

# Organic and Inorganic Chemicals



*PVC is a very durable, resource-saving plastic used in many applications that contribute to improving the quality of life, including building materials such as vinyl siding and window frames for houses.*

## Completion of Global PVC Strategy

The globalization of Shin-Etsu's PVC business has successfully moved ahead.

In December 1999, Shin-Etsu completed the acquisition of Rovin, based in Rotterdam, the Netherlands, from Shell Chemicals Ltd. and Akzo Nobel Chemicals NV. Currently, Rovin is divided into two companies: Shin-Etsu PVC B.V. and Shin-Etsu VCM B.V. The annual production of the two companies is 400,000 tons of PVC and 500,000 tons of VCM, respectively. In the United States, Shin-tech Inc., a wholly owned subsidiary based

in Freeport, Texas, boasts the largest PVC production capacity of any single facility in the world at 1.45 million tons annually. Shin-tech has also started construction of a second facility in Addis, Louisiana. Completion is scheduled for the second half of 2001 and annual production capacity for the new plant will be 590,000 tons.

Both Shintech plants purchase VCM from adjacent Dow Chemical facilities. With these moves, Shin-Etsu has further solidified its position as the world's largest manufacturer of PVC. Shin-Etsu's facilities in Kashima, Japan, produce 550,000 tons of PVC annual-

ly, and CIRES, S.A., the Company's subsidiary in Lisbon, Portugal, produces 150,000 tons per year, giving Shin-Etsu a total PVC production capacity of 2.55 million tons per year. When the Addis plant comes on-line that total will rise to 3.14 million tons per year, giving the Company an estimated 12% of the world market for PVC. Shin-Etsu has further strengthened its position in terms of production in the three key regions of Asia, North America, and Europe.

The world market for PVC grew solidly in 1999. In North America, in particular, helped by the strong U.S. economy, sales grew by

7.4% on a year-on-year basis, especially pipes, siding, window frames, and other construction and building-related materials. Although growth in Japan was not so strong, the Company achieved double-digit sales growth in Asia as a result of the economic recovery of the ASEAN nations and increased demand in China. In addition, sales in European markets enjoyed strong growth due to increases in sales of window frames and other materials.

As a result, Shin-Etsu successfully improved revenues in the United States, Europe, and Asia, and the Company's PVC business achieved good sales results.

### **Silicones Business Posts Steady Growth**

Shin-Etsu is the largest manufacturer of silicones in Japan and the fourth worldwide. In fiscal 2000, Shin-Etsu's silicones business grew steadily in the major markets of Asia, including Japan, North America, and Europe. Shin-Etsu increased production capacity for crude methylsilane at the Matsuida Plant of the Gunma Complex by about 35% in September 1999, and the facilities are still operating at high capacity. A major factor behind this situation was the quick recovery of the Asian economies, with South Korea and the ASEAN nations at the fore. Sales of all silicones products increased. Demand for heat-cure rubber for use in mobile phones, keyboards, and copier and printer rolls, was quite strong, both in Japan and abroad, particularly in Asia. In Japan, sales of specialty silane for pharmaceutical and electronics applications grew steadily, and CF silane as a coupling agent for tires, also performed well. In addition, new products for personal care applications attracted attention worldwide.

Both Shin-Etsu Silicones of America, Inc., based in Akron, Ohio and Shin-Etsu Silicones Europe B.V., based in Almere, in the Netherlands reinforced their RTV rubber operations during the period under review. The market for silicones grew steadily in the U.S. and Europe with demand for elastomers leading the way.

Prices for some products in the Asian region were revised to help improve profitability.

### **Cellulose Derivatives Emerging as the Third Key Segment**

Cellulose derivatives are the third largest product group in the Organic and Inorganic Chemicals Sector in terms of sales and revenue. In fiscal 2000, sales of cellulose derivatives achieved positive growth both in Japan and abroad.

Shin-Etsu maintained production of METOLOSE® near its maximum capacity of 15,000 tons per year.

