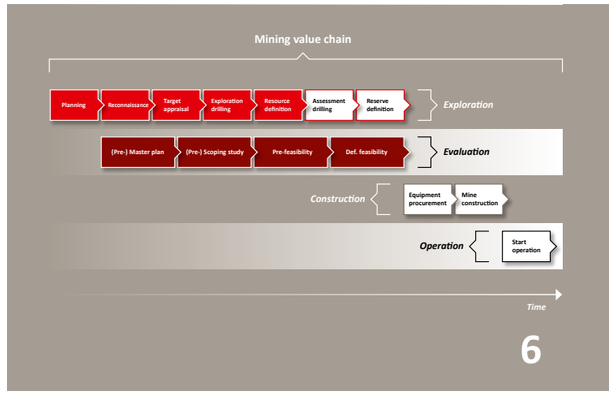
IHC MERWEDE

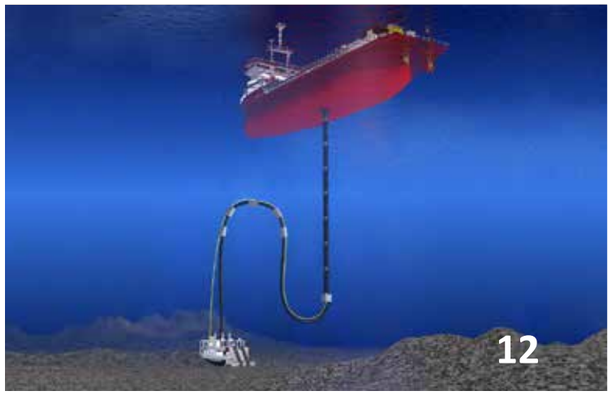
Mining

Reliable partner for efficient mining life cycles

The technology innovator.

Contents





Reliable partner for efficient mining life cycles

A growing population and increasing GDP are market drivers for a robust increase in mineral demand. In addition, challenges for supply – including declining head grades and limited exploration success – drive the mining industry towards new frontiers.

Integrated dredge- and marine-mining solutions

IHC Merwede focuses on integrated mining solutions for the onshore, nearshore and deep-sea mining market segments. The company strongly believes in an integrated approach to achieve the best results for the mining operation, by helping to create an economical and technically viable business model.

In this case, it forms a partnership with customers from the point of exploration through to the development of the mine, implementation and life-cycle support. Throughout the various stages of mining, IHC Merwede offers a number of consultancy and advisory services and in-depth studies to determine the overall technical and economic feasibility. It can also support the mining operation, resulting in optimal use of the equipment at minimal cost.

In addition to an integrated approach, IHC Merwede also offers stand-alone products. The company designs, builds and supplies advanced mining vessels and equipment, ranging from mining dredgers and crawlers, slurry transport systems and mineral separation plants, to plant automation and control.

Reliable partner

IHC Merwede has an impressive track record in the largest tin, alluvial gold and mineral sand operations worldwide. Its roots can be traced to the end of the 18th Century, with the delivery of two gold dredgers to Italy and Russia. The union, as it is known today, was created by six Dutch shipyards joining forces to build six sea-going tin dredgers for the Billiton Company, a former Royal Dutch Shell subsidiary.

Today the company builds the innovative vessels and advanced equipment used for extracting mineral sands, gold, tin, platinum and diamonds up to 200 metres below the surface around the world. It is also developing equipment for even deeper waters.

The depth of experience among the IHC Merwede team consists of geologists, engineers, technicians and other specialists. Now situated in South Africa, Australia, The Netherlands and Singapore, IHC Merwede is dedicated to developing a regional mining presence on a global basis. Each office is a dedicated centre of excellence, a one-stop-shop for the regional market and provides a global network with highly qualified personnel.

IHC Merwede is committed to building strong relationships with renowned companies and research institutes within the industry. The company's long-standing financial stability makes it possible to provide customised financial solutions, offering the opportunity for investment and developing business models for rental purposes.

