TOSOH

POSITIONED FOR GROWTH

Annual Report 2013

Tosoh Corporation and consolidated subsidiaries
Fiscal year ended March 31, 2013

TOSOH CORPORATION

Values based on monozukuri—*"a craftsman-like approach" to product detail and quality—have shaped Tosoh's destiny and growth for more than 75 years. We take pride in having established a resilient global enterprise whose products and services are woven into the fabric of modern life.*

Tosoh Corporation is a Japanese chemical company established in 1935 and listed on the First Section of the Tokyo Stock Exchange. It is the parent of the Tosoh Group, which comprises 132 companies worldwide and a multiethnic workforce of over 11,000 people and generated net sales of ¥668.5 billion in fiscal 2013, ended March 31, 2013.

TOSOH

Paul Duin
Tosoh Europe B.V. (Amsterdam, The Netherlands)
Product Manager, Ceramics Department

YTTRIA-STABILIZED ZIRCONIA

Tosoh's yttria-stabilized zirconia (YSZ) is superior to other machinable materials in most respects. It therefore has unlimited potential in the manufacturing field.

Most ceramics are hard but brittle, making them unsuitable for products that have to endure wear and tear or sudden shocks. YSZ overcomes this limitation through a technological breakthrough that produces a microcrystalline grain structure. As a result, YSZ has high strength and wear resistance, flexibility, and a useful life far beyond that of average ceramics and is commonly referred to as ceramic steel.

Add heat-insulating properties and oxygen-ion conductivity, and YSZ possesses all the properties and potential for application in a wide range of industrial and commercial fields. It is also used in consumer goods, such as luxury watches and ceramic knives, and in dental materials because of its natural beauty and soft texture.

Paul Duin graduated with a degree in chemical engineering and joined Tosoh Europe B.V. in 1999 to sell advanced ceramics. He is typical of Tosoh's corporate culture of long-term service and results. Duin is striving for a sales record that will represent an eightfold increase in turnover compared with the year he joined the company.

Shota Yanagi joined Tosoh in 2007 and has six years of experience as a plant operator. Tosoh has high expectations of him as a plant operator specializing in zirconia manufacturing.

The grinding media and dental markets generate the bulk of YSZ demand. Demand from the dental market has expanded sharply. New grades of YSZ are finding application in huge untapped aspects of the dental markets in Japan, the United States, and Europe.

Demand, meanwhile, from the consumer goods industry is likewise growing strongly. Manufacturers are coming up with new applications for YSZ. Smartphone makers in particular are looking at YSZ as decorative material.

To meet soaring demand for its YSZ, Tosoh moved to a two-plant production organization. The company built a new plant at its Yokkaichi Complex in 2009 to supplement the plant at the Nanyo Complex. Having dual plants also assures customers of stable supplies. Should something befall one plant, the other could take up the slack. In 2012, Tosoh again boosted its YSZ production capacity, about 20%, by expanding the Nanyo Complex plant.

New grades of YSZ are finding application in huge untapped aspects of the dental markets in Japan, the United States, and Europe.

Tosoh built the world's first commercial zirconia plant in 1983. Since that time, YSZ has been increasingly used in the manufacture of industrial parts and components for its strength, resistance to rust, corrosion, and chemical reactions; its exponentially greater heat-insulation properties than metals; and its machinability. YSZ, in fact, has become the world standard for fiber-optic connectors. It is also a high-performance grinding media, with beads as small as 0.03 millimeters.

The dental industry values YSZ for its strength, durability, natural look, and chemical inertness. These properties make it ideal for use as artificial teeth and crowns and in bridges and other substructures. To further stimulate demand in this market, Tosoh recently introduced its Zpex® line. The line includes a highly translucent YSZ and Zpex Yellow, a colored YSZ that enables dental technicians to better match tooth coloring.

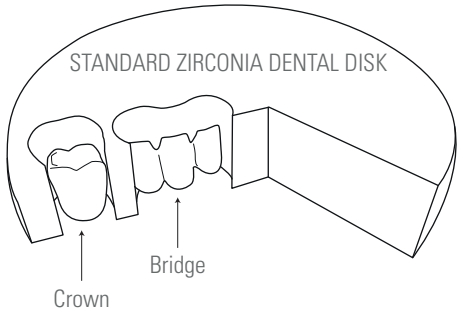
Calls for improved dental care are rising around the world, so the dental industry represents a large growth market for Tosoh's YSZ. The intention to sell the product to dental markets overseas figured prominently in the company's recent expansion of its YSZ production capacity.

ZIRCONIA IN DENTAL MATERIALS

Sintered zirconia is hard and therefore difficult to fabricate. For that reason, zirconia crowns and bridge restorations are made from a pre-sintered zirconia disk, which shrinks only about 21%, using a computer-aided design and computer-aided manufacturing (CAD/CAM) system. The fabricated zirconia dental appliance is then sintered to ensure its hardness.

In CAD/CAM fabrication, the standard zirconia disk has a diameter of 98 millimeters and a thickness of 10 millimeters to 25 millimeters. This is sufficient to fabricate a full set of teeth.

Translucent grades of zirconia are popular for dental work on front teeth, which require superior cosmetic qualities. Worldwide, the dental industry values Tosoh's Zpex line of translucent zirconia for CAD/CAM system disks. The Zpex lines features superior cosmetic qualities, high durability, and predictable shrinkage.



