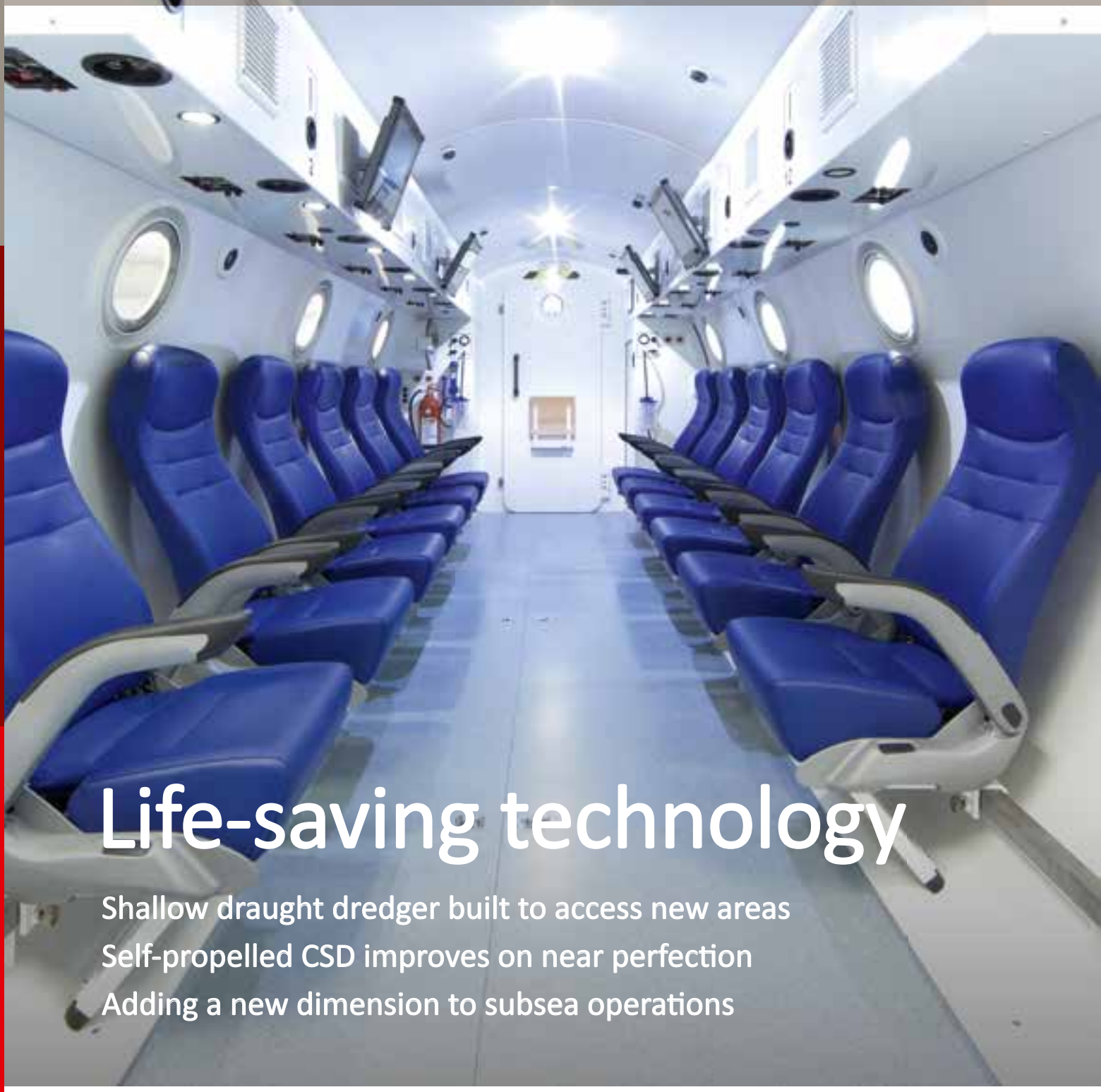
IHC MERWEDE

IHC Merwede

Insight

Dredging | Mining | Offshore

Spring 2014 | E 4



Life-saving technology

Shallow draught dredger built to access new areas

Self-propelled CSD improves on near perfection

Adding a new dimension to subsea operations

The technology innovator.

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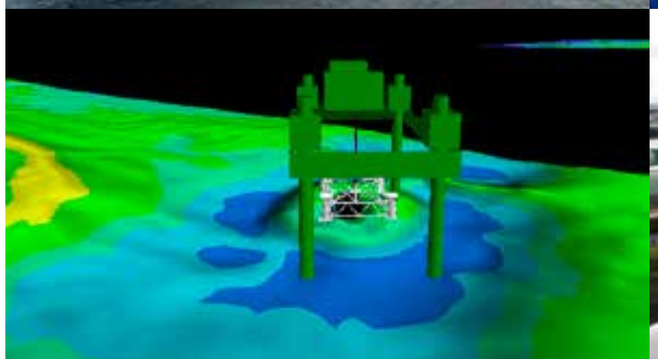


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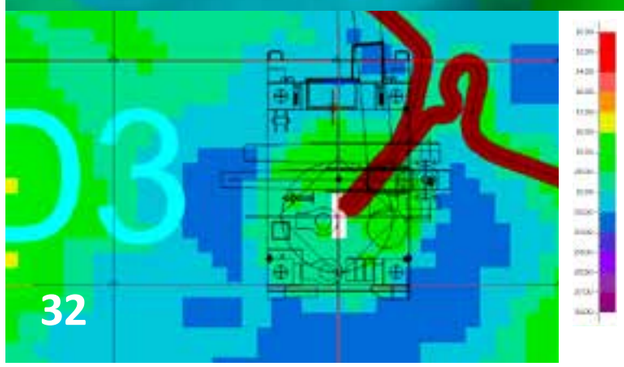
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Welcome

Dear reader,

In this issue, we have endeavoured to bring you a broad and interesting mix of stories from the world of IHC Merwede, starting with a remarkable trailing suction hopper dredger (TSHD) recently built for Baggerbedrijf De Boer – Dutch Dredging. The dominant characteristics of this TSHD, the ALBATROS, are the shallow draught and air draught, and a 'keep-it-simple' approach to any technical installation on board. Despite the literally low profile, the vessel has high potential in the dredging market.

High expectations are also held for the AMBIORIX, a self-propelled cutter suction dredger (CSD) owned by DEME, and a sister ship of the company's D'ARTAGNAN, built in 2005. Adapted to meet the requirements of new legislation and incorporating a list of practical additions, she is the perfection of an already high-grade original design. This feature highlights some specific aspects of this mega CSD, namely sailing direction, versatile soil processing capability, flexible spud carriage and state-of-the-art control and automation.

IHC Merwede employs many experts for the building of integrated and standard offshore working vessels. Among them is IHC Hytech, a company that excels in diving technology, decompression and breathing. A young offshoot of the IHC Merwede family tree, the company demonstrates a broad portfolio and a wide knowledge base. *IHC Merwede Insight* takes a closer look at its field of expertise, with a particular focus on its decompression chambers and related technology.

Staying below the surface, this issue also reports on how visualisation of the sea floor below a dredger or offshore vessel is barely sufficiently served by the usual 2D presentation of a wealth of data, obtained by surveying, and updated by dredging or offshore activities. That's why IHC Systems and DEME have developed a new 3D-Viewer that virtually overcomes all 2D disadvantages. Z-scale amplification and shadow manipulation greatly improve awareness of the sea floor among operators, particularly those new to the profession.

Turning to IHC Life-cycle support (LCS), we explore the vision behind this concept, which was adopted by IHC Merwede in 2007, and the wealth of services it now encompasses. Using examples from each of the five stages it comprises, it is evident that many employees are involved in perfecting these services. Overall, LCS demonstrates the extent of IHC Merwede's ongoing commitment to its customers and products.

Finally, the next issue of *IHC Merwede Insight* is scheduled to coincide with the Shipbuilding, Machinery & Marine Technology – International Trade Fair (SMM) on 9 to 12 September 2014 in the Hamburg Messe in Germany. We hope to see you there.

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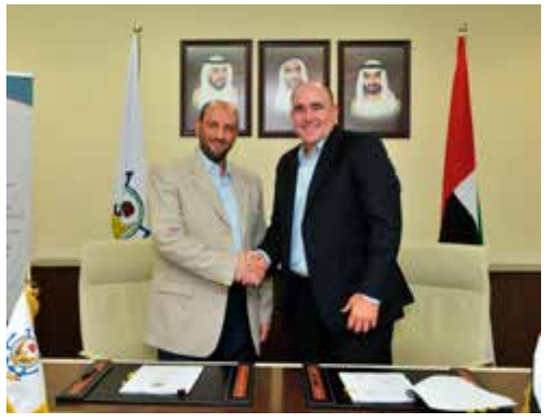
New sales landmark for IHC Parts & Services

The dredging industry's largest order for floating discharge lines has been secured by IHC Parts & Services. The confirmation of the purchase of 85 12-metre armoured floating discharge hoses by the National Marine Dredging Company (NMDC) is believed to have set a new sales landmark in this particular sector of the market.

The General Manager of IHC Middle East, Robert Jonk, and NMDC's CEO, Yasser Nasser (both pictured right), signed the contract on behalf of two of the world's leading dredging industry companies. The floating discharge lines will be used in conjunction with seven of the cutter suction dredgers built for NMDC by IHC Merwede, namely the AL SADR, AL MIRFA, KATTOUF, UMM AL AMBER, AL HAMRA, AL KHATEM and UMM EL ZEMOUL.

The armoured floating discharge hoses will have internal diameters of 750 and 850mm respectively. The high-tensile forged steel rings help to make the products highly wear resistant and an ideal solution for applications in the rather abrasive slurries found in the Middle East. This order is seen as a major achievement for IHC Parts & Services, following the extension of its product portfolio to include rubber hoses for the dredging market in 2009.