METOLOSE® is used in industrial applications, for example, as a binder for ceramics in industrial electronics, as a thickener in body shampoos, and in construction applications to improve the water retention of cement and mortar. Both the Japanese and international markets for this product have grown. The greatest growth has been as an additive in pharmaceuticals. Used as film coating for tablets intended to dissolve in the stomach or intestines, cellulose derivatives have enjoyed good sales both in Japan and abroad. International sales, in particular, have expanded, pushed by the development of new dosage forms, which in turn has led to new applications. Shin-Etsu's exclusive low-substituted hydroxypropyl cellulose (L-HPC), used as a binder for tablets, has also enjoyed good sales in both Japanese and international markets.

During the second half of the period under review, Shin-Etsu increased prices for a number of products.

## **Production of Silicon Metal: A Core Material**

Shin-Etsu Chemical's wholly owned, Australian-based subsidiary, Silicon Metal Company of Australia Ltd. (Simcoa), produces 30,000 tons of silicon a year.

In addition to playing a leading role in the stable supply of the principal material for such core Shin-Etsu products as semiconductor silicon, synthetic quartz, and silicones, Simcoa is also competitive in markets in Oceania, Asia and the U.S.

Ferroalloy operations conducted by a subsidiary, Shin-Etsu Metallurgical Co., Ltd., were transferred to Toyo Denka Kogyo Co., Ltd., in April 1999, due to poor profitability projections.

## **Pheromones, POVAL, and Other Chemicals**

Synthetic sex pheromones have a special place in Shin-Etsu's range of products.

Shin-Etsu's pheromones are a type of acetylene derivatives that disrupt the mating of harmful insects and when applied to cotton, apples, pears, grapes, tea, and other agricultural products, harmlessly prevent the insects' reproduction.

Currently, the business is not significant in terms of production volume or revenues, but Shin-Etsu is the world leader in synthetic pheromones, and achieved approximately 20% growth in the world market during the year. The main reason for this growth was the increased use of pheromones to protect apple crops from harmful insects in the United States. Shin-Etsu is confident that demand for pheromones as an environmentally safe replacement for conventional agricultural pesticides will increase.

Polyvinyl alcohol (POVAL) is a water-soluble polymer like METOLOSE® but less expensive, and used as a coating for paper and as an adhesive. As growth for existing applications has been slow, the development of new applications is indispensable and competition among firms has been fierce. One such new application is for film. POVAL film is used in polarizer film and food packaging, and the Company expects future growth in this area.

Caustic soda is produced in tandem with chlorine. While the volume of caustic soda sold has increased, demand for chlorine for vinyl chloride has shown even stronger growth, leading to an oversupply of caustic soda and a stagnating market. The result was revenues roughly equal to those of the previous fiscal year.

Production of chloromethane increased as a result of improved sales in such promising fields as pharmaceuticals and agriculture, as well as increased consumption for home use. Shin-Etsu strengthened its methylene chloride business by purchasing operations from Mitsui Chemicals, Inc., on April 1, 2000.

# Electronics Materials

In 1999, the market for semiconductor devices bounced back from the decrease of the previous year and grew strongly. The strong markets for communications equipment and PCs in 1999 are expected to continue in 2000. Accordingly, the buoyant markets for the various materials used for these devices are also expected to continue. Shin-Etsu makes wafers, photoresists, photomasks, and other items used in the pre-production processes of semiconductors. These products, together with the Company's synthetic quartz, which is used in the production of stepper lenses, make Shin-Etsu the only company in the world offering such a wide assortment of pre-production materials for semiconductors.

## **Semiconductor Silicon Business Rebounds**

Increased production of communications devices, principally mobile phones, and personal computers (PCs) led to greater demand for semiconductor silicon products in fiscal 2000. Growth centered on DRAMs for PCs, flash memory, microcomputers for communications devices, and microprocessing units (MPUs) for PCs. Inventory adjustments for analog semiconductors and discrete semiconductors have progressed, but the recovery of demand for audio-visual equipment and other consumer electronics devices, which make up the bulk of applications, was slow, only finally turning around in the second quarter of 1999.

Production capacity on lines for leading-edge devices was insufficient when demand for MOS memory and MOS micro took off in

the second half of 1999 so device makers increased production capacity for 8-inch wafers and announced new plans to increase production in Taiwan and Korea. In 2000, they also announced plans to increase production capacity for 8-inch wafers in Japan.

