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Company Overview
Company Overview (As of December 31, 2017)

- **Established**
  October 1925

- **Head Office**
  1-4-16, Yaesu, Chuo-ku, Tokyo

- **Employees**
  957 : Consolidated / 480 : Non-consolidated

- **Business**
  Ferroalloys / Functional Materials / Environment / Electric Power

- **Group Affiliates**
  7 domestic, 2 overseas affiliates

- **Scale : Consolidated**

  (FY 2019) | mil. yen
  --- | ---
  Net sales | 70,477
  Total assets | 85,224
  Owner’s equity | 54,609
  Capital | 11,042
  Interest-bearing Liabilities | 13,987

- **Stock**

  (As of December 31, 2019)
  Outstanding shares | 146,568,067
## Business Sectors and Products

<table>
<thead>
<tr>
<th>Sector</th>
<th>Typical Products</th>
<th>Markets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ferroalloys</td>
<td>Ferroalloys</td>
<td>Steel, stainless steel, and specialty steel</td>
</tr>
<tr>
<td>Functional Materials</td>
<td>Cathode material for Li-ion batteries, Metal hydride alloys, Ferroboron, Zirconium oxide, Boron oxide, boric acid, Manganese inorganic chemical products</td>
<td>Lithium-ion batteries, Nickel-metal hydride cells, Neodymium magnets, amorphous metals, Electronic parts, optical lenses glass, surface treatment, Supplements, additives for laminated ceramic capacitors, etc.</td>
</tr>
<tr>
<td>Environment</td>
<td>Chromic recovery, boron recovery, nickel recovery, water and wastewater treatment facilities, Melting and solidification of incineration ash in electric furnaces</td>
<td>Surface treatment, electronic parts, automobile parts, industrial waste disposal plants, Local governments and companies discharging industrial waste</td>
</tr>
<tr>
<td>Electric Power</td>
<td>Electric power</td>
<td>Power companies</td>
</tr>
</tbody>
</table>
## History

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1925</td>
<td>Ogaki Denki Yakin Kogyosho Co., Ltd. (later Nippon Denki Yakin Co., Ltd.) established, begins production and sale of various ferroalloys</td>
</tr>
<tr>
<td>1963</td>
<td>Nippon Denko Co., Ltd. formed with merger of Nippon Denki Yakin Co., Ltd. and Toho Denka Co., Ltd.</td>
</tr>
<tr>
<td>1969</td>
<td>Tokushima Plant built, begins operation (equipped with pier facilities and large electric furnace)</td>
</tr>
<tr>
<td>1970</td>
<td>Completed first electric furnace (40,000 KVA) at Kashima Plant</td>
</tr>
<tr>
<td>1976</td>
<td>Began producing manganese inorganic chemical products at Taguchi Plant (current Myoko Plant)</td>
</tr>
<tr>
<td>1984</td>
<td>Begins production and sale of ferroboron using an electric furnace</td>
</tr>
<tr>
<td>1989</td>
<td>Begins production and sale of zirconium oxide</td>
</tr>
<tr>
<td>1996</td>
<td>Begins sale of AQUA PACK cartridge-type demineralizer</td>
</tr>
<tr>
<td>1999</td>
<td>Begins sale of MR-PACK pure water production unit</td>
</tr>
<tr>
<td>2000</td>
<td>Completes expansion of ferroboron production facility</td>
</tr>
<tr>
<td></td>
<td>Completes new zirconium oxide plant</td>
</tr>
<tr>
<td>2002</td>
<td>Starts up nickel recovery and recycling</td>
</tr>
<tr>
<td>2003</td>
<td>Acquires lithium manganese battery materials business</td>
</tr>
<tr>
<td>2004</td>
<td>Starts fluorine and phosphorus recovery and recycling business / Begins delivery of pure water production units for fuel cell use</td>
</tr>
<tr>
<td>2005</td>
<td>Completed construction of waste melting furnace (EM1) at Kashima Plant and began treatment of industrial waste and special industrial waste.</td>
</tr>
<tr>
<td>2010</td>
<td>Completes first stage of large-scale plant for automotive battery materials</td>
</tr>
<tr>
<td>2011</td>
<td>Completes second stage of large-scale plant for automotive battery materials</td>
</tr>
<tr>
<td>2013</td>
<td>Acquires manganese mining interests in South Africa</td>
</tr>
<tr>
<td></td>
<td>Obtained approval for soil decontamination at Kashima Plant.</td>
</tr>
<tr>
<td>2014</td>
<td>Changes Japanese name upon merger with Chuo Denki Kogyo Co., Ltd. (English name unchanged)</td>
</tr>
<tr>
<td>2014</td>
<td>Received facility accreditation under the Japanese government’s Feed-In Tariff (FIT) scheme for renewable energy sources</td>
</tr>
<tr>
<td>2018</td>
<td>Completed construction of waste melting furnace (EM3) at Kashima Plant.</td>
</tr>
<tr>
<td>2019</td>
<td>Begins the operations at Horoman-gawa No. 3 Power Plant</td>
</tr>
</tbody>
</table>
Ferroalloys, materials essential to steel

