Gunbai Column No. 01

Eiichi Shibusawa
Born in Fukaya City, Saitama Prefecture, in 1840. He visited Europe at the age of 27, and after returning to Japan, established a commercial law office in Shizuoka. Later, as a member of the Ministry of Finance, he was involved in nation-building after the Meiji Restoration. After leaving the Ministry of Finance, he became General Supervisor of the Dai-ichi National Bank. He focused on the creation and development of companies and was involved with about 500 companies during his lifetime.

Continuous social contributions, now and forever

Eiichi Shibusawa and Denka

Japanese banknotes will be getting a redesign in 2024. The new 10,000-yen banknote will feature the image of Eiichi Shibusawa, also known as "the Father of Capitalism in Japan." As it happens, Eiichi Shibusawa was deeply involved in the establishment of Denka.

Our company's predecessor was Hokkai Carbide plant, a business founded by Tsuneichi Fujiyama in Tomakomai. This plant used carbide to manufacture lime nitrogen, a fertilizer. The Mitsui Zaibatsu provided the original funding to establish this company, so later directors included Takuma Dan and other capable members of the Mitsui Group.

However, in July 1914, World War I broke out. Trade was cut off, and the Japanese economy stagnated. After assessing the situation, Takuma Dan and the other directors decided to establish a new company in the hopes that the Hokkai Carbide plant could contribute to the domestic chemical industry instead of fertilizer production. On March 18, 1915, Takuma Dan visited a prominent businessman to discuss this idea. That businessman was Eiichi Shibusawa. On April 1, twenty-one venture capitalists, including prominent members of Mitsui, founded Denki Kagaku Kogyo (former name of Denka). Eiichi Shibusawa's name is recorded in the founder's list.

Eiichi Shibusawa advocated the theory of a moral economy, stating that even if the purpose of a company is to pursue profits, it should maintain a basis in morality and take responsibility for the prosperity of the nation and humanity as a whole. This is in line with The Denka Mission, namely, "Taking on the challenge of expanding the possibilities of chemistry to create new value and contribute to sound social development." Now, after 100 years of business, we will reexamine our origins and take on new challenges to make further contributions.

The DenkaWay Autumn 2019 Vol.01

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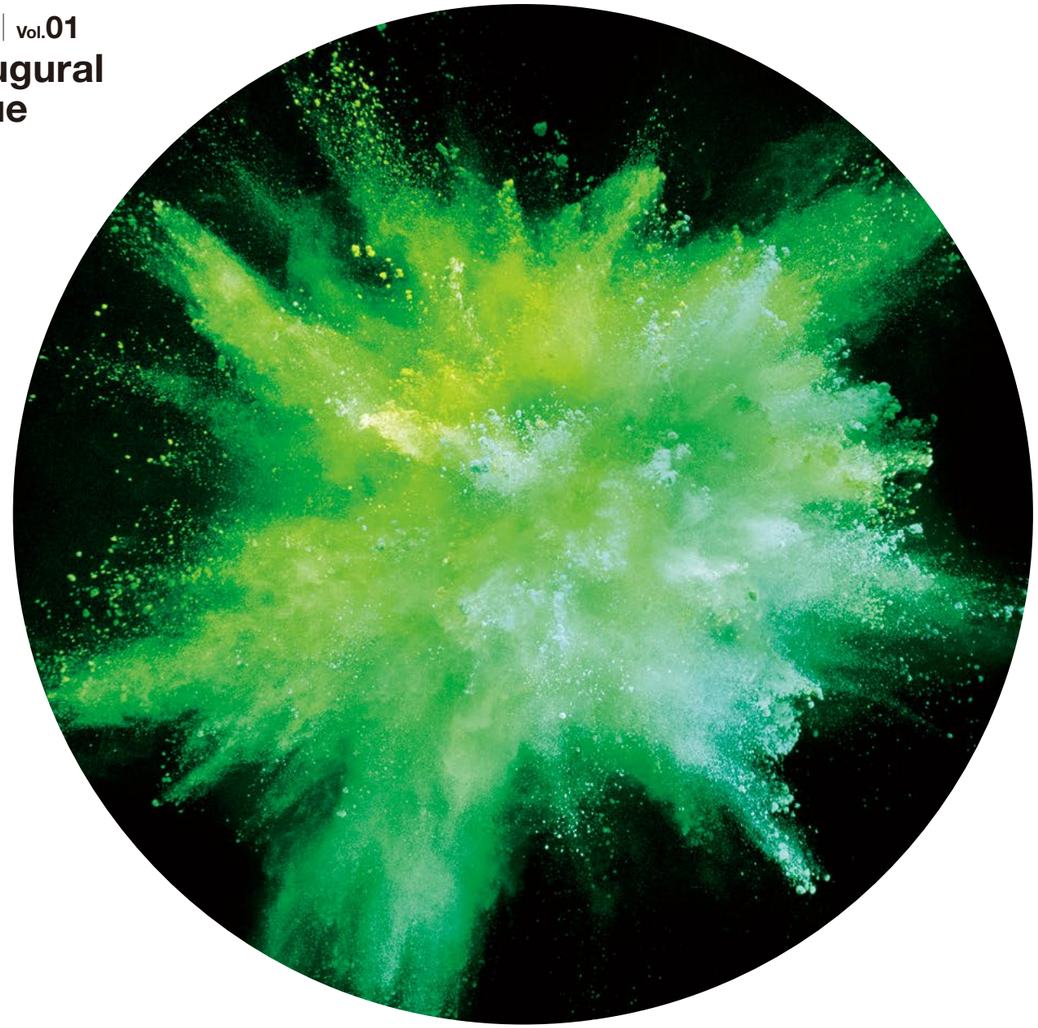
Denka

The DenkaWay

Autumn

2019 | Vol.01

Inaugural Issue



Amazing the World

Contents

Challengers for
Denka Value-Up

A New Path for Denka

A Few Words on the Launch of The Denka Way

Manabu Yamamoto, President

Thank you for picking up a copy of our new corporate magazine, The Denka Way. We launched the magazine under this name with the intention of conveying to all of our stakeholders the genuine value of a company pursuing specialization.

