# R&D for Business Strategy


A drilling machine of bent drilling hole method

For more than a century, Penta-Ocean has continued to develop innovative solutions to the myriad of challenges it has faced when completing monumental construction projects against seemingly impossible odds. As society has progressed, the complexity of construction requirements and Penta-Ocean's ability to meet and surpass them, consistently, has made the Group one of the world's leading developers of construction materials, and methods and has earned it a place of recognition for its construction technology capabilities.

This reputation has led to the procurement of many very-large-scale civil and architectural engineering projects in Japan and overseas. Faced by ever increasing competition, however, the need to develop ever more efficient and cost saving materials, machines and construction protocols for projects with widely varying requirements and environmental challenges has become essential for survival in today's global construction market. Penta-Ocean continues to lead the industry in this area.

During the term, the Group's expenses for ongoing research and development amounted to ¥1,558 million (US$14.7 million). This led to the introduction of new and innovative machinery and methods designed to improve both the efficiency and cost effectiveness of construction work in various areas of Penta-Ocean's activities.

The following are some of the technologies developed and marketed during the term under review.

### Bent drilling hole method for preventing ground liquidation

This method consists of an advanced hole drilling system for improving soil directly below a structure using a drilling machine mounted on the ground and drilling holes in a curved direction, eliminating the use of the conventional curved drills that have made this process difficult. The system is particularly useful in improving the soil under existing hazardous material storage tank foundations, constructed prior to the current safety requirements that went into effect in 1994.

This method is also being used to improve contaminated soil, in the confined installation of pipelines, and for auxiliary use in tunneling work in congested urban environments.

### MELIT method developed for underground sewer conduits

Penta-Ocean developed its MELIT (MEchanically LInking a pipe jacking Tunnel to an underground structure) Method to improve the process of connecting new conduit with existing underground sewer conduits by mechanical cutting existing pipelines laterally. The system is equipped with small and medium-diameter pipe-jacking conduits. This innovative remote controlled method needs no face-cutting or large-scale soil improvement work.

When connecting an existing conduit laterally with a new conduit utilizing conventional methods, soil improvement is often necessary, or additional adjacent structures, such as shafts must be built. This process often increases costs and the amount of time required to complete the projects.


Incinerator ash-granulating/sintering system


Sample of recycling ash waste

The newly developed MELIT Method uses a propelling unit consisting of a cutting ring mounted on special self-replaceable blade teeth for cutting existing conduits. It is made of steel or RC that pushes forward the cutting ring after installing a new conduit and directly cutting the lateral side of an existing conduit. The process hermetically joins the new one with existing underground conduits.

### Eco-Screw System for recycling large volumes of dredged sediment

In the term under review, Penta-Ocean introduced Japan's largest eco-screw system, an innovative


Eco-Screw system

dredging devise that continuously dehydrates sand and soil brought up by the dredger, or by a muddy earth pressure-shield excavator used in harbors, streams, and lakes.

Soft dredged sediment discarded as waste in the past, is now subjected to a dehydrating process by an eco-screw system for recycling as river bank and land reclamation material. Soil excavated using a shield machine can also be improved into a Class 3 construction soil level by dehydrating it using this system.

### 3D Logistics Movement Survey System using mobile unit-positioning

This system detects the movements of workers in plants, warehouses, and physical distribution centers and their vehicles in a 3-dimensional system designed to analyze efficiency by reproducing actual work situations. The automatic, unmanned system makes it possible to survey and analyze a wide range of information and input variables in order to improve operating efficiency. The rapidly expanding range of applications for the system now encompasses retailers, medical care facilities, and physical distribution planning and control industries.

### Incinerator ash-granulating/sintering system for recycling ash waste

This technology incorporates the processes of selective elimination of large impurities mixed in incinerator ash; drying and crushing of the ash; granulation by adding an auxiliary agent; and formation of safe, recycled products by sintering at 1000˚C to 1050˚C. Dioxins contained in the ash are thermally decomposed and heavy metals are devolatilized and insolubilized, while waste heat from the sintering process is effectively used in an ash-drying processes.

The grain size of the recycled material can be adjusted during the granulating process. The end material has a similar appearance and physical characteristic to natural gravel and is widely applicable as sand for plant cultivation and fish farming, and as a construction material. The development of this technology has been subsidized by the Ministry of the Environment and has won an award from Japan Waste Research Foundation.