Size Reduction of Solid Wastes as a Preprocessing Stage for Biological, Physical, and Chemical Processes

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INTRODUCTION

Size reduction will be an important unit operation supporting the recycling of solid wastes generated during extended space travel and planetary surface stays. The objective of this research project is to develop feasible size reduction processes that can be used to pre-process waste prior to conversion to resources by back-end biological, physical, and chemical treatment subsystems. The study consists of designing, constructing, and testing size reduction equipment and of measuring the performance of the equipment. Key process performance parameters scheduled for evaluation are the energy required for size reducing waste to the required product size, and grinder wear. Several circumstances combine to make the design of size reduction equipment for space missions a unique challenge, including the broad range of product sizes required among the back-end conversions under consideration by NASA, the necessary ruggedness of the size reduction equipment, and the high energy usage. The engineering design goal of the project is a piece of equipment that minimizes volume, mass, consumables and energy usage while achieving the desired product sizes.

The testing phase of the project has just begun and the preliminary results of testing will be presented at the Workshop.

CURRENT STATUS OF THE RESEARCH

Methods
Samples of representative mission waste will be size reduced in proto-type equipment designed and modified by CalRecovery to minimize energy use and wear of the grinding elements. Performance of the equipment will be characterized in terms of specific energy requirement and wear, and of particle size distribution of the size reduced product. Primary and secondary size reduction equipment are being characterized. Solid waste and biomass residue are being used as test feedstocks.

Results
The performance of the size reduction equipment will be presented, including energy consumption and wear as functions of waste characteristics and product particle size. The data will be compared to those for size reduction of terrestrial solid wastes.

Conclusion
The test program will establish the performance envelope of the size reduction equipment and provide NASA with the magnitude of the key resource requirements for size reduction processes that will be required to support recycling of solid wastes during long-duration, crewed space missions.

FUTURE PLANS
The first year of this two-year research and development project is dedicated to testing and the evaluation of fundamental process performance parameters. The objective of the second year is process and equipment optimization.

INDEX TERMS
Solid waste, waste management, resource recovery, processing, size reduction, grinding, particle size, energy requirements