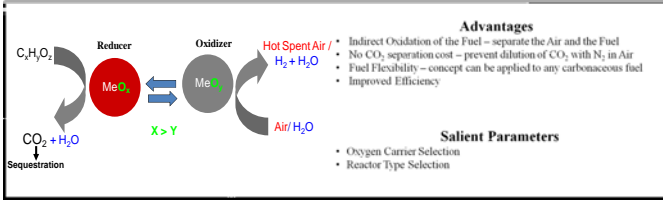


Pilot Scale Demonstration of the Syngas Chemical Looping Gasification Process

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INTRODUCTION



OXYGEN CARRIER SELECTION

Desired Properties

- Good oxygen carrying capacity
- Good gas conversions in both the reduction and oxidation reactions
- High rates of reaction
- Satisfactory long term recyclability and durability
- Good Mechanical Strength
- Suitable heat capacity and high melting points
- Low cost and ease in scale up of synthesis procedure
- Resistance to contaminant and inhibition of carbon formations
- Health and Environmental Impacts

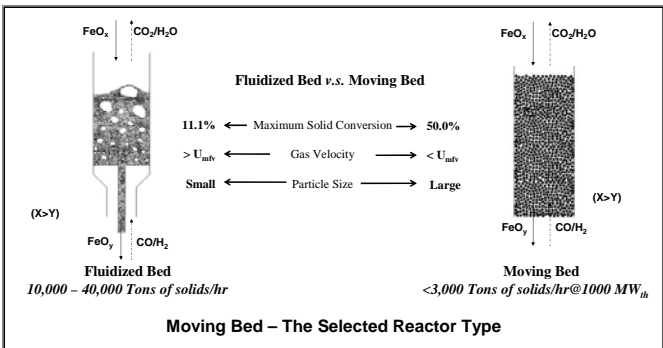
Comparisons of the Key Properties of Different Metal Oxide Candidates

	Fe ₂ O ₃	NiO	CuO	CoO
Cost	+	-	-	-
Oxygen Capacity (wt%)	30	21	20	21
Thermodynamics	+	+	+	+
Kinetics/Reactivity	-	+	+	-
Melting Points	+	-	-	+
Strength	+	-	-	-
Environmental and Health Effects	-	-	-	-

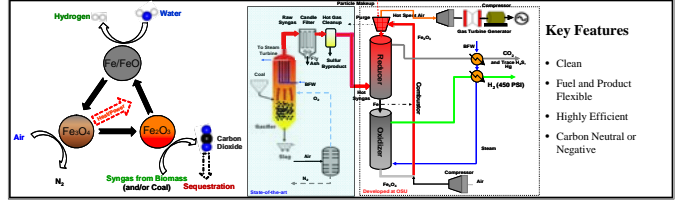
+: positive; -: negative; -: neutral

Iron Oxide – The Selected the Oxygen Carrier

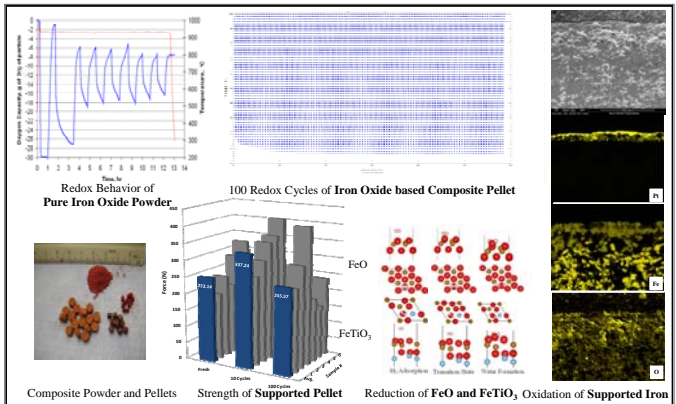
REACTOR TYPE SELECTION



SYNGAS CHEMICAL LOOPING (SCL)



OXYGEN CARRIER PERFORMANCE



PILOT SCALE SCL PROJECT

Full Size Cold Model

Hot Unit P&ID

Current Status

- B&W selected as the A&E firm;
- Preliminary P&ID completed;
- Preliminary design specification documents completed;
- Internal HAZOP completed;
- Cost estimate based on preliminary P&ID completed;
- Updated budget and schedule being prepared for DOE review.

• Construction and shakedown completed
• Finished two tests successfully

SUB-PILOT SCALE SCL DEMONSTRATION

Sub-Pilot Test and Process Analyses

- Five Test Campaigns
- 50+ hours of continuous operations
- > 99% syngas conversion and > 98% H₂ purity were achieved
- Non-mechanical valves tested successfully
- Flexible for H₂, electricity, and liquid fuel productions
- 10-20% more efficient than conventional processes with 100% CO₂ capture

Techno-Economic Evaluation of SCL

	IGCC Process	SCL Process Electricity	Conventional Coal to Hydrogen Process	SCL Process
Coal Feedstock(\$/hr)	132.9	132.9	132.9	132.9
Carbon Capture(\$/hr)	0	200	0	200
Hydrogen(\$/hr)	0	0	14.4	15.6
Net Power (MW)	348.1	422.0	57.6	57.4
Efficiency(\$/hr)	34.8	42.2	62.7	66.5

25 kWth Syngas Chemical Looping Unit at OSU

Process Concept Proved Ready for Pilot Tests

Technologies: 1. Sub-Critical PC; 2. Supercritical PC; 3. IGCC; 4. SCL-USC; 5. SCL - H₂ - CC

CURRENT STATUS AND FUTURE WORK

Task	Phase I			Phase II			Phase III			
	2010	2011	2012	2010	2011	2012	2010	2011	2012	
Cold Model Design and Testing	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3
Pilot System Design and Site Commitment from Southern										
Phase I Milestone: Smooth Cold Model Operation and Detailed P&ID										
Oxygen Carrier Particle Synthesis and Sub-Pilot Scale Testing										
Pilot System Construction and Inspections										
Phase II Milestone: Construction and Inspection of Pilot System										
Shakedown and Initial Startup of the Pilot System										
Pilot System Testing										
Process Analysis and Commercialization Plan										
Phase III Milestone: Successful Pilot Testing and Process Analyses										

Project on Schedule

ACKNOWLEDGEMENT

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- Ohio Department of Development (ODOOD)
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