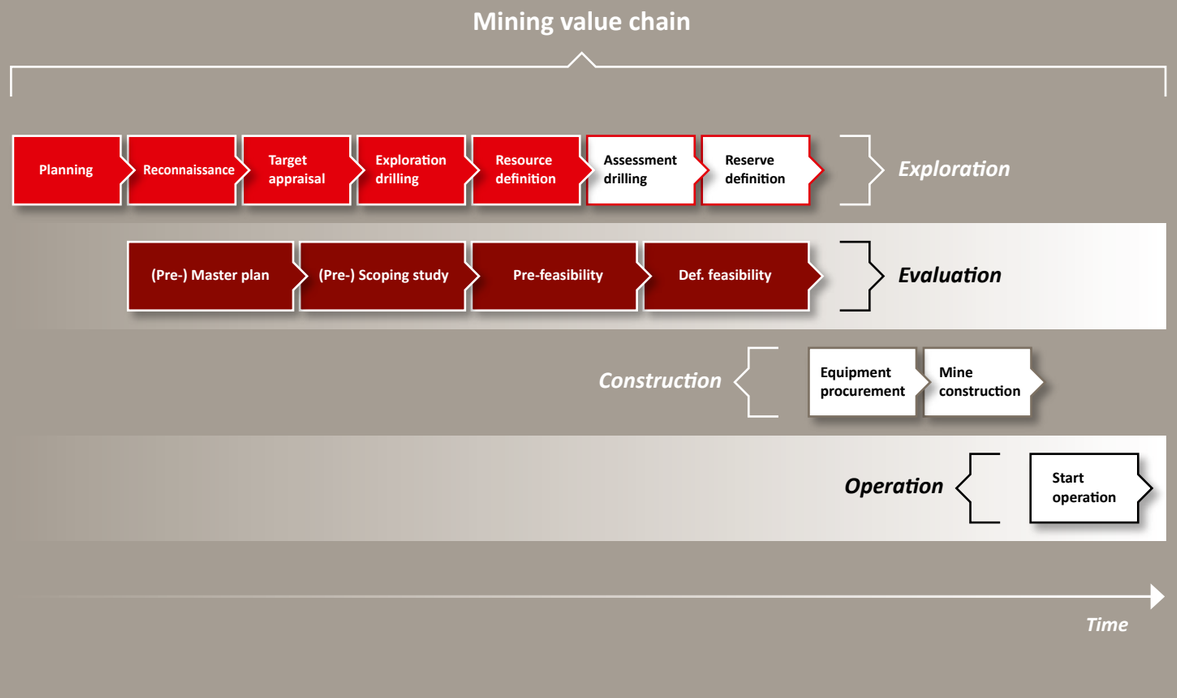
Thanks to its range of advisory services, equipment supply and total solutions, IHC Merwede is a reliable partner throughout the life cycle of a mine.

Innovative vessels

Advanced equipment

Life-cycle support

Mining life cycles



IHC Merwede strongly believes in an integrated approach throughout the mining life cycle to achieve the best results for the mining operation. It recognises the mining value chain with the phases shown in the table above.

IHC Merwede can add value to the chain by providing the services that eventually lead to integrated mining systems:
- advisory services
- research and development
- engineering and construction
- and operational support.

It enables IHC Merwede to deliver high-quality products that are safe to operate.

Advisory services

IHC Merwede understands the importance of clear and sound advice to support customers in the development and operation of their mining projects. The company offers advisory services throughout the mining value chain. Its core knowledge and expertise is centred around dredge and marine mining, and mineral processing. A track record in alluvial- and marine-mining projects allows IHC Merwede to provide tailor-made advisory services for (among others) mineral sands, gold, tin and diamonds.

Guiding the way in offshore mineral exploration, IHC Merwede has developed its knowledge and expertise in offshore mineral exploration. In this new area of the industry, it can provide a suite of services focussed on the management of efficient and effective exploration programmes to realise the potential of the mineral deposits.

Leading expertise to evaluate your project

IHC Merwede delivers in-depth studies, ranging from scoping level to bankable feasibility studies, whether the deposit lies onshore, nearshore or in deep sea. It can demonstrate the potential for increased project value when employing dredge- and marine-mining techniques. Some applications include the evaluation of a comparison between dry truck and shovel operations, and dredge- and marine-mining dredger operations.

