Chemistry

Ammonia

NH_3

Produced from

Nitrogen

- Obtained via fractional distillation of liquid air

Hydrogen

- Obtained from catalytic cracking of large hydrocarbons (crude oil) or electrolysis of water

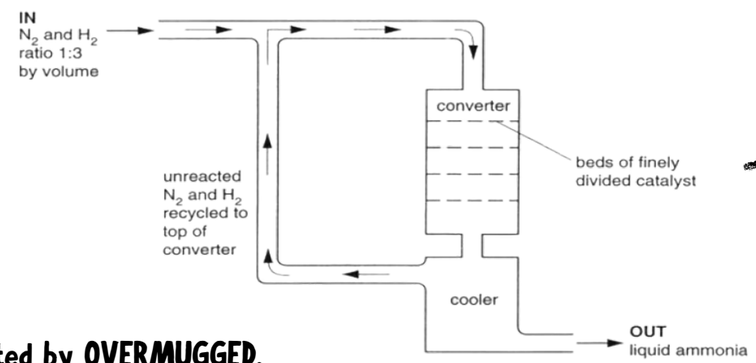
Haber Process

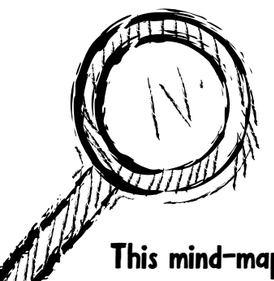
$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$

- Nitrogen and hydrogen react in a <u>1:3 ratio</u>
- Converter has finely divided iron catalyst to increase the rate of reaction.
- $NH_3(g)$ produced condensed to liquid in the cooler.
- Temperature in the cooler should be kept at a temperature lower than the b.p of $NH_3(g)$ but higher than the b.p of $N_2(g)$ and $H_2(g)$, to allow $NH_3(g)$ to condense to liquid state while $N_2(g)$ and $H_2(g)$ remain in gaseous state (recycled).

Analysis:

- <u>Not costly</u>, as nitrogen, hydrogen and iron are available at low costs.
- <u>Efficient</u> as the leftover reactants are recycled and re-enters the reaction chamber.
- Reaction is <u>exothermic</u> as heat is released to maintain the temperature of the set-up.





This mind-map is created by OVERMUGGED.

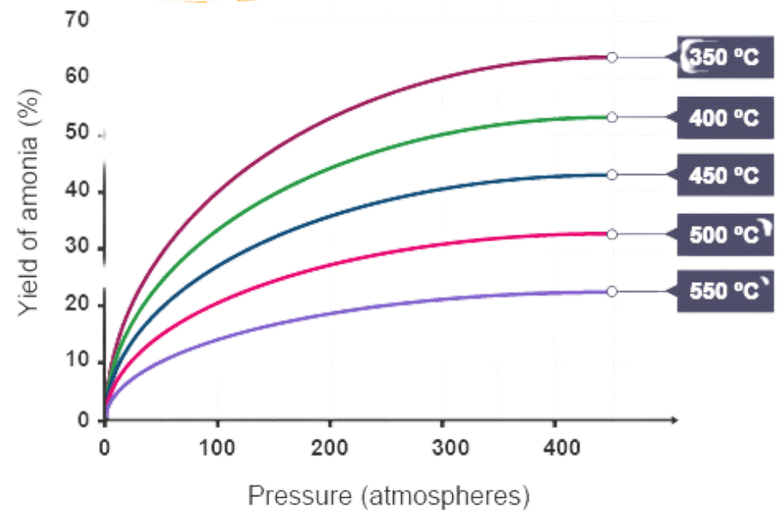
Properties

- Chemical formula of NH_3.
- Gas a r.t.p.
- Aqueous NH_3 is a weak alkali that partially dissociates in water to produce low concentration of OH^- ions.

$NH_3(g) + H_2O(l) \rightleftharpoons NH_4^+(aq) + OH^-(aq)$

- Used to manufacture fertilisers, plastics, textiles, pesticides and dyes.

Conditions



From the graph, theoretically, increasing pressure and decreasing temperature will maximise the yeild of ammonia. However,

- High pressure is <u>costly</u>, and poses <u>greater safety risks</u>.
- Low temperature -> Increase yield, but a low temperature will result in a slow reaction,
- More efficient to use a higher temperature to increase rate of reaction.
- Unreacted gases will be <u>recycled</u> via the chamber and eventually 98% of the reactants will be converted to ammonia. Hence, yield is not a priority.