"The IHC Parts & Services team is delighted to confirm this significant sales agreement as part of our successful business relationship with NMDC," said Jonk. "The customer has ordered a smaller selection of armoured floating hoses from us in the past and they have proved to be a hugely successful acquisition. NMDC has once again opted for IHC Parts & Services, due to a high level of satisfaction with its existing products' reliability and wear resistance."

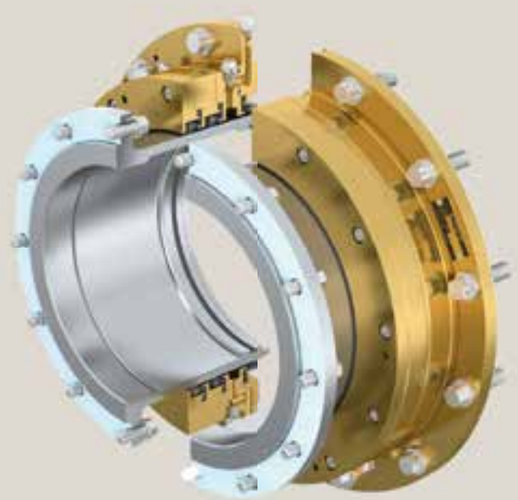
SUPREME Athmos™ seal sets the benchmark

IHC Sealing Solutions launched the zero-pollution SUPREME Athmos™ seal at the Europort exhibition in Rotterdam last November. In keeping with the company's long-term objective of maintaining sustainable safety standards, this unique product will set a new benchmark in the market.

The SUPREME Athmos seal enables ships – with limited draught up to approximately five metres – to prevent oil from being emitted into the environment. An innovative system has been developed to provide a safe and sustainable operation by capturing every possible drop of oil. Water is prevented from entering the system by collecting any leakages from the seal into a drain tank. Once full, this tank is automatically drained into the vessel's general waste oil tank.

Ship owners will also enjoy the peace of mind that comes from the SUPREME Athmos seal having a fail-safe option, incorporating a condition-monitoring function. In the unlikely event of the system failing, it switches to the normal sealing mode, the drain tank captures the little oil that the seal uses and the tank indicates when it should be emptied.

"In addition to the standard working principle of keeping oil in and water out of ships, the unique SUPREME Athmos seal delivers many more benefits to ship owners," said Dustin van Horik, IHC Sealing Solutions' Marketing Manager. "Our research shows that the market demands zero pollution and we're delighted to introduce a sustainable solution that meets this requirement."



IHC Merwede secures orders worth € 350 million

GDC's latest trailing suction hopper dredger

IHC Merwede has been successful in securing orders worth € 350 million for a wide range of dredging and offshore vessels and equipment. The company's Dredging division has confirmed new contracts for the delivery of a large custom-built trailing suction hopper dredger, 13 units that will be supplied by IHC Beaver Dredgers and a cutter suction dredger training simulator. The Offshore division has also announced orders for the construction of a 300-tonne pipelaying vessel, as well as a J-Lay pipelaying system and a tandem mooring system.

In the Dredging division, IHC Merwede will soon start constructing the largest trailing suction hopper dredger it has ever produced for a Chinese customer, CCCC Guangzhou Dredging Company (GDC). It has selected IHC Merwede as its partner – as it offers the best possible solutions in the market – for the high-end products. This latest addition to GDC's dredging fleet will be built at a Dutch shipyard, despite the fact that it is based in a country with an in-depth knowledge of the field of shipbuilding.

The remaining 13 dredging vessels consist of 11 standard IHC Beaver® cutter suction dredgers, a Delta Multi Craft standard work boat and a booster station. IHC Merwede's policy is to deliver standard vessels and equipment from stock, so it is able to meet the demand for short delivery times in this market.

In addition, Huta Marine Works has commissioned IHC Merwede to develop and supply a cutter suction dredger training simulator. This will accompany the delivery of the previously ordered custom-built cutter suction dredger, which is currently under construction at the IHC Merwede yard in Kinderdijk. Huta Marine Works will use the simulator in training courses for operators of the latest cutter suction dredgers in its fleet and this will include the technical capability to incorporate future vessels.

In the Offshore division, the 300-tonne pipelaying vessel ordered by Sapura Navegação Marítima will be delivered with a pipelay spread supplied by IHC Engineering Business. This ship will install flexible pipelines in Brazilian waters, pursuant to Petrobras' contracts for the charter and operation of pipelaying support vessels, previously awarded to Sapura Navegação Marítima.

An additional offshore order from Petrofac includes the design and construction of a 2,000-tonne capacity J-Lay pipelaying system. This will be installed on a new deep-water construction vessel in 2016 to lay 36-inch diameter pipe in water depths of up to 3,000 metres.

The tandem mooring system – used for the safe mooring of the bow of an export tanker to the stern or bow of a FPSO – will be the 17th product of its kind put into operation by IHC Merwede in the floating production market. It will be installed on one of MODEC's FPSO vessels in Ghana.

Bram Roelse, IHC Merwede's CEO, commented: "These valuable new orders are confirmation of IHC Merwede's reputation as 'the technology innovator'. We invest in long-term relationships to provide the best possible solutions, so that our international customers continue to appreciate the reliability and efficiency of our products and services."

Innovative self-propelled CSD for Boskalis

IHC Merwede has been awarded the contract for the design, construction and delivery of a 23,684kW self-propelled cutter suction dredger (CSD) from Royal Boskalis Westminster (Boskalis). The innovative new dredging vessel will be one of the largest CSDs of its kind in the world.

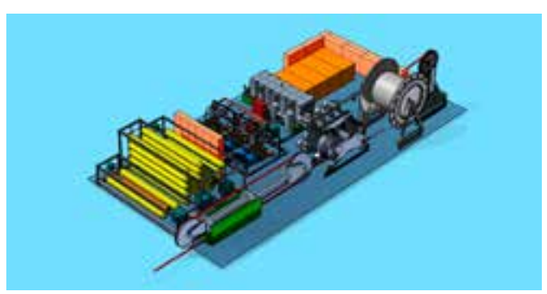
As part of the close cooperation and working relationship between Boskalis and IHC Merwede, much attention has been paid to the design of this latest CSD in terms of safety, the environment and increased operational workability. A particular feature of the vessel is the widening of the aft ship in order to reduce the draught.

“IHC Merwede is delighted to confirm this valuable new dredging project in 2013,” said Bram Roelse, IHC Merwede’s CEO. “The order from Boskalis confirms that the dredging market has renewed confidence in IHC Merwede’s exceptionally high levels of quality and reliability, as well as enhancing the company’s positioning as ‘the technology innovator’.”

EPC delivery of unique AHC system

IHC Merwede has signed a new contract for the EPC (engineering, procurement and construction) delivery of an Active Heave Compensation (AHC) system. This advanced equipment will be designed, built and supplied as a reliable solution for the deep-water subsea installation of heavy modules in dynamic sea states.

The integration of the active heave compensator and winch system means that this system is unique. It will be placed on board the new-build heavy lifting/pipelaying vessel (with a 5,000mT crane), YANTAI 5000, which is being constructed for the Yantai Salvage Bureau by Shanghai Zhenhua Heavy Industries Co., Ltd. (ZPMC) in China.



The AHC system package will be delivered by IHC Hytop, and consists of the following extensive range of equipment: an active heave cylinder set; the main HPU; a 400mT traction winch; a storage winch for 3,500m of wire rope; the complete drive and control system with motion reference unit; and local control cabins.

“IHC Merwede is delighted to confirm this contract with ZPMC for the supply of the new AHC system for deep-water lowering,” said Wouter Kruijt, IHC Hytop’s Managing Director. “This provides further evidence that IHC Merwede is firmly established in the design and development of advanced equipment for the offshore market – and the industry at large.”

MaXine 50 enhances safety and efficiency

IHC Vremac Cylinders introduced the MaXine 50 heave compensator to its Dutch, Belgian and German offshore partners in October 2013. The group of lifting specialists responded enthusiastically to the dynamic launch and demonstration of the innovative new product.

The hoisting and lowering of loads under maritime conditions have to overcome the peak forces that stem from the oscillation of waves. The MaXine range of heave compensators reduces these forces and extends the weather window, so that operators can minimise downtime and work for longer periods in high sea states.

The system is positioned between the crane hook and the load to keep the rope taut at all times. It reduces the peaks and troughs by following the motion of the sea, and allows work to proceed safely, efficiently and in a controlled manner. In addition, MaXine acts as a stand-alone system – eliminating the need for an external power source – and may even be used under water.

This approach was perfectly demonstrated at the launch by setting up a series of tests on location at IHC Vremac Cylinders’ headquarters at Apeldoorn in The Netherlands. The MaXine 50 was utilised by a 12.2-tonne Mammoet mobile crane, with the hoisting ropes gathered together into a single shackle. This was connected to a quick-release hook, which in turn was welded on to a seven-tonne plate resting on the ground.

The hoisting of the crane led to the extension of the MaXine 50 in the same way as a spring. When the quick-release hook was activated, the MaXine contracted and the 12-tonne plate pulled upwards. The hoisting speed and height were the important parameters highlighted by IHC Vremac Cylinders, along with the combination of the natural frequency and the damping. The first three demonstrations were measured and proved to be exactly correct, as a clear sign that the MaXine 50 is fit for purpose.

“We received some useful feedback from the crane driver, who was initially sceptical about the demonstration,” said IHC Vremac Cylinders’ account manager Marcel van Haaren. “However, his opinion was transformed when the hoisting of a five-tonne deadweight ran so smoothly. The energy generated by lowering this weight was successfully consumed by the acceleration of the remaining load and the weight of the MaXine 50.”