The background to this is the major changes taking place in the business environment. We are expanding all over the world, and our businesses continue to diversify. And the more diverse our businesses, the more diverse our stakeholders. Under these circumstances, how are we to convey Denka's direction and the vision behind it with any persuasiveness? After careful deliberation, we have concluded that the best approach is to broadcast our usual internal communication to the outside as well, or in other words, to remove the barriers between inside and out and communicate without discrimination.

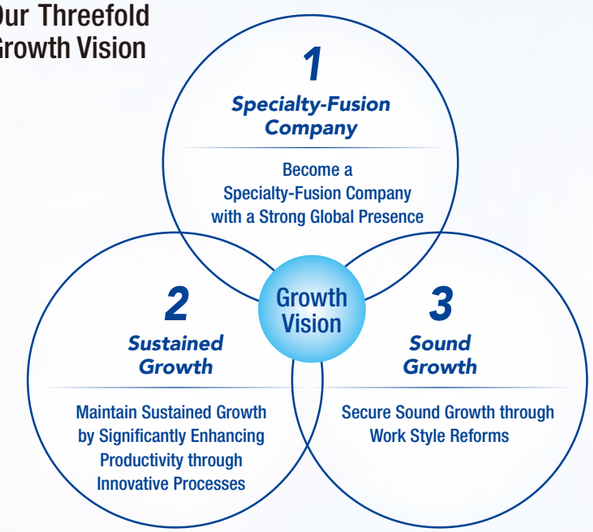
This magazine will be published in two languages, Japanese and English, and it will communicate our corporate ideals and visions through our business activities to everyone around the world.

In this first commemorative issue, we will provide an outline of our 5-year (FY2018 – FY2022) management plan "Denka Value-Up." We are currently working toward the fulfillment of our threefold growth vision, our ideal to realize another 100 years of growth. In this issue, we will cover our two strategies, "Introduction of Innovative Processes" and "Business Portfolio Shift," with a focus on accelerating growth of specialty businesses. We will also introduce six employees who are taking on challenges to carry out these strategies.

Finally, the launch of this corporate magazine is in itself a new challenge to realize Denka Value-Up. Moving forward, we will continue our efforts to make The Denka Way a bridge between us and our stakeholders. Most of all, we ask for your support as Denka embarks on a new path.

Management Plan
Denka Value-Up (FY2018 – FY2022)

Our Threefold Growth Vision



Two Growth Strategies

1 Business Portfolio Shift

Accelerate growth of specialty businesses

Healthcare	Environment and Energy	High-value-added Infrastructure
➡ P.6	➡ P.5	➡ P.7

» Specialize our key operations
» Redefine the positioning of the commodity businesses

2 Introduction of Innovative Processes

Production Process Reforms	R&D Process Reforms	Operational Process Reforms
➡ P.6	➡ P.7	➡ P.4

01

Operational Process Reforms × Omi Innovation Hub

Creating the Next 100 Years with Coworkers and Community

Ayame Ogawa
Administrative / HR Section, Administrative Dept. Omi Plant

"If we all work together, we can innovate and increase production. The Omi Innovation Hub project was established with that ideal in mind," explains Ayame Ogawa, a member of the project team.

Originally, each department's offices were spread out around Omi Plant.

However, internal collaboration was an issue, so we made "fostering cross-functional collaboration" our goal for Denka Value-Up. During this project, we continuously discussed the best way to set up offices to facilitate communication. "We bounced ideas off each other with an awareness that we needn't be bound by tradition." Ayame thoroughly investigated records of past meetings, and a communication area was set up between two departments that often interacted. "They changed from a closed relationship where most meetings took place in a conference room to an open relationship where it was easy to ask for advice. Now, Omi Plant has an atmosphere that encourages teamwork."

Additionally, Ayame reports an improvement in incorporating the perspectives of different departments. Currently, they're reviewing routine procedures and data sharing. "We'd like to make this an office that anyone can use comfortably and improve the overall atmosphere of Omi Plant."

Omi Plant will celebrate the 100th anniversary of its establishment in 2021.

The hub also has an open space that local residents and children can use. "It's the community that's made Omi Plant what it is today. We're going to face the next 100 years as Team Omi!"

Shinya Takemoto
Architect
Architectural Design Division
Kajima Corporation

Message from Our TEAM member

A place to gather in the light

I was conscious of creating a place where employees and local residents could gather under a gentle, natural light. The exterior is made of milky white glass that lets sunlight into the office. In addition, an employee communication area is set up in the center of the office. A soft light shines in from the high windows. I was delighted that we could produce new scenery with Mt. Kurohime and the Omi River in the background to create a calm and dignified appearance that suits Denka.

Omi Innovation Hub

A general office in Omi Plant. It functions as a hub of innovation and houses areas for employee exchanges and an open space for members of the community.

02

Environment and Energy × Food Packaging Materials

Creating High-Value-Added Products as a Group

Bentos, sushi, noodles, donburi, salads… You can find a wide range of products in the food aisles of convenience stores and supermarkets. Denka's food packaging business manufactures sheets that serve as raw materials for containers and finished containers and supplies them countrywide.

"Let's make more eco-friendly containers." This topic came up in the Household Packaging Materials Dept. at the end of 2016. Up to that point, the food packaging industry was primarily concerned with heat resistance. However, in the face of increasingly severe environmental issues such as global warming, it was thought that "eco-friendliness" was bound to receive more attention in the future. Four parties immediately began working on this development: The Household Packaging Materials Dept., the Polymer & Processing Research Lab, Chiba Plant, which is responsible for sheet manufacturing, and Denka Polymer, which is responsible for molding. Masahiro Inoue, who transferred to the Household Packaging Materials Dept. in July 2017, also joined this project.

The proposed new product was "Eco-Clear." In addition to maintaining the transparency and durability of its predecessors, it is also lighter, which results in reduced CO2 emissions during the manufacturing and recycling processes. "What elongating and molding processes can we use to make it thinner while maintaining durability? The four parties met repeatedly to discuss and solve each issue." Then, at the end of 2018, Eco-Clear was finally adopted for certain products at major convenience store chains. "Most people probably don't notice that the lids are thinner now. But for us, this is an important step forward. Food retail is a huge market. So, if our product is widely adopted, it will result in considerable reductions in CO2. And this is just the beginning. As a group, we can make even more forward-thinking specialty products and spread them worldwide."

