KOBELCO's Materials and Solutions for Architecture and Civil Engineering

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Abstract

The architecture and civil engineering sectors face a range of pressing social challenges, including the need to respond to increasingly frequent natural disasters, a shrinking workforce caused by a declining birthrate and aging population, and the urgent task of reducing greenhouse gas emissions. To address these challenges, the KOBELCO Group has identified five materialities (key issues) and is actively pursuing initiatives to resolve them. The Kobe Steel Group operates a diverse range of businesses, and in addition to leveraging the technologies cultivated in each field, KOBELCO Group contributes to society by integrating expertise across its business areas to generate powerful synergies. This article introduces the materials and solutions that the KOBELCO Group provides for the architecture and civil engineering sectors, organized according to these key materialities.

Introduction

Thirty years have passed since the Kobe Earthquake of 1995 struck the southern part of Hyogo Prefecture on January 17, 1995. The KOBELCO Group suffered immense damage from this disaster and experienced firsthand the threat such catastrophes bring and the challenges of recovery. Just the earthquakes of a maximum seismic intensity of 7 alone since the Kobe Earthquake of 1995 include the 2004 Niigata-Chuetsu Earthquake, the 2011 Tohoku Earthquake and Tsunami (Great East Japan Earthquake), the 2016 Kumamoto Earthquakes, and the 2024 Noto Peninsula Earthquake.[1)] The challenge of ensuring safety and security against increasingly severe natural disasters has become a top priority for Japan. Further pressing challenges standing before the country include reducing greenhouse gas emissions to achieve carbon neutrality by 2050 and overcoming labor shortages due to the rapid trend of an aging population alongside a declining birthrate.

The KOBELCO Group's corporate philosophy served as a springboard in 2021 for identifying the company's five materialities (key issues). We must address these to become an indispensable part of society by ensuring the continuous growth of the KOBELCO Group, which will stem from resolving societal challenges and creating value over the medium to long term.

This paper centers around the KOBELCO Group's materialities most relevant to the societal challenges detailed above and broadly introduces KOBELCO's materials and solutions that support the architecture and civil engineering needs associated with these materialities.

1. Societal challenges in architecture and civil engineering

1.1 Increasingly severe natural disasters

Japan is an earthquake-prone country. Listed above are the earthquakes with a maximum seismic intensity of 7; however, since 1995, there have been 10 earthquakes with a maximum seismic intensity of 6-, including the 2018 earthquake with an epicenter of the northern part of Osaka Prefecture, and six earthquakes with a maximum seismic intensity of 6+, including the 2007 Niigata Chuetsu-oki Earthquake.[1)] Furthermore, the Nankai Trough megaquake, predicted to have a 30-year probability of 70% to 80%, is expected to reach a maximum seismic intensity of 7 and generate tsunami waves over 10 meters high.[2)] This event is anticipated to affect an extensive area in the form of substantial casualties and damage to buildings, essential utilities, and infrastructure.

Beyond earthquakes, natural disasters caused by torrential rains and typhoons believed to be influenced by climate change are increasing in frequency. The extensive and prolonged heavy rainfall of the July 2020 Kumamoto heavy rains caused flooding, landslides, and the washing away of 10 bridges, significantly damaging the roadway network.[3)]

The increasing severity of natural disasters points to the dire need for a safe and secure society through national resilience. In turn, the pertinent needs are to extend the lifespan of societal infrastructure through inspection and repair, ensure structures are outfitted with safety measures, and update aging infrastructure.

1.2 Labor shortages due to a declining birthrate and aging population

Japan's population has been declining since its peak of 127.84 million in December 2004. It is

Table 1 KOBELCO's Materiality

Materiality	Indicators
Contributing to a green society	Response to climate change ／ Response to resource recycling
Ensuring safety and security in community development and manufacturing	Supplying energy focused on S+3E Providing materials and machinery that meet needs
Providing solutions for the future connecting people and technology	Reforms in manufacturing and operations through digital transformation (DX) Integration and innovation of diverse intellectual assets
Promoting active participation of diverse human resources	Diversity and Inclusion (D&I) ／ Work style reform Human resources development
Pursuing governance that supports sustainable growth	Compliance and risk management ／ Human rights Safety and health ／ Quality assurance ／ Corporate governance

projected to reach 115.22 million (90.1% of the peak) by 2030. Furthermore, it is projected to fall below 100 million around 2048 and drop to 95.15 million (74.4% of the peak) by 2050. Meanwhile, the aging rate – the proportion of the population aged 65 and over – was 19.6% in 2004 but is projected to reach 31.8% in 2030 and 39.6% in 2050.[4] This rapid shift of a declining birthrate alongside an aging population poses a serious challenge, as it will lead to shortfalls in the workforce and successors needed to support society and industry.