IHC Vremac Cylinders has designed a wide range of MaXine heave compensators, which are capable of handling weights between 50 and 500 tonnes. These products are primarily manufactured for the rental market and the company is making a significant investment in a fleet for this sector.

SAPURA sister vessels signal milestone in IHC Merwede's history

IHC Merwede has successfully named and launched two identical pipelaying vessels, SAPURA DIAMANTE and SAPURA TOPÁZIO, in separate ceremonies at the company's shipyard in Krimpen aan den IJssel, The Netherlands. The ships, ordered by Sapura Navegação Marítima – a joint venture between SapuraKencana and Seadrill – are the first two in a series of five fully integrated offshore vessels, which will be completely designed, engineered and built by IHC Merwede.

The naming of these innovative offshore vessels was carried out by: Mrs Christina Lucia Duarte Pinho, the Executive Manager of Petrobras E&P Service (SAPURA DIAMANTE); and Puan Sri Datin Seri Yazreen Yahya, spouse of Tan Sri Dato' Seri Shahril Shamsuddin, President and Group CEO of SapuraKencana (SAPURA TOPÁZIO). After delivery, the sister vessels are destined to go to Brazilian waters to develop deep-sea oilfields of up to 2,500 metres on behalf of Petrobras.

Both ships will be equipped with a pipelaying spread designed by IHC Engineering Business. These comprise of two below-deck storage carousels, with capacities for 2,500t and 1,500t of product respectively. A vertical (tiltable) lay system – with a 550t top tension capacity – will be permanently installed for the deployment of a range of flexible products. The tower orientation allows for maximum deck space, while utilising a high-capacity 610t abandonment and recovery (A&R) system. A custom-designed control system from IHC Drives & Automation integrates each aspect of the pipelaying spread to ensure excellent performance, safety and reliability.

"In a relatively short period of time, we have built a wonderful partnership with Sapura Navegação Marítima," said Arjan Klijnsoon, Managing Director of IHC Merwede's Offshore division. "The launch of the first two vessels for this customer is a milestone in our history. Once again, we have proved to be a reliable partner for such complex projects, with the build of all of the equipment and the vessels itselfs on schedule."

"Sapura is pleased to be working with IHC Merwede on this series of sophisticated flexible pipelaying vessels," said Mark Allpress, SapuraKencana's Project Manager. "IHC Merwede has shown that it can bring together all of the expertise and equipment from its internal companies in The Netherlands and UK, as well as the many local subcontractors, to build high-quality vessels in accordance with the contract schedule. Sapura trusts that the current level of performance on the first two vessels will be maintained through to delivery of the last vessel."

Message in a bottle

Melanie Taal of the IADC (International Association of Dredging Companies) had the good fortune to find something of special value on the beach at Scheveningen recently. She found an empty bottle with the words "*Flessen Post van de Sleephopper zuiger DCI XXI*" (Message in a bottle from the trailing suction hopper dredger DCI XXI), which had washed up on the shore of The Hague's holiday resort.

DCI DREDGE XXI was designed, engineered and built by IHC Merwede for the Dredging Corporation of India (DCI). The bottle had been thrown into the water during the vessel's sea trials in January 2014. It is a tradition within the company's production department at its Kinderdijk shipyard to send a message in a bottle during such trials, with the lucky recipient of the bottle destined to receive a picture of the vessel.

On 23 January, the 5,500m³ trailing suction hopper dredger was handed over to DCI at the Kinderdijk shipyard. She is the final vessel in a series of three, preceded by the DCI DREDGE XIX and DCI DREDGE XX, which are already operating successfully in India.

President Obama sees IHC Merwede's MV Drive at Vacon

On Wednesday 15 January 2014, US President Barack Obama made a visit to Vacon's Research and Development Centre in Durham, North Carolina, USA, where he came into contact with an example of IHC Merwede's advanced equipment. During his tour of the impressive facility, the President was shown a pilot version of the company's Medium Voltage (MV) Drive.

IHC Merwede has designed the MV Drive in cooperation with Vacon, which develops, manufactures and sells AC drives and inverters on a global basis. The MV Drive is built by IHC Merwede, before being tested by the Finnish company's American subsidiary.

The 4.16 kilovolt drive has been specially designed for marine applications and can withstand heavy vibration, dirty working environments and high temperatures. The water-cooled frequency converter is available in a range of 1 to 11 megawatts, and will be applied to dredging and offshore vessels by IHC Merwede. The drive is able to vary the speed of electric motors in an energy-efficient manner.

IHC Motion Control & Automation's Director Joti Hakkert said: "We offer integrated, customised and innovative systems – such as the MV Drive – to the maritime industry in conjunction with our global network. It's an honour for everyone associated with IHC Merwede that our innovative product was on display at our partner Vacon's Research and Development Centre during this important event."

IHC Merwede's CEO Bram Roelse added: "The IHC Merwede group is working at the cutting edge of technology across a broad range of developments in the dredging, mining and offshore markets. The link to Vacon is one of the initiatives that help us to reinforce our position as 'the technology innovator'."

IHC Merwede appoints Bram Roelse as CEO

IHC Merwede has announced that it has appointed Bram Roelse as the company's new Chief Executive Officer (CEO) with immediate effect as of 1 April 2014. He has taken over this leading role within the company from predecessor Dirk Philips who stepped back in November 2013.

Mr Roelse (56) has worked at IHC Merwede for the past 13 years. He was originally appointed as the Managing Director of the company's business unit IHC Systems. At the end of 2004, he moved to the company's shipyard at Kinderdijk, where he became Director of the Dredging division.

As a member of IHC Merwede's Board of Management since 2002, Mr Roelse began work in his previous post as Chief Operating Officer (COO) in September 2013, when he also became a member of the Board of Directors. Prior to his time at IHC Merwede, he had gained invaluable experience in the naval shipbuilding and oil and gas industries.

IHC Merwede's Supervisory Board is convinced that Mr Roelse is capable of developing and continuing the company's business strategy, as the current direction that IHC Merwede is taking was partly his responsibility as COO.

IHC Merwede reveals healthy order book

IHC Merwede successfully increased its order book in 2013 across the main sectors of its business: offshore and dredging. The company received almost € 1.8 billion worth of new orders in the past year. At the end of 2013, the order book was valued at over € 1.7 billion, which is the equivalent of a backlog of approximately two years.

IHC Merwede develops and builds innovative vessels, advanced equipment and life-cycle support services for the dredging, mining and offshore industries. These markets have been performing well, despite the global economic situation and the knock-on effect for the maritime industry.

In 2013, IHC Merwede achieved a revenue of € 985 million (2012: € 895 million) and a net profit of € 56 million (2012: € 37 million). The company is looking ahead to the remainder of 2014 with increasing confidence.

Market developments

The shipbuilding industry is characterised by a huge overcapacity in ships and shipyards around the world due to the ongoing economic uncertainty. As a result, there was an increased level of competition for IHC Merwede in 2013, with new entrants to the dredging and offshore sectors aiming to offset the decline in their traditional markets. However, IHC Merwede distinguishes itself with a consistent focus on delivering value to its customers.

In the dredging market, new investments continue to be made selectively, and these are dependent on the latest regulations and the addition of new product groups. A positive factor is the growth of state-owned enterprises, which are autonomous in their decision-making in the face of global economic developments.

The current economic climate is also unfavourable for the start of full-scale developments in alternative extraction possibilities within the mining market. IHC Merwede remains active in the areas of nearshore/onshore mining and studies for deep-sea mining. It is expected that investments in equipment will be driven by changes in political and economic conditions.

The offshore market continues to evolve. IHC Merwede profited from the sale of various vessels and equipment in 2013, including six pipelaying vessels to SapuraKencana and Subsea 7 – the company's largest ever order. It is expected that further investments – related to the Brazilian market – will not be curtailed, and IHC Merwede intends to build upon its strong and reliable position in this territory.

"We are delighted to confirm that IHC Merwede's order book has increased substantially over the past financial year," said IHC Merwede's CEO Bram Roelse. "This is due to the successful implementation of the group's long-term business strategy, especially in the dredging and offshore markets. It also ensures that we are in a strong position moving forward over a number of years and provides us with a stable platform for ongoing development on a global basis."

'AL BAHAR' C/D HUTA 12 named and launched

IHC Merwede has successfully named and launched the 23,545kW self-propelled cutter suction dredger 'AL BAHAR' C/D HUTA 12 in a ceremony on 8 March 2014 at the company's shipyard in Kinderdijk, The Netherlands. It is building the innovative vessel for Huta Marine Works, which is based in Saudi Arabia. The ceremony was performed by Ms Sylvia Wuebbens, the daughter of Mr M. Wuebbens, the Managing Director of Huta Marine Works.

The contract for the design, construction and delivery of the vessel was signed between Huta Marine Works and IHC Holland, part of IHC Merwede, on 11 October 2012. The keel was laid on 14 August 2013 and the ship will be delivered in the third quarter of 2014.

IHC Merwede was awarded this project due to the reliable technology at its disposal and an excellent track record following the notable delivery of a previous order for Huta Marine Works – the stationary cutter suction dredger AL SAKAB. 'AL BAHAR' C/D HUTA 12 is named after one of the favourite horses of Prophet Muhammad. It means strong, smooth and swift, like the flow of running water.

'AL BAHAR' C/D HUTA 12 has been designed and built using the latest technological developments. She is equipped with separate accommodation for the sailing and operating crews, a travelling deck crane and azimuth thrusters. Special attention has been paid to the maintenance features and accessibility. The vessel will be deployed predominantly on both sides of the Arabian Peninsula, where she will dredge hard soil in difficult climatic conditions.