Masahiro Inoue
Household Packaging Materials Dept. Living & Environment Products

Eco-Clear

An eco-friendly BOPS (Biaxially Oriented Polystyrene Sheet) that allows for thinner, lighter containers with increased durability. This contributes to reducing CO2 emissions and waste.

03 Production Process Reforms × IoT

Continuously Taking on Challenges to Explore New Possibilities

Seraya Plant is one of the largest styrene resin production bases in the world. During standard operations, it is necessary to manage various data such as safety and quality. However, in the event of a malfunction, it often took a lot of time to find the faulty parts and production was sometimes delayed. "We could not achieve the goals of Denka Value-Up without improving operational efficiency, so we thoroughly investigated on-site issues." Jeffrey Tok interviewed staff in every department and identified challenges in sharing analytical data. "The introduction of a system to centrally manage data for each process in the plant has greatly facilitated information sharing. It's now much easier to find malfunctions, and the productivity of the entire factory is increasing."

"Our future goal is to make more use of analytical data," says Jeffrey. "I want to explore various possibilities using IoT. I believe we have a lot more growth potential."

Jeffrey Tok
Denka Singapore Pte. Ltd. Seraya Plant

Remote monitoring system using IoT

At Seraya Plant, inspections were often time-consuming and machinery was prone to failure. However, digitalization of management methods has allowed for remote management, and this has greatly reduced costs and CO_2 emissions.

05 High-value-added Infrastructure × Specialty Cement Additives

Challengers for **Denka Value-Up**

I Want to Contribute to the People Who Are Creating Our Future

"Amazing! It's already set!" remarks a worker in a certain mine in Mongolia in the spring of 2017. They're using Denka's special cement additives. Regular concrete takes a few hours to harden, but this product takes mere minutes. Naturally, this will dramatically increase work efficiency. Weize Wang, who is in charge of sales, says, "I am eager to contribute to safety and efficiency for on-site workers."

Weize has been engaged in overseas sales of special cement additives for about two years. With the market spreading to Europe, North America, China, Asia, and Australia, he is currently focused on developing markets in Asian regions. "While we boast a high market share in Japan, people in the civil engineering and construction industries overseas haven't really heard of us," Weize explains. "That's why I want to convey the excellence of the Denka brand. Someday, I'd like to travel around the world and see all the tunnels where Denka products have been used. That's my dream at the moment."

Weize Wang
Special Cement Additives Overseas Business,
Special Cement Additives Dept.
Infrastructure & Social Solutions

Special cement additives

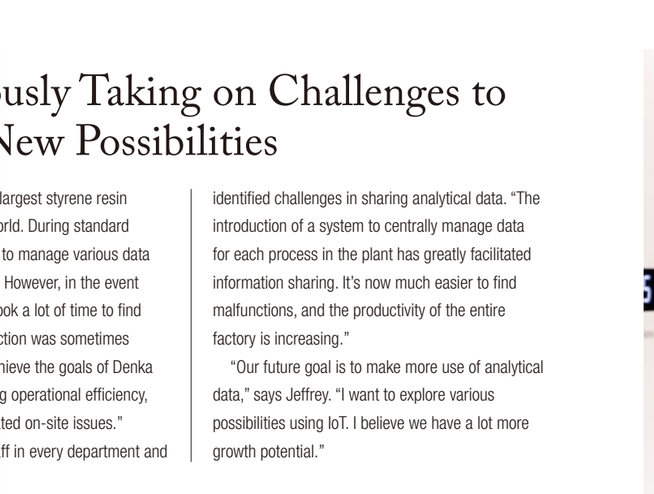
With a lineup of 300 types for different applications, sprayable quick-setting materials boast a 90% share of the domestic tunnel market. This business, which is part of high-value-added infrastructure, is expected to make up 10% of the profit target for Denka Value-Up.

04 Healthcare × Development of Norovirus Vaccines

Creating a Future Where We Can Live with Peace of Mind

Norovirus can be found all over the world. This disease is highly contagious, and an effective treatment or preventative measure has yet to be discovered. Franziska is trying to change this situation with the power of vaccines.

Franziska Jarczowski is the development manager for the Norovirus vaccine project. As the Norovirus mutates quickly, developing a vaccine is extremely difficult. However, Franziska's project team aims to create a working vaccine using a combination of biology, chemistry, and engineering. "Vaccine development is a series of unanticipated challenges. You need to combine existing technology with new ideas to create new solutions. Communication is very important. I want to save all the people suffering from the norovirus around the world by creating a research system that allows for the integration of different fields. That is my mission," Franziska says, her sights set squarely on the future.



Franziska Jarczowski
Specialty Icon Genetics G.m.b.H

magnICON

An as yet unimplemented technology platform for developing norovirus vaccines. Development of new production technologies and antibodies used for test reagents is currently underway.

06 R&D Process Reforms × Internal Open Innovation

Sharing Knowledge and Pushing Each Other to New Heights

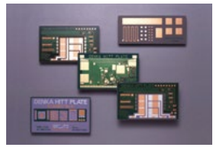
How many people are capable of creating something completely new? Eri Sasaki is currently trying to develop a new heat dissipation material using thermosetting resin, and she's teamed up with Denka's Omuta and Shibukawa plants to do so. Their goal is to contribute to energy savings in electric vehicles by combining the Advanced Technologies Research Institute's knowledge of resin and the plants' knowledge of substrates and heat dissipation sheets.

"This kind of in-house open innovation has picked up speed since the establishment of the Denka Innovation Center in 2014," explains Eri. "Advances in video conferencing systems and office consolidations allow for collaborations with departments and bases that we've never worked with before. Our company also has a vast amount of data from its 100 years of history. By maximizing these elements, I believe we can create products that the world has never seen before."

Eri Sasaki
Specialty Ceramics Research Dept.
Advanced Technologies Research Institute
Denka Innovation Center

Denka Hitt Plates

Denka Hitt Plates, which are similar to the product Eri is developing, achieve high thermal conductivity using heat resistant resin with a high inorganic content filler. This contributes to energy saving in home appliances and automobiles.