The key to efficient dredge- and marine-mining systems is the optimal combination of the excavation tool and the mineral processing plant. Matching capacities is the key design feature for the primary integrated dredge- and marine-mining solution.

Research and development

Research and development (R&D) programmes are of strategic importance and IHC Merwede spends approximately three per cent of its revenue on product development. The company strives to be recognised as a key partner - and not just a supplier.

The R&D programme for mining is focused on technology that is directly related to the excavation work or material transportation. Its aim is to achieve optimal production performance by developing technologies for:
- excavation
- slurry transportation
- and power supply.

IHC Merwede strives for excellence in environmental engineering that eventually leads to sustainable product developments.

Engineering and construction

IHC Merwede is dedicated to supplying integrated mining systems. The company ensures that the integrated, high-quality products will function together as a mining system with optimum production performance. With manufacturing facilities around the world, IHC Merwede is able to safeguard the quality of its specialist and innovative designs.

Financial services

It's becoming increasingly important for customers to arrange finance, not just during the period of construction, but also after the delivery of the vessel. IHC Merwede specialises in offering attractive packages that enable customers to achieve long-term operational excellence. Arranging pre-delivery finance is now a standard feature in many contracts. These arrangements are based on IHC Merwede's solid balance sheet and track record in the market.

Operational support

IHC Merwede is not only dedicated to supplying integrated mining systems, but also works with customers to prolong the mining operation. The company's life-cycle support package maximises the uptime and return on investment, and therefore reduces the total cost of ownership and maintains correct and safe operations.

Support local community

IHC Merwede has regional offices to promote and offer its range of services. These enable the company to support and train crew members and build locally, so they will be able to fully operate and maintain the mining equipment.

Spare parts and component repair

IHC Merwede provides logistical support for maintenance and emergency recovery. The company focusses on system availability with supply of spare parts and repair of components. Its global network of qualified service technicians, sourcing officers and stock locations is available to all customers.

Renovation

The renovation of vessels and equipment is a complex process. IHC Merwede possesses the expert knowledge to research, engineer and install to the high standards required for optimal performance. This results in the start of a new life cycle for the vessel or the extension of the existing life cycle.

OceanflORE

IHC Merwede continuously investigates development opportunities that reduce risks and increase confidence in deep-sea mining construction and operations. OceanflORE (a joint venture with DEME) highlights this confidence by providing a mining solution to extract deep-sea minerals at fixed prices per unit.

Training

IHC Merwede offers on-board crew training with the delivery of a new vessel and equipment. As a result, the vessels are fully deployable from their maiden voyage. IHC Merwede can also carry out training at any stage of a vessel's life cycle. The company offers a complete spectrum of high-quality training anywhere in the world. The programmes range from general to highly specialist bespoke courses on the use of equipment or on specific competences, resulting in increased value to the customer through improved performance and reduced maintenance costs.

Market segments

Mineral sands operation

Onshore mining

The global economy has relied upon the supply of land-based minerals for hundreds of years. Since the 19th Century, mining methods have evolved and alternatives have been developed.

There are two main methods of mining:
- dry excavation using picks, shovels, trucks and excavators
- and dredge mining using floating dredgers.

The core technology around dredge mining is underwater excavation and slurry transport. Based upon more than 250 years' experience, IHC Merwede is capable of delivering innovative technology for dredge mining.

Advanced dredge-mining technologies offer an attractive and cost-effective method of extracting land-based minerals in aquatic conditions. Dredge mining excels with high volumes in bulk transport at lower costs. The most suitable deposits for dredge mining include mineral sands, gold and platinum.

Integrated systems

IHC Merwede designs, builds and supplies mining dredgers and separation plants. Its product portfolio includes:
- diesel- and electric-powered mining dredgers
- slurry transport systems
- floating and land-based separation plants
- dewatering installations
- and plant automation and control.