Fer Tummers, Managing Director of IHC Merwede's Dredging division, said: "Huta Marine Works and IHC Merwede are both proud of the 'AL BAHAR' C/D HUTA 12. We have worked closely with Huta's staff to achieve a successful outcome. Both companies already have a history of strong cooperation, demonstrated by the delivery of the cutter suction dredger AL SAKAB. Once again, we have proven to be a reliable partner with the construction of this high-quality dredger in record time."

AMBIORIX: sister ship of DEME's most powerful CSD

1. CSD AMBIORIX at work…
(Courtesy DEME)

In 2005 IHC Merwede delivered a self-propelled mega cutter suction dredger (CSD) to dredging contractor SDI, a subsidiary of the Belgian DEME Group [1]. The D'ARTAGNAN became the largest and most powerful dredger of its fleet. In 2010 DEME ordered the delivery of another similar vessel from IHC Merwede. She was named AMBIORIX and handed over in May 2012, proudly taking her place among the world's most powerful CSDs (*figure 1*).

The AMBIORIX is a self-propelled CSD that sails with a bow-mounted cutter ladder (*figure 2*). She can discharge the dredged soil and rock either through a shore discharge line or a barge-loading installation, which considerably supports operational versatility and mobility. The propellers and double-walled inboard dredge pumps are directly diesel-driven, whereas the single-walled ladder pump, the cutter and the principal winches are driven by frequency controlled AC electric motors. The jet pump – providing jet water to the cutterhead – is driven by a soft-started AC motor. Two tiltable spuds (*figure 3*) – one of them installed in a flexible spud carriage – enable quick mobilisation.

2. ..and sailing: the dredger is very easy to mobilise, not least because of...

3. ..the spuds that are tiltable by their own means

4. Statue of Ambiorix in Tongeren, Belgium
(Courtesy Ad Meskens/Wikimedia Commons)

5. The inboard dredge pumps can add 2 x 6,000kW to the pumping process and be switched in or out of the flow path by gate valves

She is named after the legendary leader of a Gallic tribe (*figure 4*), living in an area that encompassed parts of present-day France, Belgium and The Netherlands (Gallia Belgica). Ambiorix and his men resisted the Roman legions of Julius Caesar (100-44 BC) for about three years. Subsequently the latter wrote the famous words: “Of all these [tribes] the Belgae are the bravest” in his *Commentarii de Bello Gallico I,3*.

The AMBIORIX is a sister ship of the D’ARTAGNAN, with an identical design. However, as several years have passed since the manufacture of the D’ARTAGNAN, the consequences of new legislation and technology appear on board the AMBIORIX, resulting in some differences.

Imperative in this respect is the legislation that requires double-walled fuel and lubrication oil tanks, and new regulations on ballast water tank conservation (according to the IMO PSPC standard). These have had rather a large impact, as they required the redesigning of the vessel’s bottom, hull and cofferdams at unchanged hull dimensions. Consequently, there was less room for some technical installations, so inventive solutions had to be found to fit them in, especially to maintain the same fuel capacities (autonomy). The installation of an alternative emergency power supply system also influenced the design of the new vessel.

In addition, some smaller alterations were made, following the customer’s experience with the D’ARTAGNAN and other CSDs, which resulted in practical and ergonomic improvements. These included a Green Passport, the installation of a chemical store, adaptation of the cutter work platform and touchscreen controls. Even minor changes, such as the relocation of a grease point, or an additional bookshelf on the bridge, were made among about 130 other adjustments, and contributed to the completion of the AMBIORIX, the perfection of an already excellent original. The remainder of this article explores some of the highlights of the new vessel in greater detail.

Sailing direction

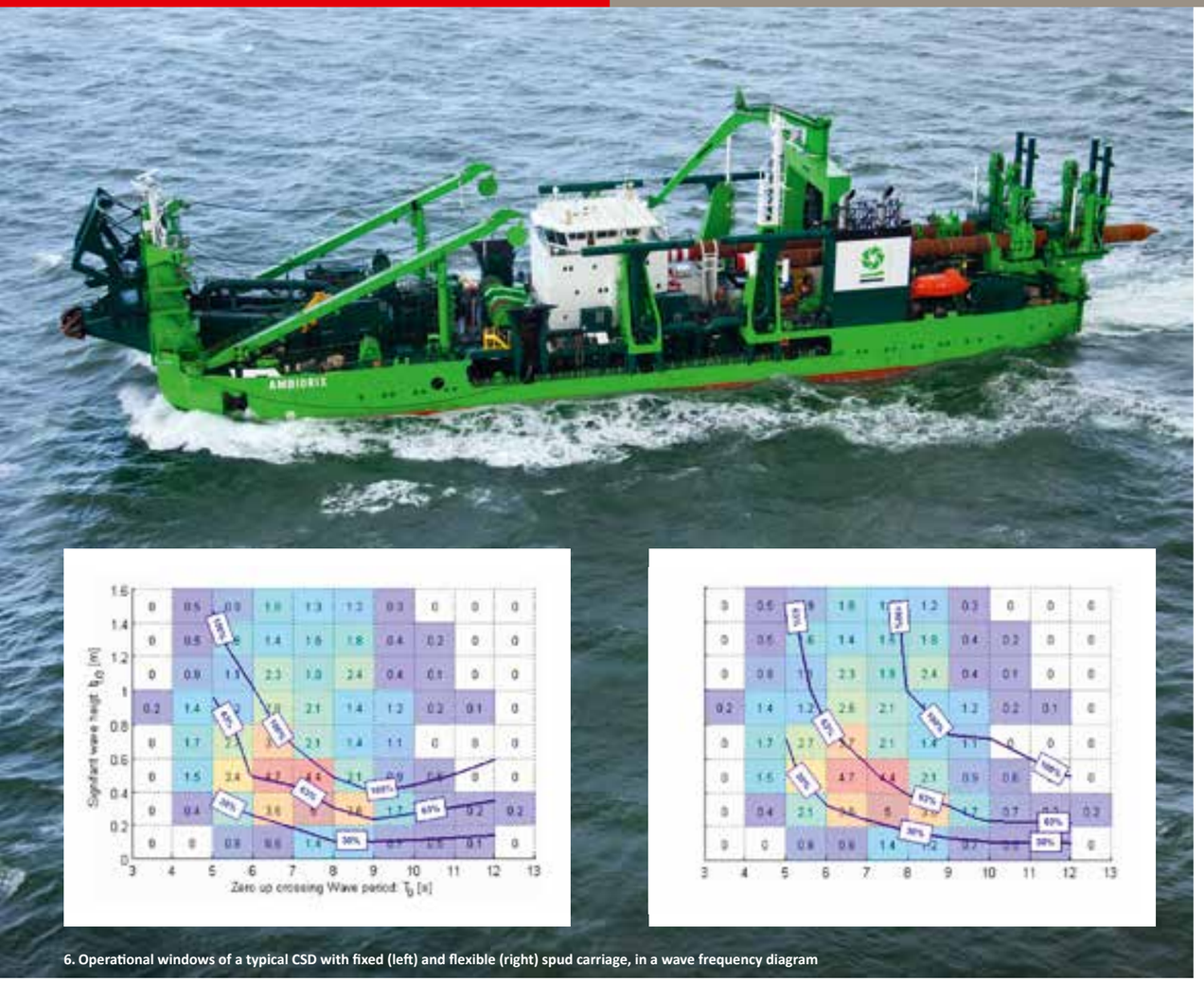
One feature of the AMBIORIX is the bow-mounted ladder, which is analogous to several self-propelled CSDs, but contrary to other lookalikes. For example, DEME’s first self-propelled CSD, the VLAANDEREN XIX [2, 6] has a stern-mounted ladder and is ‘dragged’ by the propellers near the spuds, rather than ‘pushed’ as usual. The pros and cons of the bow- or stern-mounted ladder are discussed extensively by the former head of IHC Dredgers’ design department, Ir. Arend Zinkweg, in two earlier issues of IHC Merwede’s magazine [2].

The pros and cons have to do with bow height, freeboard, classification, bow wave impact on either the ladder (*figure 2*) or the spud carriage, the vulnerability of propellers near the ladder during slope dredging, and other factors. These have a considerable influence upon the design of major vessel components. It seems not easy to determine the most dominant factor. Possibly the wisest approach to the question from a builder’s perspective is the summary in reference [1]: “Ultimately, the choice depends on which features are emphasised most, from the owner’s perspective, based on the company’s philosophy, normal practice and expected future operation.” This implies that the builder has to come forward with alternatives and evaluate the technical consequences of certain choices, but ultimately the customer decides.

Versatility in several soil types

The AMBIORIX is highly capable of rock cutting. As set out in reference [3], it is not the application of huge power on the cutterhead as such that makes a CSD a rock-eating machine. Several specific features earmark a rock-cutting CSD:

- cutter energising system with considerable power and torque reserves
- high cutter power in balance with the installed pump power
- robust cutter drive that tolerates highly dynamic load conditions
- appropriately dimensioned cutter shaft and couplings that dampen down high torque peaks
- semi-elastic, sea water-flushed cutter bearing for shock absorption
- robust construction of cutter ladder and spuds, fit to withstand high loads



6. Operational windows of a typical CSD with fixed (left) and flexible (right) spud carriage, in a wave frequency diagram

7. 675kW water-cooled variable frequency drive interior

- swing winches and gearboxes capable of generating high pulling forces.

On the AMBIORIX these features have been balanced in order to create an optimal design. She boasts a high cutter-pump power ratio, for example, and has robust cutter and winch drives. The heavy cutter ladder – weighing over 1,300 tonnes – was designed with help of the Finite Element Analysis (FEA) method. An additional ballast of 120 tonnes in its lower end increases the ground pressure, which is also beneficial for rock cutting. DEME and IHC Merwede developed a concept that allows for the replacement of the regular cutterhead by the smallest possible one at the given suction pipe diameter. This enables the AMBIORIX to exert increased rock-cutting forces at unchanged torque figures.

