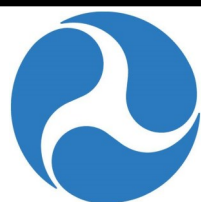


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U.S. Department of
Transportation



Project Title: ***Effects of Syngas Sources on Ethanol Production
via Fermentation***

DR. MARK WILKINS

Project Outcomes:

- The potential impurities which can impact fermentation system have been identified. The effects of benzene and ammonia, ethane, acetylene, ethylene and acetone on *Clostridium ragsdalei* cell growth, enzymatic activities, and product distribution have been quantified.
- It was found that ammonia in producer gas can accumulate to high concentrations and raise the osmolarity of the media, which can inhibit cell growth. Ammonium ions non-competitively inhibit hydrogenase activity, and inhibition is significant for typical syngas ammonia concentrations. Higher levels of osmolarity will also alter the ratio of [EtOH] versus [HAc]. Thus, ammonia should be removed from syngas prior to fermentation.
- At benzene levels typically found in media (around 0.6 mM), there is minimal effect on cell growth and ethanol production.
- Hydrogenase activity was reduced by 5%. Therefore, benzene impurity within syngas does not need to be vigorously removed as in the case for ammonia.
- Ethane was not observed to affect ethanol formation.
- Acetylene at levels as low as 0.2% inhibit cell growth, ethanol and acetic acid formation, alcohol dehydrogenase (ADH) activity, and hydrogen consumption.
- Ethylene slightly inhibited ethanol formation.
- Acetone that is in producer gas after wet scrubbing to remove tars was converted to isopropanol at >90% yield by *C. ragsdalei*.
- Isopropanol is a valuable industrial compound with potential fuel value.

Other Sources of Funding:

Subcontract: Brigham Young University. The total sub-contract amount to BYU included graduate and undergraduate student stipends, equipment, materials and supplies and travel expenses. A cost share match was provided by BYU. The overall cost share match was met period-by-period by OSU and BYU (included indirect costs).

Oklahoma State University Cost Share:

Salaries of Drs. Bellmer and Huhnke were provided as matching funds.



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