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Author: Mr. Satinder Shergill
Cranfield University, United Kingdom

Dr. Jenny Kingston
Cranfield University, United Kingdom

ISRU COMMINUTION AND BENEFICIATION FOR PARTICLE SIZE AND SHAPE MODIFICATION

Abstract

The benefits of comminution and beneficiation for ISRU processing has often been overlooked on the assumption that extra-terrestrial regolith particles have already been comminuted by micro-meteoroid impacts over millennia. Hence it is important to recognise that although there will certainly be particle sizes present that could be further processed without size reduction, there is still a wide particle size distribution expected on planetary surfaces even in small sample areas. As uniformity in particle size cannot be expected, it is thus better to frame the purpose of ISRU comminution as particle size control and not just reduction. Understanding particle size requirements and the properties of these particles and grains at different stages of the ISRU chain would greatly enhance the separation, handling and transport of ISRU material across subsystem interfaces. Comminution could also enable the smoothing of rough regolith particles (shape modification), to minimise the abrasive nature of highly angular regolith particles and grains. It is generally acknowledged that comminution can result in modification of particle shapes and so can be useful for terrestrial mining uses, but this feature of comminution is yet to be fully explored for ISRU. Certain comminution processes can result in more angular particles, which is useful for a potential increase in surface area for chemical reactions. While other comminution processes will result in the smoothing of highly angular particles, which would be useful for reducing abrasive contact, and in turn could extend the lifetime of all operational machinery, seals and hardware that the regolith encounters. This paper explores and presents some of the methods, and benefits of comminution and beneficiation for ISRU, being investigated at the Cranfield Space Research Centre.