Whereas the AMBIORIX has been well equipped for rock cutting, she also excels in other soils, due to the huge power of the three dredge pumps, giving her the capability to discharge soils over distances ranging from about 80m during barge loading to over 10km by a shore discharge pipeline. Swallowing up densely packed sands is facilitated by the jet water, bursting out of the cutter hub. In addition, the jet water can be distributed inside the cutterhead to facilitate cutting of heavy clay. The mighty dredge pumps can be 'switched' in and out of the flow path by opening and closing gate valves in their suction and pressure lines (*figure 5*).

Flexible spud carriage

Simulations and investigations carried out by IHC Merwede – as well as users' experience with broken spuds and spud carriages – have revealed that the spud forces due to swell by far exceed the forces caused by dredging, even those caused by rock cutting. This is a consequence of the fixed coupling between the vessel and spud carriage, resulting in high loads on the spud when the vessel is moved by waves.

The solution, among others applied on D'ARTAGNAN, was to slightly 'decouple' the stiff rotational connection between vessel and spud carriage. This was achieved by 'pending' the spud carriage in an arrangement of steel wires, connected over guide sheaves to a system of pre-tensioning cylinders, load-limiting cylinders and controllable accumulators.

This system allows a certain degree of rotational freedom of the spud carriage, resulting in lower spud forces and the possibility to limit the spud forces to a safe level. The load limiter system is of an auto-reversible character: once the overload is gone, the system automatically moves the carriage back to the normal working position. By varying the pressure in the accumulators, the spud carriage can be given 'weak' or 'stiff' behaviour.

This technique considerably broadens the operational window in swell (*figure 6*). Since the forces on the spud carriage depend on water depth, wave patterns, soil characteristics, dredging method and other constantly changing circumstances, the intricate system is not easy to adjust and commission. Therefore IHC Merwede has developed simulation and design tools to predict the behaviour of the system and determine its optimal settings. The results have been convincing on large and small CSDs [4, 5].

Control and automation

Following its experience with D'ARTAGNAN, DEME looked for some improvements to be made to the winch drives. At the time, IHC Drives & Automation had just completed its 1MW prototype of a low voltage (LV) variable frequency drive. This appealed to DEME's technical staff, so the supply of the electric motors and the water-cooled 675kW drives (*figure 7*) for the swing winches, 800kW drive for the ladder winch and 55/150kW drives for the gland pumps became the first order for the then new IHC Merwede business unit. The active front ends (AFE) of these drives facilitate energy recuperation and reduction of harmonic distortion. As an illustration of the flexibility of the IHC Merwede organisation, these alterations were smoothly integrated into the sister vessel of the D'ARTAGNAN.

During the last decade, IHC Systems and DEME have closely cooperated in the further development of the automatic cutter controller (IHC ACC®) and the addition of Artificial Intelligence in its control routines. The AMBIORIX has gained from the growing insights in this field, which show no signs of stopping.

8. Dredging and navigation control consoles

9. DEME: "creating land for the future" (Courtesy DEME)

One feature was the model-based, artificially intelligent pump controller, which was first used on the VLAANDEREN XIX in 2007 for a joint DEME-Boskalis venture in Brazil [6]. This seems the more appropriate in controlling and distributing the huge pump power of 15,400kW under several working circumstances. The model is able to calculate the average grain size by extended Kalman filtering, and – in the wake of it – the required critical velocity in the pipelines. This enables the optimisation of the mixture flow in relation to fuel costs and emissions close to what is theoretically conceivable.

Also the result of growing insights is a new control algorithm for the swing winches in relation to the soil properties. Rather than requiring speed control, several soil types benefit from the application of torque control instead. However, in doing this, active oscillation damping is required to prevent instability. In recent years, this technology has been managed and incorporated in the ACC®, providing very flexible and optimised swing control, especially in challenging operations like cutting rock. The Human Machine Interface (HMI) was optimised following comments made by the D'ARTAGNAN's operators, and also upgraded to touchscreen control.

Finally, among the usual control consoles (*figure 8*) and many other examples of modern control and automation, which cannot be detailed within these pages, the AMBIORIX has been equipped with the 3D-Viewer for dredge performance presentation, as described in pages 32-35 of this issue.

Conclusion

IHC Merwede successfully delivered the AMBIORIX within the tight contractual schedule. Equipped with new and proven features, she offers many benefits for the owner, including versatility, flexibility and easy mobilisation, as well as excellent durability and capabilities for working in severe conditions. Among the many heavy cutter suction dredgers commissioned in recent years, she has her own place and will, without doubt, contribute effectively to the ambition of DEME, which is: "creating land for the future" (*figure 9*).

Principal characteristics	AMBIORIX
Built	IHC Dredgers, 2012
Type	Self-propelled cutter suction dredger
Owner	DEME
Classification	Bureau Veritas Class I, ✠ Hull ✠ Mach, Special Service, Dredger, Unrestricted Navigation, AUT-UMS. Green Passport
Length overall	123.8m
Beam	25.2m
Draught at International Freeboard	6.15m
Dredging depth	6-35m
Diameter of dredging pipelines	1,000mm
Total installed power	26,100kW
Trial speed, loaded	11 knots
Accommodation	43 people

References

[1] "D'ARTAGNAN, Mega Cutter Suction Dredger". *Ports and Dredging 164*. IHC Holland, Sliedrecht, The Netherlands, 2005. 4-9.

[2] *Ports and Dredging 096*, 9-11 and *Ports and Dredging 097*, 6-8, on the principal choices and consequences of the subject and their application on the VLAANDEREN XIX. IHC Holland, Rotterdam, 1978.

[3] "Power girls: cutter suction dredgers for rock cutting". *Ports and Dredging 175*. IHC Merwede, Sliedrecht, The Netherlands, 2010. 16-19.

[4] "Dynamic simulation of cutter dredger at sea". *Ports and Dredging 169*. IHC Merwede, Sliedrecht, The Netherlands, 2008. 6-13.

[5] "DODO: a reliable response to the challenges of dynamic behaviour". *Ports and Dredging 174*. IHC Merwede, Sliedrecht, The Netherlands, 2010. 26-31.

[6] "A boost to sustainable growth: innovative dredging at Sepetiba Bay". *Ports and Dredging 168*. IHC Merwede, Sliedrecht, The Netherlands, 2007. 8-15.

ALBATROS:
low-profile, high-potential TSHD

1. The exterior of TSHD ALBATROS during sea trials…

Following Boskalis and Van Oord, Baggerbedrijf De Boer is the third largest dredging company in The Netherlands. The 50-year old firm is an independently owned company, led by the nestor of the Dutch dredging world, Cees van de Graaf Sr. and his sons, Cees and Hugo.

Its portfolio includes the usual maintenance and capital dredging and surveying works, and related marine operations. With a no-nonsense approach and keep-it-simple philosophy, the company resides in the heartland of dredging – Sliedrecht – and has gained a strong position in harbour and river maintenance dredging all over the world.

The flat organisational structure of Baggerbedrijf De Boer guarantees clear communication, quick decisions and flexibility to customers. Simultaneously, the company demonstrates a high level of technical know-how, reliability, professionalism and financial stability. Most of this is achieved by proactively maintaining working relationships, enthusiasm, expertise and craftsmanship at all levels of the organisation, accompanied by personally guided on-the-job training for new recruits.

Mr Van de Graaf says, he does not believe so deeply in cutter suction dredgers and all their mobilisation fuss, so Baggerbedrijf De Boer predominantly operates trailing suction hopper dredgers (TSHD) in the range of 475-4,317m^3. One of them is the 2,680m^3 IHC Merwede-built AMAZONE [1], which Van der Graaf refers to as “one of the best vessels in the whole world” (*figure 3*).

An example of the company’s no-nonsense approach is the fact that it would sooner send a plough-type bed-leveller vessel (*figure 4*) after a TSHD than perform costly mound-flattening operations (Dutch/Flemish: *bulten jagen*) by the TSHD itself. Therefore, the second most prominent vessel type in its fleet is the bed leveller, which egalises the draghead tracks by dragging/towing a plough over them.

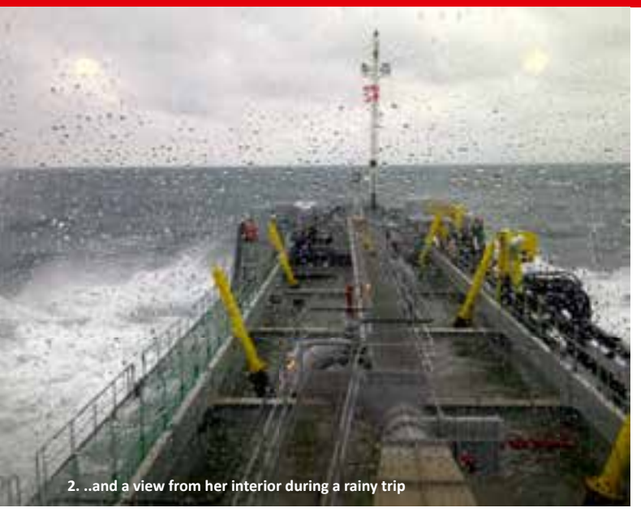
The efficiency of the almost exclusively Dutch crews is demonstrated by the ability to remain competitive in the international market (despite comparably higher Dutch wages). It is also epitomised by a common image of one of Baggerbedrijf De Boer’s vessels sailing to the unloading site with a very dense load of mud/silt (*figure 5*).

In short, Baggerbedrijf De Boer is a professional Dutch player. When the company planned to build a new vessel, many shipyards competed to win the assignment. IHC Merwede was successful: it was awarded the contract to build the ALBATROS (*figures 1, 2*).

