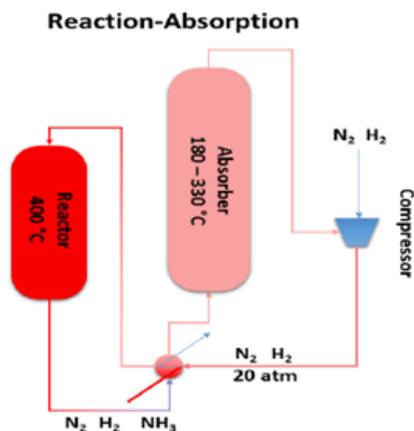


## Efficient, Low Pressure Ammonia Production Using Stable Absorbents



Ammonia is almost entirely produced by the Haber-Bosch process, a catalytic process that produces a mixture of hydrogen, nitrogen, and carbon dioxide by burning fossil fuels with air and water. While the process works well and is a mainstay of commodity chemical manufacture, it requires fossil fuels and is alone responsible for nearly 3% of global carbon dioxide emissions. Furthermore, high pressure and high temperature are expensive, which can limit production in developing countries. These disadvantages are serious enough to sustain continuing research, especially for development of new energy efficient ammonia production technologies that lower greenhouse gas emissions.

### Description of the Invention

Novel, stable ammonia absorbents improve the manufacturing efficiency of ammonia by efficiently separating hydrogen/nitrogen from 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. They enable a scalable process to make ammonia that operates at lower pressures than conventional Haber-Bosch processes. 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. 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.

### Features and Benefits

- 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

### Potential Applications

- Ammonia production
- Fertilizers

### Technology Status

Proof of Concept.

### IP Status

Patent Pending

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### Case Reference

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