SynFuels and Oxidizers – What is an RTO?

- Oxidizer
  - Converts volatile organic compounds (VOCs) into carbon dioxide, water
  - Oxidation is thermal process → often requires outside energy source
  - Natural Gas – Most common energy source
SynFuels and Oxidizers – What is an RTO?

- Thermal Efficiency
  - Efficiency = measure of combustion energy recovered
  - Most efficient oxidizer – regenerative thermal oxidizer (RTO)
  - RTO thermal efficiency – commonly 95% or greater
SynFuels and Oxidizers – What is an RTO?

COMBUSTION CHAMBER
HEAT RECOVERY MEDIA

ROTARY DIVERTER VALVE

Fuel Gas
Combustion Air
Inlet
Flush / Seal Air
Outlet
SynFuels and Oxidizers – What is an RTO?

- Combustion Chamber
- Heat Recovery Media
- Rotary Diverter Valve
SynFuels and Oxidizers – What is an RTO?

- Natural Gas Consumption
  - Even with 95% recovery, RTO often requires significant added energy
    - up to 7 – 14 mcfh treating 50,000 – 100,000 scfm
  - Resulting byproducts of combustion – greenhouse gas emissions
SynFuels and Oxidizers –
SynFuels Properties

- Synthetic Fuel – An alternative to consuming natural gas

- Produced from Biomass
  - Organic Waste is converted into combustible synthetic fuel (synfuel)

- SynFuel = Renewable Energy!
SynFuels and Oxidizers –
SynFuels Properties

- **Clean Burning** - like Natural Gas

- **Flexible Substitute for Natural Gas**
  - Natural Gas lower heating value (LHV) – 1,000 btu / scf
  - SynFuel LHV – 150 - 300 btu / scf
Biomass Input

- Often found as industrial waste
- Organic
- eg. Food Processing Waste, etc.
Synfuels and Oxidizers – Synthetic Fuels

- Biomass Input Variables
  - Moisture
  - Metals Content
  - Other Variables Case Specific
SynFuels and Oxidizers – What is a Gasifier?

● Principle of Gasification

- Thermochemical conversion of organic solid to combustible gas

- Uses heat to convert carbon-containing fuel into “syngas”

- Starved air process
SynFuels and Oxidizers – What is a Gasifier?

- Simple, Industrially Robust
- Flexible – Can handle
  - Different biomass
  - Fluctuating feedstock – eg. feed rate, moisture content
Design Options

- **Updraft**
- **Fluidized Bed**
- **Downdraft**

Final Selection – Site specific, feedstock specific
• Typical Gasifier Design Basis

  • Evaluate Feedstock Capabilities

    • Goal - Least amount of feedstock prep needed
      - drying, sorting, cubing, etc.
SynFuels and Oxidizers – What is a Gasifier?

- Typical Gasifier Design Basis (cont.)
  - Modular design – Scalable
    - Design and test one reactor of fixed size
    - Multiple units to meet process heat requirement
    - Maximum no. of units limited only by feed system, site constraints
    - Multiple reactors provide redundancy → high online reliability
SynFuels and Oxidizers – What is a Gasifier?

**Typical Gasifier Design Basis (cont.)**

- Modular design
  - Multiple units can operate simultaneously
  - Thermal output can exceed 100 MMbtu/hr
- Small footprint (typical 8ft. x 10ft., each module)
- Multiple Feedstock capable
SynFuels and Oxidizers – What is a Gasifier?

Biomass
(15-50% Moisture, min. 12-15 lbs/ft³, max. 6” any dimension)

Air
(~150 SCFM for 650 lb/hr biomass feed rate)

Producer Gas
(1,000°F, 165 Btu/Cu.Ft.)

Residue
(~1.5% of inlet biomass weight)
Inlet Streams -

- Biomass Feed
- Gasifier Air Volume
- Req’d Secondary Combustion Air Volume
SynFuels and Oxidizers –
Gasifier Energy Summary

Outlet Streams -

- Hot Flue Gas
- Ash Residue
SynFuels and Oxidizers –

The Sustainable System

- Little or no Impact on Byproduct Emissions

- Gasifier Combustion
  - CO emissions – 20% reduction from natural gas combustion
  - NOx, PM(10) – 0 - 3% change from permitted levels
SynFuels and Oxidizers –
The Sustainable System

- Competing Combustion
  …with Solid Waste Combustion…

  - PM(10) emission – increase by factor of 10 or more

  - NOx, CO – significant increases, depending on process
SynFuels and Oxidizers –
The Sustainable System

- Reduced natural gas consumption
- Converts organic waste into usable fuel
SynFuels and Oxidizers –

The Sustainable System

1. **FEEDSTOCK TRANSPORT & SITE STORAGE**
2. **FEEDSTOCK CONVEYING TO GASIFIERS**
3. **DRYING / AIR/O2**
4. **PYROLYSIS**
5. **OXIDATION / AIR/O2**
6. **REDUCTION**
7. **RESIDUE SEPARATION**
8. **GASIFIER MODULES**
9. **KILN, BOILER, RTO, DRYER, SYN-FUELS PROCESS, ETC.**
10. **GAS DISTRIBUTION AND BALANCING MANIFOLD**
11. **PRODUCER GAS PIPING TO PROCESS**
12. **PRODUCER GAS CYCLONE**

**Temperature Range:** 800-1,000°F