A zirconia disk with a diameter of 98 millimeters and a thickness of 10 millimeters to 25 millimeters can be used to fabricate a full set of teeth.

Miki Yamashita
Tosoh Corporation (Shunan, Japan)
Chemical Manganese Project Team Construction Group

CHEMICAL MANGANESE OXIDE AND ELECTROLYTIC MANGANESE DIOXIDE

Tosoh's raw materials for battery cathodes are essential for the shift to hybrid and electric vehicles.

Tosoh is the world's largest manufacturer and seller of electrolytic manganese dioxide (EMD), which is generally used to manufacture cathodes for dry cell batteries. Recently, EMD has also come into use as a precursor for the manufacture of lithium manganese oxide (LMO). LMO is employed to produce materials for the cathodes of the lithium-ion batteries (LIB) for electric and hybrid cars.

Tosoh's development of chemical manganese oxide (CMO) production technology increases its manganese oxide production capacity. This underpins Tosoh's ability to meet the growing demand for manganese oxide while continuing to supply it to the traditional dry cell battery market. The high quality and rigorous control of specifications made possible by Tosoh's production technology give the company competitive advantages in the market for manganese oxide.

Miki Yamashita is a career researcher who joined Tosoh in 2009. Her main areas of responsibility are the synthesis of CMO and new materials on a laboratory scale. Yamashita also is involved with LMO synthesis and the assessment of lithium-ion battery properties.

Takenori Kurogi is a recent mid-career recruit. He worked at a major Japanese company for 12 years before joining Tosoh in 2012. Tosoh utilizes Kurogi's considerable job experience in an administrative capacity.

The market for electric and hybrid cars is expanding amid heightened awareness of environmental and energy issues, such as global warming and escalating emission standards. Consequently, global requirements for LMO are expected to expand sevenfold by 2015 and to result in a similar demand curve for manganese oxide.

Tosoh has the largest EMD production capacity in the world and supplies approximately 20% of the world market. Our new CMO production technology increases our capacity to supply our targeted markets. It also enables us to produce material particularly suited for the production of LMO for the lithium-ion batteries in automobiles.

Compared, moreover, with our traditional method of making manganese oxide, our new technology is highly energy efficient, requiring neither electrolytic cells nor pulverizers. In addition, it allows us to finely control substances, to ensure uniform particle size and to almost completely remove impurities. This enables us to flexibly meet customer needs and to improve production efficiency and overall quality.

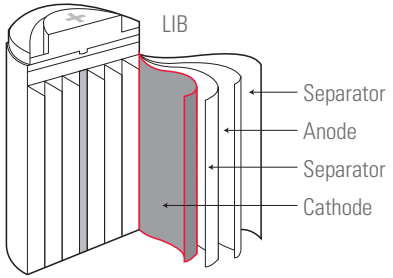
Tosoh has the largest EMD production capacity in the world and supplies approximately 20% of the world market.

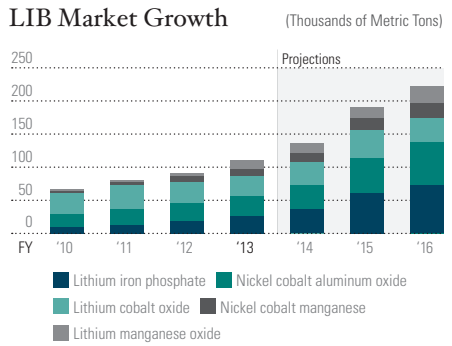
Our subsidiary Tosoh Hyuga Corporation completed construction of the Tosoh Group's first CMO plant in March 2013. The new plant adds 5,000 metric tons to Tosoh Hyuga's 33,000-metric-ton annual production capacity of EMD. The subsidiary is the sole producer of EMD in Japan. Tosoh's other EMD production facilities are overseas, at Tosoh Hellas A.I.C., in Greece. Tosoh Hellas's annual EMD production capacity of 26,000 metric tons makes it the largest manufacturer of EMD in Europe.

Rechargeable lithium-ion batteries are not only used in electric and hybrid cars. They also are employed as electric power storage batteries in emergency systems and in such consumer electronics products as personal computers, cell phones, portable compact music players, digital cameras, and electric tools.

SUPPLYING MATERIALS FOR THE HYBRID AND ELECTRIC VEHICLES OF THE WORLD

CMO and EMD are used to produce the LMO and the nickel cobalt manganese (NCM) used in the cathodes of the rechargeable lithium-ion batteries that power the hybrid and electric vehicles that the world is shifting to. When the particle size of the LMO applied to the cathode in the manufacture of lithium-ion batteries is small and uniform, improvement in output and battery life is achieved. Tosoh's CMO particles are precisely optimal in size and shape for the manufacture of superior LMO for use in hybrid and electric vehicle lithium-ion batteries.