Mining dredgers

Mining dredgers deliver more constant levels of productivity and have the ability to handle a higher concentration of solids. The most modern of these vessels are hydraulic mining dredgers. Dredge mining is not only used below the water table. Mining ponds can also be fed by water pumps.

Mineral processing

IHC Merwede is capable of designing integrated solutions linked to the separation plant, due to its in-house knowledge of mineral processing. The company is also able to deliver solutions for feed preparation, sizing and gravity separation. It has expertise in the use of gravity as the primary physical element for separation and concentration, making it possible to deliver a well-controlled feed to the processing plant.

Development from dry to dredge mining

Changing from a dry method of mining to dredge mining can prolong or renew the life of a mine. Using this technique to extract minerals can maximise revenues, because it can extend the economically viable limit.

Converting to a dredge-mining operation requires a complete change of mindset. The project will go from a multi-faceted to a single-unit operation at double the capacity. Based on exploration results, some of the subjects that need to be addressed include planning in advance, water management, mining pattern, water depth and proper tailings management.

Due to its knowledge, the company is able to facilitate the conversion by supplying equipment, educating and training local crew, and offering life-cycle support. As an example of moving from dry to dredge development, a case in Brazil is highlighted as a point of reference.

Case study

Due to the characteristics of placer deposit, dredge mining is often the most feasible extraction method by achieving maximum recovery at the lowest operational cost.

IHC Merwede has a long and successful track record of designing vessels for onshore mining projects. A good example of this would be the six mining dredgers, built for a renowned mineral sands operator in South Africa.

In Brazil, a dry-mining operation was nearing the end of its economic life. With extensive lower grade ore within the concession areas, an economically viable operation required a lower cost solution. A dredge-mining operation was the preferred choice, run by the company's own staff.

With IHC Merwede's experience and expertise, the theory of dredge mining, design and specification, and maintenance and operational procedures were relayed in classroom-based and hands-on training. This level of cooperation makes it possible to pursue excellence in operational and safety performance. The mining dredger and plant is operating well above the originally conceived target.

Market segments

Offshore tin mining operation

Nearshore mining

Mining in the sea

Current reserves on land or at shallow depths are limited and it will become more feasible to mine nearshore deposits from an economic point of view. Nearshore mining is a stimulus for companies to extend their mining sites to marine environments or to deeper waters.

IHC Merwede can help customers to:

- extend their existing mining systems to reach greater depths
- work in waves and currents
- and reach deposits located further offshore.

Using vast experience of working in the harsh nearshore environments of the dredging industry, IHC Merwede – as the technology innovator – has all of the specialist capabilities at its disposal to reach a successful result.

It provides its customers with complete nearshore solutions for extracting (among others) gold, tin and phosphate.

Integrated systems

Every mining application is unique. Therefore, IHC Merwede uses its experience and expertise to deliver tailor-made solutions to its customers.

Suitable nearshore applications within its product portfolio include:

- mining cutter suction dredgers
- integrated bucket ladder dredgers
- trailing suction hopper dredgers
- mining crawlers
- slurry transport systems
- mineral separation plants
- and plant automation and control.

Mining dredgers

The mechanical bucket and hydraulic mining dredgers are the most commonly used in nearshore mining operations. The bucket ladder mining dredger is suitable for many (including hard) soils and especially those containing boulders and stones. It can mine selectively, creating accurate profiles and can clean from pond to bedrock level.

Nearshore Jig-installation

Mineral processing

IHC Merwede can provide the nearshore operation with an integrated mining solution on board the vessel. It can be equipped with a mineral processing installation, making the vessel a complete stand-alone mining operation. The company is also able to deliver a well-controlled feed to the processing plant, providing solutions for feed preparation, sizing and gravity separation.

Product development

IHC Merwede is in a unique position as a global player in these industries, because it is able to incorporate best practice from each sector to extract deposits at greater depths. Research to establish a reliable understanding of dynamic forces is the key to develop design improvements and solutions for operational restraints.