The Ministry of Land, Infrastructure, Transport and Tourism is promoting i-Construction as a countermeasure.[5] Introducing ICT at construction sites and similar operations as well as achieving remote operation and automation of construction machinery will significantly improve productivity. Accordingly, further developments are anticipated in BIM/CIM, which are technologies that enable centralized digital control of processes from design to execution and maintenance management.

1.3 Reducing greenhouse gases

One outcome of the October 2020 extraordinary Diet session was the declaration of the goal of "achieving a carbon neutral, decarbonized society by 2050." Japan's CO_2 emissions in fiscal year 2023 totaled approximately 988.71 million tons. The industrial sector accounted for the largest share, at 34.3%. Within the industrial sector, the steel industry accounts for 38.7%.[6] As such, developing technologies to reduce CO_2 emissions in the ironmaking process is critical for achieving carbon neutrality. The construction industry has already taken various strides toward this objective. Examples include decarbonizing buildings and construction materials, reducing CO_2 emissions at construction sites, and using digital technologies to improve construction efficiency.

2. The KOBELCO Group's materialities

Table 1 shows the five materialities of the KOBELCO Group.[7] We used a three-step process to identify these materialities. Step 1: Make a comprehensive list of significant societal challenges. Step 2: Map the importance of societal challenges and select relevant issues for the Group. Step 3: Consolidate similar issues and narrow them down to key issues.

This paper focuses on three materialities that are particularly relevant to the societal challenges detailed in Section 1: ensuring safety and security in community development and manufacturing, providing solutions for the future connecting people and technology, and contributing to a green society.

3. KOBELCO's materials and solutions supporting architecture and civil engineering

The KOBELCO Group solves the challenges faced by customers and society through its three core business areas: the materials business area, which includes steel, aluminum, advanced materials, and welding; the machinery business area, which includes machinery, engineering, and construction machinery; and the electric power business area, which leverages the technologies and expertise cultivated over many years of operating in-house power generation systems in our ironmaking plants. **Table 2** shows the products in each business area that center around the fields of architecture and civil engineering.

The technologies honed in each business area have led to unique solutions in which value and approach are prioritized over scale, in turn yielding many technologies, products, and services that have captured top market shares all over the world. Furthermore, integrating expertise across these business areas creates synergies that serve as seeds for innovation. We continuously create

new value in myriad ways, such as in the form of technological developments that combine steel and welding technologies, and in the form of low-carbon ironmaking technologies that combine steel and engineering technologies.

Table 3 shows KOBELCO's materials that support architecture and civil engineering. In addition to various steel materials and welding consumables, we produce iron powder, slag products, bolts, and aluminum products. We have also recently begun using crafting technology for construction and industrial machinery to produce custom furniture.

Table 4 shows KOBELCO's solutions (including machines and systems) that support architecture and civil engineering. In the area of steel product application technologies, we have developed a design method for column-to-beam connections and a lateral buckling restraint method for steel beams, fostering safety and optimization in steel structures. Furthermore, many of our customers are already using our various welding robots to optimize steel frame fabrication and on-site welding work. We are also engaged in the engineering of projects such as direct reduced iron plant operations and analysis and testing of construction machinery and materials.

The following sections introduce the latest technologies of the materials business and

Table 2 KOBELCO's Businesses for architecture and civil engineering

Businesses		Products
Materials businesses	Steel & Aluminum	Wire rods and bars, steel sheets (hot-rolled, cold-rolled, surface treated), steel plates, slag products
	Advanced materials	Steel castings and forgings, steel powder
	Welding	Welding materials (covered welding electrodes, wires for automatic and semi-automatic welding, fluxes), welding robots, welding power supplies, robotic welding systems, welding-related testing, analysis, and consulting
Machinery businesses	Machinery	Various plants (steel rolling, nonferrous metals, etc.), analysis and evaluation of various materials
	Engineering	Various plants (direct reduction ironmaking, waste treatment, etc.), civil engineering, urban transit systems
	Construction machinery	Hydraulic excavators, mini excavators, environmental recycling machinery, crawler cranes, wheel cranes, DX Solution
Electric Power Business		Electric power supply, heat supply

