EFFICIENT THERMOCHEMICAL HYDROGEN SULFUR CYCLE FOR H_2 PRODUCTION

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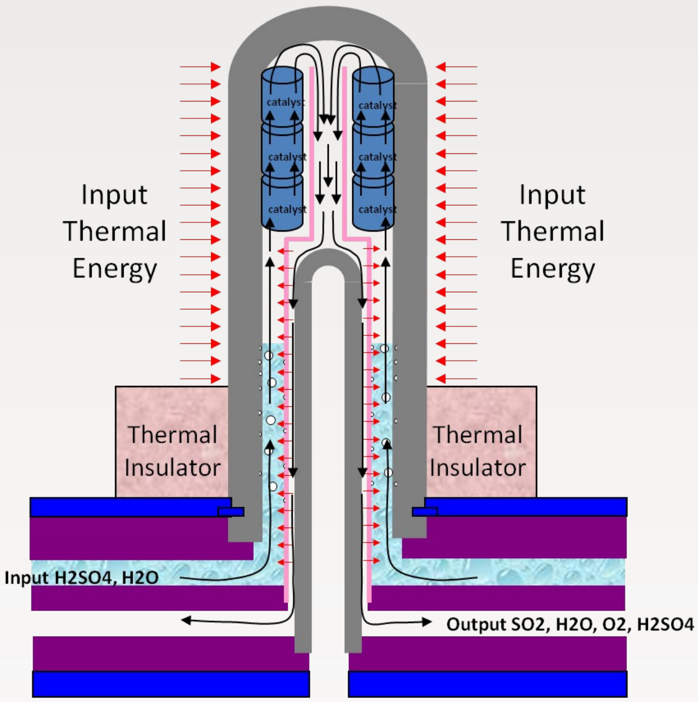
TECHNOLOGY SUMMARY

US PATENT # 7,645,437

(SD # 10208 AND 10737)

With the growing pressure placed on energy efficiency and reliance on fossil fuels, alternative sources of energy are increasingly important. One of the most promising is the production and use of hydrogen as an environmentally friendly energy source. One of the most promising current techniques involves the Hydrogen Sulfur (HyS) Cycle. The HyS cycle is composed of two reactions: 1: the conversion of sulfuric acid (H_2SO_4) to sulfur dioxide (SO_2) and oxygen (O_2) and 2: the conversion of water (H2O) and sulfur dioxide (SO_2) to sulfuric acid (H_2SO_4) and hydrogen (H_2). The first reaction has often proved highly inefficient due to non-recycled reactants, and often falls victim to corrosion due to the high acidity of the reactant, leading to high costs in equipment replacement.



Sandia has developed a novel approach to completing the first reaction in the HyS Cycle that consists of an integrated concept for a heat exchanger/catalytic decomposer that integrates an acid boiler, superheater, and acid decomposer in a single unit. Integration of these units allows for recovery and reuse of sulfuric acid, significantly increasing the efficiency of the overall system. The equipment consists of a group of heat exchanger tubes manifolded together at one end with the other end of each tube sealed. The integrated heat exchanger can be manufactured out of metals, ceramics, glass, quartz or combinations of these types of materials. The liquid acid enters the manifold of tubes and travels up through the outer heat exchanger tube. As it flows up, it is vaporized by heat supplied from the outside of the outer tubes. The vapor is then superheated and then enters the catalytic portion (top) of the unit where it decomposes to produce SO_2 and water. The gas products then travel down through the center of the inner heat exchanger tube and out of the manifold. Heat supplied to the outer tube for the acid boiling, superheating, and catalytic decomposition is recuperated as the hot gas products travel back down the inner tube. The catalyst can be a pure metal such as platinum or other meal catalyst, or metal catalyst coated onto a support material. The support material can be a single piece or multiple pieces. While hydrogen production for green energy is the most foreseeable use of this technology, this technology can also be used to generate ammonia, propane, or for thermal energy storage.

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POTENTIAL APPLICATIONS

- Agricultural- aid in the generation of ammonia for fertilizer production
- Automotive/Transportation– hydrogen to be an alternative energy source in fuel cells for vehicles or hydrocracking of petroleum products

TECHNOLOGICAL BENEFITS

- Impervious to corrosion issues that have plagued current technology
- Closed loop cycle with recycled sulfuric acid offers high efficiency
- Integrated boiler, superheater, and acid decomposer for even greater increase in efficiency
- Design is easily scalable for large scale processing

TECHNOLOGY READINESS LEVEL

Sandia estimates this technology to have a technology readiness level of approximately 5. Key elements of this technology have been demonstrated in laboratory relevant environments.

CONTACT INFORMATION

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Or to learn more, please visit our website at https://ip.sandia.gov.