ALBATROS’s design principles

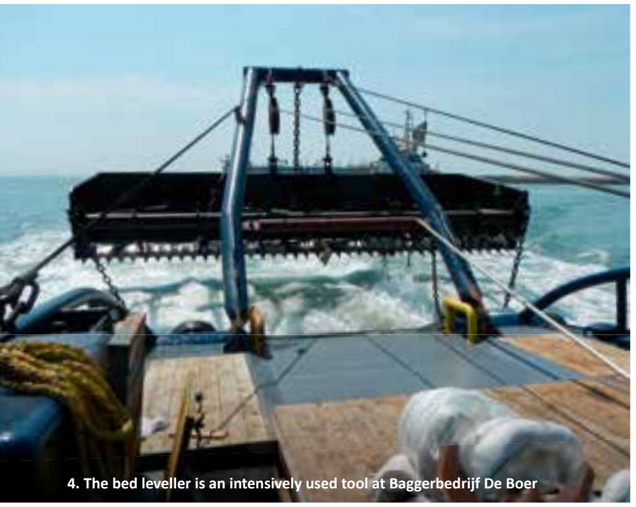
The ALBATROS is a twin-screw TSHD with a single suction pipe on starboard and water jets on the suction head and in the hopper. A swell-compensator allows operations in higher sea states. The jet pump also serves a degassing system. The IHC single-walled dredge pump is installed in a separate pump room in the fore ship (*figure 6*). An adjustable cylindrical overflow is positioned in the hopper. The hopper contents can be unloaded through a row of six single, box-shaped bottom doors, or through a self-emptying system that delivers the soil to a bow connection, to which a shore pipeline or a rainbow nozzle can be joined.

The crucial design criterion was the owner’s requirement that it had to match shallow draught lines and have a very low



2. ..and a view from her interior during a rainy trip

3. IHC Merwede-built TSHD AMAZONE, "one of the best vessels in the whole world", according to her owner



4. The bed leveller is an intensively used tool at Baggerbedrijf De Boer

5. Proof of operator craftsmanship: a very dense load of silt is brought up by the AMAZONE

profile above the waterline, called 'air draught', otherwise known from coasters. This enables the dredger to pass bridges and access rivers farther inland. Baggerbedrijf De Boer discovered that many inland ports cannot be dredged easily – or have to rely on excavators on pontoons – because of shallow depths and obstacles such as bridges. The ALBATROS was designed to eliminate these handicaps, to be an instrument for the disclosure of markets, and to reach ports which had literally been inaccessible for TSHDs until then.

These shallow draught and air draught criteria led to a design including, for example, a recessable wheelhouse and exhaust ducts, and a tiltable deck crane, main and foremast. The suction pipe gantries are of an adopted low design (*figure 7*) and the bottom door cylinders had to be installed at an angle (*figures 2 and 8*). Even the bow-coupling gantry can be lowered, whereas the rainbow nozzle has no separate foundation, but must be inserted in the bow coupling.

It is clearly evident: the ALBATROS really demonstrates a low profile (*figure 8*). The shallow draught was achieved by meticulously calculating the vessel's breadth and the full bow. The limited air draught can also be maintained during the empty sailing part of the dredging cycle, by filling the hopper and an unusual number of ballast tanks with water.

The other criterion principally influencing the design was Van de Graaf's 'keep-it-simple' approach, which is well known in The Netherlands. This is behind the aim to achieve maximum productivity from equipment by:

- fulfilling the specified functionality with as few on-board components as possible in order to principally reduce investments and maintenance
- installing components and systems that are maximally understandable – and consequently maintainable – for the average operator and board engineer
- preventing, as much as possible, reduced subsystem efficiency caused by energy conversion, especially on smaller vessels
- operating the vessels with a small, well trained and competitive crew.

These requirements forced IHC Merwede engineers to recall some basic knowledge and once more learn how to design a low-profile vessel, with no extended integrated systems, diesel-electric solutions or frills, and a healthy focus on proven commercial off-the-shelf (COTS) technology. This resulted in a process of value engineering. The fruitful application of current technology led to the optimum solutions, achieved with components and constructions as straightforward as possible.

Consequently, the propellers, main generators, dredge pump, jet pump and bow thruster are all directly driven by their own diesel engine, for example. Other subsystems are installed as such, including their own control equipment as separate units, not incorporated in or controlled by a higher system.

However, the current technology for control and monitoring of the vessel on the bridge has already evolved too far to think of predecessors: there is simply no going back to good old control levers and indicators. The ALBATROS is touchscreen-operated like her larger sister vessels (*figure 9*). Nobody is concerned about that, however, especially not the younger generation of operators.

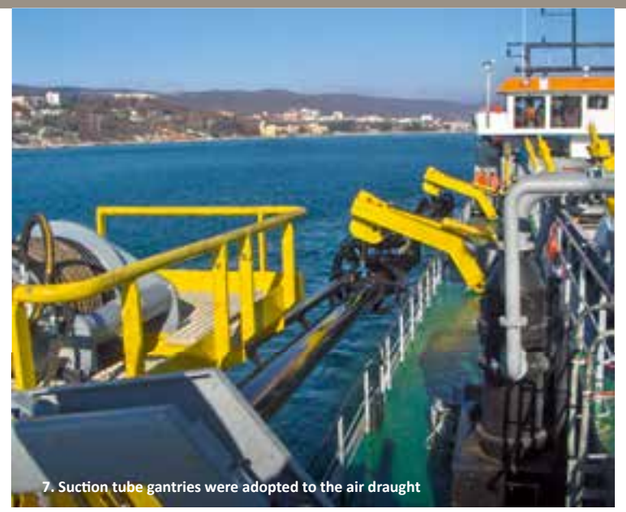
Due to the size of the vessel and the complete outfit, the interior of the vessel is very crowded (*figure 10*). However, what's important is that it works well for the dedicated operators and engineers of De Boer. Before this article was published, the ALBATROS had already earned respect for her productivity and efficiency, due to the experience of IHC Merwede and De Boer.

Construction process

An ISO 9001-certified East European shipyard was entrusted with the post-engineering, manufacturing and commissioning of the ALBATROS, under the supervision of IHC Global Production. Vital components, such as the suction pipe with gantries and the dredging control installation, were supplied by IHC Merwede. For other components, several new and existing suppliers were engaged.

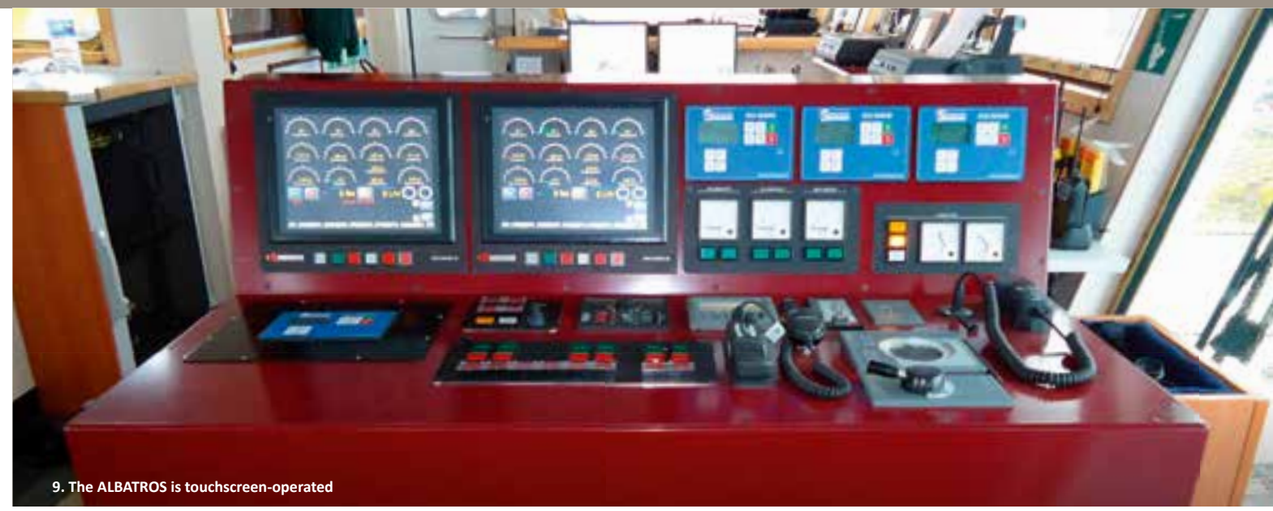
Innovative vessels

6. An overview of the pump room in the fore ship



7. Suction tube gantries were adopted to the air draught

8. The ALBATROS's striking shallow air draught demonstrated by the recessed wheelhouse's roof at the level of the railing



9. The ALBATROS is touchscreen-operated

10. Due to the size of the vessel and the complete outfit, the interior of the vessel is very crowded

Workers at the shipyard were coached intensively by a building team comprising IHC Global Production and two experienced officers from Baggerbedrijf De Boer. This team worked vigilantly and was intentionally committed to the solution of potential problems in collaboration with the shipyard workers. The teamwork was highly praised by everyone who was interviewed for this article. One achievement in particular, was that sound and vibration were kept amply below specified levels. The result is a beautiful dredger, delivered within time and budget, and to the full satisfaction of the owner.

Conclusion: low profile, high potential

Despite the ALBATROS's literally low profile, the vessel has high potential. Cees van de Graaf Sr. is expecting her to open up markets and dredging jobs, which were previously inconceivable using a TSHD. Therefore, he considers the investment worth every euro, and predicts that this market will grow and require more vessels of this type.

In other words, just as the jumbo dredgers proved to create and develop their own market, so will the shallow draught dredger. IHC Merwede feels honoured to have contributed to this initiative and wishes Baggerbedrijf De Boer, the ALBATROS and her crew the best of luck for the future.