Think INNOVATION

Introducing articles that provide hints for innovation

No.01

Creating “Individualistic” Teams

Music Director of
the New Japan Philharmonic

Toshiyuki Kamioka

PROFILE

In 1979, he entered Tokyo University of the Arts, where he studied conducting, composing, and piano under Martin Mälzer. Afterwards, he studied abroad at the University of Music and Theatre in Hamburg. After several posts including music director of the Hessian State Theatre of Wiesbaden and music director of North West German Philharmonic, he became the fourth music director of the New Japan Philharmonic in September 2016. He is also chief conductor of the Copenhagen Philharmonic and full professor at the Saarbrücken University of Music.

Horizontal connections allow us to move people

I joined the New Japan Philharmonic in 2016. Japan and Germany have very different cultural and value systems. However, one thing remains the same: Orchestras must play good music that moves people. My mission is to lead the team known as the New Japan Philharmonic to new heights by combining the strengths of Germany and Japan.

The most important element for creating good music that moves people is “individuality.” However, the other day, I heard a man in a very senior position say the following: “Japan still tends to work in vertical hierarchies. Our horizontal bonds are weak.” Actually, I think this provides an excellent hint for injecting more individuality into Japanese orchestras.

©Rikimaru Hotta

Japanese orchestras excel in order, since many Japanese musicians strictly follow the conductor’s lead. Although this does make for excellent harmony, if taken to the extreme, it results in musicians simply waiting for the conductor’s instructions and performances that lack personality.

On the other hand, German musicians don’t try to match the conductor. They play freely, listening to each other’s sounds. Taken to the extreme, this results in a fractured orchestra. However, at times, it can also make for a very moving performance. Why is that? Because if we acknowledge and support each other, we can bring out our true selves. It’s the result of a strong connection between the musicians, or in other words, strong “horizontal bonds”.

All people have individuality. It’s only when we exercise our horizontal bonds to take advantage of that individuality that we can really move people.

People can’t be themselves unless they’re at ease

So, what should a conductor do to bring out the individuality of his performers? I make a point of trying to preserve people’s innate strengths. An orchestra is a large group of 100 people. Everyone has a different way of thinking, yet we must make music together. The fastest way is to find common ground, yet that is very difficult with orchestras. Everyone has different instruments, parts, and experience.

Given this situation, the conductor must not try to impose his or her ego upon everyone. Certainly, the conductor reads the score and is familiar with the piece of music and its various parts. There may be moments when he or she can provide valuable insight on how to bring out a song’s essence. At first, it may seem that everyone following the conductor’s instructions is a shortcut to success. However, I prefer to take advantage of each individual musicians’ strengths, even if it means a longer journey. It’s impossible to move people unless one’s own feelings are in the music. In order to bring out this individualism, it’s important to create a comfortable environment where everyone can play at ease.

Our destination is “playing good music to move people.” The conductor’s role is to provide support so that everyone might arrive at that destination together.

History

Starting from Limestone, A History of Continuously Amazing the World

Denka was originally founded 104 years ago as Denki Kagaku Kogyo in 1915. After that, the technology used to create carbides was applied to produce various new products, eventually leading to our five current departments: Life Innovation, Electronics & Innovative Products, Infrastructure & Social Solutions, Elastomers & Performance Plastics, and Living & Environment Products, which continue to amaze the world.

1970

Living & Environment Products

Enjoying fashion with piece of mind

Toyokalon

The world's first PVC fiber for hair products produced at industrial scale. Afro-textured hair is prone to breaking when straightened, and African women have long struggled to create various hairstyles. However, with Toyokalon, they can create free and natural-looking hairstyles.

Infrastructure & Social Solutions

Greatly contributing to Japan's agricultural development

Production of carbide and lime nitrogen

Using hydroelectricity as a power source, we made calcium carbide from limestone and coke, and began production of the derivative, lime nitrogen fertilizer. This new fertilizer was highly praised for its excellent effects and was eventually used across Japan. It greatly contributed to Japan's agricultural development.

1915

1980

Infrastructure & Social Solutions

Increasing efficiency and safety of tunnel construction

Denka Natmic

An accelerator for shotcrete used in tunnel construction. In addition to adhesive properties that allow for quick setting of cement, it is also resistant to water. It has been adopted for many tunnels, such as those on the Shin-Tomei Expressway, and contributed to increase efficiency and safety for tunnel construction.

1962

Elastomers & Performance Plastics

Supporting manufacturing in various applications

First chloroprene rubber produced in Japan

Chloroprene rubber boasts many excellent properties such as oil resistance and heat resistance. Denka was the first manufacturer in Japan to successfully commercialize this product using its proprietary technology. Chloroprene rubber is used in the manufacturing of various parts and products including adhesives, wet suits, and constant velocity joint boots for automobiles.

2000

Life Innovation

Improving QOL for people around the world

Rapid diagnostic kits for influenza

Denka develops testing reagents for influenza viruses and various other bacteria. In 2000, we developed the first rapid diagnosis kit for influenza in Japan. We have since continued to make improvements, and last year, we added analysis equipment capable of automatically reading from test devices using optical sensors to our lineup, contributing to the efficiency of influenza medical care in the medical field.

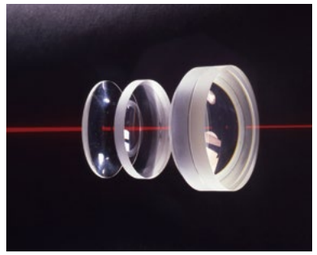
1976

Electronics & Innovative Products

Denka's unique high-performance industrial adhesive

HARDLOC

A high-performance industrial adhesive created with Denka's proprietary technology. It combines strength and tenacity for excellent adhesive properties. It is extremely workable (normal temperature quick-hardening, etc.) and is used for speakers, golf clubs, sheet metal adhesion, and other products.



