Research and Development

To date, the Teijin Group has capitalized on its accumulated expertise in polymer science to cultivate a variety of new products and businesses. Today, guided by its brand statement, “Human Chemistry, Human Solutions,” the Teijin Group is endeavoring to ensure sustainable growth by enhancing its core competencies as well as provide solutions that deliver the value that society and its customers expect.

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The Teijin Group has formulated an R&D road map to guide its efforts to develop innovative technologies, enhance production technologies and increase the value of intellectual property, and to bring its technologies and intellectual assets to play in all aspects of Group R&D.

The Teijin Group’s R&D road map

In line with our belief that technology is a crucial aspect of management, we have integrated our management, technology and marketing strategies to form a detailed R&D road map. Guided by this road map, we are promoting ambitious R&D efforts and at the same time fostering the R&D personnel that are the Teijin Group’s future.

Strengthening R&D capabilities

Our basic approach to R&D focuses on three key considerations: contribution to sustainable growth, speed of application and global relevance.

- **Contribution to sustainable growth**
  
  Sustainable growth for the Teijin Group depends on its ability to continuously cultivate successful businesses. Accordingly, we are concentrating R&D investments in promising, strategically important areas, and taking steps to improve the efficiency of R&D activities.

  Environmental sustainability is another aspect of this consideration, and we thus prioritize projects that have the potential to reduce environmental load. This is the rationale behind our efforts to develop commercially viable chemical recycling technologies for polyester fibers and films and polycarbonate resin, and heavy metal-free catalysts.

- **Speed of application**

  The potential not only for shortening the development cycle, but also for facilitating the timely launch of products, is an essential condition of market leadership. Accordingly, we are promoting collaboration with customers, as well as with academic institutions and other research organizations from initial research through to development, with the aim of expediting the transformation of technologies into commercially viable products.

- **Global relevance**

  The ability to provide solutions that respond to market needs and cultivate new markets depends on a global perspective as well as a global R&D network. The Teijin Group scores well on both counts. Currently, we have eight major research sites in Japan and
six overseas employing a total of more than 1,400 researchers. Three facilities, one each in Japan, the Netherlands and Thailand, conduct synthetic fibers-related R&D. Films- and pharmaceuticals-related R&D are also handled by three facilities, in Japan, the United States and the United Kingdom.

R&D System

An R&D system designed to offer solutions

The Teijin Group’s R&D efforts are administered by the Research & Technological Strategy Meeting, which brings together the Group Chief Technology Officer (CTO) and the CTO of each business group, as well as individuals in charge of intellectual property, marketing and other functions. The Research & Technological Strategy Meeting is responsible for formulating the Teijin Group’s R&D road map and strategies related to, among others, intellectual property, R&D personnel and technological markets.

We have evolved a three-stage corporate research (Groupwide basic research) system encompassing the discovery of new research seeds; business development aimed at reforming our business portfolio; and the incubation of new businesses, which includes conducting feasibility studies and developing mass production technologies. These efforts are spearheaded by the New Business Development Group. Individual business groups also conduct R&D aimed at maximizing their own particular strengths.

Our approach to R&D is based on collaboration between corporate research personnel and business groups, as well as between marketing and R&D teams. Our marketing staff organizes independent technology exhibits for major automobile and consumer electronics manufacturers with the aim of discerning customer opinions and incorporating them into R&D from the earliest stages. It also collaborates with other companies and academic institutions with the intention of accelerating R&D efforts and cultivating cutting-edge research seeds.
Corporate research
Positioned within holding company Teijin Limited, the New Business Development Group plays a key role in the cultivation of new businesses by emphasizing corporate research—business development-oriented research for the Teijin Group as a whole—and business incubation. The New Business Development Group encompasses three facilities. The Innovation Research Institute focuses on emerging core technologies in such areas as next-generation high-performance films, nanofibers and advanced biotechnology. The Electronics Materials Research Laboratories is engaged in liquid crystal (LC) device-related materials development. The Structural Analysis Research Laboratories employ state-of-the-art structural analysis technologies to conduct high-level materials analysis and assessment.

Business group-affiliated R&D
Research laboratories and R&D centers attached to individual business groups conduct business-specific research and product development with the aim of responding to market trends and keeping abreast of customer and market needs. These facilities also cooperate with related business group research organizations, generating considerable synergies. Facilities aligned with materials-related businesses, for example, focus not only on R&D related to Teijin’s core polyester, aramid, carbon fiber and polycarbonate materials, but also on developing groundbreaking processes and recycling technologies.

Nanotechnology
Teijin conducts extensive research in nanotechnology with the aim of cultivating new products and new fields. This research focuses on three areas: nanostructure control technologies, including molecular-level polymer engineering and the structural control of material properties using self-organization; nanocomposite technologies, notably the use of nano-order materials in high-performance compounds; and nano-order polymer layering and other nanoprocessing technologies.