IHC Merwede has also benefitted from working with Baggerbedrijf De Boer's team. A host of new insights was achieved on value engineering, straightforward solutions and building a well-made vessel abroad. The company believes that this vessel is a step forward in the market for smaller TSHDs.

IHC Merwede may have developed a reputation as the builder of large and intricate dredging and offshore vessels, but this project has proved that it is still a worthy contender in the market for building small, cost-effective, no-nonsense dredgers too. In conclusion, the ALBATROS promises to be a gem that fits into many jewels.

Principal characteristics	ALBATROS
Built	IHC Dredgers/IHC Global Production
Type	Trailing suction hopper dredger
Owner	Baggerbedrijf De Boer – Dutch Dredging
Classification	Bureau Veritas I ✠ Hull ✠ Mach, Hopper dredger, unrestricted navigation ✠ AUT-UMS/Green Passport
Length overall (hull)	75m
Beam	13.4m
Draught International Freeboard (Summer)	3.21m
Draught at Dredging Mark	3.48m
Air draught	8.25m above base
Hopper capacity	1,500m^3
Dredging depth	30m
Suction tube diameter	600mm
Total installed power	approx. 3,500kW
Speed, loaded	9.5 knots
Accommodation	8 people

References

[1] "Old LESSE gets younger sister AMAZONE". *Ports and Dredging 149*. IHC Holland, Sliedrecht, The Netherlands, 1977. 9-11.

IHC Hytech:
masters in hyperbaric technology

1. The interior of a self-propelled hyperbaric lifeboat (SPHL)

IHC Merwede designs and builds innovative vessels with fully integrated functionalities, which include dedicated mission equipment for solving challenges in the field of subsea and deep-sea constructions, connections and interventions. One of these challenges is the provision of reliable and safe diving support. For this purpose the company offers totally integrated custom-built vessels, such as the SEVEN ATLANTIC (*figure 2*) [1] and the pre-designed ready-to-build IHC Supporter® class [2] series, both provided with integrated saturation diving equipment. This is further complemented by the ability to provide air and mixed gas diving equipment for surface-orientated diving operations, either integrated in the vessel design or as standalone systems.

In line with the company's designation as 'the technology innovator', the building of these vessels and the integration of diving support equipment require that diving and subsea technology must be part of IHC Merwede's knowledge base and specialist portfolio. In addition to the extensive experience the company has gained through the integration of third-party systems, there was a distinct requirement to further develop the in-house knowledge of interfacing saturation dive systems within this specific market. This goal was achieved with the acquisition of the Dutch company, Hytech, based in Raamsdonksveer and established in 1989. The name is short for hyperbaric technology, i.e. technology to support human operations under hyperbaric conditions. In 2011 it became IHC Hytech.

This firm employs people with a wealth of experience in every area of commercial diving, not only from a manufacturer's perspective, but also from the perspective of personal professional diving and offshore operator experience. They know that "the most simple tasks above water will become very complicated under water and heavily depend on the supporting technology", in the words of Johan de Bie, the company's Managing Director.

With the acquisition of Hytech, IHC Merwede not only acquired qualified specialists to extensively support its shipbuilding experts in the integration of third-party-supplied diving equipment, but also a firm with an attractive product and services portfolio in a number of related markets. In some of these, IHC Hytech is a global leader, and in others, it is among the top three suppliers. The company's motto, "we keep you breathing" underlines the focus of IHC Hytech.

Commercial diving

Commercial diving refers to diving in support of the oil and gas industry, and is required for the installation, inspection, maintenance and repair of subsea mattresses, risers, pipelines, jackets and anodes, for example. Typical diving jobs include welding, cutting, drilling, grinding, cleaning, metrology measurements, monitoring, inspection and fastening.

The discipline is subject to huge constraints and risks, caused by many different factors, such as poor visibility and illumination, confined spaces, sea states, temperature differences, currents, underwater noise, decompression sickness and marine life, for example. Therefore, it is governed by an abundance of safety rules and regulations from governmental institutions, business associations and classification societies. Technical and operational guidelines are founded on the basis of the approved code of practices as developed for work in the UK and Norwegian sector of the North Sea and the Atlantic. They give strict directions on the design and usage of diving equipment offshore.

2. Diving support vessel (DSV) **SEVEN ATLANTIC** (Courtesy Subsea7)

4. Mobile diver attendant recompression transportable (DART) coupled to attachable transportable entrance lock (ATEL) is ideal for the attended transfer of a diver to a hyperbaric medical facility

3. Preparing a so-called wet bell with umbilical: various colours represent different supplies, such as support gases, hot water, communication, video and electrical supply

5. The detailed technology of decompression chambers, which are always supported by personnel at the external control stand to take care of the divers

6. A Launch And Recovery System (LARS) transports the divers to and from the operational depth in a controlled manner, and provides all lowering and hoisting, entry and exit, and guidance of umbilicals

7. Hyperbaric oxygen treatment chamber with control and monitoring system

8. The interior of a hyperbaric oxygen treatment chamber and a view of its interior seating arrangement

Unlike recreational snorkelers and scuba divers, or those who carry out military or scientific diving with rebreathers, commercial divers are always supported by a breathing gas supply via a so-called umbilical. This consists of one or several bundled hoses and cables (*figure 3*), supplying breathing gas (air, nitrox or trimix), hot water, communications, electric power, video and measurement signals.

Up to depths of 50 metres, surface-supplied divers normally breathe compressed, cleaned and filtered air with the normal nitrogen/oxygen content. For particular diving operations, this is sometimes substituted with an enriched oxygen-content breathing gas called nitrox. When the diving operation is even deeper, up to 70 metres, the breathing mix is diluted with helium and this triple gas mix is called trimix.

Surface-supplied diving, however, has one essential key feature. After each individual dive, the diver has to resurface and gradually decompress to atmospheric pressure, by the controlled release of the gasses absorbed by blood and tissues. This prevents the gaseous bubbles from unwanted release, causing harm to the body tissue. Decompression usually takes place inside a so-called 'deck decompression chamber', safely on board the vessel. This is contrary to recreational divers, who undergo their decompression in the water.

At depth ranges from 25 metres down to 300 metres, the method of saturation diving can be applied. The divers then continuously live in pressurised habitats on board the vessel and are transported in pressurised diving bells from the habitat to the subsea work site and back. The diving bells also serve as the connection points for the individual diver umbilical that is connected to the diving helmet. The divers breathe a specific mixture of helium and oxygen called heliox. During saturation dive operations the diver's body is fully saturated with the inhaled gas composition, hence the term 'saturation diving'.

The divers live, work and relax under the required working pressure and are allowed to endure this for 28 days, including the essential period of decompression. Saturation diving greatly extends the duration of diving works – shifts of eight hours per bell run are considered normal. However, the equipment costs for saturation diving are considerably higher than for surface-supplied diving. Below 300 metres, atmospheric diving suits or remote operated vehicles (ROVs) are commonly used.

IHC Hytech's markets and products

To meet the extremely high-quality and safety requirements for commercial diving, IHC Hytech designs, builds, tests and services all components and systems under full certification and classification of the relevant legislative bodies and authorities. Design, production and testing of certified and dedicated monitoring and control equipment are also completed in-house.

The company supplies hyperbaric technology for the diverse range of markets listed below. However different they may seem, they are interconnected by the need for and application of the core competences and technology of IHC Hytech: decompression, breathing and hyperbaric safety.

1. *Diving industry:* for inshore, offshore, governmental and military projects, IHC Hytech supplies the full scope of products, ranging from personal diver gear up to complete systems. Examples include decompression chambers (*figures 4-5*), launch and recovery systems (LARS) for controlled diver transportation (*figure 6*) via diver cages, wet bells, gas monitoring, gas management panels and complete chamber control systems (*figure 14*).

2. *Hyperbaric oxygen therapy:* this market involves the manufacturing of pressure chambers for hyperbaric medical treatment in hospitals and health clinics. IHC Hytech's HBO-T systems comply with all applicable medical regulations and can house up to 20 patients (*figures 7-8*).

3. *Life-support equipment:* IHC Hytech delivers equipment (*figure 9*) for inert entry in onshore, low-oxygen and/or hazardous spaces, such as confined space entry, chemical tanks and reactors, during maintenance or welding works, for example.

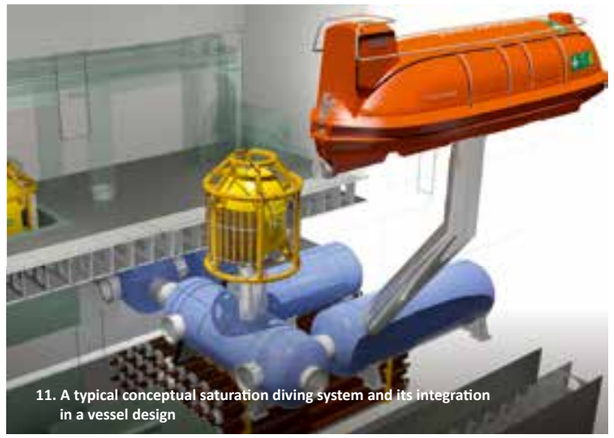
4. *Hyperbaric tunnelling equipment:* to enable entry to the pressurised area in front of tunnel-boring machines, IHC Hytech designs, builds and supplies a range of hyperbaric personnel transfer shuttles, decompression/living chambers and emergency escape chambers. This is completed with an array of intricate control panels, meticulously designed and built for a variety of tunnelling work by IHC Hytech (*figure 10*).

5. *Life-cycle support:* worldwide service support is provided by various teams for training, operation, maintenance, repair and upgrading of all equipment supplied by IHC Hytech.

