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DECARBONISATION AND LOW CARBON AMMONIA

ORICA

Orica KI Ammonia Plant Background

- MW Kellogg designed plant commissioned in 1969 to make 540 mtpd.
- Since initial commissioning the plant has been up-rated to ~1060 tpd.
- Ammonia from Orica KI is predominantly used for manufacturing ammonium nitrate but is also used directly as a fertilizer and some other special applications.
- Change of feedstock from Naphtha to Natural Gas in 1982.
- Significant modernsation has been implemented throughout the life of the plant.
- The KI Ammonia Plant has been decarbonising for decades!

Conventional Ammonia Production

$3\ H_2$	+	$1\ N_2$	<>	$2\ NH_3$
Hydrogen	+	Nitrogen		Ammonia

A 3 to 1 ratio of hydrogen to nitrogen is required to make ammonia.

Hydrogen source:

- Natural Gas Feed to Steam Methane Reformer, Secondary Reformer, Water Gas Shift Conversion, CO2 Removal

Nitrogen source:

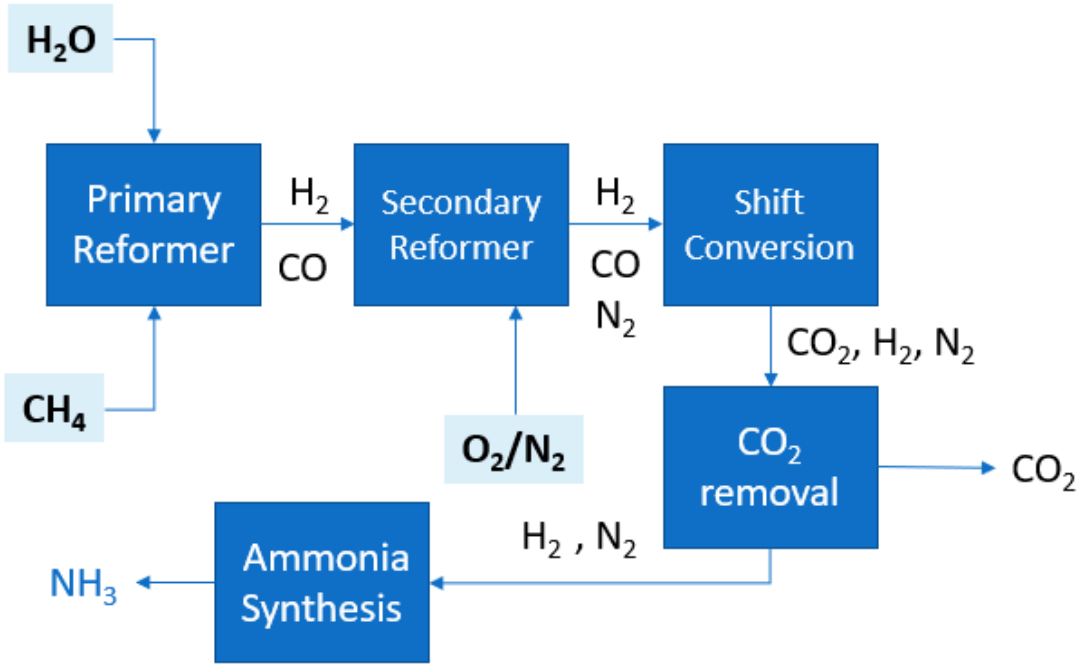
- Air injection into Secondary Reformer

Natural Gas Supply:

~ 65% for Feed Gas

~ 35% for Fuel Gas

Emissions ~ 785 kt CO2



Decarbonisation Options: Past and Future

Past

Standard ammonia plants focus on fuel or feed efficiency improvement projects.

Fuel: Improved energy recovery (reduced fuel consumption)

Feed: Improved hydrogen yield from feed gas (i.e. improved reformer performance, purge gas recovery).

Use purified CO_2 in downstream processes or sell as product. Some plants use CO_2 for urea production, KI doesn't do this.

Figure: Example of standard decarbonisation project. Install improved heat exchanger to reduce steam, and hence fuel consumption (~10kt/y CO_2)

Future

Alternate feedstocks, e.g.:

- Renewable power to produce hydrogen from electrolysis
- Syn gas produced by waste recycling process (i.e. pyrolysis of waste)

Use purified CO_2 in downstream processes or sell as product.

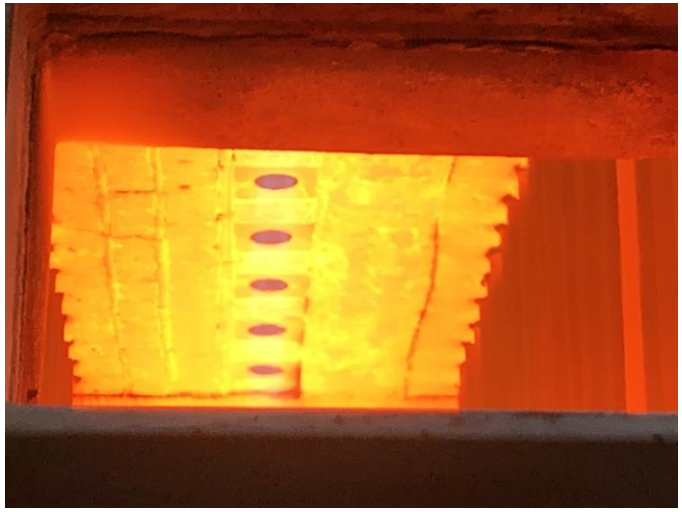


Figure: Example of standard decarbonisation project. Recovery vented hydrogen during start-up, to offset natural gas consumption.

KI Ammonia Plant Overview and renewable hydrogen addition to the process

Phase 1: Replace ~7% natural gas with renewable hydrogen. Limitation in conventional ammonia plants with secondary reformers, is the secondary reformer outlet temperature. Engineering to overcome intermittent nature of supplied renewable hydrogen.

Future phases: Further engineering is required to manage the steam balance on the ammonia plant.

Technically possible to convert to 100% renewable hydrogen.