- Enhance performance (strength, heat resistance, etc.) of existing materials
- Develop new functions that lead to the development of new products and markets
- Apply technologies in new fields, and fields fusing nanotechnology and biotechnology
Creating value in new, leading-edge markets

Going forward, we will work to maximize our core technological capabilities in the areas of polymer science, pharmacology, biology, information sciences and electrical and electronics engineering, and to combine these with nanotechnology and other advanced technologies to develop new markets and create new value for customers. We have grouped these markets into four fields, which we have termed “automobiles and aircraft,” “information and electronics,” “health care,” and “environment and energy.”

The automobiles and aircraft field promises significant future market growth. Accordingly, we are conducting extensive R&D aimed at developing materials that will help make automobiles and aircraft lighter and more energy-efficient as well as enhance their performance.

In the information and electronics field, efforts focus on the development of optical disc- and LCD-related components, as well as on products related to mobile Internet, life sciences and knowledge management. In particular, we are developing applications for various outstanding products produced by the Teijin Group in optical films and electric and electronics materials.

In the health care field, we are developing new drugs and home health care equipment for bone and joint, respiratory, and cardiovascular and metabolic disease therapies, enabling us to offer total solutions. We have also commenced R&D in the area of regenerative medicine, which combines biotechnology and polymer nanotechnology.

In the environment and energy field, we have applied our unique polyester chemical recycling technologies in groundbreaking fiber-to-fiber, film-to-film and bottle-to-bottle recycling systems. We have also succeeded in developing technology for chemical recycling of polycarbonate.
R&D Activities in Fiscal 2005

Basic policy
Recognizing that ongoing R&D is essential to sustained growth, the companies of the Teijin Group strive to ensure the efficient, forward-looking allocation of investment. The Group’s R&D network comprises eight sites in Japan and six overseas, which employ a total of approximately 1,400 researchers. Efforts are overseen by the Chief Technology Officer (CTO) with the aim of centralizing all aspects of the Group’s R&D program, including basic research, and strengthening cooperation among sites.

In fiscal 2005, investment in R&D amounted to ¥31.2 billion, an increase of ¥1.2 billion from fiscal 2004.

Synthetic fibers
R&D for polyester fibers, aramid fibers, carbon fibers and other products in this segment focuses on cultivating new functions, adding greater value and making products more environment friendly. During the period, subsidiary Teijin Fibers launched SALATCOMPO™, a unique, nanotechnology-based textile with outstanding perspiration-absorbent and quick-drying properties. SALATCOMPO™ feels considerably less sticky against the skin than other fibers, dries promptly and prevents the unpleasantness of evaporative cooling from air conditioning. Teijin Fibers also developed AEROCAPSULE™ GAMMA, a hollow filament for use in futon and cushions that has three holes and a spiral structure like wool, which impart a long-lasting full, soft texture. On another note, Teijin Fibers commenced sales of WAVERON® UV, a polyester yarn for use in non-sheer curtains that blocks out UV light to protect tatami (traditional Japanese straw floor matting) and furniture from UV damage.

During the period, Teijin Fibers enhanced the technologies used in its fiber-to-fiber recycling system. The company has launched fiber-to-fiber recycling with leading U.S. outdoor gear manufacturer Patagonia, and is expanding application of this system in Japan for sportswear and uniforms, as well as in new fields.

In the area of industrial fibers, Teijin Techno Products is focusing efforts in the area of meta-aramid fibers on developing applications in high-performance fireproof clothing and next-generation manufacturing technology. The company is also promoting the development of applications for a new type of para-aramid fiber, as well as conducting research in the use of nanotechnology to enhance fiber performance, including the use of electrospinning for forming nanofibers into high-performance filters and other applications. Teijin Twaron, in the Netherlands, continues to develop groundbreaking next-generation manufacturing technologies with a view to expanding its capacity at some point in the future. Teijin Twaron also recently developed Sultron® 3000, a novel rubber additive that significantly increases the performance and economy of tires. Subsidiary Toho Tenax is endeavoring to expand the use of carbon fiber composites by cultivating general industrial applications, including new aircraft components, automobile components and robots.

Synthetic fibers-related R&D expenditures in fiscal 2005 amounted to ¥7.4 billion.

Films and plastics
In the area of films, we are promoting development efforts related to PET films and PEN films. In the area of FPDs, notably LCDs and plasma displays, we are emphasizing the development of new high-performance films and coated films. In the area of data storage media, we are responding to needs deriving from rapidly increasing storage capacities by developing high-performance base films. We are also working to develop industrial and packaging films with reduced environmental impact. As well, we are promoting expanded applications for TEONEX® PEN film in the IT and automotive industries.
In plastics, our efforts currently focus on improving the physical properties of polycarbonate resin and developing processing technologies for polycarbonate film and sheet and environment-friendly technologies. In 2003, in a joint project with Meiki Co., Ltd., we developed and installed one of the world’s largest extrusion presses. During the period under review, we modified this press to accommodate two-color molding, a project that was completed in June 2006. We also forged ahead with the development of technologies for integrated molding of windows and exterior panels with the aim of reducing weight and minimizing parts requirements.

