COMMERCIAL TORREFACTION: IT'S A GAS!

BBI INTERNATIONAL BIOMASS CONFERENCE & EXPO
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Dan Herren, President
Advanced Torrefaction Systems, LLC

TORREFACTION

250 – 300 C
OXYGEN-FREE ENVIRONMENT

BIO-COAL

- Carbon-neutral, renewable energy source with characteristics similar to coal
- Substitute for coal at power plants
  - Co-firing
  - 100% Replacement
- Substitute for white wood pellets at power plants
  - Biocoal = can be produced at a cost on par with white wood pellets (on an energy basis)
  - Biocoal = lower cost of use for the end user
- Many Feedstocks
  - Wood
  - Energy crops
  - Agricultural waste
  - Other waste products

OTHER BIO-COAL USES

- Feedstock for the production of liquid fuels
- Feedstock for the production of chemicals
- Energy source for heat in industrial processes
- Filler for plastics compounding
- Substitute for white wood pellets in residential and commercial heating applications
- Reducing agent in the production of steel

WHY HASN'T TORREFACTION TAKEN OFF?

- Given its tremendous potential, over the last decade torrefaction has received worldwide attention.
- Many tens of millions of dollars have been spent on the development of torrefaction technology.
- Development over the last decade includes:
  - R & D: Universities, research institutes, governments, private sector
  - Pilot and demonstration plants
  - Commercial-scale plants

Torrefaction is still not viable at commercial scale.

WHAT IS PREVENTING COMMERCIAL-SCALE TORREFACTION?

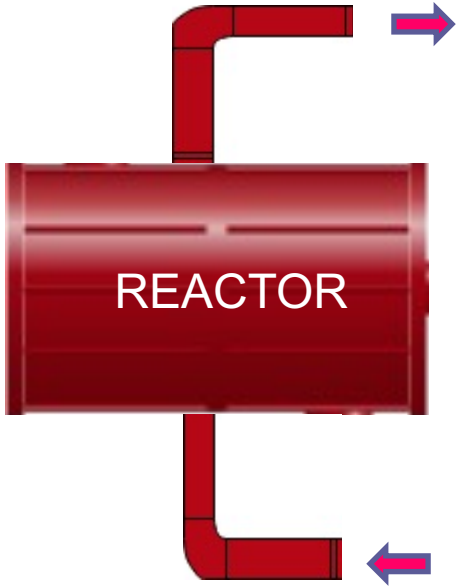
CURRENT TORREFACTION TECHNOLOGY

- **ROOT PROBLEM:** Current technology cannot effectively handle the volatile gases (VOCs) produced in the torrefaction process.
- **RESULT:** High concentration of VOCs throughout the whole system.

HIGH CONCENTRATION OF VOCs

CURRENT TECHNOLOGY

Torrefaction Gas



VOC ≈ **150,000 PPMv**

Traditional
Heat Source

(e.g. Thermal Oxidizer)

PROBLEMS CAUSED BY HIGH CONCENTRATION OF VOCs

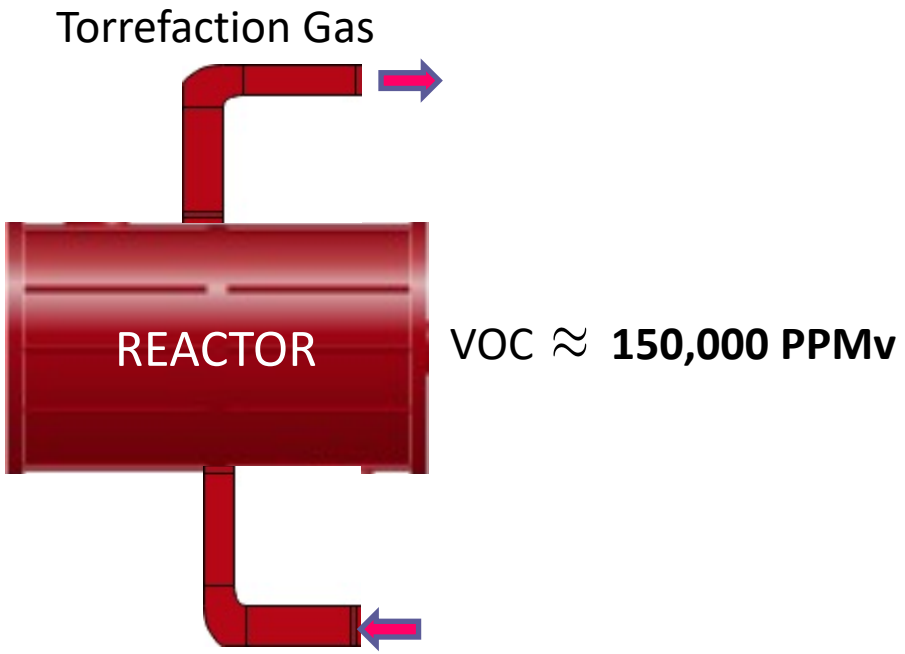
- Condensation of gases on piping, equipment and controls, negatively impacting operational reliability
- Increased risk of fires and explosions
- Employee health and safety concerns
- Environmental concerns
- Condensation of VOCs on final product

WHAT IS THE SOLUTION??

INERT GAS!

Safe, efficient and reliable torrefaction requires large volumes of inert gas for use throughout the process.

TRADITIONAL vs. INERT GAS HEAT SOURCE



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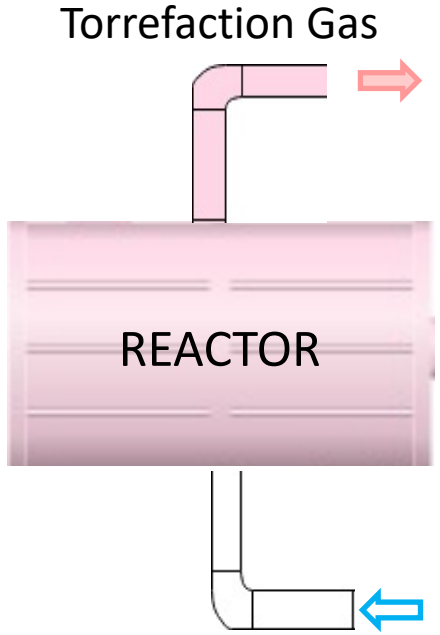


VOC ≈ **10,000 PPMv**

Inert Gas
Heat Source

Over 90% Reduction in VOCs

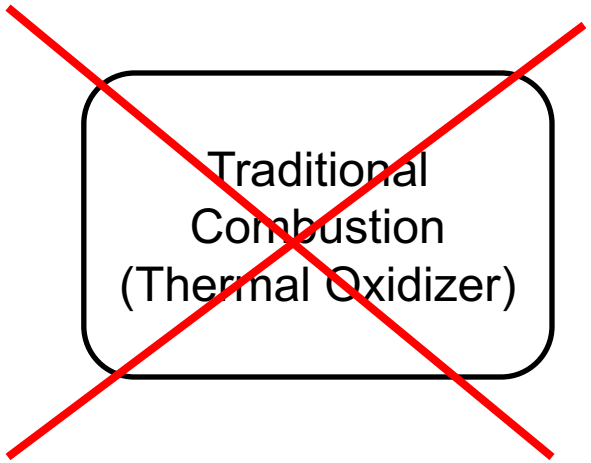
INERT GAS

- Current technology, which uses traditional combustion as the heat source for the reactor, cannot provide the inert gas required for commercial torrefaction.
- Purchasing or producing large volumes of inert gas (and heating it up) is cost-prohibitive.

SO WHERE DOES IT COME FROM?

CATALYTIC OXIDATION

CURRENT TECHNOLOGY



CATALYTIC TECHNOLOGY

OXIDATION
CATALYST

CATALYTIC OXIDATION

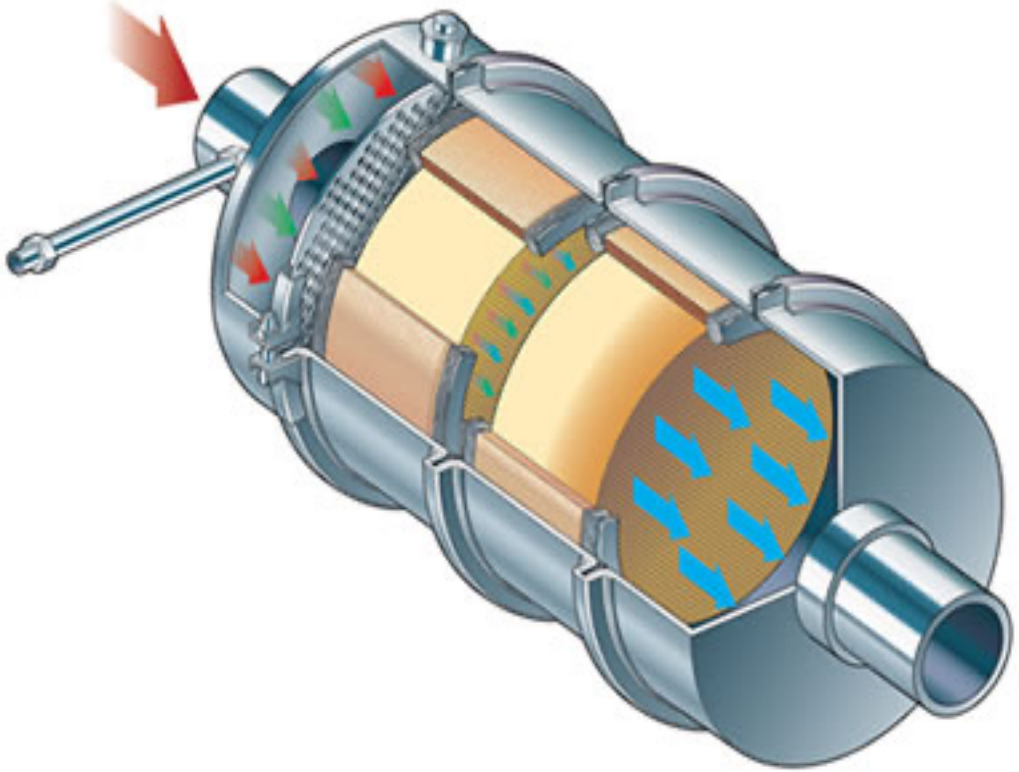
- Combusts VOCs at up to a 99+% efficiency producing an essentially inert, hot flue gas stream----and it's FREE!! as a byproduct of the combustion
  - Heat source for torrefaction and drying
  - Purge gas for use throughout entire system
  - Inert medium for cooling
- Reduces concentration of VOCs in the reactor by over 90%

BENEFITS OF REDUCING HIGH CONCENTRATION OF VOCs WITH INERT GAS FROM AN OXIDATION CATALYST

- Essentially eliminates condensation of gases on piping, equipment and controls, allowing reliable operations
- Reduces risk of fires and explosions
- Reduces employee health and safety concerns
- Essentially eliminates environmental concerns
- Reduces condensation of VOCs on final product

OXIDATION CATALYST

Process off-gas in
(VOCs, CO and H_2O)

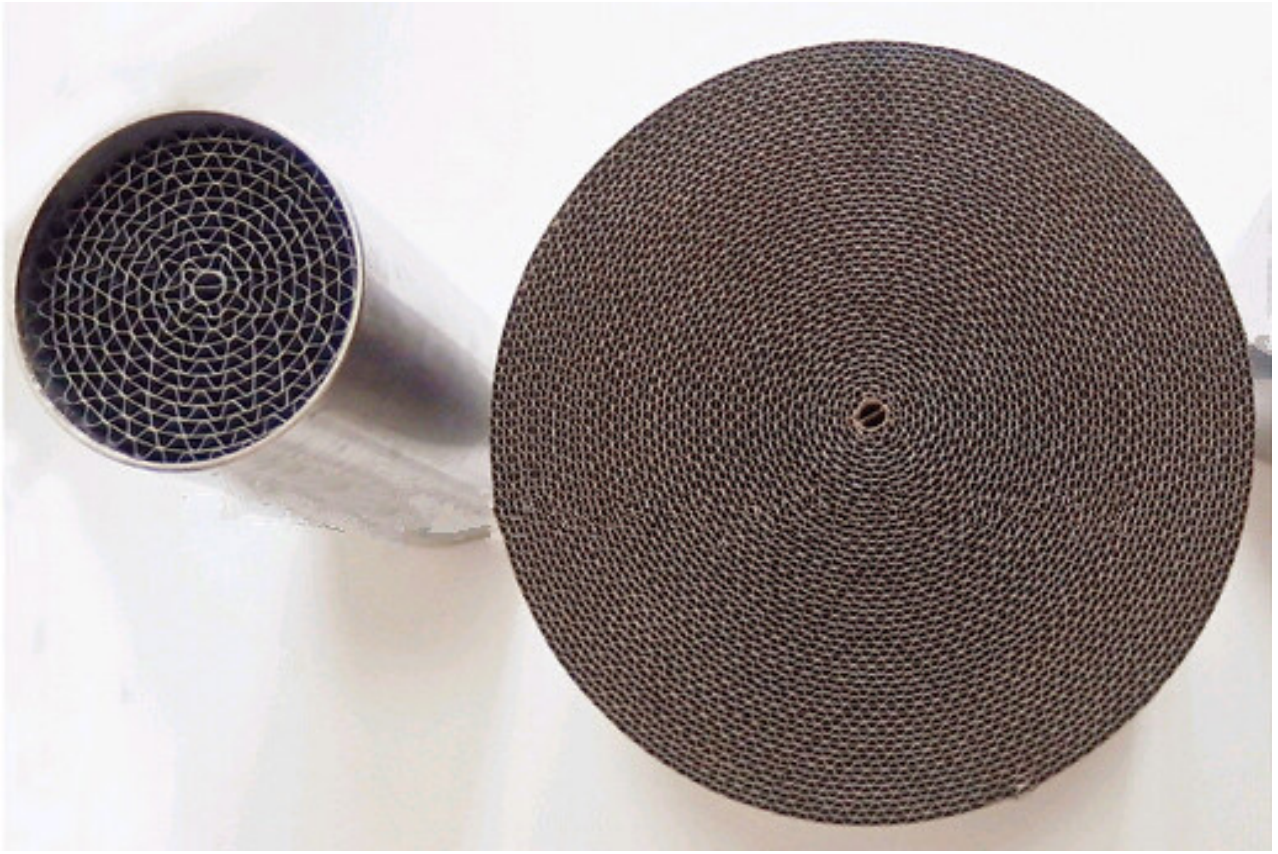


Combustion
air in

CO_2, N_2, H_2O and
heat out

From Johnson Matthey website

OXIDATION CATALYST BED



OXIDATION CATALYST

- Tried and true technology used throughout the world
- Combusts VOCs at a much lower temperature (under 1100° F) than traditional combustion
  - Creates essentially no NOx
  - Less ambient heat loss improves process efficiency

CATALYTIC OXIDATION TECHNOLOGY TESTED AT THE INL

Catalytic OxidationTechnology has been successfully tested at the Idaho National Laboratory.

Quote from Idaho National Lab Scientist-in-Charge

“Torrefaction was never this easy without the catalyst because oxygen levels are much easier to control and there is no black gooey torrefaction oil.”

Why use traditional combustion that results in a very high concentration of VOCs and the problems that creates when the use of an oxidation catalyst can reduce that concentration by more than 90%?

Catalytic oxidation is the

MISSING LINK

that will finally make torrefaction commercially viable.

THANK YOU!

DAN HERREN, PRESIDENT
ADVANCED TORREFACTION SYSTEMS, LLC
ST. LOUIS, MISSOURI
dherren@atscat.com
314-650-1186 (US)