Green Chemicals From CO: The Killer Solution!

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MATT!!!!
Overview

- Where CO comes from
- Chemicals from CO
  - Acetic Acid
  - Polyurethane
  - Methanol
  - Formic Acid
- Conclusion
Where CO comes from

Partial Oxidation
\[ \text{CH}_4 + \text{O}_2 \rightarrow \text{CO} + 2\text{H}_2 \]

Steam Methane Reforming
\[ \text{CH}_4 + \text{H}_2\text{O} \rightarrow \text{CO} + 3\text{H}_2 \]

Gasification
\[ \text{C} + \text{H}_2\text{O} \rightarrow \text{CO} + \text{H}_2 \]

Feedstocks: Natural Gas, Biomass and Coal
Acetic Acid

- Originally made with phosgene
- Captiva vs Monsanto Processes
- Made from Methanol and CO in the presence of an Iridium or Rhodium catalyst
Acetic Acid Cont.

Monsanto- Rhodium Catalyst

- 30 to 60 atmospheres and 150 to 200 Celsius
- Methyl Iodide created
- Rate due mostly to catalyst and Mel concentrations
- Byproducts include CO2, H2, and propionic acid
Acetic Acid Cont.

Captiva-Iridium Process

- Iridium is 18 times cheaper than Rhodium
- Promoters such as Zinc Iodide can be added
- Extremely High Purity produced with low organic iodine impurities
- Less dependent on CO partial pressure
Polyurethane

- 80 billion dollar industry by 2020
- Home construction
- Clothing, appliances, boats, car emission, electronics, flooring, medical
- Skating(wheels)!
- Carbon monoxide is used to make phenyl carbonate
- Phenyl Carbonate is reacted with amine to make urethane

![Lower energy consumption due to polyurethane use](image)
Other Chemicals

- Methanol
  - Used in production of other chemicals and can be used to fuel vehicles (monster trucks)

  \[
  \text{CO} + 2\text{H}_2 \rightarrow \text{CH}_3\text{OH}
  \]

- Formic Acid
  - Antibacterial and preservative

  \[
  \text{CH}_3\text{OH} + \text{CO} \rightarrow \text{HCO}_2\text{CH}_3
  \]
Conclusion

- CO can be used to create greener routes to produce chemicals
  - Acetic Acid
  - Polyurethane
  - Methanol
  - Formic Acid
References

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