Reforming landfill gas to syngas
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Abstract
A preliminary investigation into the dry reforming (synthesis gas production) of landfill gas (LFG), has begun using precious metal catalysts. Thermogravimetric analysis was performed on the dry reforming reaction over 0.5% Pt/γ-Al₂O₃ catalysts. Variables such as reforming temperature, CO₂ concentration, and the effect of pre-reduction have been studied. It was found that reforming at 500°C with pre-reduction gave the most H₂ production for reactant gas concentrations similar to LFG. However, at the high temperature there was significant weight gain measured. EDX analysis and follow-up oxidation tests confirmed that it was due to carbon deposition on the catalyst surface. Yet, this weight gain, up to 25%, in some cases, did not coincide with a decrease in catalyst activity as was the case for the lower temperature tests. One possible mechanism for this is the onset of the carbon gasification (Boudouard) reaction at high temperatures. For increased CO₂ concentrations, the activity of the catalyst at high temperatures was maintained (high production of syngas) despite significant carbon deposition.

Background
Methane reforming reactions
Steam reforming: CH₄ + H₂O → CO + 3 H₂ ΔH = + 261 kJ/mol
Partial oxidation: CH₄ + 1/2 O₂ → CO + 2 H₂ ΔH = + 44 kJ/mol
Enhanced Combustion
• Adding H₂ to a hydrocarbon fuel
• Lower emissions of soot, NOₓ, hydrocarbons, and carbon monoxide
• Feed source is LFG with a fraction of it preprocessed (reformed into H₂/CO)

Results

Experimental Methods

Conclusions
• Higher temperatures yields higher mass gains
• Higher temperatures yields more H₂/CO
• No real significant change in BET
• EDX results show correct trends in terms of C
• Model development–Estimation of Durability – long term deactivation
• Space velocity, new catalyst formulations, durability, addition of inlet oxygen, long term deactivation
• No appreciable performance on Au/Al₂O₃.