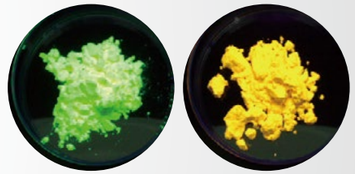
2009

Electronics & Innovative Products

Making LEDs longer lasting and brighter

Alonbright

Alonbright is a SiAlON phosphor used for LED modules for LCD backlighting and LED illuminating devices. Compared to conventional silicate phosphors, it is more resistant to temperature changes and contributes to increased lifespan and brightness for LEDs.



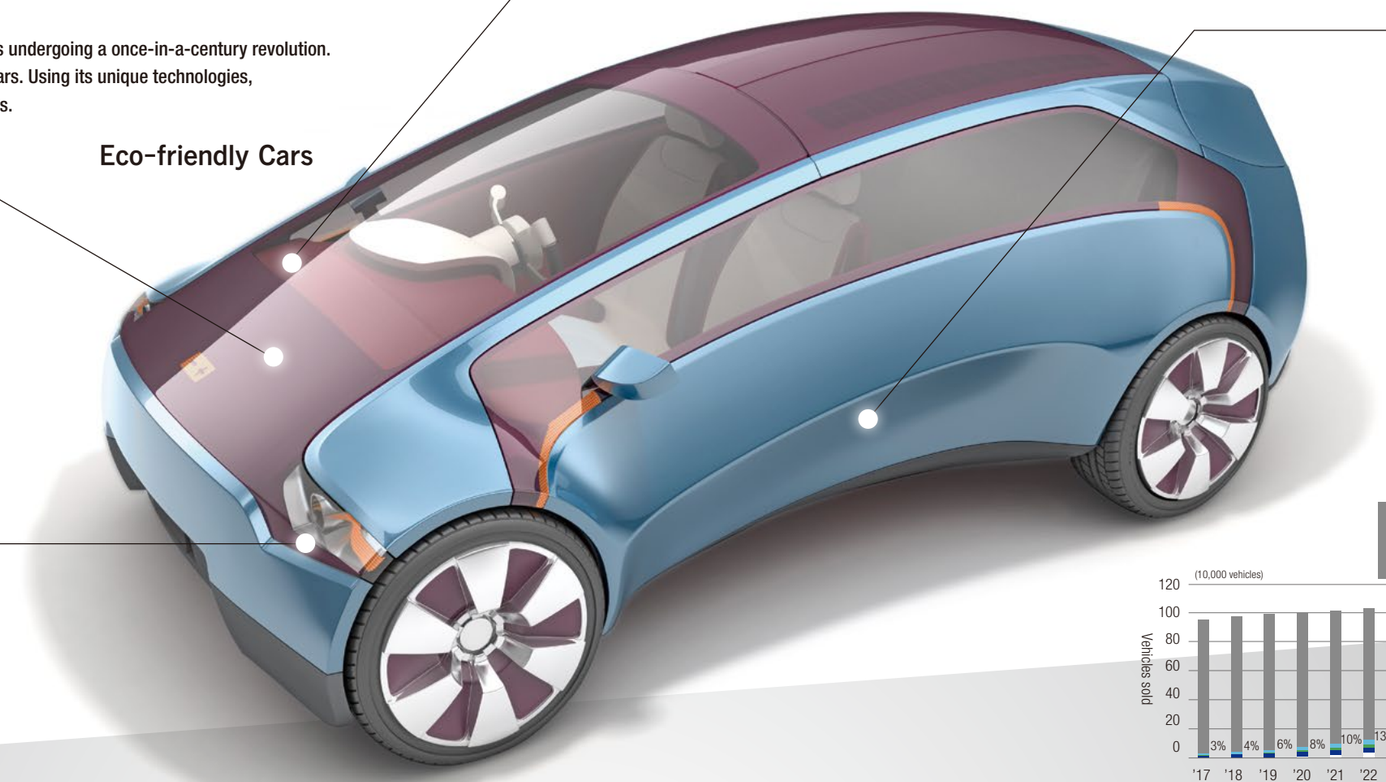
Amazing the World with Innovation

Close Up Project

Clean Energy

Going Beyond Conventional EV Wisdom with the Power of Chemistry

Based on the keyword "global warming countermeasures," the automobile industry is undergoing a once-in-a-century revolution. In particular, the field of Electric Vehicles (EVs) has been growing rapidly in recent years. Using its unique technologies, Denka is contributing to global warming countermeasures through chemical materials.



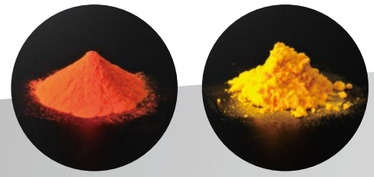
Power Control Unit (PCU)

A PCU is a device that appropriately adjusts the electricity of an EV or hybrid EV with a motor when the car starts, accelerates, or decelerates. Denka's aluminum nitride and silicon nitride plates, which are highly conductive ceramic substrates, are used for the inverter that powers the motor. Denka is one of the few manufacturers that supplies both AN and SN places.

Aluminum nitride plates (left)
Silicon nitride plates (right)

LED lights and indicators

Replacing conventional HID lamps with LED lights allows for the creation of lighter vehicles. Hitt Plates, which combine high thermal conductivity and durability, are used for the headlights' metal substrates, and Alonbright, which has excellent weather resistance and doesn't drop in fluorescent intensity at high temperatures, is used for the indicators and tail lamps.



Alonbright

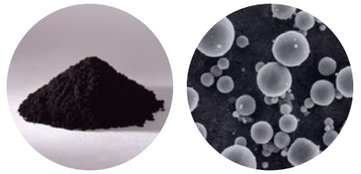
Wire harness binding

The wire harness transmits signals and electrical power inside the automobile. Denka's Vini-Tape® is used as an adhesive tape to separate these wires into groups. Both thin and light, this product contributes to reducing the weight of automobiles.

