

# R&D and Intellectual Property Activities

Supporting the Kobe Steel Group, the Technical Development Group engages in basic and advanced research and works closely with the business segments. Kobe Steel's laboratories pursue the development of truly distinctive "Only One" products and ever higher levels of manufacturing excellence.

The Technical Development Group serves as Kobe Steel's R&D base, undertaking research to enhance the profitability of the business segments while pioneering new products and technologies for the future.

## R&D Activities

### Materials Research Laboratory

The Materials Research Laboratory (MRL) bases its research on four technical fields: refining and solidification, materials design, mechanical working and surface control. For the materials business, MRL is working to develop new high-performance products based on material and surface design and control, as well as optimize manufacturing processes. For machinery-related businesses, MRL focuses on creating differentiated products utilizing its expertise in materials. MRL also strives to develop new businesses based on high value-added products.

### Mechanical Engineering Research Laboratory

At the core of the Mechanical Engineering Research Laboratory are the fields of structure, strength, dynamics, acoustics, fluid and heat transfer, combustion, advanced simulation technology in the chemical field and testing, measurement and analysis technologies. This laboratory focuses on enhancing product performance and production processes, streamlining designs, and developing new products and technologies to improve product development capabilities in machinery, materials, the environment, energy and steel structures.

### Production Systems Research Laboratory

The Production Systems Research Laboratory (PSRL) introduces innovation to production technologies to bolster the Group's manufacturing capabilities, utilizing cutting-edge technologies for measurement and inspection, control, production planning, information systems and signal processing. It also seeks to develop new lineups of products that have at their core the strong technologies it has cultivated.

### Electronics Research Laboratory

The core technologies of the Electronics Research Laboratory (ERL) include those related to thin-film materials, microfabrication and superconductivity. ERL plays a part in strengthening the Kobe Steel Group's business competitiveness in such growth fields as nanotechnology, the environment and energy. In addition, it capitalizes on its electromagnetic design and electronic control technologies in its efforts to develop novel products in power electronics and to make inroads into new businesses.

### Coal & Energy Technology Department

The Coal & Energy Technology Department (CETD) is developing energy conversion technologies such as upgrading low-grade coal through dewatering and deashing, coal liquefaction and hydro-cracking of heavy oil. CETD is striving to find ways to effectively use the world's untapped natural resources and contribute to securing stable and diversified energy sources for Japan.

### R&D-related Subsidiaries

- Kobelco Research Institute, Inc.
- Shinko Research Co., Ltd.

## Recent R&D Achievements

### Structural Analysis of Materials at Atomic Level Helps Create New Products and Technologies

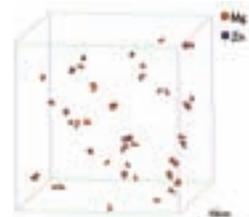
Kobe Steel has developed technology for a three-dimensional atom probe for atomic-level analysis of the microstructures that determine the performance of metals such as copper. With this new technology, the surface quality of aluminum alloys used in automobiles can be improved.

Aluminum-magnesium alloys (5000 series) feature superior formability and show promise in enabling greater flexibility in component design and in forming difficult to mold parts to help make vehicles lighter. However, inhibiting the surface distortion pattern known as the "stretcher-strain mark" (SS mark), which is caused by the atomic level structure, has been a longstanding problem. To solve this problem, we used the most advanced three-dimensional atom probe capable of evaluating the cubic distribution of atoms and developed a method of sample preparation, measurement, and analysis. With this method, we determined the three-dimensional distribution of elements in the metal sample. By forming a minute cluster (an aggregate of atoms), we were able to inhibit the SS mark's formation.

We will leverage this new analysis method to propose the use of new materials to automakers and to increase the performance of steel and other materials.



Three-dimensional atom probe



Cluster mapping of magnesium and zinc

### Technology for Harnessing Untapped Energy

In response to the electric power supply situation in Japan, we offer technology that harnesses previously untapped energy.

Japan, a volcanic country, has renewable energy sources such as geothermal power. To harness this energy source, Kobe Steel has developed a small binary power generation system called Microbinary that generates power from hot springs and steam. A binary generator is a power generation system that heats and vaporizes a working medium with a low boiling point using hot water between the temperatures of 70°C to 95°C and then uses the steam thus generated to rotate a turbine.