Table 3 Materials by KOBELCO supporting architecture and civil Engineering

Items	Materials
Steel plates for buildings[22]	TMCP Steel plate for building structures ／ 780 N/mm²-class steel plate for building structures
Circular steel tube[22]	Circular steel tube for building structures
Rectangular steel tube[22]	Rectangular steel tube for building structures 590 N/mm²-class rectangular steel tube for building structures
Steel plates for bridges[23]	Corrosion resisting steel Eco-view Plus™, a repaint term extension under high humid environment Crack initiation resistant steel "EX-Facter™"
Welding materials[24]	Gas shielded arc welding materials ／ Submerged arc welding materials Electroslag welding materials
Anchor bolts sets	TS700 anchor bolts
High-strength reinforcing bars	High-strength shear reinforcing bars[25]
High-strength bolts	Shinko high-strength bolts
Wire rods and bars	PC steel products ／ Steel wires Earthquake-resistant cable braces® ／ Stealth brace for traditional wooden buildings RE-SET cables ／ Cable inspection and repair
Steel sheets	Highly corrosion-resistant hot-dip coated steel sheet KOBEMAG®
Steel slag	Ground granulated blast-furnace slag Steel slag as a ground improvement material ／ Steel slag as marine environment restoration
Steel powder	Steel powder for purifying soil and groundwater ECOMEL™[21]
Aluminum	Aluminum honeycomb panels[26]
Wooden furniture(Fig.14)	Custom-made wooden furniture[27]

Table 4 Solutions by KOBELCO supporting architecture and civil engineering

Items	Solutions
Design and construction method	Design technology for column to beam connection of circular hollow section steel columns Design technology for column to beam connection of square hollow section CFT steel columns Lateral buckling restraint method for steel beams using the stiffening effect of the slab Structural performance of exposed column bases using TS700 anchor bolts
Direct reduced iron field process	MIDREX® Process
Welding system[24]	Structural steel welding robot system ARCMAN™ Compact portable welding robot ARCMAN™ PORTABLE
Construction machinery	Hydraulic excavators ／ Crawler cranes Telework system for construction sites K-DIVE® Revit® Add-in software for crane construction planning K-D2PLANNER Drone-based inspection solution K-AIR REAL
Structural evaluation	Structural evaluation, evaluation of structural components, various structural analyses[28) 29)]

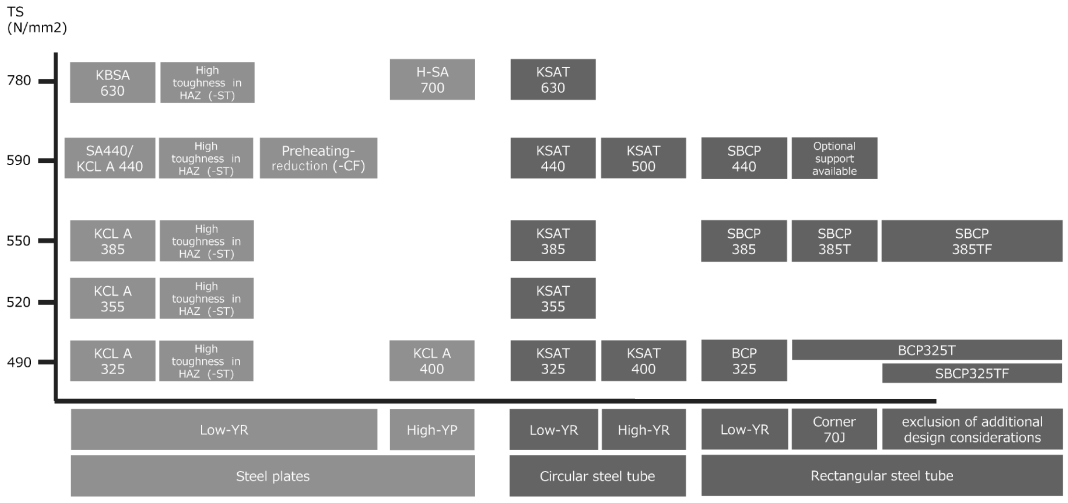

Fig. 1 Steel plates, circular steel tubes, rectangular steel tubes for buildings

machinery business that serve the architecture and civil engineering fields. Each section covers a different materiality.