Ferroalloys are of vital importance in making steel, as they are a necessary “seasoning” found in every piece of steel.

### Steelmaking process

<table>
<thead>
<tr>
<th>Steelmaker</th>
<th>Coke</th>
<th>Blast furnace</th>
<th>Converter furnace</th>
<th>Completion as steel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iron ore</td>
<td>Sinter</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Limestone</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Ferroalloys are of vital importance in making steel, as they are a necessary “seasoning” found in every piece of steel.

### Typical ferroalloy products and applications

<table>
<thead>
<tr>
<th>Ferroalloy</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ferromanganese (main product)</td>
<td>Make steel stronger &lt;br&gt; Nippon Denko main product: Ferromanganese</td>
</tr>
<tr>
<td>Silicomanganese</td>
<td></td>
</tr>
<tr>
<td>Ferrovanadium</td>
<td>Oil well casings, line pipes, springs</td>
</tr>
<tr>
<td>Ferrochrome</td>
<td>Stainless steel products</td>
</tr>
<tr>
<td>Ferrosilicon</td>
<td>Deoxidizing</td>
</tr>
</tbody>
</table>

They make steel stronger and tougher, as well as more resistant to heat and corrosion.

### Ferroalloys market scale (2019)

In Japan, approx. 447 billion yen <br> (Source: Nippon Denko estimate)

The trading price depends mainly on global market conditions. <br> Trading takes place at a price calculated by converting the global price in US dollars to yen at foreign exchange rates. <br>(Similar to the export industry, the profit structure is such that a weaker yen increases profits.)
Our main product, high-carbon ferromanganese

Main raw materials

Manganese ore
Manganese ore imported from various countries is refined using optimal blending techniques. Saves electricity and other energy.

Coke
Made by steaming and baking coal. Acting as a reducing agent, removes oxygen in the ore.

Electric furnace
Melts at very high temperatures.

Every measure is taken to protect the environment.
Exhaust gas is used as fuel for in-house power generation.

High-carbon ferromanganese
High-carbon ferromanganese is a ferromanganese product having a relatively high amount of carbon.

Nippon Denko has the No. 1 share in Japan

Metals from electric furnace

After cooling, becomes a product

Slag
Note: Slag is a by-product occurring in the process of manufacturing metal.
Global crude steel production in each country and ferroalloy production by product

Global crude steel production

- China
- Jpn
- EU
- CIS
- N.America
- S.America
- Africa
- Others

(Source: WSA data)

Global ferroalloy production

- HcFeMn
- M·Lc-FeMn
- SiMn
- FeCr

(Source: IMnI data [FeMn and SiMn]; ICDA data [FeCr]; USGS data [others])
Trends in ferroalloy production and imports, and crude steel production (Japan)

- Ferroalloy production and imports (1,000 tons)
- Crude steel production (mil. tons)

Percentage of ferroalloys produced domestically

(Source: Steel statistics, Nippon Denko estimates)

Ferromanganese
Silicomanganese
Ferrochrome

(Source: Steel statistics)
Ferroalloy raw material: Global production and trade in manganese ore

Global production of manganese ore
2018: 57.36 mil. tons

Ore from China is mostly low-grade ore
Processing low-grade ore results in a large amount of slag, for a low metal recovery rate.

Mostly high- or medium-grade ore
Less slag is produced than with low-grade ore, so the metal recovery rate is higher.

