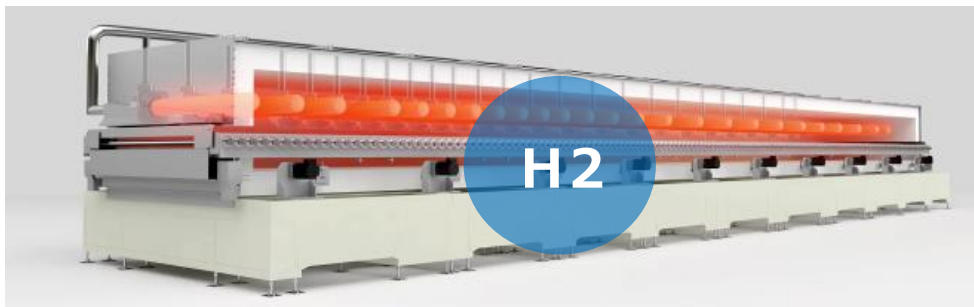


Nov.04, 2021
NORITAKE CO., LIMITED
Tokyo Gas Co., Ltd.
Tokyo Gas Engineering Solutions Corporation

World's First Hydrogen Combustion-type Continuous Combustion Furnace for Making Lithium-ion Battery Electrode Materials Goes on Sale

~Zero Carbon Achieved for Making Lithium-ion Battery Electrode Materials~

NORITAKE CO., LIMITED (Noritake), Tokyo Gas Co., Ltd. (Tokyo Gas) and Tokyo Gas Engineering Solutions Corporation (TGES) have announced the development of the world's first hydrogen combustion-type continuous combustion furnace^{*1} "C-SERT-RHK-Nero^{*2}" (Nero) for making lithium-ion battery (LiB) electrode materials. The furnace has achieved zero carbon emission for making lithium-ion battery electrode materials by adapting a special ceramic radiant tube burner. Nero, created by the fusion of Noritake's firing furnace technology^{*3} and Tokyo Gas/TGES hydrogen combustion technology^{*4} is an innovative device to realize zero carbon emission at firing.



World's first hydrogen burning-type roller hearth kiln for lithium-ion battery electrode materials (C-SERT-RHK-Nero)

Nero performs stable heat treatment using hydrogen as fuel at the high temperature (1,000 degrees C or higher) required in the manufacturing process of LiB electrode materials which are in high demand in recent years. High-temperature firing by hydrogen mono-fuel combustion does not generate CO₂, but there are issues to be cleared such as stable heating and suppression of NO_x (nitrogen oxides) generation especially in narrow space. However, by combining the three companies' technologies, they have overcome the problems and succeeded in commercializing this product.

Noritake, Tokyo Gas and TGES intend to use the highly efficient heating technology of Nero not only for LiB electrode materials, but also for applications such as automobile manufacturing fields (i.e. hot stamping) and 5G electronic parts that require stable heat treatment at high temperature. Three companies will also apply this technology in other fields of applications to contribute to decarbonization of heating processes for various products.

■ Features of this product

1. Achieve zero carbon by adapting hydrogen combustion type
2. Suppress NOx (nitrogen oxides) generation at hydrogen combustion



Since the combustion speed is fast and the flame temperature is high for high-temperature firing by hydrogen mono-fuel combustion, suppression of NOx generation is possible by original combustion technology while NOx tends to be generated especially in narrow space.

3. Achieve temperature accuracy equivalent to natural gas combustion by original firing technology and high-durability burner

Three companies have solved the issue of durability which was a problem for the conventional electric heating type by adapting special ceramic with high heat-proof and corrosion resistance (active oxidation resistance^{*5}, lithium attack resistance^{*6}) to the burner as a heating element (radiant tube). With original firing technology, stable heating such as leveling of temperature distribution, smooth temperature follow-up, and maintenance of oxygen concentration becomes possible and thus temperature accuracy equivalent to that at natural gas combustion is achieved by hydrogen combustion.

4. Applicable to heat treatment at various high temperatures

- LiB field: Cathode material, anode material, next-generation battery material
- Automobile field: Super high-tensile steel plate (hot stamp), sintered parts, plug, sensor, catalyst, magnetic material
- Communication field: 5G electronic parts, ferrite, ceramic circuit board, target material, etc.