4. Ensuring safety and security in community development and manufacturing

This section introduces materials that contribute to a safe and secure society and strengthen resilience against the societal challenges described in Section 1.1.

4.1 Steel plates, rectangular steel tubes, and circular steel tubes for building

Steel plates used in large structures such as high-rise buildings are available in a wide range of tensile strength classes, from 490 N/mm^2 to 780 N/mm^2 (**Fig. 1**). Particularly in recent years, as structures have grown larger, steel plates used in high-rise buildings and skyscrapers have become thicker and stronger. Kobe Steel's steel plate and welding divisions collaborate to develop technologies that yield higher-quality weld joints. One result of these efforts is that we can ensure the high HAZ toughness and weld metal strength required of electroslag welds in welded box columns.

Additionally, we are collaborating with Sasaki Pipe & Tube Co., Ltd., which has a 15,000-ton press (one of the largest in Japan), to commercialize rectangular and circular steel tubes. Our extensive range of tubing includes rectangular steel tubes in tensile strength classes from 490 N/mm^2 to 590 N/mm^2, and circular steel tubes in tensile strength classes from 490 N/mm^2 to 780 N/mm^2 (Fig. 1). We are also developing application technologies for rectangular and circular steel tubes, which will be described later.

4.2 Steel plates for bridges

Beyond general-purpose steel materials, Kobe Steel develops and markets steel plates that reduce the life cycle cost of bridges and extend the service life of steel bridges.

In developing and commercializing Eco-

View Plus™, we became the first in the industry to release corrosion-resistant steel plate that is suitable for high-humidity environments and works synergistically with coatings. This product was registered in the Ministry of Land, Infrastructure, Transport and Tourism's New Technology Information System (NETIS) on February 20, 2024. For more information, see p.71 of this issue, "Corrosion Resisting Steel Eco-view Plus™, a Repaint Term Extension under High Humid Environment."

In October 2023, we released the fatigue crack-resistant steel EX-Facter™, a steel plate with added elements for fatigue crack initiation resistance to extend fatigue life. We anticipate that this product will be used where fatigue cracks are difficult to detect, such as in the case of steel deck inspections, and we will promote its widespread adoption.

4.3 Welding materials

Kobe Steel's lineup of welding materials is tailored to the strength classes of steel used in the gas-shielded arc welding, submerged arc welding, and electroslag welding of structural steel column fabrication. Some of our forthcoming developments will satisfy needs for further improvements in productivity and welding quality. For instance, we are developing a robot system and specialized welding wire for structural steel columns, as well as welding materials compatible with steel materials of various strength classes, including steel with a tensile strength class of 780 N/mm^2. For more information, see p.86 of this issue, "Latest Trends and Lineup of Welding Consumables for Structural Steel."

4.4 PC (prestressed concrete) strand/wire

Kobelco Wire Company, Ltd. offers a wide range of PC strands for use in bridges and buildings to enhance strength and compensate for weaknesses in concrete. We have been involved researching PC construction methods since PC was first introduced in Japan, and have since focused on improving the quality of PC steel strand, fostering mass production, and developing new products.

Tourism to cultural heritage buildings has been increasing; since these buildings are accessed by the general public, structural soundness is critical. The ϕ7 mm Stealth Brace[Note)] for traditional wooden architecture has high-strength galvanized steel wire to improve seismic resistance while preserving the cultural elements of structures. For more information, see p.95 of this issue, "Stealth Brace for Traditional Wooden Architecture."

Fig. 2 Earthquake-resistant cable brace

Our earthquake-resistant cable braces, which use high-strength PC steel strands[8)], are lighter and more flexible than conventional braces (**Fig. 2**). They substantially reduce temporary scaffolding needs and construction periods. Since its launch in 2013, this technology has been adopted in over 200 projects.

This product is key for the bridge sector, as the number of bridges requiring reinforcement is increasing due to deterioration and increased design loads.