Japan’s manganese ore imports
2019: 1.04 mil. tons

Chile’s manganese ore imports
2019: 34.19 mil. Tons (Estimated)

Chinese manganese ore import volume
(mil. tons)

Global production of manganese ore

(Source: IMnI data)

China's manganese ore imports
(Source: Ministry of Finance customs data)

(Source: IMnI data)

(Source: China Customs data)

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### Product price (quarterly average)

<table>
<thead>
<tr>
<th>Period</th>
<th>FMnH (Eur)</th>
<th>FMnH (US)</th>
<th>Mn ore</th>
</tr>
</thead>
<tbody>
<tr>
<td>'11</td>
<td>1,042</td>
<td>1,073</td>
<td>5.5</td>
</tr>
<tr>
<td>'12</td>
<td>1,044</td>
<td>1,075</td>
<td>4.7</td>
</tr>
<tr>
<td>'13</td>
<td>984</td>
<td>1,053</td>
<td>4.5</td>
</tr>
<tr>
<td>'14</td>
<td>902</td>
<td>1,050</td>
<td>4.5</td>
</tr>
<tr>
<td>'15</td>
<td>823</td>
<td>1,034</td>
<td>4.2</td>
</tr>
<tr>
<td>'16</td>
<td>819</td>
<td>937</td>
<td>3.2</td>
</tr>
<tr>
<td>'17</td>
<td>836</td>
<td>937</td>
<td>3.2</td>
</tr>
<tr>
<td>'18</td>
<td>724</td>
<td>881</td>
<td>2.8</td>
</tr>
<tr>
<td>'19</td>
<td>695</td>
<td>840</td>
<td>2.1</td>
</tr>
</tbody>
</table>

Source: Metals Week [US market]; Metal Bulletin [European market]

### Product prices and ore prices

![Graphs showing the transition list (FMnH & Mn Ore) and FMnH ($/t) / Mn Ore ($/Mn%)](image_url)
Ferroalloys business of Nippon Denko

- **High-carbon ferromanganese**
  - High-carbon ferromanganese is our company’s main product. It is produced domestically, taking advantage of the competitiveness of the Tokushima and Kashima Plant.
  - The product has a very high manganese content with few impurities. It is used as an additive in the final stage of steelmaking, in place of manganese metal. (see p. 14)
  - Manganese metal: A metal with a manganese purity of nearly 100%. It is used as an additive in making steel, stainless steel, and aluminum.

### Trends in percentage of each alloy in Nippon Denko ferroalloys sales

<table>
<thead>
<tr>
<th>Year</th>
<th>Others</th>
<th>Ferrovanadium</th>
<th>High-carbon ferromanganese</th>
<th>SLP Ferromanganese (our product name)</th>
<th>Silicomanganese</th>
</tr>
</thead>
<tbody>
<tr>
<td>'14</td>
<td>10</td>
<td>7</td>
<td>68</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>'15</td>
<td>4</td>
<td>7</td>
<td>62</td>
<td>14</td>
<td>14</td>
</tr>
<tr>
<td>'16</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>17</td>
<td>4</td>
</tr>
<tr>
<td>'17</td>
<td>1</td>
<td>6</td>
<td>17</td>
<td>17</td>
<td>3</td>
</tr>
<tr>
<td>'18</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>15</td>
<td>4</td>
</tr>
<tr>
<td>'19</td>
<td>5</td>
<td>1</td>
<td>69</td>
<td>18</td>
<td>5</td>
</tr>
</tbody>
</table>

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High-purity ferromanganese is being manufactured by means of original technology using as raw material a by-product of high-carbon ferromanganese.

- Demand will rise further with increased production of high-grade steel.

An electric furnace was added in 2008. Production capacity was raised from 18,000 tons to 30,000 tons annually.

- In 2010, further expansions raised annual production capacity from 30,000 tons to 40,000 tons.

- We are helping to ensure stable procurement by users and increase our earning power.

What is SLP ferromanganese?
(SLP: Super-low phosphorus)

- Very low-carbon ferromanganese with manganese purity of 90% and low phosphorus content.

- As a raw material essential to high-grade steel production, it is used in place of manganese metal.

Manganese metal

- Annual demand for manganese metal in Japan is about 50,000 tons, all of which is imported, some 90% of it from China.

- Because of the very high dependence on China, producing it in areas other than China or possibly switching to an alternative are options being considered.

Superiority

Strategy

Manganese metal

- Annual demand for manganese metal in Japan is about 50,000 tons, all of which is imported, some 90% of it from China.

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Superiority

Strategy

Manganese metal

- Annual demand for manganese metal in Japan is about 50,000 tons, all of which is imported, some 90% of it from China.