The company is also continuously looking for improvements in its mineral processing development programme, making use of its experience and expertise in gravity separation equipment. It is currently investigating a processing plant in situ with a high capacity of solids. Studies for enhanced efficiency and finer particle recovery are in progress, as well as others on lowering initial, maintenance costs, and achieving greater availability.

Case study

IHC Merwede has a long track record of excavating nearshore material. For example, over the past century it has been cooperating with one of the world's largest producers of tin in Indonesia, which has subsequently ordered a number of vessels.

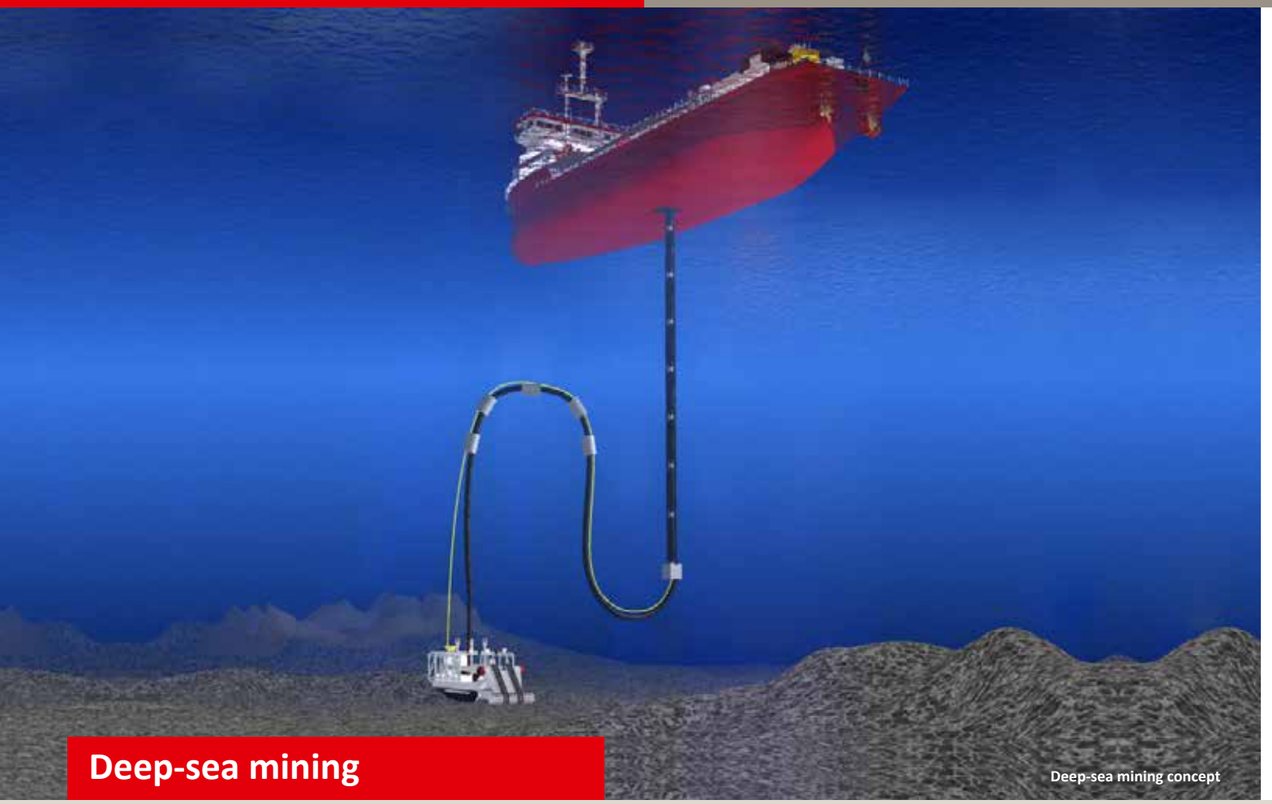
The operation is several kilometres offshore in depths of up to 50 metres below sea level. Offshore mining presently accounts for about 30 per cent of its mining production.

Faced with depletion, the mining company discovered new deposits at depths of around 90 metres and beyond. To reach these depths, IHC Merwede supplied the lower part of the ladder equipped with:

- a mining dredging wheel and its hydraulic drive
- an electric-driven submerged dredge pump controlled by a variable frequency drive
- and all of the necessary instrumentation.

