



Steam Hydrogasification Study

Conversion of Biowaste to Substituted Natural Gas



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Background

- Conversion of renewable feedstock is an integral part of California's strategy to reduce greenhouse gas emissions
- In 2009, AQMD funded CE-CERT for a bench scale demonstration project to produce Substituted Natural Gas (SNG) from biowaste using Steam Hydrogasification Reactor (SHR)



Steam Hydrogasification

- Gasification in hydrogen-rich environment for SNG production
- Utilizes steam to increase the reaction rate
 - Lower residence time (smaller reactor)
 - High efficiency at lower temperature
 - High efficiency at lower pressure



Others: CO, CO₂, C₂₊

SHR Attributes

- Capable of processing wet feedstock
- No expensive oxygen plant required
- Operates at lower temperature
- Lower capital and operating costs
- More energy required to bring the reactor to gasification temperature
- Hydrogen supply

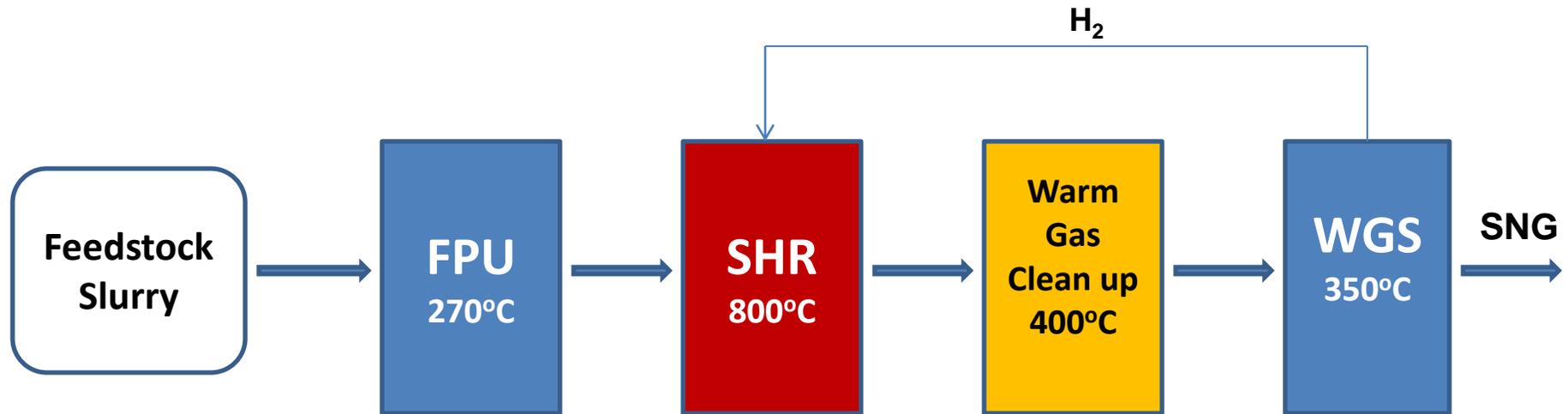
SHR Demonstration Project

- Bench scale demonstration project
- \$210K project cost (\$100K AQMD)
- Feedstock
 - Pine sawdust and biosolids (waste water sludge)
 - Pretreated in hydrothermal reactor for 40% + solids loading
- Pressurized rotating kiln type SHR
- Water Gas Shift (WGS) reactor for hydrogen supply
 - HTS catalysts used to convert CO to H₂



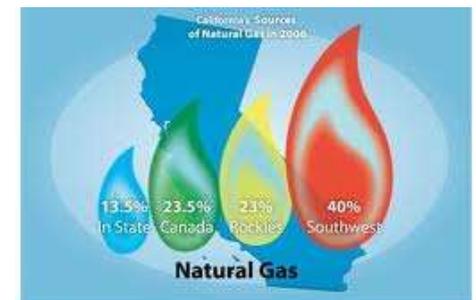
Figure 7 Kiln Steam Hydrogasification Reactor

SHR Process



Project Findings

- 60% plus carbon conversion rate
 - Unconverted carbon (Char) used for heat source
- 90% methane SNG produced at the optimum conditions
 - 1.5:1 water to feedstock mass ratio
 - 1:1 H₂/C feed mole ratio
- Capable of generating 15.4 BCF annually (5% of CA production capacity)
 - Transportation fuel
 - Electricity generation



What's Next

- PDU scale demonstration project
- Utilize Fluidized Bed to simulate production scale operation
- H₂ feedback to SHR (gas separation and compression)
- Integration with CNG generator for electricity generation
- Will provide important information for a pilot plant design