- Because of the very high dependence on China, producing it in areas other than China or possibly switching to an alternative are options being considered.
Resource strategy and optimal location are the way to win out over rivals

- Domestic production in our top field: High-carbon ferromanganese

  Domestic Plant (Tokushima & Kashima), one of the world’s most competitive

  Enable just-in-time supply by producing in domestic plants located near the sea

  Obtaining stable supply of the ores needed for ferroalloy production
  - Acquired manganese mining interests
    Investment in Kudumane Investment Holding which invests to Kudumane Manganese Resources (South Africa)
  - Diversification of ore procurement sources

- Grow stronger through best-location production

  Silicomanganese, ferrosilicon, etc.

  Measures

  Use of low-cost electricity

  Participate in Malaysian production

  Pertama Ferroalloys Sdn. Bhd. (Malaysia)
Functional Materials
### Functional materials products

<table>
<thead>
<tr>
<th>Functional materials products</th>
<th>Type and use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cathode material for lithium ion batteries</td>
<td>Cathode materials for lithium-ion batteries</td>
</tr>
<tr>
<td>Metal hydride alloys</td>
<td>Anode materials for nickel-hydrogen batteries</td>
</tr>
<tr>
<td><strong>Ferroboron</strong></td>
<td></td>
</tr>
<tr>
<td>For amorphous alloys</td>
<td>Raw material of amorphous alloy (FeSiB)</td>
</tr>
<tr>
<td>For magnets</td>
<td>Raw material of neodymium iron boron (NdFeB) magnet alloy</td>
</tr>
<tr>
<td>For steel</td>
<td>Used as additive in steel as one kind of ferroalloy</td>
</tr>
<tr>
<td><strong>Manganese inorganic chemical products</strong></td>
<td>See p. 22 for details.</td>
</tr>
<tr>
<td><strong>Zirconium oxide</strong></td>
<td></td>
</tr>
<tr>
<td>For electronic ceramics</td>
<td>Raw material of ceramic capacitors, PZT piezoelectric actuators etc.</td>
</tr>
<tr>
<td>For glass</td>
<td>Used as additive in high-refractive optical glass lenses, etc.</td>
</tr>
<tr>
<td>For functional film</td>
<td>Raw material of optical adjustment coating and hard coating materials, etc.</td>
</tr>
<tr>
<td>Composite oxide for catalysts</td>
<td>Catalytic promoter for purifying automobile exhaust gas</td>
</tr>
<tr>
<td><strong>Boron oxide, boric acid</strong></td>
<td></td>
</tr>
<tr>
<td>For glass</td>
<td>Used as additive in liquid crystal glass, optical glass, glass fiber, etc.</td>
</tr>
<tr>
<td>Other applications</td>
<td>Raw material of boron compounds, disinfectants, surface treatment agents, etc.</td>
</tr>
</tbody>
</table>
Lithium-manganese oxide

Our Cathode materials for lithium-ion batteries

- Start commercial production in 1997
- The pioneers of cathode materials for large lithium-ion batteries
- ISO 9001 and ISO 14001 certified plants
- The contract manufacturing asked from Sumitomo Metal Mining

Main applications

Large lithium-ion batteries for EV and HEV.
Large lithium-ion batteries for Energy storage system.

Principle of lithium-ion batteries

Battery materials manufacturing plant
(Takaoka, Toyama Prefecture)

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**Metal hydride alloys (Hydrogen storage alloys)**

- 1992 started commercial production.
- Global No.1 supplier of these alloys for use in hybrid car batteries employed in Toyota hybrid vehicles.
- ISO 9001 and ISO 14001 certified plant

**Main applications**

Anode material for nickel-hydrogen batteries used as drive batteries in hybrid vehicles.

**Features of Metal hydride alloys**

- Long life span equivalent to vehicle life
- Ample output to ensure startability at low temperatures and power acceleration

**Principle of nickel-hydrogen batteries**

Charge $\rightarrow$ Discharge $\leftarrow$

Metal hydride alloys anode

$$\text{NiOOH} + \text{MH} \rightarrow \text{Ni(OH)}_2 + \text{M}$$
### Ferroboron: Key to energy saving and advanced functionality