Keita Ito
Tosoh Corporation, Nanyo Complex (Shunan, Japan)
Staff Member, Specialty Materials Department

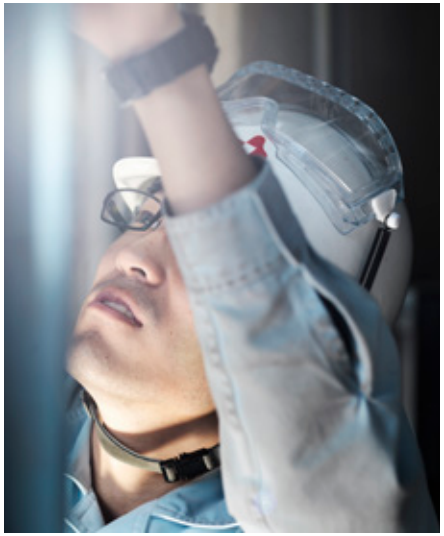
ZEOLITES

Synthetic zeolites are stable and nonflammable solids customizable to meet specific adsorption or catalytic needs in industrial and environmental processes.

The crystalline structures of synthetic zeolites feature an open, uniform shape of negatively charged stacked alumina and silica tetrahedra. The negative charge is neutralized by cations, such as potassium, sodium, or calcium, that are embedded in the synthetic zeolites' crystalline structure. At the research level, there are more than 200 different known zeolite crystalline structures; however, only about 15 have been commercialized.

Zeolites can act as molecular sieves. They trap molecules that are smaller than their pore size while ignoring larger molecules. Significantly, the pore size of zeolites can be modified by ion exchange to meet a specific adsorption target. Their catalytic and other properties likewise can be changed, by controlling the silica to alumina ratio. High-silica zeolites (HSZ) generally have a silica to alumina ratio of five or more, which gives them superior thermal stability and catalytic properties.

Keita Ito began his career at Tosoh in 2009. His job as a staff member at the Specialty Materials Department of Nanyo Complex includes contributing to increased production capacity and the development of new grades of zeolites.



Ito concentrates his efforts on the HSZ line of high-performance zeolites used primarily for catalysts and adsorbents.

Tosoh manufactures two types of zeolites, Zeolum® and HSZ. In general, Zeolum is used to remove water and impurities in the manufacture of ethylene, chlorofluorocarbons, and other chemicals. In addition, it adsorbs carbon dioxide (CO_2) in cryogenic distillation processes and removes sulfur from liquefied petroleum gas (LPG). Other uses include its prevention of cloudiness in multilayer glass, its removal of trace moisture from urethane paints and sealants, its control of moisture in pharmaceutical and food packaging, and its cleaning of exhaust gas.

More specifically, the chemical industry uses Zeolum, Tosoh's line of zeolite molecular sieves, extensively in processing gases for drying, purification, and separation purposes. Zeolum NSA is a lithium, LSX-type zeolite that offers heightened aluminum content for superior nitrogen adsorption. Zeolum NSA is therefore especially suitable for use in oxygen PSA systems.

Tosoh's HSZ line includes high-performance catalysts and adsorbents valued for their high thermal and acid stability. They find application as petroleum refining catalysts in hydrocracking, isomerization, and dewaxing processes and as petrochemical catalysts in alkylation and isomerization processes. HSZ also is used as an adsorbent of harmful volatile organic compounds (VOCs).

HSZ is most in demand as a material for the catalyst in the catalytic converters of automobile exhaust systems. Calls for the product are surging as countries introduce stricter environmental laws and emission standards. Japan raised the bar on emissions in 2009, the United States implemented its US10 emissions standards in 2010, and Europe initiated its Euro VI standards in 2013 for enforcement in 2014.

Tosoh seeks to capture a major share of this growing market and has been raising its

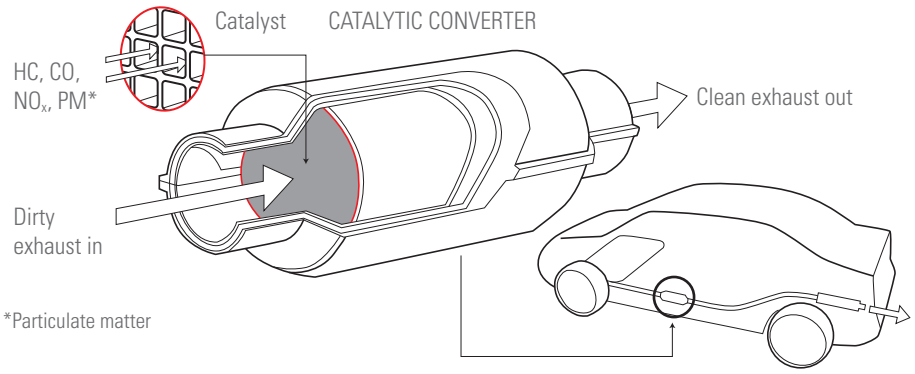
HSZ is most in demand as a material for the catalyst in the catalytic converters of automobile exhaust systems.

HSZ production capacity in stages in line with tougher emission standards in its main markets. We doubled our HSZ production capacity in 2009 by building a zeolite plant at our Yokkaichi Complex to supplement our original plant at the Nanyo Complex. And in March 2013, we completed an expansion to the Yokkaichi Complex plant that increases our overall zeolite production 50%.

TOSOH ZEOLITES CLEAN EMISSION GASES IN CATALYTIC CONVERTERS

Automobile emission standards place limits on how much carbon oxide (CO), hydrocarbon (HC), nitrogen oxide (NOx), and particulate matter (PM) vehicles may emit. There is a strong trend toward stricter regulations on emissions, particularly for diesel vehicles.

