NASA SBIR/STTR Technologies

Advanced Carbothermal Electric (ACE) Reactor

Orbital Technologies Corporation – Madison, WI
PI: Robert J. Gustafson
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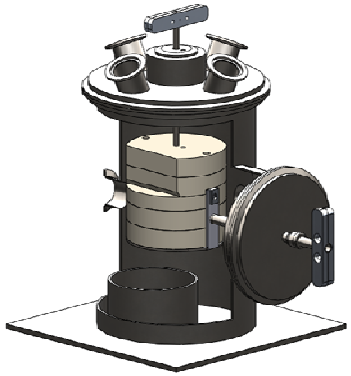
Identification and Significance of Innovation

ORBITEC proposes to develop and test the Advanced Carbothermal Electric (ACE) Reactor Engineering Unit to efficiently produce oxygen, iron and glass from regolith. The ACE reactor uses an innovative method to electrically heat the regolith to temperatures over 1800ºC within a thermally insulted environment. The ACE reactor offers significant advantages over current carbothermal reactor approaches. In addition to efficiently producing oxygen, the ACE reactor separates the processed regolith into metallic iron and a silicate glass that can be formed into structural components.

TRL Range at beginning & end of Phase 2 Contract: 4 → 5/6



Cutaway View of the Phase 1 Prototype ACE Reactor

Molten JSC-1A simulant pouring out of the Prototype ACE Reactor

Technical Objectives and Work Plan

The overall objective of the Phase 2 effort is to develop and test an ACE Reactor Engineering Unit.

Task 1. Refine System Requirements
Task 2. Evaluate Improved Heating Methods
Task 3. Life Testing of the Crucible and Heating System
Task 4. Develop the Preliminary Design
Task 5. Perform Subsystem Testing
Task 6. Develop the Detailed Design
Task 7. Build the ACE Reactor Engineering Unit
Task 8. Develop the Control System
Task 9. Perform Check-Out Tests
Task 10. Laboratory Testing
Task 11. Delivery of the ACE Reactor Engineering Unit
Task 12. Project Management and Reporting

NASA and Non-NASA Applications

The ACE Reactor will efficiently produce oxygen, iron and glass from regolith to support human exploration of the Solar System. The unique ACE Reactor design requires 84% less thermal energy than the current state-of-the-art carbothermal reduction reactors to operate. This allows at least 12 times more regolith to be processed with the same amount of thermal energy. The ACE Reactor also separates the processed regolith into metallic iron and a silicate glass that can be formed into structural components. The innovative electric resistance heaters being developed for the ACE reactor could have a significant commercial market as the first high-temperature heating elements that can operate at temperatures >1400 C in oxidizing, reducing, or vacuum environments.

Firm Contacts

Robert J. Gustafson, PI, 608-229-2725, gustafsonr@orbitec.com
Eric Rice, Contracting Officer, 608-229-2730, ricee@orbitec.com