<table>
<thead>
<tr>
<th>Product</th>
<th>Description</th>
<th>Use or typical applications</th>
</tr>
</thead>
</table>
| For amorphous alloys | Amorphous (noncrystalline) alloy ribbons with thickness of just a few tens of microns are produced by extremely rapid cooling of Fe, Si, B, or other alloys from molten state, at a rate of around a million degrees C per second. | Used mainly as the steel core material of amorphous transformers  
When amorphous alloys are used as steel core material in transformers, electrical (no-load) loss at the steel core is very small for improved energy efficiency.  
- In China and India, where the electric power infrastructure is being put in place, adoption of energy-saving amorphous transformers is growing.  
- In Japan, the Top Runner energy efficiency program was applied to industrial transformers in April 2006.  
- In the US, energy efficiency standards even stricter than Japan’s Top Runner program came into force in January 2010 applicable to distribution transformers.  
- Demand is expected to grow even further with the growing global trend toward energy efficiency. |
| For magnets     | A neodymium iron boron (NdFeB) magnet is the strongest kind of permanent magnet. These magnets are essential to making smaller, lighter, and more efficient products from electronic devices to home appliances and automobiles, resulting in energy savings. | Typical applications of NdFeB magnets  
- Motors of hybrid vehicles and electric vehicles  
- Head actuator mechanism for hard disk drive reading and writing  
- Motors in energy-efficient appliances (air conditioners, etc.)  
- Electrical generator in wind power system |
| For steel       | Adding a very small amount (10 to 100 ppm) of boron to steel improves its hardenability and high-temperature strength.                                                                                         | Typical applications  
Wires used in suspension bridges, nuts and bolts, claws of power shovels  
- Nippon Denko is the only ferroboron manufacturer outside of China. |
Manganese inorganic chemical products

- **Overview of manganese inorganic chemical products business**
  - 1976 Started commercial production
  - The only Japanese domestic manufacturer of diverse manganese inorganic chemical products
  - ISO 9001 and ISO 14001 certified plants
  - Kosher and FDA certified plant (manganese sulfate)

- **Features of manganese inorganic chemical products**
  - Holder of technology for high-purity refining of manganese ore
  - Thorough removal of alkaline metals and alkaline earth metals by crystallization and recrystallization processes
  - Thorough removal of iron by use of oxidizing agent and optimization of reaction pH

- **Types and uses of manganese inorganic chemical products**

<table>
<thead>
<tr>
<th>Products</th>
<th>Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manganese sulfate</td>
<td>Animal feed additives, catalyst raw materials, supplements, fertilizers</td>
</tr>
<tr>
<td>High-purity manganese sulfate</td>
<td>Cathode materials for lithium-ion batteries</td>
</tr>
<tr>
<td>Manganese carbonate</td>
<td>Animal feed additives, surface treatment agent raw materials, soft ferrite</td>
</tr>
<tr>
<td>High-purity manganese carbonate</td>
<td>Additive in laminated ceramic capacitors, thermistors</td>
</tr>
<tr>
<td>Chemical manganese dioxide</td>
<td>Ozone decomposition catalysts, deodorizing catalysts, oxidizing agents for organic synthesis</td>
</tr>
<tr>
<td>Reduced ore</td>
<td>Flux</td>
</tr>
</tbody>
</table>

Manganese inorganic chemical products manufacturing plant (Myoko, Niigata Prefecture)
What is zirconium oxide?

- Electronic ceramics, with zirconium oxide as raw material, have the electrical properties for storing electricity and converting between electricity and pressure.
- A high refractive index is achieved by using zirconium oxide as an additive in optical glass and functional film.

Nippon Denko and zirconium oxide

- Began production at the Tokushima Plant in 1989
- Won acclaim for ultrafine particles and high purity
- Sold mainly for use in electronic parts and optical lenses

Main applications and products

<table>
<thead>
<tr>
<th>Electronic ceramics</th>
<th>Glass and film</th>
</tr>
</thead>
<tbody>
<tr>
<td>This material is used in ceramic capacitors and ceramic filters in the electrical circuits of digital consumer electronics, PCs, mobile phones and other digital devices. It is also used in inkjet printers, for example in devices controlling ink spraying. Another application is for use in gyro sensors for preventing camera shake and for detecting smartphone tilt.</td>
<td>Another use is in the optical lenses of digital cameras, and in films for liquid crystal displays.</td>
</tr>
</tbody>
</table>
Zirconium oxide ~ Expanding application to new fields ~

- **Catalytic promoter for purifying automobile exhaust gas (ceria-zirconia)**
  - Used in three way catalysts for automobile exhaust gas.
  - Oxidation and reduction reactions remove pollutants from exhaust.
  - Its role is to store and release oxygen as oxidation and reduction reactions take place.

  ![Chemical Reaction Diagram](image)

  \[
  \text{HC} \rightarrow \text{CeO}_2 \rightarrow \text{CeO}_{2-x} + \frac{X}{2}\text{O}_2
  \]

  - Oxygen storage
  - Oxygen release

- **Zirconium oxide for functional film**
  - Mainly used as an optical adjustment coating material in functional films for touch panels.