5. Correspondence to firing mixture of hydrogen and natural gas

By firing a mixture of natural gas and hydrogen that is still high in price, CO2 emissions can be reduced while reducing energy cost compared with firing of natural gas alone.

■ Detail video on YouTube



<https://youtu.be/uZcaQGxviY>

■ RHK lineup for LiB electrode material

<Natural gas type: C-SERT-RHK>

- Capable to reduce maximum 40% energy cost, compared with electricity type
- Achieve high durability by adapting special ceramic radiant tube burner in same way as Nero

<Electricity type: C-SERT-RHK-Fos *7>

- High durability, compared with conventional electric type, by adapting special ceramic radiant tube burner in same way as Nero
- Capable with electricity when securing natural gas and hydrogen utility is difficult.

■ Noritake's website for decarbonization industrial furnace technical information

https://www.noritake.co.jp/noritake_dift/

- * 1 : Continuous hydrogen combustion-type furnace: Roller-type furnace that performs high-quality heat treatment by processing products to pass through the set temperature continuously by roller conveyance
- * 2 : C-SERT-RHK-Nero; Hydrogen combustion type C-SERT-RHK
C : Ceramic, SERT : Single End Radiant Tube Burner, RHK : Roller Hearth Kiln
Nero: means water in Greek (hydrogen combustion type)
- * 3 : Noritake's firing furnace technology:
World's leading track record in firing furnaces for manufacturing LiB electrode materials.
Noritake's consistent, high-speed and atmosphere-controlled heating technology for roller hearth kilns cultivated in tableware manufacturing contributes to the development of advanced industries with high quality and equipment technology essential for mass production.
- * 4 : Tokyo Gas/TGES hydrogen combustion technology;
They have developed regenerative burners and ceramic radiant tube burners (C-SERT) as pioneers of energy-saving burners in Japan and are proud of their track record of selling 1,200 C-SERTs.
- * 5 : Active oxidation resistance: an oxidation phenomenon that occurs in an environment with a very small amount of oxygen concentration at high temperature (aka production environment for negative electrode materials). Since this phenomenon exhausts the atoms that make up the ceramic, the life of the general-purpose ceramic heater is shortened significantly.
- * 6 : Lithium attack resistance: a phenomenon in which highly corrosive lithium contained in the cathode material melts, adheres to, and damages walls and heating equipment (gas burners and electric heaters)
- * 7 : Means light in Greek, high corrosion resistance heater type

NORITAKE CO., LIMITED

Headquarters: 3-1-36, Noritake-shinmachi, Nishi-ku, Nagoya, Aichi 451-8501, Japan

Establishment: January 1, 1904

Main Business: Industrial Products Business, Ceramics & Materials Business,
Engineering Business, Tabletop Business

Website: www.noritake.co.jp/eng/

Representative Director & President: Hiroshi Kato

Capital: 15,632 million yen

Tokyo Gas Co., Ltd.

Headquarters: 1-5-20 Kaigan, Minato-ku, Tokyo, Japan

Established: October 1, 1885

Main Business: Gas business. Electric power business. Overseas business.
Energy-related business. Real Estate business, etc.

Website : www.tokyo-gas.co.jp/en/

Representative Corporate Executive Officer, President and CEO: Takashi UCHIDA

Capital : 141.8 billion yen

Tokyo Gas Engineering Solutions Corporation

Headquarters: 1-2-3 Kaigan, MInato-ku, Tokyo, Japan

Establishment: April 1, 2015 (as a wholly owned subsidiary of Tokyo Gas Co. Ltd.)

Main Business: On-site energy services. Regional energy services. Planning, design,
construction, operation, and maintenance of energy-related facilities.
Sales for related facilities including LNG Receiving Terminals, pipelines, gas
supply facilities, power generating facilities, CHP, burner, energy utilizing
facilities, etc.

Website: www.tokyogas-es.co.jp/en

President and CEO: Yasuhiro KONISHI

Capital: 10 billion yen