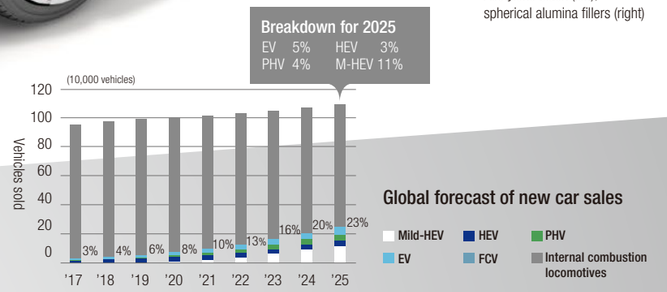
Vini-Tape®

Lithium ion secondary battery

Lithium ion secondary batteries, which are indispensable for EVs, are batteries that can be repeatedly recharged by moving lithium ions from the positive electrode to the negative electrode. Ultra-high purity acetylene black is used as a conductive material, and spherical alumina, which makes use of our unique ultra-high-frequency melting technology, are used as heat-dissipating materials.



Acetylene black (left),
spherical alumina fillers (right)



Amazing the World with Innovation

A once-in-a-century revolution taking place in the automobile industry

Global warming has been an issue for a long time. The average global temperature over land and sea rose 0.85°C between 1880 and 2012. And if we don't put effective measures in place to prevent global warming, the average global temperature is expected to be 2.6 – 4.8°C higher at the end of the 21st century (2081 – 2100) than it was around the end of the 20th century (1986 – 2005). In Japan, about one third of the year will feel like a mid-summer's day.

There are various greenhouse gases that cause global warming, but carbon dioxide is the gas that has the greatest impact on our planet. Ever since the Industrial Revolution, we've been burning fossil fuels such as oil and gas to create energy and grow the economy. As a result, the amount of carbon dioxide in the atmosphere is said to have increased by 40% compared to pre-industrial levels. Global warming countermeasures are now a common issue around the world.

Against this backdrop, the automobile industry is undergoing a once-in-a-century revolution. The trend of vehicle electrification is picking up speed as the demand for Electric Vehicles (EVs) that do not emit carbon dioxide increases. EVs accounted for 6% of new car sales in 2019, but this number is expected to grow to 23% by 2025. In addition, new technologies such as "automated driving" and "connected cars"*1 that use AI (Artificial Intelligence) and ICT (Information and Communication Technology) are coming into practical use, and progress is being made toward solving the problem of short driving ranges by manufacturing lighter vehicles.

Denka's unique products contribute to the proliferation of EVs

As a chemical manufacturing company, Denka is contributing to global warming countermeasures by providing materials and parts for EVs. The Automotive Materials & Solution (AMS) Development Division was established in 2016, and we've used our many years of technological expertise to develop unique products that are now the de facto standard for EVs.

For example, our products are used in lithium-ion secondary batteries (LIB), which are indispensable for EVs. One such product is acetylene black, a conductive aid*2. With its high purity and excellent electrical conductivity, it contributes to a longer battery life. Heat countermeasures are also essential for LIBs, which generate heat while in operation. To that purpose, our spherical alumina fillers are used as heat dissipation materials to prevent degradation and ignition of LIBs. Spherical alumina have high thermal conductivity, allowing for effective cooling. This contributes to improving both electric mileage*3 and safety.

In addition, Denka's chemical materials are used in the power control units, wireless harness bundles, lights, and other places, and with the rise of vehicle electrification, we expect demand for these products to increase. In order to realize a clean and safe society, we will continue to take on challenges in the EV field.

*1 Cars capable of connecting to the Internet to acquire and analyze various data such as road conditions to improve safety.
*2 Materials used to reduce electrode resistance when forming electrodes for lithium ion batteries.
*3 The distance that you can travel for each unit of electric power. LIBs suffer from an issue where performance decreases due to the heat generated while in operation, thus reducing electric mileage.

Future Perspective

Open Innovation

The future of polymers, as told by a key member of the Evolmer® development team

The new high-performance elastomer "Evolmer®" was launched by Denka in January 2019. What role did open innovation play in this development project? And what does the future hold for polymers? Here, we will publish a roundtable discussion between Prof. Mori from Yamagata University, a key member of the development team, and researchers from the Denka Innovation Center.

From left in the photo

Ruriko Sekiya
Advanced Polymer Research Dept.
Advanced Technologies Research Institute
Denka Innovation Center

Yuhei Ishigaki
(Ph.D. in Engineering)
Advanced Polymer Research Dept.
Advanced Technologies Research Institute
Denka Innovation Center

Prof. Hideharu Mori
Professor
Department of Organic Materials Science,
Graduate School of Organic Materials Science,
Yamagata University

Jun Watanabe
General Manager
Advanced Polymer Research Dept.
Advanced Technologies Research Institute
Denka Innovation Center

What is Evolmer®?

Evolmer® is Denka's third functional elastomer following Denka Chloroprene® and Denka ER®. It boasts excellent mechanical strength, oil resistance, and wear resistance. It also features a balance of physical properties not found in conventional elastomers, such as a low compression set at low temperatures and excellent resistance to fatigue from flexing in dynamic environments.

Over 10 years of joint research

When did you start developing Evolmer®?

Ishigaki: This project was a direct result of the Denka Value-Up management plan in 2018. One aspect of this plan is to "specialize our key operations," so we decided to develop new materials using Denka's unique strengths. To do so, we asked for Prof. Mori's help.

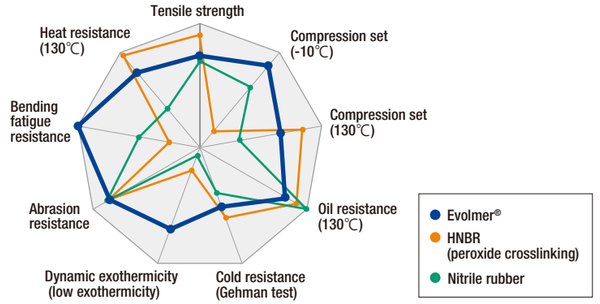
Watanabe: We signed a comprehensive joint research agreement with Yamagata University in 2013, and the following year, we established the Denka Innovation Center to actively promote open innovation. However, we've been acquainted with Prof. Mori long before that, since 2008.

Mori: How nostalgic. I was busy researching the creation of high-function polymers by controlling molecular weights and their distributions through RAFT polymerization*, and you called on me to create new value using Denka's assets.

