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Efficient Ammonia Production Using Stable Absorbents

IP Status: Pending US Patent; **Application #:** 16/759,950

Low Pressure Ammonia Production with Higher Yield

Stable ammonia absorbents are used to efficiently separate hydrogen/nitrogen from ammonia, thereby improving the manufacturing efficiency of ammonia. These absorbents are simple to make and are comprised of chloride salts carried on various supports. By adsorbing ammonia at reactor temperatures, these absorbents allow the reactor to achieve up to 100% nitrogen/hydrogen conversion to ammonia. Stable ammonia absorbents, especially those that operate at high temperatures, are valuable for either large or small-scale ammonia synthesis. They enable a scalable process to make ammonia that operates at lower pressures: as little as 20 atm vs. up 200 atm for the standard Haber Bosch process. The combined attributes of improved yield and lower process pressure decreases energy use resulting in overall reduction of cost to manufacture ammonia and capital equipment costs. In addition, this ammonia synthesis method enables storage of stranded energy via distributed manufacture of ammonia and would efficiently make use of peak wind or solar-generated electricity to make hydrogen (from electrolysis of water) and nitrogen (by pressure swing absorption of air), thereby storing this energy as ammonia. Thus, this process enables both improved large scale ammonia manufacturing plant efficiency and more widely distributed small scale ammonia manufacture.

Solid Absorbents are More Efficient

Current ammonia production, both large and small scale, is inefficient. Ammonia must be removed from the product stream and unreacted hydrogen and nitrogen must be recycled back to the reactor. Current methods to separate ammonia from the product stream are complex, expensive and ill-suited for small scale production. This new method makes ammonia at lower pressures than conventional Haber-Bosch processes. Absorption enables lower process pressure (versus condensation of liquid ammonia, as done conventionally). Using stable absorbents of high capacity, such as those created in this technology, overcomes current obstacles resulting from using unsupported chloride salts by creating new robust ammonia solid absorbents that can separate ammonia at lower temperatures and therefore use less energy.

BENEFITS AND FEATURES:

- Improved yield nitrogen/hydrogen conversion to ammonia (up to 100% vs. 20% for the conventional Haber Bosch process)
- Lowers capital costs
- Operates at lower pressure
- Scalable (small or large scale)
- More efficient (less energy consumption)
- Method enables distributed small scale ammonia manufacture using solar and wind generated electricity
- New particulate product - supported particulate chloride salt for ammonia absorption
- New equipment – absorption bed for low pressure, high efficiency ammonia production

Technology ID
20180113

Category
Engineering & Physical Sciences/Materials
Engineering & Physical Sciences/Sustainable Technology

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APPLICATIONS:

- Ammonia production
- Fertilizers
- Energy storage (ammonia as fuel)

Phase of Development - Proof of Concept

Researchers

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Publications

Better Absorbents for Ammonia Separation
ACS Sustainable Chemistry & Engineering, March 30, 2018; 6, 5, 6536-6546

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The University relies on industry partners to scale up technologies to large enough production capacity for commercial purposes. The license is available for this technology and would be for the sale, manufacture or use of products claimed by the issued patents. Please contact us to share your business needs and technical interest in this technology and if you are interested in licensing the technology for further research and development.