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Development of Wear-Resistant Cast Iron based on High Entropy Alloy approach

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The high entropy alloys (HEAs) concept expanded the boundaries of materials science and promoted the development of metallurgy for new alloys. High Chromium Cast Irons (HCCI) has proven to be an effective material for applications in aggressive environments, where resistance to abrasion, erosion, and corrosion/erosion are required. Its superior abrasive wear resistance is attractive to process hard materials in grinding, milling, and pumping applications. This high wear resistance is due to HCCI's high volume fraction of hard carbides. The carbide-forming elements competed with one another during the nucleation and growth phenomena in solidification and this competition led to the suppression of carbides coarsening, resulting in the obtention of fine and disperse carbides. In this study, the HEA approach was applied to modify a conventional HCCI, according to ASTM A532 Grade II-D, by adding a large content of carbide-forming elements to the material in order to obtain a Wear-Resistant High Entropy White Cast Iron (HEWCI). The abrasive wear characteristics of this new alloy were evaluated. Dry Sand/Rubber wheel (ASTM G65) test was performed, where the material was pressed against the rubber wheel with a load of 130 N and exposed to 6000 revolutions while silica sand, with grain size between 210-415 µm, was added to the system at a rate of 6g/s during 30 min. The results presented an 8,96 mm^3 of volume loss for the new HEWCI and these results are more than five times superior in comparison with standard values of AISI H13 and AISI D2, as reported in ASTM G65 normative.