The market for silicon wafers bottomed out in Asia in the third quarter of 1998 and in the Japanese market in the fourth quarter of the same year. Demand has since trended toward recovery and the market is currently expanding.

However, price competition in the wafer market in the first half of 1999 has had a lasting effect, and real recovery in terms of sales revenue did not occur until the second half of the year.

By region, the sharp increase in demand in Asia, including South Korea, which specializes in memory production, and Taiwan,

where foundry production capability increased rapidly, was of special note in 1999.

Shin-Etsu Handotai (SEH) is the world's largest wafer maker. Shin-Etsu is not merely responding to growing markets but also moving ahead with developments to improve device makers' chip acceptance rates and the development and production of more advanced wafers. In preparation to supply 300 mm (12-inch)-diameter wafers, demand for which is expected to take off in 2000 or 2001, a pilot plant capable of producing up to 10,000 units a month has been set up at the Shirakawa Plant in Fukushima, Japan. It is located in spacious facilities, allowing easy expansion and enabling Shin-Etsu to meet the increased demand for this product.

Shin-Etsu has also begun to produce next-generation wafers, Silicon On Insulator (SOI), and is prepared for their full-scale use in the 21st century.

### **Greater Market Share for Photoresists and Pellicles**

There are two types of photoresists: those for semiconductors and those for magnetic heads.

Shin-Etsu's photoresists for semiconductors are leading-edge KrF excimer photoresists, which allow detailing finer than 0.30 microns in precision processing for semiconductors. Sales are rising steadily.

The need for photoresists is increasing because demand for smaller and smaller semiconductors is growing as the overall market for semiconductors continues to expand. Shin-Etsu is a late entrant in this field but the Company's efforts to narrow its focus are bearing fruit as Shin-Etsu's share of the world market is increasing rapidly.

Photoresists are also used in magnetic heads used to read hard disk drives. The market is small but growing and Shin-Etsu holds considerable market share for such a technologically critical component.

The Company doubled production capacity for photoresists at its Naoetsu facilities in April 2000.

The market for pellicles, film-like coating materials used to cover semiconductor reticles (the portion of semiconductors where circuits are drawn) to protect them from dust and other impurities, is small and specialized. The Company's sales are growing steadily.

### **Strong Sales for Epoxy Molding Compound**

Ignited by fast growth in the demand for PCs, mobile phones, digital home electronics, and other devices in 1999, shipments of epoxy molding compound (EMC), used to encapsulate semiconductors, rose steadily both in Japan and abroad. In particular, shipments to semiconductor manufacturers in Asia that are consigned by Japanese and U.S. firms increased considerably. On a component basis, sales of EMC for use on discrete semiconductors, microprocessing units, and DRAMs increased. While the Company expects shipments of EMC for semiconductor use to hold steady in 2000, Shin-Etsu also plans to meet the demands of "green procurement policies" by devoting resources to expanding sales of "green compounds" that do not use bromine or antimony as flame retardants.

## **Use of Rare Earth Magnets in the Electronics Industry Stagnates**

About half the demand for rare earth magnets is for use in the voice coil motors (VCMs) of hard disk drives (HDDs). In terms of total units, the HDD industry has grown 10%. Sales of high-end devices with VCMs have struggled, while demand for lower-priced low-end devices has increased, causing overall sales revenue to stagnate. The increase in low-priced computers has led to a strong movement to reduce the number of components and reconsider their functionality. However, the Company expects new applications for HDDs in consumer information devices.

# Functional Materials and Others

## Growth in the Range of Applications for Synthetic Quartz

Synthetic quartz sold well during the period under review. Shin-Etsu produces chlorosilane, a base material also used in the production of silicones, in a vertically integrated framework extending through the manufacture of a commercial product. Shin-Etsu possesses all production techniques for synthetic quartz in all application fields for the electronics and telecommunications sectors. As a pioneering manufacturer of synthetic quartz, Shin-Etsu maintains a superior position in terms of quality and stability of supply.

