

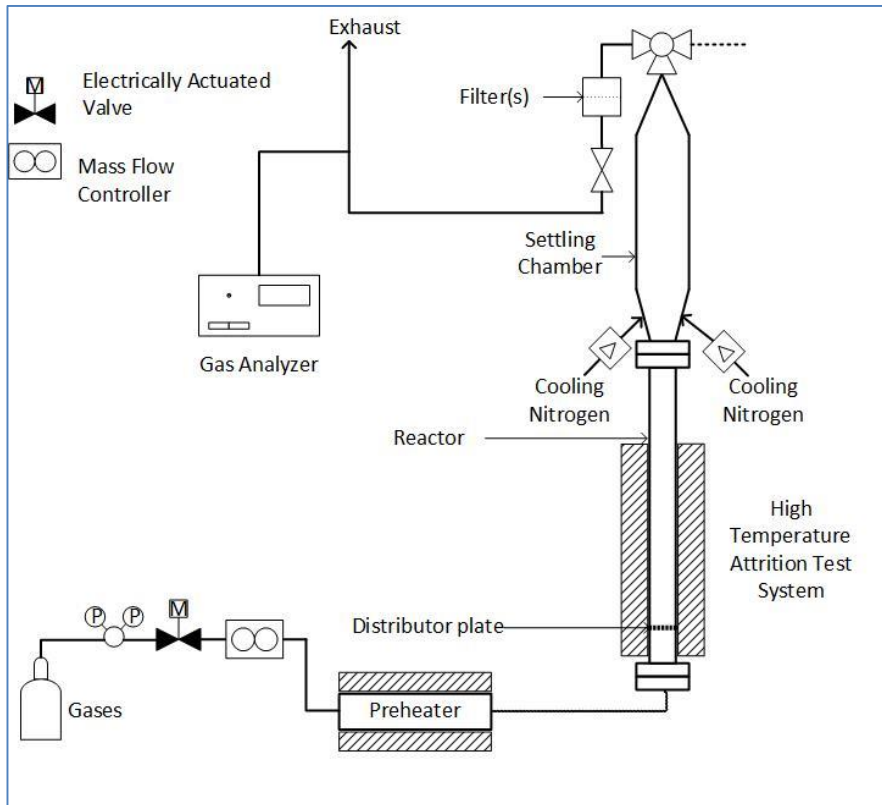
# Attrition Evaluation of Materials at High Temperatures and Reacting Conditions



Envergex LLC  
Sturbridge, MA and Grand Forks, ND

- Particle attrition (fines generation/fragmentation) results with materials during industrial processing
- Attrition can be caused by variety of mechanisms including compression, impact, shear, as well as chemical and thermal stresses
- Our unique facility is designed to evaluate particle attrition under high temperature and reacting conditions

## Jet Attrition Test Facility Console



## Jet Attrition Test Facility

- High temperature attrition test section
- Range of jet velocities
- Gases ( $N_2$ ,  $O_2$ ,  $CO$ ,  $H_2$ ,  $CH_4$  and others)
- Material quantity: 30-50 g/test
- Reacting or cyclic (oxidation/reduction) operation
- Measurements (real-time/cumulative)
  - Attrition rates
  - Real-time exit gas compositions/reaction rates for reactions
  - Retained material size distribution
  - Material microstructure / composition
  - SEM/EDAX/XRF

## Applications

- Chemical Looping – Oxygen Carrier Evaluation
- Limestone calcination
- Fluidized Bed Combustion–Limestone- $SO_2$  Capture
- Catalysts under reacting conditions
- Fluidized Bed Drying