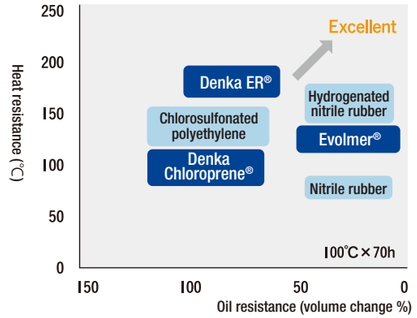
Sekiya: How did you benefit from the collaboration, professor?

Mori: I was particularly keen to work with chloroprene, a material used to make polychloroprene. It's not an easy material to get hold of due to the difficulties inherent in extracting and transporting it, but it's a wonderful monomer to research, so that made the offer very attractive. We began our joint research with a win-win relationship and have continued to explore the possibilities of polymers ever since.

A comparison between Evolmer® and other rubbers



Oil and heat resistance of different types of elastomer



The keyword is "oil resistance" Horizontal collaboration led to a hint

So those 10 years of collection led to the development of Evolmer®?

Mori: That's correct. Mr. Ishigaki joined my laboratory, and we began developing new functional elastomers.

Ishigaki: The first thing we did was to research market needs. After collecting customer feedback, we realized that "oil resistance" was an important keyword. At the time, the two most widely used rubbers were the cheap nitrile rubber and the high performing, yet expensive hydrogenated nitrile rubber. We discovered a need for an oil-resistant rubber that was somewhere in the middle of those two in terms of price and performance.

Mori: Once we knew what to make, the next phase was figuring out how to do it. After looking into several possibilities, we arrived at an approach of copolymerizing certain monomers to increase oil resistance. However, due to the special nature of the reactivity, they were not easy to polymerize.

Ishigaki: The answer lay in the polymerization technology cultivated through the development of high-performance styrene resins. Members of the Chiba Factory Polymer Research Department provided this hint. Based on their knowledge, we conducted multiple experiments with the

*Polymerization using sulfur compounds as RAFT (Reversible Addition-Fragmentation chain Transfer) agents.




cooperation of Prof. Mori, and through a process of trial and error, eventually succeeded in polymerizing a polymer with a uniform composition.

“Evolving polymers”?

So, it was a product realized through a combination of internal and external knowledge?

Ishigaki: Yes. Had we lacked one or the other, it would have been very difficult to complete the project.

Mori: It also helped a great deal that management was serious about this project. The people at the top maintained an enthusiastic attitude through the development. I’ve done joint research with several companies, but it’s rare for a large-scale product development to actually reach the market.

Ishigaki: Thanks to everyone’s cooperation, we were able to achieve not only the desired oil resistance and production costs, but also various other excellent physical properties. We’ve since received many inquiries from interested companies. Sekiya By the way, is there any meaning behind the name “Evolmer”?

Ishigaki It’s a portmanteau of “evolve” and “polymer”. This name was chosen from the 30 or 40 suggestions that the project members came up with.

Mori: I also made submitted two suggestions. I was rather confident, but alas, neither were chosen (laughs).

Collaborating to explore new possibilities

Prof. Mori, what do you think the future of polymers holds?

Mori: I think polymers still hold a lot of possibilities. New discoveries are constantly being made, and the “cutting edge” is constantly being updated. In terms of recent trends, I’d say that self-repairing polymers are very interesting. These are materials that automatically repair damage without any external stimulation or energy. Originally, these materials were researched for space exploration purposes, since it’s difficult to do repairs in outer space, but once they were commercialized for car coating materials, everyone became a lot more familiar with them. Once they can be manufactured at lower costs, I think we’ll see even more applications.

Ishigaki: Biodegradable polymers are also attracting a lot of attention. From an environmental perspective, this is likely to be considered an important quality in the future.

Watanabe: Yes, reducing impacts on the environment is a topic that regularly gets a lot of attention. Since this is something that needs to constantly be pursued, many institutions are carrying out research in different forms, and with the adoption of the SDGs in 2015, I think the number of interested companies will rise.

Sekiya: And there’s the healthcare field. I’m actually involved with a joint life sciences research project with another university, and I think that as technology in this field advances, polymers are going to play a surprisingly large role. For example, research is being conducted on bioabsorbable polymer sheets to patch up damaged blood vessels and organs to aid in regeneration, and polymers that can expand and contract to function as “muscles” for surgical robots and artificial limbs. Technological innovations in different fields may create new needs, and responding to those needs may further expand the possibilities of polymers.

Mori: That’s very interesting. I imagine there’s a big difference in mindset between someone like me who’s affiliated with a university and someone who belongs to a company.

Sekiya: What do you mean?

Mori: Well, my primary desire is to create a polymer with physical properties that have never been seen before. However, a company starts with the needs of society in mind.

Ishigaki: You can definitely feel that difference once you’re in Prof. Mori’s laboratory. One’s vision really expands when you’re developing from a flexible perspective not constrained by stereotypes. That attitude is essential for exploring new possibilities.

Mori: On the other hand, ascertaining needs is necessary to set a clear goal and contribute to society. That’s precisely why we were able to launch Evolmer®.

Watanabe: I imagine that both approaches are necessary, and that’s why there’s meaning in us continuing open innovation with universities. It’s not simply about knowledge. It’s also about expanding our viewpoints based on interactions with people possessing different mentalities and values. This will definitely become an asset for Denka in the future.

Mori: For me, I get a lot of stimulation from working together with companies. I hope that we can continue moving forward together to explore the possibilities of polymers and contribute to society.

Amazing the World with Innovation

DENKA TOPICS

Introducing Denka Group news tropics from June to September 2019

June — Increasing production of spherical alumina to expand the heat dissipation materials for automobiles business

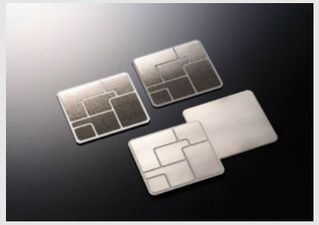

Masaharu Suzuki, Managing Executive Officer, makes a speech at the groundbreaking ceremony

We plan to increase spherical alumina production capacity to expand the heat dissipation materials for automobiles business. Production capacity will be increased fivefold through the establishment of a new spherical alumina plant at Denka Advantech Tuas Plant, a Singaporean subsidiary. On June 4, we held a commencement ceremony, including a groundbreaking ceremony and prayers for safety during the construction.