4.5 Hot-dip zinc-aluminium-magnesium alloy-coated steel sheet

Kobe Steel began manufacturing and marketing KOBEMAG® hot-dip zinc-aluminium-magnesium alloy-coated steel sheet in 2017. Its applications are expanding and now include residential construction, secondary framing, shutter slats, and perforated steel sheets. Currently, Kobe Steel handles the manufacturing process up to the hot rolling of thin steel sheets and outsources the pickling and plating processes to Nippon Steel Corporation and Nittetsu Steel Sheet Co., Ltd. However, we announced the allocation of capital expenditure in November 2024 to achieve in-house integrated production of KOBEMAG® by fiscal year 2029. Our core task in doing so is to modify the existing hot-dip zinc-aluminium-magnesium alloy-coated steel sheet equipment at Kakogawa Works.

5. Providing solutions for the future connecting people and technology

This section introduces innovations designed to address the societal challenges outlined in Section 1.2. It covers technologies for optimizing construction, application technologies for steel

Note) "ϕ7 Stealth Brace" is a trademark of Kobelco Wire Company, Ltd.

product design methods, and technological solutions related to infrastructure maintenance.

5.1 Design and construction methods for steel products

As one of our application technologies for steel plates, we developed a lateral buckling restraint method for steel beams that exploits the upper flange restraint effect of floor slabs. This method was certified by the General Building Research Corporation of Japan (GBRC).

For another one of our developments, which will expand the scope of application of 780 N/mm^2-class steel plates, we are studying the joint strength of undermatch-welded splices in the 780 N/mm^2-class steel plate of welded box columns.

Additionally, we have commercialized multiple application technologies for steel tubes that have already amassed a proven track record. One example is our design technology for the column-to-beam connection of circular hollow section steel columns (**Fig. 3**), which eliminates the need for diaphragms. Another is our design technology for the column-to-beam connection of square hollow section CFT (concrete-filled tube) steel columns (**Fig. 4**), which significantly reduces the projection dimension of conventional exterior ring diaphragms.[9)]

Kobe Steel was the first in the industry to obtain certification from the Minister of Land, Infrastructure, Transport and Tourism for TS700 anchor bolts, which have a standard strength of 490 N/mm^2. To verify the strength and rigidity of these bolts, we are researching the structural performance of exposed column bases that use these anchor bolts. We hope this contributes to the design of exposed column bases using high-strength anchor bolts.

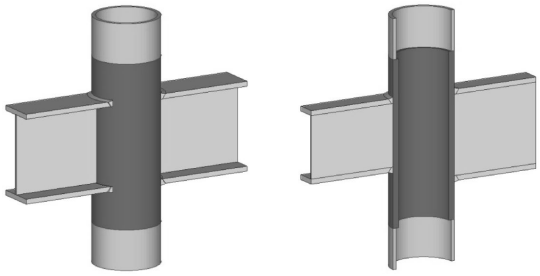

Fig. 3 Design technology for column to beam connection of circular hollow section steel columns

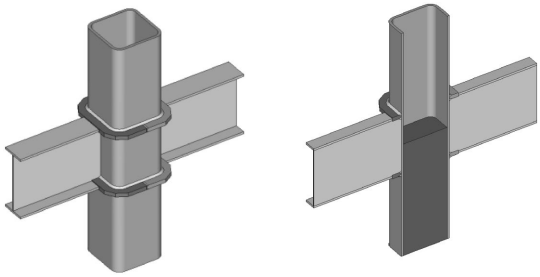

Fig. 4 Design technology for column to beam connection of square hollow section CFT columns

5.2 Welding systems

In recent years, the societal challenge of labor shortages has intensified the need for automation through robotics. This has expanded the use of large arc welding robot systems in steel frame fabrication plants and spurred a marked trend toward the use of portable arc welding robots on site. The KOBELCO Group offers a large portfolio of applicable systems, including the ARCMAN™ steel frame welding robot system. We are leading the industry by producing superior welding systems and by optimizing welding processes through perfectly coordinated welding consumables.

The ISHIMATSU™ compact portable welding robot series (**Fig. 5**) can handle a broad spectrum of welding demands, including long and multi-layer welds, not only in steel frame fabrication plants but also on construction sites. Weighing only about 6 kg, it is one of the lightest in the industry. Its fully automated welding functionality enables one operator to manage multiple units, and it is already active on numerous construction sites.[10)]

A further technological development underway for this compact portable robot lies in machine vision. We will outfit the robot with an image sensor to enable recognition of key features in the image of the molten pool for coordinated responses in control. For more information, see p.107 of this issue, "Compact Portable Welding Robot System with Vision Sensor," and p.102 of this issue, "Introducing New Automation System and CAD-Linked Software for Architectural Steel Frame Beam Welding."

