert was 600 mesh, due to the fact that this stage constitutes an important transition phase between the roughing and the polishing itself. The procedure for making the fickerts was started by weighing the castor oil polyurethane resin components (polyol and prepolymer), the RHA and SiC extenders and the diamond particles. After this, the polyol and the prepolymer were homogenized and it was necessary to use a vacuum system to remove the CO₂ generated, this process took approximately 12 minutes. Subsequently, the loads of RHA and SiC and the diamond were added to the blend, homogenized and arranged in molds suitable for dimension stone fickerts (Figure 3). After being ready, the fickerts went through 15 days of curing before being unmolded and subjected to the polishing test.

Results and Discussion

The polishing tests presented very satisfactory results concerning to the values of gloss and mass loss obtained. In the graph of Figure 4, it can be seen that the polish done with the castor oil abrasives presented a mean value for the gloss values approximately 10 GU (Gloss Unit) greater than the average gloss obtained on the part of the slab polished with the fickerts of epoxy alloy.
Conclusions

From the comparison of the polishing results obtained with the castor fickerts and with the epoxy fickert, it was possible to verify how efficient the ecological fickerts were in the polishing of the granite in question. The side of the slab polished with the castor fickert presented excellent results regarding to the gloss and low values of wear when compared to the conventional fickert used by the dimension stone industry.

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About the author(s)

Wana Favero Gaburo Dorigo, Mining Engineer
Federal Institute of Espirito Santo State, Department of Mining Engineering, Rodovia Cachoeiro – Alegre Km 05, Cachoeiro de Itapemirim-ES, Zip Code29.311-970, Brazil. E-mail. wanadorigo@gmail.com

Leonardo Luiz Lyrio da Silveira, PhD
Centro de Tecnologia Mineral – Núcleo Regional do Espírito Santo (NR-ES/CETEM-MCTIC), Rodovia Cachoeiro – Alegre Km 05, Cachoeiro de Itapemirim-ES, Zip Code29.311-970, Brazil. E-mail. leolysil@cetem.gov.br

Phillipe Fernandes de Almeida, M.Sc.
University of Sao Paulo, Department of Architecture and Urbanism, Avenida Trabalhador Sao Carlense, 400, Sao Carlos-SP, Zip Code 13.566-590, Brazil. E-mail. Phillipe.prudente@gmail.com