June — Sponsorship of 103rd Japan National Athletics Championships

From June 27 to June 30, the 103rd Japan National Athletics Championships was hosted by the Japan Association of Athletics Federations (JAAF) in Fukuoka City. As an official sponsor of JAAF, our logo was displayed inside the stadium, and we set up an athlete photo panel at the stadium gate. More than 5,000 people took photos there over the 4-day period.

June — Certified for IATF 16949 (QMS standard for the automotive industry)



In June, were acquired IATF 16949 (QMS standard for the automotive industry) for ceramic substrates produced at the Omuta Plant. Moving forward, we will continue striving to provide a stable supply of highly reliable products that make use of our unique technologies to contribute to the realization of a clean and safe society.

July — Investing in PlexBio (Taiwan) to strengthen our business alliance Measures against drug-resistant bacteria

What is the IntelliPlex™ system?
This system uses a combination of semiconductor manufacturing technology and biotechnology to simultaneously measure multiple items quickly and easily. It allows medical practitioners to identify the cause of symptoms with a single test.

On July 30, we applied to the Taiwan Financial Supervisory Commission to acquire shares of PlexBio by underwriting a capital increase through third-party allocation. By using the IntelliPlex™ system developed by PlexBio, we will be able to accelerate the development of diagnostic products. In this way, we will promote measures against drug-resistant bacteria and contribute to healthy lifestyles.

Aug. — Elementary and junior high school students experience the wonders of chemistry! Exhibited at Summer Vacation Chemistry Experiment Show for Children 2019

From August 3 to August 4, we exhibited at the Summer Vacation Chemistry Experiment Show for Children 2019 in Tokyo. Young researchers from the Denka Innovation Center led an experiment to separate substances into different components using chromatography. There were 450 participants, including parents.

Sept. — Preserving cultural assets through structural inspection technology

Using the 3D digital measurement technology developed for inspecting concrete structures, Denka and Denka Renotec are collaborating with KYOTO’S 3D STUDIO to preserve Daigoji Temple, a world cultural heritage site. Part of this initiative was introduced at the 25th ICOM General Conference, which was held at the Kyoto International Conference Center from September 1 to September 7.


Daigoji Temple, Kyoto

LINK GLOBALLY, LINK FUTURE

Group members around the world, working toward the future of Denka

The Denka Group has 6,000 employees around the world.
We posed the following question to members from different countries.

Theme What appeals to you about Denka?

YES, I CAN!

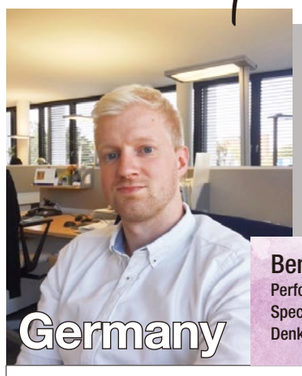
Lin Yan
Adhesives Department
Denka Chemicals Shanghai

YES, I CAN!

Joined the company in 2018. Responsible for sales, market development, and agency management of the high-performance industrial adhesive "HARDLOC." He seeks to increase brand recognition for HARDLOC in China.

Denka Chemicals Shanghai is always overflowing with good cheer. The president, vice-president, departmental managers, and drivers all work with smiles, so I can sense the team unity and warmth of the workplace every day. I'm grateful for this environment where I can work smoothly and demonstrate my abilities. I will continue working hard and believing in my peers.

How are things in China, Lin?



Bengt Schwemann
Performance Plastic Department;
Special Conductive Materials Department
Denka Chemicals GmbH

Internationality, future leading technology

Joined the company in 2017. He is in charge of sales and marketing of styrene-based resins and acetylene black for the European and CIS regions.

Working on an international stage and contributing to the future are the appealing points of working at Denka. We're currently working on improving sustainability and energy efficiency. With the shift to recyclable plastic materials and electrification of automobiles, I'd like to contribute to a sustainable future through sales of Denka products.

How are things in Germany, Bengt?

Challenges make it possible!

Joined the company in 2019. As a maintenance engineer in the Operation Department, he plans for preventive maintenance and ensures that operations flow smoothly with minimal loos.

Denka has a lot of potential for contributing to infrastructure development in Malaysia. Thanks to the expertise acquired from the Denka network around the world, our products are high quality and reliable. We're currently working on "hitozukuri" (personnel development). By training up the next generation of leaders, we can increase trust in Denka.

Kamarul Ezam
Operation Department
Denka Construction Solutions
M Sdn Bhd

How are things in Malaysia, Kamarul?

Angie Mei
Corporate Department
Denka Corporation

How are things in the USA, Angie?

Expensify & Timeout

Joined the company in 1998. As General Manager, she is involved with HR, accounting, general affairs, IT, and logistics.

Denka's strength is providing optimal solutions for both internal and external issues in a timely manner. We're currently focusing on office digitalization. We're aiming to realize a more convenient working environment through apps such as Expensify, which allows one to scan in receipts with your smartphone, and Timeout, a time-management system for employees.

Kuo Jihao
Process Technology Department
Denka Singapore Private Limited

How are things in Singapore, Kuo Jihao?

Strength in Diversity

Joined the company in 2016. As a senior process engineer, he aids in troubleshooting and optimizing plant operations.

Denka Singapore employs people from a variety of countries and cultural backgrounds, but despite language and cultural differences, they all work toward the same goal: achieving Denka Value-Up. I think working with people from varied backgrounds is very appealing, and having a diverse workplace will allow Denka Singapore to continue attracting talented individuals in future.

How are things in Vietnam, Tran Anh Quan?

Tran Anh Quan
Planning and
Coordination Department
Denka Advanced Materials Vietnam

Few in number, exceptional in talent

Joined the company in 2015. In cooperation with relevant departments, he seeks to strength internal control systems and create a better corporate culture.

At Denka, you can do rewarding work with talented coworkers. Taking on a wide range of professional challenges leads to personal growth. Personal growth leads to company growth, which in turn leads to more rewarding work or us. At our company, there's a culture of enjoying work and supporting each other. I will continue striving to acquire more rewarding work.