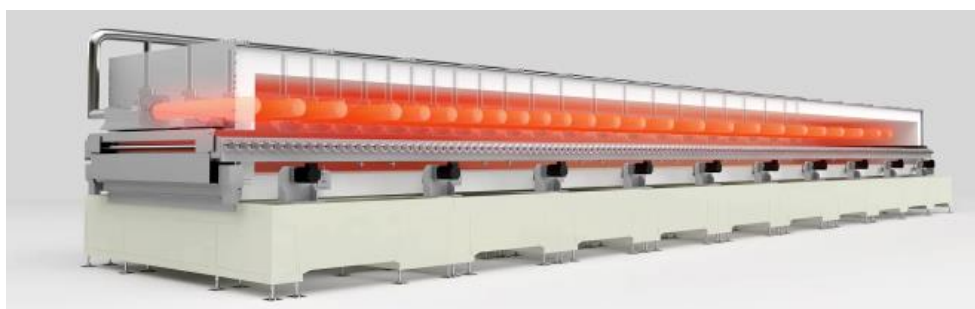


World's First Continuous Gas Combustion-type Furnace "C-SERT-RHK" for Making Lithium-ion Battery Electrodes Put on Sale by Noritake, Tokyo Gas and TGES

-Maximum 40% Reduction Achieved in Energy Costs-

NORITAKE CO., LIMITED (Noritake), Tokyo Gas Co., Ltd. (Tokyo Gas) and Tokyo Gas Engineering Solutions Corporation (TGES) have announced the world's first continuous gas combustion-type furnace for making lithium-ion battery electrodes, achieving a 40% reduction in energy costs.



The world's first gas burning-type Roller Hearth Kiln for lithium-ion battery electrodes (C-SERT-RHK)



Pilot furnace



YouTube:

<https://youtu.be/I27rXB8aWA8>



The world's first "Gas-burning Roller Hearth Kiln(*1) 'C-SERT-RHK'(*2)" for making lithium-ion battery (hereinafter "LiB") electrode materials has a highly efficient heating device that achieves energy cost reductions up to 40%(*3). C-SERT-RHK is created by the fusion of Noritake's firing furnace technology(*4) and Tokyo Gas/TGES gas combustion technology(*5) exclusively for continuous gas combustion-type furnaces by deploying TGES' special ceramic radiant tube burner.

This product performs stable heat treatment at high temperatures (1,000degC or higher) required in the manufacturing process of a LiB electrode material which is in high demand in recent years. Although the energy cost of firing at high temperature can be reduced on a gas combustion-type

furnace, an electric-type furnace has been chosen due to problems of the gas combustion type with fluctuations in furnace temperature and oxygen concentration, and durability, to name a few. 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 this product not only for LiB electrode materials, but also for applications such as the automobile-manufacturing field (i.e. hot stamping) and 5G electronic parts that require stable heat treatment at high temperatures. They will also apply this technology in other fields of applications to contribute to cost reduction of heating processes and ultimately to environmental improvement.

Special ceramic radiant tube burner to achieve stable heating and high durability

They have solved the problems of gas combustion-type burners by adopting TGES' special ceramic radiant tube burner of high heat and corrosion resistances (active oxidation resistance(*6), and lithium attack resistance(*7)) as a heating element (radiant tube) in C-SERT-RHK. Stable heating such as leveling of temperature distribution, smooth temperature follow-up, and maintenance of oxygen concentration becomes possible and thus temperature accuracy of $\Delta t=10\text{degC}$ or less is achieved at $1,300\text{degC}$.



Notes:

(*1) Roller Hearth Kiln

Roller-type furnace that achieves high quality heat treatment by processing products to pass through the set temperature for the set time.

(*2) C-SERT-RHK

Ceramic Single-end Radiant Tube Burner Roller Hearth Kiln

(*3) Trial calculation of running cost in comparison with a conventional electric-type furnace (using Japan-standard domestic energy unit price for large-volume domestic customers, furnace length 40m, effective furnace width 2,000mm, maximum temperature $1,300\text{degC}$)

(*4) Noritake's furnace-firing 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.

(*5) Tokyo Gas and TGES gas combustion technologies

They have developed regenerative burners and ceramic radiant tube burners (C-SERT) as pioneers of energy-saving burners in Japan, and are proud of a track record of selling 1,200 C-SERT units.

(*6) Active oxidation: 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.

(*7) Lithium attack: a phenomenon in which highly corrosive lithium contained in cathode materials melts, adheres to, and damages furnace walls and heating equipment (gas burners and electric heaters)

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/

President and Representative Director: 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: Takashi HIGO,

Capital: 10 billion yen

For details, please contact

Combustion System Dept. +81-3-6452-8424

tges_mm@tokyogas-es.co.jp