High-silica zeolites (HSZ) are used in reduction catalysts that are effective in meeting increasingly severe emission standards. Generally, HSZ and other materials coat a catalytic converter's honeycomb carrier, which is made of cordierite or some other ceramic.



Dr. Regina Holzhauser
Tosoh Bioscience GmbH (Stuttgart, Germany)
Director of Sales and Marketing

SEPARATION MEDIA

Toyopearl separation media consists of high-performance resins ideally suited for industrial-scale separation and purification processes.

Toyopearl is a packing material for liquid chromatography. It consists of hydrophilic, cross-linked polymer spheres ranging in particle diameter from 20 micrometers to 150 micrometers. It can be applied to large columns because of its semirigid backbone structure and features superior mechanical and chemical stability and a high adsorption capacity. These properties render Toyopearl suitable for the industrial-scale separation and purification processes commonly used by pharmaceutical, food product, and bioscience companies.

Toyopearl resins are available in a range of particle sizes for the capture, intermediate, or polishing steps of chromatography. They also are available for the most common modes of liquid chromatography: size exclusion (SEC); hydrophobic interaction (HIC); ion-exchange (IEC); and affinity chromatography (AFC) for biomolecules.

Dr. Regina Holzhauser joined Tosoh Bioscience GmbH in 2006 as its director of sales and marketing. She took over the commercial leadership of Tosoh Bioscience's separation business for process media, columns, and GPC instruments in European and some affiliated countries. Dr. Holzhauser earned a doctorate in analytical biochemistry in 1988 and worked internationally in chromatography and analytical instruments before she joined Tosoh Bioscience.

Over the past two decades, Toyopearl separation media has become increasingly popular within the biopharmaceutical industry. That industry is rapidly spreading beyond such of the developed nations as Europe, Japan, and the United States to the developing countries, including China, India, and other nations. And biosimilar molecules development has resulted in a larger market and a sharp increase in demand for Toyopearl.

Tosoh therefore decided in 2010 to double its Nanyo Complex's Toyopearl production capacity. The capacity expansion was completed in April 2012 and ensures that Tosoh can comfortably achieve its immediate goal of supplying approximately 10% of the global separation media market for biomolecules.

Tosoh accompanied its expansion of Toyopearl production capacity with the addition to its Toyopearl lineup of new purification processes products to broaden its targeted markets. The Toyopearl GigaCap series, HIC 600 series, and AF-rProtein A-650F are special grades of Toyopearl for antibody drug purification, the area of greatest demand for separation media in the biopharmaceutical products industry.

Among the advantages of Tosoh's comprehensive bioscience operations is that they employ the same chemistry used in making production-scale Toyopearl resins to produce polymeric TSKgel, PW-type analytical HPLC columns. Having the same chromatographic selectivity allows for a seamless scale-up where an analytical method developed on a TSKgel column can be easily scaled to the corresponding bulk Toyopearl resin for manufacturing use, saving valuable development time.

A comprehensive selection of such compatible products enables various synergies in the analysis, isolation, and purification of biomolecules. Tosoh's portfolio of over 500 specialty items encompassing all common modes of liquid chromatography can help purify virtually any protein, peptide, enzyme, nucleic acid, antibiotic, or small molecule. The company also offers strong technical support services in major markets.

Left: Yuta Sugimura's nine years of experience since joining Tosoh in 2005 have provided him with a strong belief in the importance of clean operations.

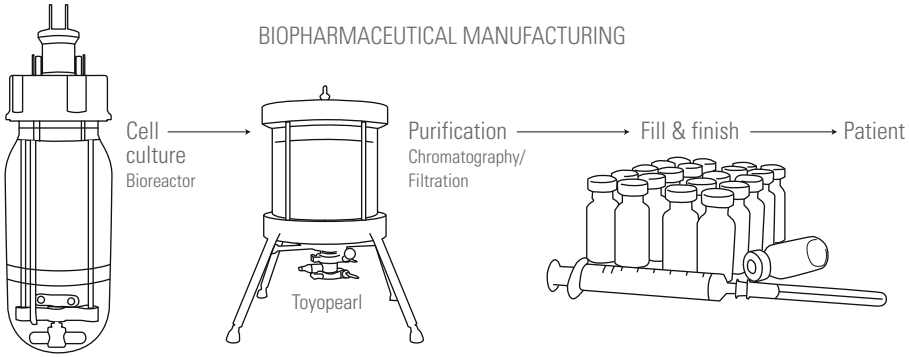
Right: Gen Nakamura began working at Tosoh a year after Sugimura joined the company. He recognizes that while the workload may be strenuous the experience is fulfilling.

TOYOPEARL AND THE BIOPHARMACEUTICAL MANUFACTURING PROCESS

Chromatography is an integral part of every biopharmaceutical manufacturing process, because biotherapeutic production is often based on cell cultures. So-called recombinant peptides or proteins need to be purified of residual impurities, such as host cell proteins, DNA, endotoxin, and viruses.

Typical purification schemes combine filtration and chromatographic steps that allow the separation of target molecules from impurities. They exploit physical properties, such as size, charge, hydrophobicity, or bio-specific interaction.

