Study on Thermochemical Iodine-Sulfur Process at JAERI

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Hydrogen Production from Water

Thermochemical IS Process

- produces hydrogen by water splitting using heat of lower than 1000°C
- needs no feed of reactants except water (closed cycle)
Hydrogen Production Tests at JAERI

lab. test (1NL/h)
showed the possibility of continuous closed-loop hydrogen production based on the enlarged chemical data base.

Bench test (1999-2004)
aims to develop the control method under modified conditions using an glass apparatus.

Hydrogen production unit

Oxygen production unit (sulfuric acid decomposer)

Bunsen reactor

Ref) A. Terada et al., 13th Int. Conf. Nuclear Engineering (ICONE13), Beijing, China, May 16-20, 2005, ICONE13-50183
Results of bench test and …

Completion of Hydrogen Production (Jun. 2004)

Continuous hydrogen production was successfully achieved with the hydrogen production rate of ca. 31NL/h for 1 week.

Ref) A. Terada et al., 13th Int. Conf. Nuclear Engineering (ICONE13), Beijing, China, May 16-20, 2005, ICONE13-50183
For efficient H₂ production,

<Approach>

(1) Extractive distillation (GA)
   Destroy the azeotrope with H₃PO₄

(2) Reactive distillation (RWTH Aachen)
   Shift the azeotropic composition at elevated pressure (e.g. 20bar).
   Carry out the decomposition in the distillation column.

(3) Membrane separation (JAERI)
   Preconcentrate the HIx soln. by electrodialysis.
   Enhance the one-pass conversion by membrane reactor.

<Problems>

/ large thermal burden for the distillation of azeotropic hydriodic acid (HI/H₂O: 1/5)

// excess HI circulation due to low equilibrium conversion of HI (ca. 20%)
As for the materials of construction,

Candidate materials has been screened by corrosion tests in the process condition.

R&D is required for the components used in the boiling sulfuric acid environments.

ex) hybridization of corrosion resistant material and pressure resistant material
Development of components: \(H_2SO_4\) Decomposer

Ref) H. Ota et al., 13th Int. Conf. Nuclear Engineering (ICONE13), Beijing, China, May 16-20, 2005, ICONE13-50494
Development of components: \( \text{SO}_3 \) Decomposer

Ref) A. Kanagawa et al., 13th Int. Conf. Nuclear Engineering (ICONE13), Beijing, China, May 16-20, 2005, ICONE13-50451