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# Comparison between three types of ammonia synthesis reactor configurations in terms of cooling methods

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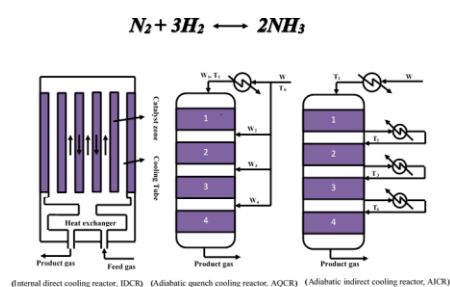
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## Graphical abstract



## Highlights:

- There are three types of ammonia synthesis reactor based on the cooling methods.
- A one-dimensional pseudo-homogeneous model is developed for these reactors.
- Optimum operating conditions are found using differential evolution (DE) algorithm.
- The most efficient cooling method is the internal direct cooling reactor.

## Abstract

In this study, simulation and optimization of ammonia synthesis reactor based on the implemented cooling methods was presented in three cases: Internal direct cooling reactor (IDCR), adiabatic quench cooling reactor (AQCR), and adiabatic indirect cooling reactor (AICR). A one-dimensional pseudo-homogeneous model was developed to investigate the effect of various parameters on maximum  $N_2$  conversion at the outlet of IDCR, 2-bed AQCR and 2-bed AICR. Differential Evolution algorithm was applied to optimize three types of ammonia synthesis reactor, considering  $N_2$  conversion as the main objective. A comparison between IDCR, 2/3/4-bed AQCR and 2/3/4-bed AICR was carried out under the optimal operating conditions by considering the same catalyst volume, operating pressure and feed mass flow rate for all three types of reactor. The optimization results show that a maximum conversion of 0.26 was achieved in 3-bed AQCR, in which the temperature of feed gas to the first bed was 635 K, dimensionless lengths of each bed were 0.13, 0.25 and 0.62, and fractions of total feed flow rate quenching from the first to end bed were 0.2, 0.26 and 0.54,

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