Toyopearl resins can be applied at various stages of the purification process in what is referred to as downstream processing. Examples of biotherapeutics purified with the help of Toyopearl are monoclonal antibodies; interferon; insulin; erythropoietin (EPO); growth factors; and blood plasma–derived proteins, such as Factor VIII.



Kazutoyo Kawahara
Tosoh Europe B.V. (Amsterdam, The Netherlands)
General Manager

VINYL CHLORIDE MONOMER

Vinyl chloride monomer (VCM) is a clear gas chemical intermediate chiefly used in the production of polyvinyl chloride (PVC), photographed above. PVC is one of the world's major construction materials.

VCM is a chemical intermediate and lies at the end of a chain of chemical processes for producing PVC, the third most widely used plastic in the world. VCM also plays an important role in maintaining a high operating rate for Tosoh's fully integrated vinyl isocyanate chain, which produces a myriad of products. A high rate of operation ensures an adequate supply of core raw materials and helps reduce costs.

Kazutoyo Kawahara began his career with Tosoh Corporation in 1990 after majoring in law. Through his work in Corporate Strategy and Planning, he was involved with Tosoh's PVC-related subsidiaries in Southeast Asia. Kawahara then took over Tosoh's global marketing for the Chlor-Alkali Division before becoming the general manager of Tosoh Europe B.V.

Tosoh supplies most of its VCM to its network of PVC-related subsidiaries in Japan, China, Indonesia, and the Philippines. We also, however, supply a significant amount of VCM to companies outside the Tosoh Group, in Japan and abroad.

Before the accident at the No. 2 VCM Plant at the Nanyo Complex in 2011, Tosoh had an annual production capacity for VCM of 1.45 million metric tons. We supplied approximately 1.1 million metric tons of that amount to our PVC subsidiaries and affiliates and sold the rest on the open market. When the accident occurred, we were in the final stages of planning expansions to our PVC production facilities in China and the Philippines that would require us to supply more of our VCM production to our network. We also were in the process of clearing a bottleneck in VCM production at the Nanyo Complex.

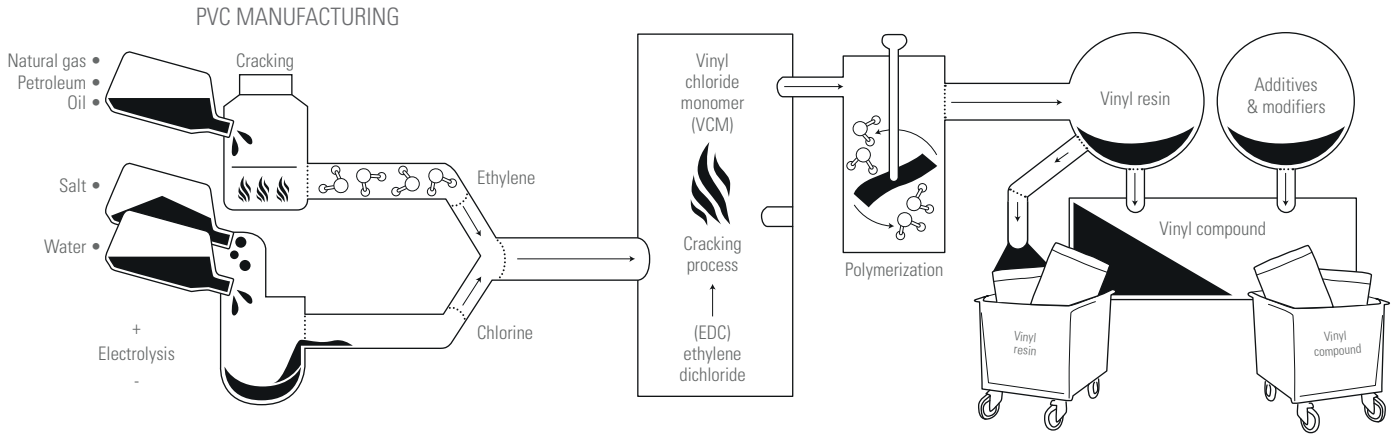
With the sharp deterioration in the yen, we are ideally positioned for profitable growth in our VCM and PVC operations.

After the accident, we implemented a strict process of ensuring the safety of our other operations and restored production at the No. 1 and No. 3 VCM Plants over about the next six months. We decided not to restart the No. 2 Plant and instead chose to expand the production capacity of the No. 3 VCM Plant by 200,000 metric tons a year. That expansion is scheduled for completion in October 2014. It will raise our total yearly VCM production capacity to 1.1 million metric tons.

Tosoh's main concern in its VCM operations is the stable supply of cost-competitive product to its PVC manufacturing network. We do, though, continue to sell on the open market as well. The strong yen and the growing use in China of the carbide method to produce PVC have forced us to look to the Japanese market in recent years for profitable external sales. We have, however, also been looking at opportunities overseas, particularly in Indonesia and India, utilizing our overseas PVC production bases. With the sharp deterioration in the yen, we are ideally positioned for profitable growth in our VCM and PVC operations.

MANUFACTURING ONE OF THE MOST POPULAR PLASTICS IN THE WORLD

Ethylene produced by a naphtha cracker is reacted with chlorine obtained from the electrolysis of salt to produce ethylene dichloride (EDC), which is then converted into VCM using Tosoh's proprietary oxychlorination process. Vinyl chloride liquid is fed to polymerization reactors where it is converted from a monomer to a polymer. The final product of the polymerization process is PVC, in either flake or pellet form. Tens of billions of pounds of PVC are sold on the global market each year.