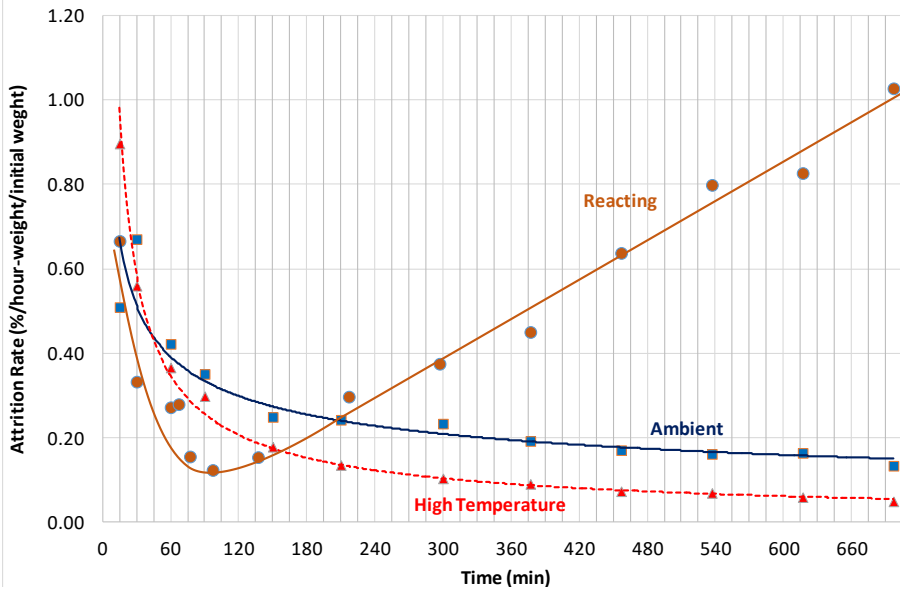
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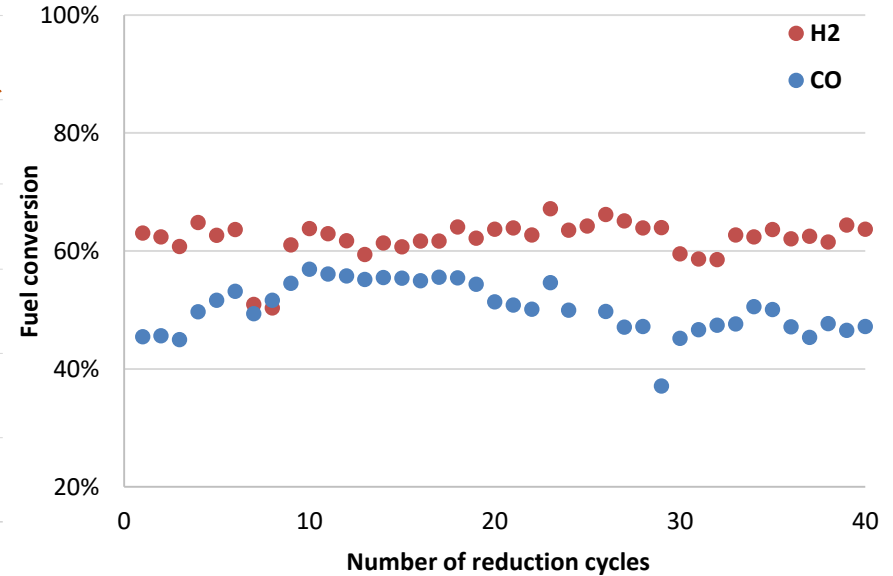
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## Jet Attrition and Reactivity Test Data

Attrition Rate of Oxygen Carrier:  
Ambient, High Temperature and Reacting Conditions



Reactivity of Oxygen Carrier



*Please contact Envergex for evaluation of  
your materials and pricing*

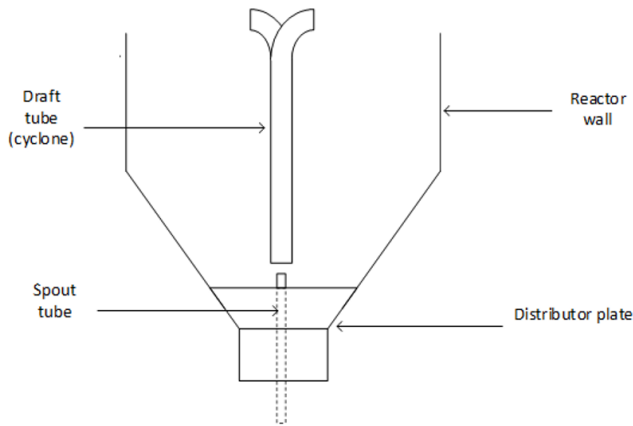
Envergex LLC  
info@envergex.com

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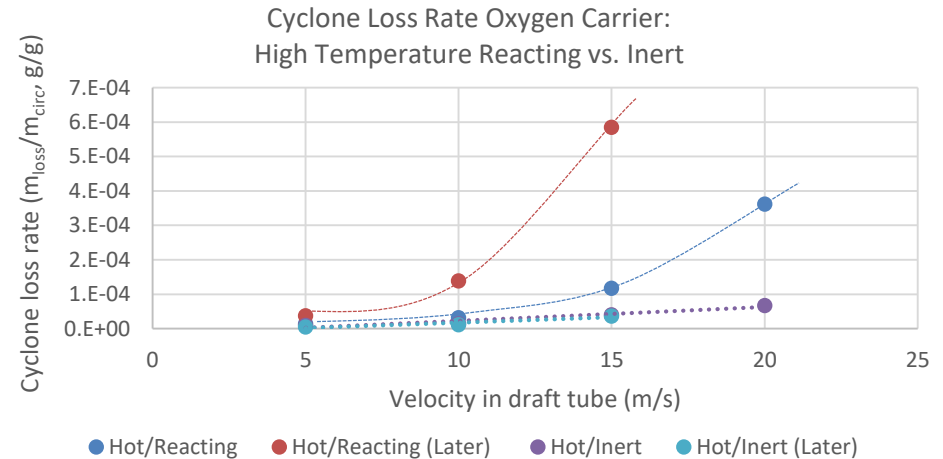
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## Cyclonic Attrition Test Facility



- High temperature attrition test section
- Cyclone inlet velocities- variable
- Gases ( $N_2$ ,  $O_2$ ,  $CO$ ,  $H_2$ , Steam)
- Material quantity: 70-100 g/test
- Reacting or cyclic (oxidation/reduction) operation
- Measurements (real-time/cumulative)
  - Attrition rates
  - Real-time exit gas compositions
  - Retained material size distribution
  - Material microstructure / composition
  - SEM/EDAX/XRF

## Cyclonic Attrition



## Applications

- Chemical Looping – Oxygen Carrier Evaluation
- $SO_2$  Capture/Calcination – Limestone Evaluation
- Catalysts under reacting conditions

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