5.3 DX (digital transformation) in construction machinery

Kobelco Construction Machinery Co., Ltd. offers a wide range of construction machinery, including

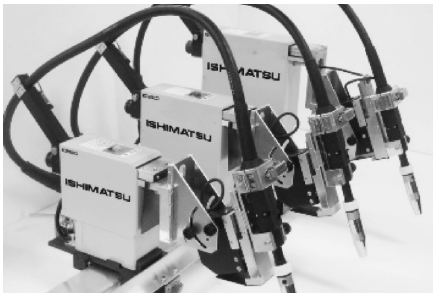

Fig. 5 Compact portable welding robot ISHIMATSU™

Fig. 6 K-DIVE®

Fig. 7 K-D2 PLANNER®

hydraulic excavators and crawler cranes. Some of our developments in this area center around overcoming today's societal challenges such as labor shortages and changes in the landscape of work arrangements. In this way, our various DX technologies make a strong contribution to society.

For example, K-DIVE® (**Fig. 6**)[11], a remote operation system for heavy machinery, promotes DX at the worksite by maintaining a constant connection between people, heavy machinery, and the site. Specifically, it enables the remote operation of heavy machinery from a cockpit in a location remote from the construction site. An operator in a single cockpit can switch between multiple machines, eliminating standby and travel time and thereby increasing efficiency in personnel allocation and process management.

We have also released the crane construction planning software K-D2 PLANNER® (**Fig. 7**)[12] as an add-in for the BIM software Revit (a registered trademark of Autodesk, Inc.). Placing cranes in the BIM model during construction planning makes it possible to run simulations and to streamline construction planning through functions such as selecting the optimal crane for a given task.

As a final example, K-AIR REAL (**Fig. 8**)[13] is a solution for using the autonomous flight capabilities of drones to photograph and support inspections of mobile cranes. It handles complex shapes, such as crane operating and idle postures, with great flexibility. With this solution, it is possible to quickly

Fig. 8 K-AIR REAL

take high-quality images and confirm conditions even in confined sites where lowering the boom is difficult. We anticipate that the scope of application of this solution will extend beyond mobile cranes by supporting the inspection of other types of equipment.

6. Contributing to a green society

This section introduces materials and solutions that reduce CO_2 emissions, such as by decarbonizing buildings and construction materials, developed in response to the societal challenges described in Section 1.3.

6.1 Low-CO_2 Blast Furnace Steel, Kobenable® Steel[14]

In releasing Kobenable® Steel, which significantly reduces CO_2 emissions in the blast furnace process, Kobe Steel became the first in Japan to commercialize a low-CO_2 blast furnace steel. Our engineering business uses the MIDREX® Process to produce HBI (hot briquetted iron, **Fig. 9**). Through high-volume charging of HBI into the blast furnace at the Kakogawa Works, we are able to substantially reduce blast furnace CO_2 emissions. Applicable steel products are classified based on the degree of reduction using the mass balance method, with blast furnace steel products with a 100% reduction in CO_2 emissions being classified as "premium," and those with a 50% reduction being classified as "half." This development has already been widely adopted in the architecture and civil engineering fields. We are currently pursuing similar initiatives for aluminum products.[15]

6.2 The MIDREX® Process[16]

Direct reduced iron (DRI) is an ironmaking process that is an alternative to operating a blast furnace. It uses hydrogen-rich reducing gas produced by reforming natural gas, or hydrogen

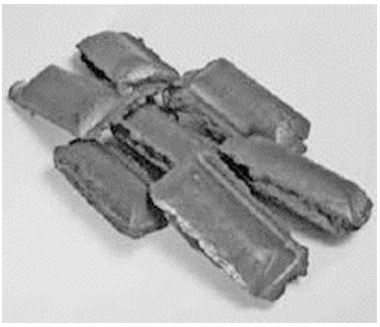

Fig. 9 HBI (Hot Briquetted Iron)

Fig.10 MIDREX® PLANT

itself as the reducing gas, to directly reduce iron ore. Since direct reduction ironmaking does not require coke or large-scale facilities as do blast furnaces, DRI plants have typically been established in natural gas-producing countries. In recent years, there has been a rise in demand for DRI as a clean iron source to replace scrap and as an ironmaking process with low CO_2 emissions. Kobe Steel owns the license for the MIDREX® Process, which has approximately 80% of the global market share in gas-based direct reduction ironmaking. We are expanding our business globally in collaboration with Midrex Technologies (Kobe Steel's wholly owned subsidiary). **Fig.10** shows a MIDREX® plant. We offer solutions for various phases of the energy transition to hydrogen, beyond the conventional MIDREX NG™ process that uses natural gas. These include MIDREX Flex™, which allows for the flexible replacement of the reducing agent of natural gas with 100% hydrogen, and MIDREX H2™, which uses 100% hydrogen as the reducing gas.