Hideki Takada
Tosoh Corporation (Tokyo, Japan)
Assistant Manager, Polymers Division, Functional Polymer Group Leader

CHLOROSULPHONATED POLYETHYLENE

Toso-CSM, or chlorosulphonated polyethylene, is a specialty-grade synthetic rubber with superior resistance to abrasion and to temperature extremes. It has applications in industrial and consumer markets.

Toso-CSM is a chlorosulphonated polyethylene. CSM, a functional polymer, is resistant to ozone, weather, oil, chemicals, and ultraviolet light. It can also easily be pigmented to produce brilliant colors, opening up a wide range of applications in the industrial and consumer markets.

CSM is popularly used in automobile and industrial hoses, adhesives and coatings, escalator railings, linings for electrical and mechanical products, roofing materials, and other industrial components and products. In the consumer market, CSM can be found in inflatable boats, folding kayaks, life jackets, windbreakers, and raincoats.

Hideki Takada began his career at Tosoh Corporation in 1992. His first assignment was in Tokyo, to chloroprene rubber sales. In 2003, he was transferred abroad to oversee the rubber business at Tosoh Europe B.V. Takada returned to Japan in 2009 to become the assistant manager of the Polymers Division and the leader of its Functional Polymer Group at headquarters.

CSM has been in high demand in the industrial market for many years. It is preferred for its superiority to rubber and for its many advantages over conventional synthetic rubber. Supply, however, has been tight because of high production costs and technological and other issues that limit the number of manufacturers capable of producing CSM.

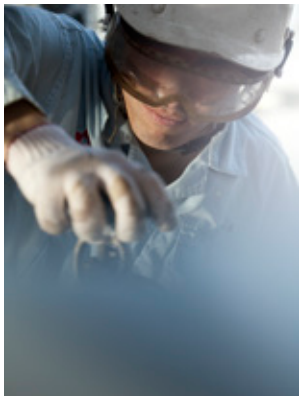
The CSM demand-supply balance was seriously disrupted in 2009 when the only other major producer besides Tosoh announced its withdrawal from the business. Tosoh stepped into the vacuum by adding a CSM production line at its Nanyo Complex, raising its annual production capacity to 8,500 metric tons. This positioned us as the major supplier in the market.

Since the completion of that expansion in 2010, the company's production lines have run at full capacity to support global demand. Tosoh holds an approximately 70% share of the world market, and approximately 80% of Tosoh's CSM production is exported.

Worldwide demand for CSM continues to rise, particularly in Asia. So Tosoh opted to boost its production capacity by debottlenecking its CSM operations. We finished this process in June 2012, raising our CSM production capacity 1,000 metric tons, to 9,500 metric tons. Global CSM high-end application demand is estimated to be 10,000 metric tons. Tosoh will consider further production capacity expansion if favorable conditions present themselves.

Other companies have entered the CSM market, but Tosoh remains the market leader and sole supplier of high-end CSM. We produce diverse Toso-CSM by varying chlorination and chlorosulphonation and the polyethylene (PE) polymer. We also manufacture an alkylated chlorosulphonated PE under the extos brand name. Extos combines excellent dynamic and low-temperature properties with the features of conventional Toso-CSM and is suited for such dynamic applications as automotive belts and boots.

Tosoh continues to pursue technology developments to improve its CSM grades, to keep ahead of the competition in CSM, and to explore new applications for its CSM products.

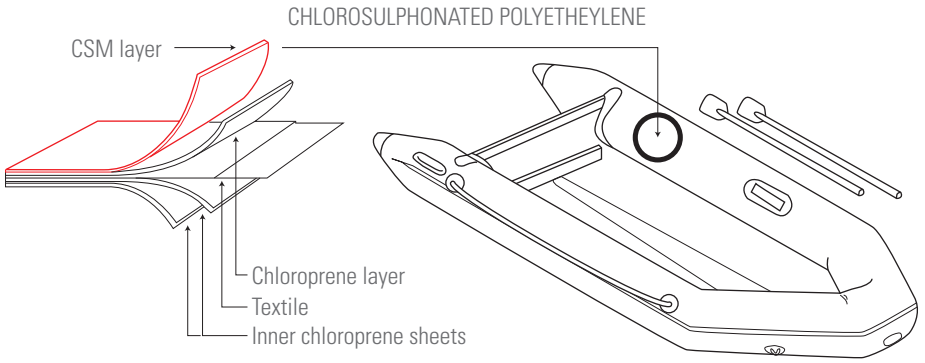


Left: Takehiko Yamamoto is a senior plant operator with a reputation for being strict but fair in his responsibilities for training new recruits.

Right: Tadashi Tamano, who is featured on this report's cover, shares Yamamoto's passion for motivating fellow employees to greater heights.

THE VARIED USES OF TOSOH'S CHLOROSULPHONATED POLYETHYLENE

Toso-CSM is produced from polyethylene by chlorination and chlorosulphonation with chlorine and sulphur dioxide gas. Various types of Toso-CSM are obtained according to the degree of chlorination and chlorosulphonation and the sort of polyethylene polymer used. CSM, or chlorosulphonated polyethylene, is popularly used in automobile and industrial hoses, adhesives and coatings, escalator railings, linings for electrical and mechanical products, roofing materials, and industrial components.