In polycarbonate resin films, we anticipate expanded demand for such products as Blu-ray Disc cover film and retardation film for LCD televisions. Accordingly, we are taking steps to improve production efficiency, including developing a new and highly efficient extrusion technology. We completed the installation of new facilities based on this technology in March 2006 and are preparing to begin commercial operation in fall 2006. On another front, in February 2005 we completed construction of a pilot plant for chemically decomposing used polycarbonate resin and recovering monomer—the principal raw material used in polycarbonate resin—and in January 2006, we succeeded in the highly efficient recovery of 99.9%-pure monomer. Going forward, we will focus on developing technologies to facilitate continuous operation.

Expenditures for R&D in films and plastics in fiscal 2005 were ¥6.1 billion.

Pharmaceuticals and home health care
R&D in pharmaceuticals focuses on three key therapeutic areas—bone and joint disease, respiratory disease, and cardiovascular and metabolic disease—and encompasses independent efforts as well as collaborative efforts with universities, research institutes and pharmaceuticals companies in Japan and overseas. We currently have two new drug candidates in the pipeline: a treatment for asthma and a treatment for osteoporosis. Overseas, we are proceeding with clinical trials for an MCP-1 receptor. In the home health care field, we are promoting the development of new therapeutic oxygen concentrators offering improved safety and ease of operation.

In fiscal 2005, R&D expenditures in pharmaceuticals and home health care totaled ¥13.6 billion.

Trading and retail
Spearheaded by Ni Teijin Shoji, R&D in this segment emphasizes the planning and development of new products. Maximizing its ability as a trading company, the subsidiary strives to build a value chain that encompasses materials as well as finished products and to reinforce our ability to add value. R&D activities include production of test pieces, quality testing and materials research.

R&D expenditures in trading and retail-related areas in fiscal 2005 amounted to ¥200 million.

IT and new products, etc.
In IT, we continue to conduct cutting-edge R&D focused on reinforcing the competitiveness of our solutions and services, as well as to collaborate with other companies and academic institutions with the intention of securing additional core technologies that will sharpen our competitive edge. In engineering, subsidiary Teijin Engineering conducts R&D aimed at cultivating environment-related businesses.

In fiscal 2005, R&D expenditures in IT- and new products-related R&D amounted to ¥300 million.

Corporate research aims to reinforce the business group’s common foundation in polymer science, as well as to cultivate new businesses and develop innovative materials in such areas as LCD films, nanotechnology-based new materials, new environmental decontamination technologies and regenerative medicine. In fiscal 2005, investment in this area totaled ¥3.7 billion. Expenditures are not apportioned to individual businesses. Accordingly, this figure is prior to adjustment for elimination and corporate.

Going forward, we will continue to strive to create a business model that reflects the spirit of our basic corporate philosophy. In line with the Teijin Group Global Environmental Charter, established in 1992, we are promoting the concept of fully closed polyester production using our chemical recycling technology. In 2005, this technology was awarded the Prime Minister’s Award and the Environment Minister’s Award in Japan. We are also developing chemical recycling technologies for polycarbonate and polylactic acid (PLA). Through such efforts, we are promoting academic research and applying achievements to the creation of a new business model that will ensure sustainable growth, as well as the development of new businesses.
Basic policy

In addition to formulating the Teijin Group’s strategies, the Teijin Intellectual Property Center Limited supports Group R&D by identifying innovations that offer market relevance, technological value, progress or originality and are thus eligible for copyright protection. The center maintains close contact with business groups to promote the protection of intellectual property through the acquisition of patents, trademarks and brand names, while at the same time it seeks to secure ownership of strategically valuable new intellectual property.

Focus on patent applications in core strategic markets and businesses

To maintain a leading global market position in its core businesses, the Teijin Group has designated a number of key strategic areas in which it is developing its capabilities. In R&D, the Group is stepping up efforts to expand its patent portfolio by gaining patent protection for new products, processes and applications, and to analyze patent information. In the electronics field, for example, the Group is seeking patents not only to develop new applications and next-generation materials that it expects will spur demand, but also to take advantage of growth in the markets for films and plastics in the PRC, ROK and other Asian countries. The Group is also increasing its overseas patent applications for such products as high-performance fibers for automotive applications in markets outside the United States and Europe. In such areas as home health care and environmental preservation, the Group is also applying for offshore patents to reinforce its global competitiveness. As a consequence, the number of offshore patents sought by the Group in fiscal 2005 was approximately 30% higher than in fiscal 2002, the year the Group adopted its current holding company system. The Group is also stepping up its efforts to acquire patents in strategic businesses, which include high-performance fibers and plastics. The number of patents filed for high-performance fibers in fiscal 2005 was significantly higher than in fiscal 2002.