6.3 CO_2 fixation and mineralization via Carbonel® rapid carbonation technology [17)]

Kobelco Eco-Solutions Co., Ltd. has been developing the rapid carbonation technology Carbonel®. This technology makes use of industrial byproducts that contain elements such as calcium (Ca), potassium (K), and magnesium (Mg) as raw materials. Examples of such byproducts include coal ash, fly ash, and slag. Reacting these substances with

Fig.11 Carbonated granulated product

Fig.12 Demonstration Plant for Carbonation and Mineralization

CO_2 in the presence of a small amount of water fixes CO_2 as carbonates (e.g., calcium carbonate, $CaCO_3$). As an extension of this technology, we are working on carbonation applications for wood biomass ash and other materials. Carbonated granulated product (**Fig.11**) holds promise for use as a concrete material, and sales of the standard Carbonel® unit (**Fig.12**) have already commenced. Furthermore, concrete materials created using this technology served as the raw material for the HPC® panels of the exterior cladding of the signature pavilion "Adventure of Life" (Kawamori Pavilion) at Expo 2025 Osaka, Kansai, Japan.[18)] We anticipate that the application of this material will expand greatly.

6.4 Hydrogen fuel cell excavator

In support of carbon neutrality, Kobe Steel and Kobelco Construction Machinery Co., Ltd. are engaged in the research and development of hydrogen-related technologies and the commercialization of products that use hydrogen. As part of these efforts, Kobelco Construction Machinery Co., Ltd. has been working toward the practical application of a fuel cell excavator powered by hydrogen since 2021. Initial testing of the prototype that was completed in March 2023

is in progress.[19] Kobe Steel's Takasago Works has already installed high-pressure hydrogen filling equipment for the hydrogen fuel cell excavator (**Fig.13**). This development is scheduled for domestic demonstration testing in fiscal year 2026. To prepare for the field introduction of the hydrogen fuel cell excavator, the Takasago Works began practical operational evaluation including continuous excavation in March 2025.[20]

6.5 Steel slag

Steel slag products hold high value as materials that reduce environmental impact from the perspectives of CO_2 reduction and of resource and energy conservation. Examples of steel slag products with an active presence on the market and in goods include ground granulated blast furnace slag, roadbed materials, civil engineering materials, and fertilizers. Recent years have seen the practical application of steel slag as a soil stabilizer.

6.6 ECOMEL® iron powder for purifying soil and groundwater [21]

ECOMEL® is an iron powder that purifies soil and groundwater through chemical reactions on the surface of the iron powder that adsorb heavy metals and decompose volatile organic compounds (VOCs). Its primary applications span a wide range of civil engineering fields and include purifying soil during urban renewal, processing contaminated soil during tunnel excavation, and controlling groundwater pollution.

Fig.13 Fuel Cell Excavator

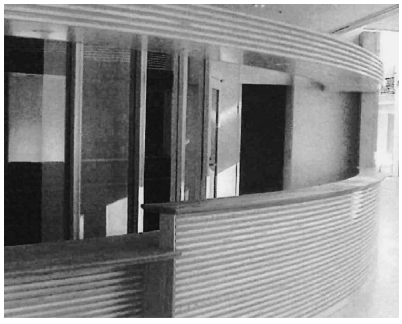
Fig.14 Wooden furniture

Conclusions

This paper addresses solutions pertinent to the societal challenges of intensifying natural disasters, labor shortages due to the declining birthrate and an aging population, and greenhouse gas emissions. Covered next are KOBELCO's materials and solutions supporting architecture and civil engineering as they relate to the KOBELCO Group's materialities.

The societal challenges outlined here are expected to increase in intensity and complexity. One of the KOBELCO Group's strengths is that the company's expertise spans a broad range of business areas. We are committed to leveraging this strength to tackle the challenges afflicting society. In doing so, we will achieve extensive value creation and foster a sustainable society.

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