POINTING THE WAY TO THE FUTURE AND LAYING THE GROUNDWORK FOR GROWTH

Research and development underpin Tosoh's chemistry of innovation.

At Tosoh, we are constantly pushing the technological envelope with unstinting research and development (R&D). We do so because of the ever-quickening pace of technological growth and progress in contemporary lifestyles. We do so because of a sense of responsibility to lead the way in providing new and better products for our customers. We do so because we know that this is also the best way to ensure the growth and evolution of the Tosoh Group.

Our R&D team consists of about 870 people at work on product and technology improvements and on laying the groundwork for future business. In fiscal 2013, we invested ¥12.2 billion (US$129.7 million) in our R&D programs.

Those programs strengthen our core businesses and enhance our ability to generate tomorrow's products and to secure our business growth. To stay on the leading edge in our fields of expertise, we bolster our independent research through joint research with external research facilities, at universities and other educational institutions and at public research laboratories. We encourage collaboration to maximize organizational resources and to generate synergies.

Our R&D oversight organization comprises various committees responsible for distinct research themes. They also drive the commercialization of emergent products and technologies. To ensure balanced oversight, representatives from our business units, laboratories, and strategy divisions sit on these committees. The committees determine the most promising strategies for Tosoh's businesses while considering the Tosoh Group's social responsibilities and environmental policies.

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ORGANIZATIONAL STRUCTURE

Our R&D activities revolve around six facilities in Japan. They include the Tokyo Research Center, the Yokkaichi Research Laboratory, the Nanyo Research Laboratory,

the Technology Center, the R&D Center of our subsidiary Organo Corporation, and the Central Research Laboratory of our subsidiary Nippon Polyurethane Industry (NPU).

The Tokyo Research Center focuses on advanced materials for electronics, health care, and other leading-edge sectors. Researchers at the Yokkaichi Research Laboratory concentrate on petrochemicals and specialty polymers. At the Nanyo Research Laboratory, researchers develop specialty technologies for applications in environmental protection and in inorganic, organic, and elastomeric materials. NPU's Central Research Laboratory undertakes research in urethane raw materials in our chlor-alkali operations, while Organo's R&D Center is responsible for research on the water treatment and related technologies of our engineering operations.

Our Technology Center, meanwhile, contributes engineering expertise to transform R&D ideas into production technologies. It is also responsible for designing production facilities for those technologies.

R&D EMPHASIS BY PRODUCT GROUP

SPECIALTY GROUP

Electronics: silica glass, materials for organic light-emitting diodes, chemical vapor deposition and atomic layer deposition precursors for semiconductor devices, transparent conductive materials, high-performance etching solvents for semiconductor manufacturing

Bioscience: immunoassay equipment and reagents, high-performance liquid chromatography diagnostic systems, genetic diagnostic equipment and reagents, high-performance separation media for pharmaceutical and medical analyses

Environmental protection and conservation: zeolites for automotive catalytic converters and precious metal recovery, chelating agents for removing heavy metals from water, materials for removing pollutants from soil

Tosoh's functional materials R&D is rooted in a commitment to contribute to the development of products to meet society's most pressing needs in environmental stewardship, health care, and more.

Contributing to the development of highly efficient and reasonably priced solar power is among our objectives. We have commercialized two types of physical vapor deposition (PVD) materials for the transparent electrode layer on a photovoltaic cell. Our zinc aluminum oxide (AZO) product is for thin film silicon photovoltaic cells, and our indium tin oxide (ITO) product is for copper indium gallium selenide (CIGS) photovoltaic cells.

We also have developed transparent conducting oxide (TCO) sputtering targets. Our enhanced ITO and AZO TCO targets achieve higher photovoltaic cell efficiency than standard targets. In addition, we have developed sputtering targets for the manufacture of the thin film transistor oxide semiconductors used in flat-panel displays. And we have developed sputtering targets for the low-temperature, low-resistance thin film used in increasingly popular touch-panel displays.

We ... have developed transparent conducting oxide (TCO) sputtering targets. Our enhanced ITO and AZO TCO targets achieve higher photovoltaic cell efficiency than standard targets.

Tosoh, meanwhile, is playing an important role in developing electronics materials and technologies for semiconductors and flat-panel displays. In the semiconductor field, for example, our researchers are developing organometallic compound materials applicable to the next generation of miniaturized circuits.

We also are contributing to the evolution of the organic light-emitting diode (OLED) displays that are becoming the world standard for their high performance and energy conservation. Following our commercialization of electron transport materials, we now also produce the high-efficiency electron hole transport materials used in OLED displays.

Some of Tosoh's most effective efforts in providing energy and environmental conservation solutions through R&D are in the automotive industry. We continue to develop improved manganese oxide materials for use in the cathodes of the rechargeable lithium-ion batteries popular for electric vehicles and that are becoming so omnipresent in society.

R&D personnel also continue to develop eco-products that improve Tosoh's heavy metal chelating and soil remediation agents. Their efforts recently produced an agent for removing anionic heavy metals, such as hexavalent chromium, that complements our line of cationic heavy metal chelates.