Supervision of the on-site assembly, instruction manuals and training completed the IHC Merwede delivery.

Market segments



Deep-sea mining concept

Deep-sea mining

Rising demand for minerals and metals

With rising commodity prices and the depletion of reserves on land, mining companies are turning their interest to the oceans' resources. Deep-sea mining is a relatively new frontier that requires the necessary market and technological developments.

Until now, only the diamond mining industry is successfully operating in deep sea. However, due to developments in the commodity market, more and more interest is being generated in other deep-sea deposits, such as marine phosphates, sea floor massive sulphides and manganese nodules.

IHC Merwede firmly believes that the future of the industry lies in deep-sea mineral mining. It has the ambition to be the industry innovator and bases its belief on the core competence and expertise in excavation and slurry transport within the company.

This belief is strongly supported by the tangible results of a dedicated deep-sea mining research and development programme, and the development of deep-sea mining technology through feasibility studies. IHC Merwede has developed deep-sea mining systems to reach depths of up to 5,000 metres.

These studies are supported by considerable experience in developing subsea remote-controlled crawler-mining systems for the offshore diamond industry.

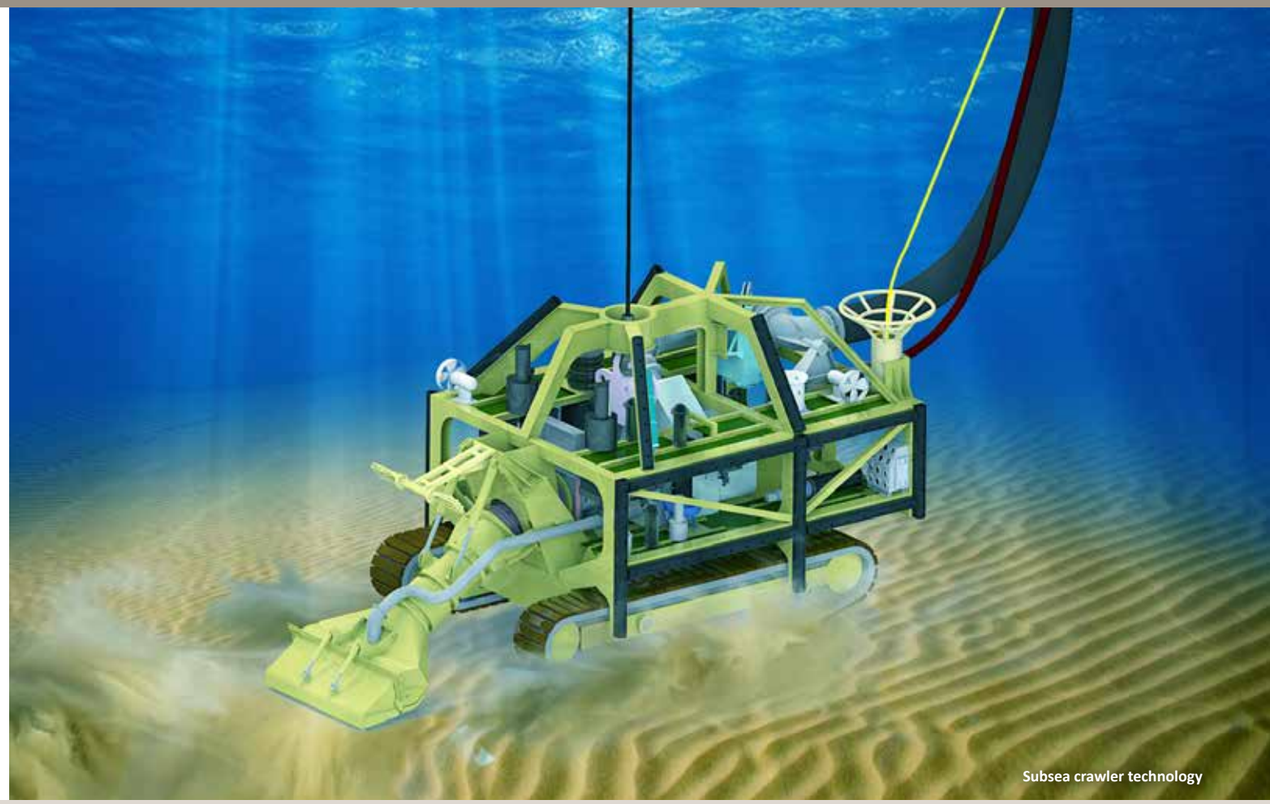
Integrated systems

IHC Merwede brings together knowledge and experience from within the IHC Merwede group to provide customers with complete deep-sea mining solutions.

A typical deep-sea mining system consists of:

- a mining support vessel
- a self-propelled vehicle (with excavation and slurry pumping system)
- launch and recovery system
- vertical transport system (with centrifugal pumps)
- electrical systems, control and instrumentation
- and positioning and visualisation systems.

IHC Merwede offers its customers a one-stop shop for custom-designed solutions. Each of its high-quality products works as part of an integrated mining system, with optimum production performance throughout the life cycle.



Subsea crawler technology

Product development

IHC Merwede has established itself as a technology innovator in deep-sea mining by its innovative thinking and a working environment that encourages creativity. The company is continuously developing technology and the market to provide its customers with efficient, safe and economically attractive solutions for all their deep-sea mining needs.

The essential technological processes for optimal production performance include deep-sea excavation, vertical transport and power supply over long lengths to achieve great depths.

Excavation is essentially the first step of production and therefore largely determines the efficiency and effectiveness of the downstream process. Once excavated, the material needs to be transported over great vertical distances in high volumes to the mining support vessel.

