Baseload CSP Generation Integrated with Sulfur-Based Thermochemical Heat Storage

General Atomics

Award Number: DE-EE0003588 | November 13, 2012 | Wong

PROJECT OBJECTIVES

Goal: To investigate the engineering and economic feasibility of supplying baseload power using a concentrating solar power (CSP) plant integrated with sulfur based thermochemical heat storage

- *This is a novel concept to store solar energy in chemical bonds. The energy storage density is two orders or magnitude higher than conventional means*

Innovation: Solar heat is converted into elemental sulfur through a thermochemical cycle

- *Energy storage is very cheap as the cost of sulfur is low*
- *The recovered heat can drive a Brayton or combined cycle*
- *Long term energy storage is possible since sulfur is stable under ambient condition*

Milestones: NA

APPROACH

- Conduct laboratory studies on reaction thermodynamics and kinetics of the sulfur generating disproportionation reaction. Effect of various potential catalysts and means to separate the reaction products will be investigated. A kinetic equation for process design will be defined.
- Improve the solar reactor design and catalyst performance to increase SO_3 to SO_2 conversion fraction
- Preliminary process component design and experimental validation for the three process steps. Carry out process integration design between the CSP plant, the sulfur processing and storage plant and the electricity generation unit.
- Design and flowsheet studies to assess the system economics, its environmental impact and pathways to ascertain safe operations of such an integrated plant.

KEY RESULTS AND OUTCOMES

- Validated the role of iodine catalyst in enhancing SO_2 disproportionation. An increase of 25 fold was achieved.
- SO_2 disproportionation rate was further increased in the new test set up

Temp (°C)	%/hr	Time to Completion (hr)	Final H_2SO_4 wt%
124	5.18	19.3	58
150	9.25	10.8	59

- Faster disproportionation reduces the capital equipment cost and LCOE.
- The work was presented at SolarPACES and a conference paper was submitted

NEXT MILESTONES

- Complete the constant SO_2 pressure test set up and begin experiments (1/31/2013)
- Define the process condition and reactor design that provides a 10%/hr disproportionation rate (4/30/2013)
- Define a kinetic equation for disproportionation process design (5/30/2013)
- Complete test set up modifications for long term catalyst testing and begin testing (1/31/2013)