

Effect of Heat Treatment on the Hardness and Abrasiveness of Almandine and Pyrope Garnet for Water-Cutting of Marble

Authors : Mahmoud Rabh

Abstract : Garnet has been used for decades as an abrasive in water jet cutting and sand blasting because of its superior physical properties. When added to use in water-cutting process of marble. A standard commercial sample of the mineral was tested in terms of the hardness and abrasiveness properties. The sample was sized to 4 fractions having the size of < 60 um, > 60 < 100 um, > 100 < 180 um > 1280 < 250 and 250 um designated the symbols, FF, MF, MC and C respectively. Each sample was separately heated in controlled conditions at temperatures up to 1000 °C at a heating rate of 10°C/min in an electrically heated chamber furnace. Soaking time at the maximum temperature was up to 6 h. Hardness and abrasiveness properties of the heat treated samples were tested to cut marble having a thickness of 25 mm. Results revealed that H/A of the natural garnet mineral increased by heating at temperatures up to 600°C and exhibited pronounced decrease with higher temperatures up to 1000 °C. Results were explained in the light of a structural irreversible dislocation (SD) of the crystals of garnet almandine $Fe_2+3Al_2Si_3O_{12}$ and pyrope $Mg_3Al_2Si_3O_{12}$. Characterization of the mineral was carried out with the help of XRD, SEM and FT-IR measurements.

Keywords : garnet abrasive, heat treatment, water jet cutting, hardness abrasiveness

Conference Title : ICSRD 2020 : International Conference on Scientific Research and Development

Conference Location : Chicago, United States

Conference Dates : December 12-13, 2020