Sustainable power supply on the other hand is essential for both the subsea excavation equipment and vertical transport systems. Development and optimisation of these technologies are the focus for IHC Merwede's research engineers.

Case study

Over the past ten years alone, IHC Merwede has been involved in multiple projects related to deep-sea mining, from mechanical design and manufacture, to electrical and control installations.

IHC Merwede has a track record of supplying equipment and subsea remote-control crawler-mining systems to world players in the marine diamond mining industry. Its latest system, mining off Namibia in water depths of up to 150 metres, included:

- the remote-controlled subsea-mining crawler
- launch and recovery system
- electrical systems
- control and instrumentation systems
- hydraulic systems
- and a four-point vessel-mooring system.

Product groups


A concept to mine coastal waters up to 100 metres


Land-based Jigs


Marine diamond-mining crawler


Mining wheel

Innovative vessels and advanced equipment

With experience accumulated over decades, IHC Merwede is the market leader for the design and manufacture of efficient, integrated vessels and equipment. The company has achieved its overall aim of supplying customers with a greater return on investment, while helping to decrease the environmental impact of their activities.

Mining dredgers

IHC Merwede designs and builds a variety of cutter suction dredgers for inland- and coastal-mining projects. These are capable of mining compacted soil types and materials, such as clay and rock.

High accuracy and a continuous rate of production ensure that cutter suction dredgers are ideal for many mining jobs. They are specifically designed for the extraction of minerals from the bottom of lakes or the ocean floor to supply separation plants. The submersible centrifugal pump allows the extraction of minerals and metals from depths of 100 metres below sea level.

Mining support vessels

IHC Merwede takes great pride in designing and manufacturing unique and innovative vessels. These are designed and built to meet individual customer requirements according to the philosophy that “for every challenge, there is a solution” – an ideal foundation for supplying mining support vessels for offshore operations. These have an adjusted design, higher specific weight and pre-processing equipment installations on board to support the mining operation.

IHC Merwede products are designed and built to meet the demands of the mining industry and include equipment that is directly related to the excavation work or the hydraulic transportation of the materials. With the integration of the advanced equipment, IHC Merwede focuses on higher profitability for each mining project. This includes higher productivity and reduced operating costs, as well as optimum efficiency and minimal downtime.