  - **Zirconia properties**
    - High refractive index (highly transparent)
    - High hardness
    - Resistant to photocatalysts

  - **Development goals**
    - High dispersibility in solvent
    - Primary particle diameter microscopically small and uniform
Having a large ion exchange resin recycling plant in Koriyama, Fukushima Prefecture, we rent and sell ion exchange towers which are water treatment equipment and perform resin regeneration on consignment.

### Pure Water Technology

**AQUA PACK**

- Cartridge demineralizer
  - Simple and easy-to-use demineralizer filled with ion-exchange resin
  - By simply connecting the unit directly to a faucet
  - Creates high-purity water by removing Ca, Na, SO4, Cl, SiO2, etc., in tap water.

**MR PACK**

Pure Water System that combines the reverse osmosis membrane (RO membrane) with the ion-exchange resin tower.

- Space-saving by a compact design
- Easy to operate by automatic control
- Capable of presenting a product specifications in accordance with customers’ demand
  - For washing of surface treatment
  - For the water for boilers and air-conditioning
  - For experiments and analysis
  - For hydrogen production

---

**Contribution to the hydrogen society**

<table>
<thead>
<tr>
<th>Purified water manufacturing for home-use fuel cells</th>
<th>Use of home fuel cells as alternative energy is on the rise. Fuel cells generate electricity from hydrogen, which is extracted from a reaction between purified water and natural gas or other source. Drawing on a wealth of experience in ion exchange resin regeneration, we are building up our business in fuel cell-related fields.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purified water manufacturing for hydrogen stations</td>
<td>Hydrogen stations are being built as Toyota Motor begins commercial sale of fuel cell vehicles. We started manufacturing purified water equipment for hydrogen production in 2005 in preparation for the Aichi Expo, and we has the top share in Japan for hydrogen stations.</td>
</tr>
</tbody>
</table>
Melting and Solidification of Incineration Ash in Electric Furnace

■ History of business
- In 1995, Chuo Denki Kogyo became the first private company in Japan to begin treatment of incineration ash generated from municipalities by melting in a ferroalloy furnace.
- In 2002, a dedicated furnace was put into operation, and treatment of industrial waste was started.
- The processing capacity of the dedicated furnace was increased in 2013.
- In 2018, the third dedicated furnace was put into operation.

■ Features
- Due to high-temperature melting and solidification, the treatment is able to break down dioxin and detoxify and stabilize heavy metals.
- The generated slag being of stable quality, it is sold for a wide range of uses as ECOLAROCK (registered trademark).
- Valuable metals (gold, silver, copper, etc.) contained in the molten metal are recycled and used.

■ Applications
- Roadbed material
- Leveling material for solar panel installation
- Embankment material for disaster recovery
- Base material for river embankment work

Environment
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Electric Power
### Electric power business

- **Overview of electric power business**
  - We built a hydroelectric power plant at Horoman-gawa River in Hokkaido in early Showa period for the pioneer of the development of the power supply in Hidaka area.
  - Renewed the power generation facilities at the No.2 and No.3 power plant.
  - Transform business to the electricity sales taking advantage of feed-in tariff system.

<table>
<thead>
<tr>
<th>Power generation facility</th>
<th>Output</th>
<th>Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horoman-gawa No. 2 Power Plant</td>
<td>4,406kW</td>
<td>Started from Nov, 2017</td>
</tr>
<tr>
<td>Horoman-gawa No. 3 Power Plant</td>
<td>6,222kW</td>
<td>Started from Feb. 2019</td>
</tr>
</tbody>
</table>
Research and development
Activity of research and development

We organize research and development activities as "Search", "Product development" and "Process technology development", and will push forward with effective research and development based on the business strategy of each business segment.

- **Ferroalloys**
  - Increase cost competitiveness and R&D for the reinforcement of the technique for environment.

- **Functional Materials**
  - Product development and process technology development to respond to various customer requests.
  - Product search for the future making use of our strengths.

- **Environment**
  - Product development to respond to customer requests in the water treatment and pure water system field.
  - Process technology development for the Melting and Solidification of Incineration Ash.

R&D organization

- **R&D Laboratory** (Anan, Tokushima): Develops ferroalloys, Functional Materials and Environment
- **Myoko Research Unit** (Myoko, Niigata): Develops raw materials for batteries and basic research