Power can be generated not only by geothermal heat, but also by hot-water biomass boilers, warm drainage water and steam from factories. Kobe Steel employed the world's first semi-hermetic screw turbine in the binary power generation system. The new system is capable of generating a maximum of 60kW on a stable basis without leakage of the working medium. This amount of electric power is equivalent to the amount consumed by about 150 average households.

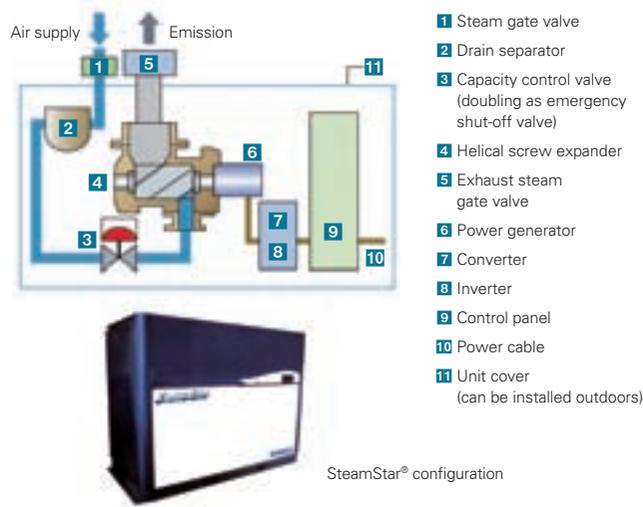
Microbinary systems have been delivered to Obama hot spring resorts in Unzen, Nagasaki Prefecture and began operation in February 2013. The delivery is part of the "Challenge 25 Community Building Project's Hot Spring Commercial Power Generation Demonstration Project based on Obama Hot Spring Thermal Discharge," a project commissioned by the Ministry of the Environment. In this experimental project, operators of Obama hot springs, with the backing of Nagasaki University, will establish associations and companies to develop the electric power generation business using untapped hot spring thermal discharge and thereby revitalize the region. As this project is unprecedented in Japan, the Obama hot spring project can serve as a model for efficient green energy utilization for many other hot springs nationwide.

Kobe Steel is working to further reduce the size and raise the power generation capacity of Microbinary and plans to spread its use to hot springs and factories throughout Japan. Another expected use is as a power generation system for disaster centers in local municipalities and other locations to generate electric power during disasters.

The SteamStar®, our compact steam-powered generator, is another technology developed for harnessing untapped energy sources and effectively using steam. Small boilers used in small- to medium-sized manufacturing facilities have been unable to completely use the low-pressure energy from steam generated during the manufacturing process. By harnessing this untapped steam energy, SteamStar® makes highly efficient power generation possible. In Japan, there are nearly



Installed image of MB-70H small-scale hot spring power generator



250,000 small boilers. If SteamStar® was installed at only 10% of those boiler sites, Japan could conserve electricity and reduce annual CO<sub>2</sub> emissions by five million tons.

## Intellectual Property Activities

### Overseas Intellectual Property Acquisition and Risk Hedging

Through the application and use of intellectual property (IP), the Kobe Steel Group ensures that its research and development and business activities can operate without restrictions. The Group also engages in IP activities to raise its corporate value. To ensure that no restrictions are placed on its overseas business development activities under KOBELCO VISION "G," the Kobe Steel Group's long-term business vision, the Group not only acquires patents in the countries in which it does business, when it comes as a condition for forming a business partnership, it also places a priority on technology agreements to hedge against businesses risks such as patent infringement by competitors and technology leakage, as well as to raise business profitability.

### Overview of Fiscal 2012

In fiscal 2012, Kobe Steel applied for nearly 900 new patents in Japan, primarily to protect "Only One" products, giving the Company approximately 5,200 patents in Japan and 4,000 patents overseas as of the end of fiscal 2012. As a result of the globalization of its business, Kobe Steel is strengthening its application of new patents overseas, especially in Asia, which now accounts for almost one-third of its total number of patent applications. Moreover, Kobe steel is fortifying its IP activities in Asia including China by, 1) increasing the number of patents applied for, 2) bolstering agreements with business alliance partners and 3) protecting the KOBELCO brand against counterfeit goods and patent infringement.