Excavation tools

The excavation tools are integrated within the mining solutions and are designed to deliver high productivity with minimal downtime. The profile, spacing and size of arm, as well as the location and orientation of the teeth, make it possible to design tools for a large range of soil conditions. The mining wheel has proved to be an excellent tool for heavy mineral miners and has been developed for both cohesive and hard soils to deliver highly productive results.

Another concept specifically developed for mining is a bucket miner concept. This has the advantages of a silent bucket chain, higher productivity and lower maintenance costs.

The Lancelot cutterhead is used in loose compacted soil. It makes better use of the available power, resulting in a higher output of mined materials thanks to its cylindrical shape and availability of more arms. The drum cutter is specifically developed for harder soils and working in the deep sea under hyperbaric conditions.

Centrifugal pumps

As the primary power source for transporting the mixture to the vessel or separation plant, IHC Merwede is able to equip the mining installation with a complete range of centrifugal pumps. All of these are available as inboard or submerged centrifugal pumps. Most of the latter are driven directly by a submerged electric motor. The design is continuously being optimised to upgrade pump production and suction characteristics, as well as reduce wear. Adding extra pumping power along the discharge line can significantly help to improve production levels over longer distances.

Slurry transport systems

IHC Merwede provides a range of high-performance floating discharge lines, rubber hoses and ball joints to transport the slurry mixture to the mining vessels or plant. Floating discharge hoses are required for slurry transport to the shore. Rubber hoses without buoyancy can be part of a floating line arrangement, such as flexible land and vessel connection or with extra flexibility in the discharge line. Ball joints provide a flexible load-bearing connection between sections of a pipeline.

IHC Jigs

IHC Merwede designs and delivers either floating or land-based treatment plants to separate, for instance, gold, lead, tin and diamonds from the mined mixture. A Jig separates minerals from slurry by a difference in specific weight, using pulsating water displacement. The concentrate cone underneath the Jig bed moves up and down in a “saw tooth” motion, creating a fast upward and slow downward stroke. This causes a pulsating water flow from the cone through the Jig bed.

Mining crawlers

IHC Merwede has been at the forefront of subsea crawler mining tool development since 1988. Following the delivery of that first crawler, the company has worked to refine and improve the original design. The results of this innovative engineering and the returns of these crawler-mining tools far exceeded customer expectation and they are still in service today.

Launch-and-recovery systems

IHC Merwede has developed many reliable and safe launch-and-recovery systems for a variety of markets. It has created everything from the mining tool, LARS, to systems for sampling tools that can be retrofitted to vessels with only minor modifications required. The company has produced systems with safe working loads of up to 250 tonnes, which will render at 500 tonnes in dynamic conditions.

Automation and control

IHC Merwede has an established reputation in the fields of electronics, automation and control. Using in-house expertise in electrical engineering, the company designs systems that integrate all aspects of these fields, to improve efficiency and user friendliness.

IHC MERWEDE

Head office

The Netherlands
Sliedrecht

Regional offices

EUROPE

The Netherlands
Alblasserdam
Apeldoorn
Delfgauw
Dordrecht
Goes
Hardinxveld-Giessendam
Kinderdijk
Raamsdonksveer
Sliedrecht

United Kingdom
Blandford Forum

France
Verberie

ASIA

P.R. of China
Beijing
Shanghai
Tianjin

SOUTH EAST ASIA

Rep. of Singapore
Singapore

ASIA

India
Mumbai

MIDDLE EAST

United Arab Emirates
Dubai

Nigeria
Lagos

NORTH AMERICA

USA
Houston, TX
Lafayette, LA
Wayne, NJ

SOUTH AMERICA

Brazil
Rio de Janeiro

Engineering & Production

EUROPE

The Netherlands
Hardinxveld-Giessendam
Heusden
Kinderdijk
Krimpen aan den IJssel
Raamsdonksveer
Rotterdam
Sliedrecht

United Kingdom
Stocksfield

Croatia
Rijeka

Slovakia
Komarno

AFRICA

South Africa
Cape Town

ASIA

P.R. of China
Dalian
Guangzhou
Shanghai

SOUTH EAST ASIA

Malaysia
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