In particular, sales of optical fiber preform, used in fiber-optic cables, rose considerably. This was because demand was driven by the sudden increase in non-voice data accompanying the expansion of the Internet and e-commerce. Shin-Etsu is the only firm in the world to manufacture optical fiber preform solely on a commercial basis.

Sales also grew for synthetic quartz photomask substrates used in production processes for IC semiconductors and for synthetic quartz ingots used in the production of synthetic quartz lenses.

Production also increased steadily at

Shin-Etsu's subsidiary Silica Products, Inc., based in Freeport, Texas, in the United States.

Shin-Etsu as well as manufacturers of both equipment and photoresists is conducting research into synthetic quartz materials that will meet the needs of the next generation of optical lithography. The Company also anticipates swift growth in the market for larger photomasks required for the production of larger LCDs.

## **Surging Oxide Single Crystal Business**

The principal application for lithium tantalate (LT) single crystals is in SAW filters for mobile phones. Sales for LT single crystals enjoyed tremendous growth in fiscal 2000 because of the explosive surge in the mobile field. As the world's largest LT manufacturer, Shin-Etsu has supported the growth of mobile telephony by repeatedly expanding production capacity. Shin-Etsu expects further growth, as the number of mobile phones will increase and more filters will be used per phone due to their enhanced functionality.

## **High Growth in the Use of Rare Earth Magnets for Nonelectronics Industries**

Sales of rare earth magnets in applications other than voice coil motors of HDDs — in particular for use in mobile phones, motors for factory automation devices, and optical pick-ups for CD-ROM, CD-R, and DVD drives — grew as a result of the growth in information-related industries and an underlying trend toward recovery in facilities investments. In addition, magnets for use in high-performance motors such as for elevators and energy-efficient air conditioners also improved steadily. Shin-Etsu expects a further improvement for these materials, driven by their use in mobile phones and factory automation devices.

## **Rare Earths Seek New Demand**

Rare earths are used as a key material in a broad range of electronics components. Shipments for these products increased during the period under review. Chip condensers and other electronics components for mobile phones and other leading-edge devices are the main applications for rare earths, and the demand for rare earths grew in line with the growth in demand for these devices.

On the other hand, sales of rare earths for use in fluorescent lights and televisions, a mainstay in the past, have stumbled under pressure from overseas suppliers.

## Fluoroelastomer SHIN-ETSU SIFEL®: A New Product with a Bright Future

SIFEL is drawing attention from around the world as Shin-Etsu's revolutionary new high-performance fluoroelastomer. The new material has superior characteristics under low temperatures when compared with similar fluoroelastomers, and also offers superior moldability and resistance to a wide range of fuels, solvents and chemicals. Shin-Etsu sees a bright future for the use of SIFEL as a replacement for rubber currently used in cars, aircraft and other applications.

## Other Business

In addition to supervising the export of facilities and technologies, Shin-Etsu's International Division is engaged in the import and export of products not handled by other Shin-Etsu sales divisions and the products of the Company's subsidiaries and affiliates. These include flexible copper-clad laminates (FCLs), non-scaling materials for PVC and other materials, and PVC shrink film produced at Shin-Etsu Chemical's Kashima Plant, vinyl chloride-vinyl acetate-copolymer Solbin®, and various thermal interface materials produced by Shin-Etsu's subsidiary, Nissin Chemical Industry Co., Ltd.

## Spotlight on Shin-Etsu Engineering Co., Ltd.

Shin-Etsu Chemical is supported by a number of subsidiaries that serve group companies as well as other parties.

Shin-Etsu Engineering Co., Ltd. (SEE) provides engineering services in a broad range of fields from chemicals to leading-edge electronics materials. In addition, SEE draws on years of experience to develop and produce mechatronics products combining proprietary optical technologies with computers. Examples of SEE's work include systems for the production and inspection of flat panel displays (FPDs), such as liquid crystal displays (LCDs) and plasma display panels (PDPs).

SEE has also developed an auto alignment system for extremely small devices with projection applications, a field in which SEE anticipates future market growth. Accurate to within 5 microns and allowing a similar degree of precision in gap control, SEE's successful research has solved some of its clients most difficult problems, and a number of the world's leading manufacturers have ordered the new systems.