Our goal in medical diagnostic systems is to put cutting-edge technologies into the hands of medical caregivers and researchers around the world.

Tosoh's vision in the global health care industry is to support better medical care in developing and developed countries. In developing countries, the priority is typically on controlling infectious diseases. The concern in developed countries is primarily cardiovascular diseases, cancer, and diabetes.

Tosoh's medical diagnostic system R&D supports the accurate and rapid diagnosis and effective treatment of ailments common to developing and developed nations and therefore helps to raise the level of health care globally. In another health-related area, our zirconia dental materials are contributing to improved treatments in dentistry.

We are, meanwhile, developing high-performance separation media for biomedical fields. Our advanced separation systems are employed, for instance, in refining antibodies.

Our goal in medical diagnostic systems is to put cutting-edge technologies into the hands of medical caregivers and researchers around the world. The Tokyo Research Center, for example, designs diagnostic and particularly genetic testing tools based on genetic analysis and genetic engineering technologies. It is making progress especially in the development of diagnostic tools for various infectious diseases. Our diagnostic systems also are contributing to research on the frontiers of medical science and drug discovery, including cancer testing technologies.

CHLOR-ALKALI GROUP

Vinyl isocyanate chain process technologies: energy-saving cathodes for electrolyzing salt, improved methods for producing isocyanate materials, other such technologies

Tosoh's innovation in electrolysis and other technologies strengthens the vinyl isocyanate chain that is the core of the company's business in basic chemicals.

The company's n-BiTAC bipolar ion-exchange membrane electrolyzer cells are the first step in the integrated operations of the company's vinyl isocyanate chain. They are the best of their kind in electrical efficiency, and Tosoh R&D continues to develop and test cathodes that likewise conserve power.

Tosoh and its wholly owned subsidiary NPU collaborate in R&D to improve the vinyl isocyanate chain's production processes. They also cooperate in developing applications for the heat-resistant polyurethane foam used in the construction industry and for other urethane-based products.

Tosoh's R&D bodies work as a group in developing comprehensive technologies to improve the manufacturing processes of the vinyl isocyanate chain, from catalyst development through process improvement.

PETROCHEMICAL GROUP

Polyethylene: high-performance materials for laminates and food packaging, including high melt strength polyethylene—with molding-grade applications in development—and ethylene vinyl acetate film for encapsulating photovoltaic cells, quality improvements in production processes, increased transparency in film

Adding value to commodities is the essence of Tosoh's R&D in petrochemicals. We primarily seek to improve and develop polymers and related technologies.

We ... are developing materials that resist the surface degradation common in insulation materials.

Tosoh's development and improvement program for commodity polyethylenes aims to differentiate the company's products in the market through superior functionality. Our new and better grades of foams, laminates, food product packaging, and other applications contribute to our sales of petrochemicals. We also continue to develop new applications for our high melt elasticity polyethylenes. Our goal is to expand their use in the automotive, packaging, construction materials, and medical care industries.

The Petrochemical Group joins the Specialty Group in making photovoltaic cells an important research theme. The Petrochemical Group is developing resins for this growing market, with an emphasis on high-performance ethylene vinyl acetate (EVA) sealing film. Tosoh is one of only a few companies worldwide making grades of EVA suitable for the encapsulant film of photovoltaic cells. And our researchers are developing highly durable EVA-based adhesives.

The supply of raw materials for petrochemical resins provided by C_5 and C_9 fractions is becoming an issue in the petrochemical industry because of the decline in the operating rates of naphtha crackers. Consequently, our researchers are concentrating on developing manufacturing technologies that substantially improve the production volume of naphtha crackers.

Among high-performance resins, we are developing polyphenylene sulfide (PPS) resins with superior metal bonding and high thermal conductivity characteristics. Commercial applications are available for smartphone bodies. Tosoh has had good success in introducing metal adhesion PPS compounds for the electronics industry. We also are developing materials that resist the surface degradation common in insulation materials.

Our R&D in chloroprene rubber (CR) focuses on reengineering our manufacturing processes to expand production and on developing new grades of CR in accordance with the requirements of customers. Similarly, we are working to improve our production processes for chlorosulphonated polyethylene (CSM) rubber. We also are developing new grades of CSM to support our position as the world's top CSM manufacturer.

Our petrochemical-related R&D programs also are tasked with discovering new applications for products. We are looking into uses for PVC paste besides wallpaper and flooring materials. In addition, we are aggressively developing new polymer materials for use in optical materials for LCDs and in substrate materials for flexible displays.

ENGINEERING GROUP

Water treatment technologies: ultrapure water production, purified water production, filtration, wastewater treatment, valuable resource recovery, waste reduction, groundwater treatment, ion-exchange membranes

Soil treatment technologies: soil remediation

The R&D Center of our subsidiary Organo Corporation forms the core of Engineering Group R&D. That facility emphasizes developing basic technologies, improving products, and devising new products and services to complement and bolster Organo's offerings.

In addition to soil remediation technologies and services, Organo's range of products and services includes water treatment equipment, such as pure, superpure, and clean water producing equipment; water treatment plants, such as wastewater treatment or chromatography separation systems; water treatment chemicals; and food additives and materials for food processing.

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