STUDY OF CATALYSTS FOR METHANOL STEAM REFORMING

Introduction

Steam reforming of methanol is a sustainable method for producing high-purity hydrogen, essential for decarbonizing industries. This low-carbon alternative reduces greenhouse gas emissions and supports global sustainability. Methanol's transport and storage ease making practical hydrogen carrier. Optimizing catalyst performance and reactor efficiency can boost hydrogen yields, cut energy use, and lessen environmental impact, marking it as a key clean energy technology.

Objectives

Study Catalyst Preparation Techniques: Review the wet impregnation and dry impregnation methods for catalyst preparation.

Explore the Efficiency of Methanol Steam Reforming: Investigate reactor designs and conditions that could maximize hydrogen production, focusing on energy efficiency and emission reduction.

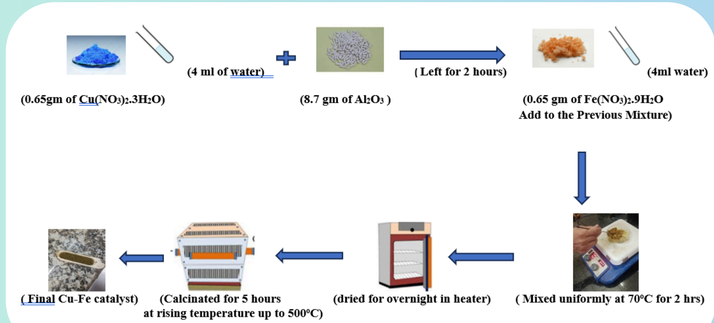
Literature

Methanol steam reforming (MSR) produces hydrogen efficiently using methanol (CH_3OH) as feedstock, which is easy to transport, store, and relatively non-toxic. The typical mix is a 1:3 ratio of methanol to water.

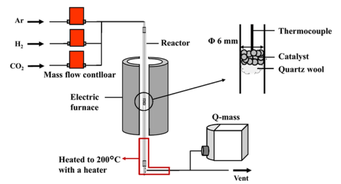
- **Methanol Steam Reforming:** $CH_3OH+H_2O \rightarrow CO_2+3H_2$
- **Water-Gas Shift Reaction:** $CO+H_2O \rightarrow CO_2+H_2$

Challenges include catalyst deactivation, high energy consumption, and CO_2 emissions. Research aims to improve catalyst stability and sustainability.

Cu-Fe catalyst preparation by dry impregnation

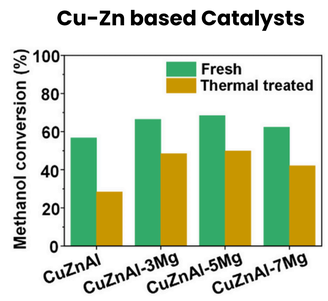


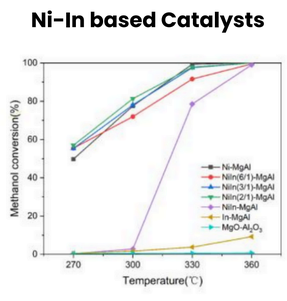
Tubular Reactor for Catalyst Testing



- **Successfully load the prepared catalyst into a tubular reactor for testing its performance, though actual testing was not conducted due to time constraints.**

Methanol Conversion for Bi-Metallic Catalysts





Methods of Preparation of Catalyst

Wet Impregnation: Soaking the support material in a solution containing metal precursor followed by drying and calcination to deposit the metal into support

Dry Impregnation: The metal precursor is mixed directly with the dry support material, followed by drying and calcination

Sol-Gel Method: A solution (sol) containing the metal precursor is converted into a gel, which is then dried and calcinated to form catalyst

Potential Challenges With Catalyst

Catalyst deactivation: Catalyst loose their activity due to sintering, leading to decomposition

Metal Agglomeration: Metal particles clump together at high temperature reducing surface area

Coke formation: Which blocks active sites reducing performance

Thermal stability: At high temperature catalyst degrade over time

Results

- The catalyst was successfully prepared using the dry impregnation method. The catalyst will be tested under steam reforming conditions to evaluate its performance in hydrogen production.

References

- A review study on methanol steam reforming catalysts by Mohsen Rostami, Amir Hamzeh Farajollahi, Rasool Amir.
- Hydrogen production via steam - reforming of different fuels by Maria Portarapillo, Danilo Russo, Almerinda, Di Benedetto.

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Name of the Supervisor: Dr. Sweta

Grade : A / B / C

Signature of the Supervisor with date