Efficient, Low Pressure Ammonia Production Using Stable Absorbents

Name / Technology Title:

Efficient, Low Pressure Ammonia Production Using Stable Absorbents

Long Description:

Low pressure ammonia production employs stable absorbents

Novel, 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 temperature, 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. Combining improved yield and lower process pressure decreases energy use resulting in overall reduction of cost to manufacture ammonia. In addition, this method for ammonia synthesis enables distributed manufacture of ammonia and could use stranded energy such as wind or solar-generated electricity to make hydrogen (from electrolysis of water) and nitrogen (by pressure swing absorption of air). Thus, this process enables both more widely distributed small scale ammonia manufacture while also improving existing large scale ammonia manufacturing plant efficiency.

Solid absorbent enables lower pressure process

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 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

APPLICATIONS:

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

Phase of Development

Choose from the following table, additional information may be included when describing the phase of development:

Physical Science
Concept
Proof of Concept
Prototype dev
Pilot scale demonstration
Pre-market validation

<table border="3"><colgroup><col width="500"></colgroup>
<tbody>
<tr><th bgcolor="7a0019">Interested in Licensing?</th></tr>
<tr><td> 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 < a href=https://secure.nouvant.com/umn/technology/XXXX/inquiry/new>NAME to share your business needs and technical interest in this XXXX technology and if you are interested in licensing the technology for further research and development.</tr></td></tbody></table>

Key Phrases:

Ammonia
Ammonia absorption

Commented [DLF1]: Which one applies?

Built lab scale reactor and tested. Continuing to optimize chemistry/material of the absorber.

Ammonia condensation
Ammonia manufacturing
Haber-Bosch process
Reactor
Stable ammonia absorbents
Wind-generated electricity
Solar-generated electricity

Supplemental Information:

Technical Publications

DOI:

Commented [DLF2]: Please list DOI links

Category Classification:

Commented [DLF3]: Do any others apply?

Agriculture & Horticulture			
Ag Biotechnology		Veterinary Medicine	
Food Science & Nutrition		Other	
Plant Varieties			

Engineering & Physical Sciences			
Chemical	x	Photonics	
Cleantech		Robotics	
Communications & Networking		Semiconductor	
Design Specifications		Instrumentation, Sensors & Controls	
Industrial Biotechnology		Transportation	
Materials	x	Other	
Nanotechnology			

Life Sciences			

Ag Biotechnology		Industrial Biotechnology	x
Biologics		Medical Devices	
Biomarkers		Pharmaceuticals	
Cellular Therapeutics		Research Tools	
Cleantech		Veterinary Medicine	
Diagnostics/Imaging		Human Health	
Food Science & Nutrition		Other	

Inventor(s)

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Patent Information

- Provisional patent application filed.

Office for Technology Commercialization, University of Minnesota

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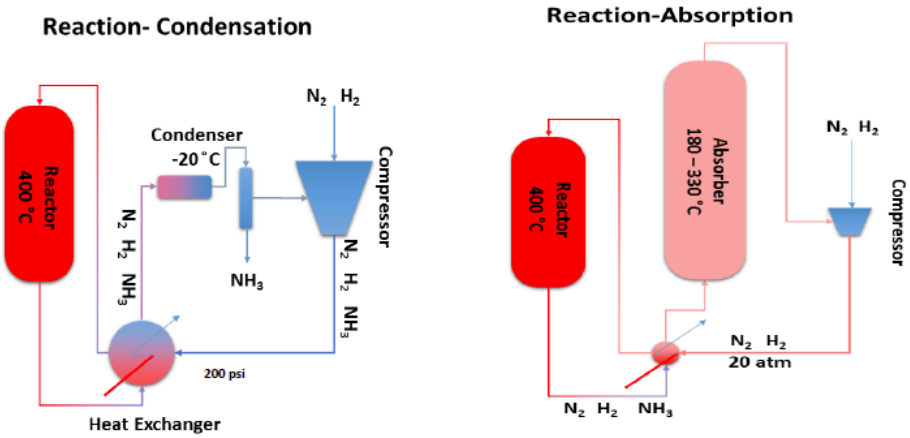
Technology Licensing Officer

Images:



Cite:
Caption: Conventional vs. absorption-based ammonia synthesis
Alt-text: In the conventional system, the ammonia produced is separated by condensation. In the new process, it is removed by absorption.

Cite: amazon.com
Caption: Ammonia
Alt-text: