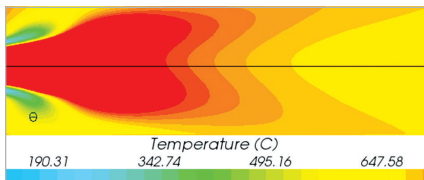


HYDROGEN FUEL BURNER TECHNOLOGY

Hydrogen is becoming more desirable as a fuel source for heaters. H₂, however, has some unique properties which lead to distinctive combustion characteristics. As a result, while hydrogen firing in conventional and ultra-low NOx burner technology is possible and solutions for firing 100% H₂ exist and can be applied to existing heaters and boilers, a burner manufacturer with experience in hydrogen firing should always be consulted. The experts at John Zink Hamworthy Combustion, a Koch Engineered Solutions Company, have proven hydrogen-firing experience.



CFD

We use proprietary CFD analysis techniques to predict and improve combustion performance and pollutant emissions, allowing us to optimize equipment within your specific application before it is ever manufactured. We've proven hydrogen-fired burners at our R&D center, the largest and most advanced testing complex of its kind.



Burners

We're a leader in process burner and boiler burner design and manufacturing, including designs for firing up to 100% hydrogen. We offer a broad range of burner solutions through some of the most trusted brands on the market.

**FIRING
100%
HYDROGEN**



Support

From installation to ongoing preventative maintenance services, our team can fine-tune your equipment for optimal hydrogen-burning performance, improved reliability, and efficient operation. We offer 24-hour emergency assistance, on-site technical support, and thousands of spare and replacement parts in stock ready to go.

Partner of Choice

GLOBAL SCALE

KES is an affiliate of Koch Industries who has \$100+ billion¹ in revenues, global presence, investment grade credit

¹ As estimated by Forbes

DECISIVE ACTION

Unrivaled ability to marshal resources to move decisively and with certainty when the right opportunities present themselves

PRIVATE

KES' status as a private company and management philosophy allows partners to focus on capturing opportunity long-term

MUTUAL BENEFIT

True partnership mentality. Expectation that KES will work to make partnerships as successful as possible

KOCH LABS

Experts: Engage KES' internal subject matter experts to help better understand market and customer opportunities as well as solving technical challenges

Develop: Use KES and Koch-affiliate facilities and businesses as a test-bed for product development and proof of concept, allowing for quicker time to market and product design cycles

Engage: Opportunity to engage KES and Koch affiliates as a partner, customer, and a supplier

Hydrogen At A Glance

HYDROGEN FACTS

- Refineries are the largest consumers of hydrogen on a global basis
- Hydrogen is produced from natural gas through Steam Methane Reforming (SMR) or Autothermal Reforming (ATR)
- Carbon dioxide is a by-product pollutant of the reforming processes
- Capturing the CO₂ emissions from the reforming process for utilization or storage avoids unwanted emissions (blue hydrogen*)
- Electrolysis of water utilizing renewable energy is an alternative means of hydrogen production without the CO₂ emissions (green hydrogen*)

POTENTIAL BURNER ISSUES

- Flashback
- Less flexibility for heavy fuels
- Increased NOx emissions
- Additional maintenance
- Incompatible materials of construction

FURNACE PERFORMANCE

- Decreased flame length
- Position of peak heat flux in furnace varies, a case-by-case CFD analysis is recommended
- Increased overall radiant heat flux

* U.S. Energy Information Administration, "Hydrogen Explained." <https://www.eia.gov/energyexplained/hydrogen/production-of-hydrogen.php>. Last accessed March 2, 2021.

HYDROGEN-FIRED SOLUTIONS	
Application	John Zink Equipment
Air Heating, Drying	<ul style="list-style-type: none"> • Kiln Burners • Air Heaters • Specialty Combustion Products • Pyro-processing Systems
Ethylene, Power Generation, Refining, Reforming, Steam Generation	<ul style="list-style-type: none"> • Low-Emission Burners • Ultra-Low Emission Burners
HRSG	<ul style="list-style-type: none"> • Duct Burners

HYDROGEN FAQs

Why hydrogen?

Hydrogen is quickly gaining traction as a strategy for carbon emissions reduction in the industry. Replacing traditional fossil fuels with green hydrogen (produced through electrolysis of water utilizing electricity from renewable sources) and blue hydrogen (produced through SMR and ATR of methane while capturing the CO₂) is an effective means to reduce your overall carbon emissions by avoiding the generation of CO₂ emissions at the combustion source.

What is the maximum composition of hydrogen in the fuel that can be fired in conventional burner technology?

Depending on the type of burner installed, up to 100% hydrogen can be fired with minor modifications to the burner. Premix burners specifically have a potential for flashback and therefore are limited in the hydrogen content which can be handled.

Will NOx emissions increase with increasing hydrogen content?

The NOx emissions could potentially increase due to the increase in adiabatic flame temperature and its impact on thermal NOx. Because hydrogen increases the flame stability, it may be possible to increase fuel staging to mitigate the overall impact on NOx emissions.

Will performance of UV flame scanners be impacted as hydrogen content increases?

Hydrogen flame is detectable in the range of 300 nm which is within the capability of current scanners. Tests performed to date with typical scanner technology have been successful from 100% natural gas to 100% hydrogen.

Provided by