6. *Integration of saturation diving systems:* combining experience in vessel integration and advanced equipment – such as self-propelled hyperbaric lifeboats (SPHL) – with

9. Life-support truck for up to four umbilical supplies

10. Hyperbaric tunnelling living chamber control panel



11. A typical conceptual saturation diving system and its integration in a vessel design

12. An SPHL is a hyperbaric evacuation chamber for divers, with bottom-entrance lock, installed inside a SOLAS- and DNV-approved self-propelled lifeboat

13. Control apparatus outside of the hyperbaric evacuation chamber, which enables the life-support crew to control the living environment of the divers

14. Medusa dive simulator control panel including fly-by-wire controls and remote monitoring of diving conditions (Courtesy Royal Dutch Navy)

knowledge of diving, IHC Hytech is able to offer integrated third-party diving system solutions, including DSV Class notation. Further details of saturation systems are explained below.

Saturation system integration

As set out in reference [1] the integration of a saturation diving system in a vessel requires the utmost craftsmanship, engineering, construction and management skills of shipbuilders. For example, extremely low tolerances must be maintained during fabrication and subsequently during operation of the vessel at all sea states.

Saturation diving systems are composed of: living and sleeping chambers; equipment and food locks; closed diving bells; diving bell handling systems; and self-supporting rescue systems. All pressure compartments must be kept under the constant pressure of the designated heliox mixture, provided by a large breathing gas treatment and monitoring plant inside the ship (*figure 11*). Transfer of divers from 'living' to 'diving' or 'rescue' spaces is only possible by controlled locks. IHC Hytech – as the in-house competence centre for offshore diving – plays a crucial role in the integration of such saturation systems in standard and custom-built IHC Merwede diving support vessels.

IHC Hytech has gained the knowledge for this challenge from its experience with self-propelled hyperbaric lifeboats. Together with its strategic partner, Oceanwide Safety at Sea in Rotterdam, IHC Hytech is the global market leader in this sector and its track record includes vessels such as the SEVEN OSPREY, SKANDI ACHIEVER, TOISA PEGASUS, HARKAND ATLANTIS, WELL ENHANCER, SEVEN HAVILA, BOSKALIS CONSTRUCTOR and many more.

Self-propelled hyperbaric lifeboat (SPHL)

It is mandatory for diving support vessels (DSV) to be equipped with adequate and dedicated safety equipment to allow for the evacuation of divers under pressure in life-threatening situations. For that purpose, two SPHLs are provided, one on either side of the DSV, which are permanently connected to the saturation diving system complex.

The principle of the SPHL is the installation of an independent autonomous saturation system chamber, i.e. a saturation diving evacuation chamber, in a standard self-propelled and SOLAS-approved GPR hull (*figure 12*) that is otherwise normally equipped with a propulsion system, cooling system, hot water plant, navigation control and monitoring equipment, food/water supply and medical aid kits. The evacuation chamber, suitable for up to 24 divers (*figure 1*) at working pressures specified up to 400 metres of seawater, is accessible through a lock in the bottom of the lifeboat. This lock normally connects the SPHL to the vessel's saturation diving chamber system and is kept under pressure.

In compliance with IMO regulations and on the basis of the presumption that some means of rescue will arrive within that time span, the SPHL is capable to offer autonomy for the evacuated divers for 72 hours. The heliox and oxygen supplies needed for that period are stored in gas cylinders in the boat.

The CO_2 produced by the divers' metabolic oxygen consumption is filtered by CO_2 removal scrubbers, containing exchangeable canisters with soda lime granulate. Once saturated the canisters are exchanged with fresh unused ones through a so-called 'medical lock', which also serves for the exchange of other supplies. A hyperbaric toilet completes the outfit.

Divers in an SPHL must be assisted by 'unpressurised' crew: a helmsman; diver life-support supervisor specialists on mixed gas breathing and decompression; and dive technicians who can operate the medical lock for the passage of goods.

The outside of the evacuation chamber, accessible through the lifeboat's passageway, is crammed with control and monitoring equipment (*figure 13*) by which the crew can tend the divers and operate the chamber. To guarantee simplicity, safety and reliability, it consists of redundant valves, pressure regulators, manometers, couplings and the like – highly appealing to those who grew up before the computer games' era. As testimony for the quality of IHC Hytech, any and every component as shown in this picture is documented, certified, approved and traceable during its whole lifetime.

Conclusion

Leading mission equipment specialist IHC Hytech makes a significant contribution to the technological reputation of IHC Merwede in the offshore oil and gas market. Due to its core competences and technology, namely decompression, breathing and hyperbaric safety, the company plays a crucial role in building innovative and integrated diving support vessels, and is renowned as IHC Merwede's in-house competence centre for offshore diving mission equipment.

References

[1] "Seven Atlantic commissioned". *Ports and Dredging 175*. IHC Merwede, Sliedrecht, The Netherlands, 2010. 20-25

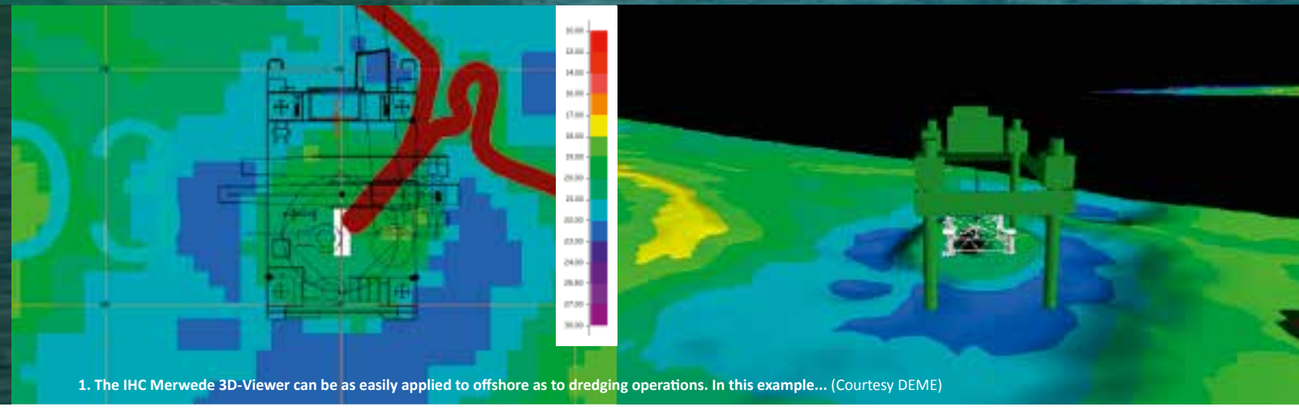
[2] "IHC Packhorse® and IHC Supporter® class". *IHC Merwede Insight 3*. IHC Merwede, Sliedrecht, The Netherlands, 2013. 32-37

2. ..on the IHC Merwede-built NEPTUNE... (Courtesy DEME)

3D-Viewer: innovative tool for improved subsea operations

One of the major challenges for efficient and accurate dredging and offshore operations on the sea floor, and in channels and harbours, is to position 'tools' and/or 'structures' within specified tolerances at the correct geographical location and depth. 'Tools' in this case refers to dragheads, cutterheads and backhoes, and 'structures' are pipelines, pipeline covers, jackets, templates (*figures 1-3*), underwater cables and manifolds, for example.

Deviations from specification can cause high additional costs in the cases of under/over dredging and relocation of a template. They can even turn out rather disastrous if a heavy structure is placed at the wrong spot and consequently collapses – or if a pipeline is not correctly covered by a layer of stones.



1. The IHC Merwede 3D-Viewer can be as easily applied to offshore as to dredging operations. In this example... (Courtesy DEME)

To prevent this, digital sea bottom information – survey data – is collected by in-surveys, utilising for example, echo sounders, multibeams, side-scan sonars, soil samples and possibly borehole information, related to DGPS geographical data. The best DGPSes can reach X-Y-Z (northing-easting-height) accuracies within a few centimetres.

When survey data is digitally combined with the project maps and plans, a ready-to-start site/work map appears, in which the intended works are related to the locational information. These digital designs are usually presented using commercial and internationally available computerised hydrographical presentation system software packages. The principal element of such presentations is the so-called 'Digital Terrain Model' (DTM), a matrix model with a pre-configurable resolution of e.g. 1m, in which each cubicle represents interrelated work, bottom and geographical information.

Such systems present bottom charts related to all usual chart data and grid conventions. They are also able to present vertical sections of working areas, profile slopes and much more. Due to their specialist nature, the systems are usually operated by experts, called 'surveyors'. With their assistance, DTM presentation systems provide the operators of dredgers and offshore working vessels with the appropriate information to position 'tools' correctly.

IHC Systems' DTPS

During the last two decades, IHC Systems has developed and operated a 'survey system' software package with special features, named Dredge Track Presentation System (DTPS). It can run on any PC of sufficient specifications, either stand-alone, or integrated within IHC Merwede's Digisys vessel automation platform, both on survey vessels and working vessels.

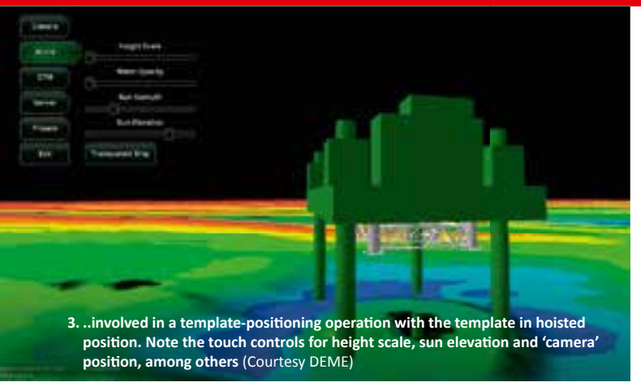
The package has been designed with the operator in mind, and can be largely used without the need for surveyor assistance. Although it has been built on a strong hydrographical foundation, it is not based on a complex survey package, and requires almost no online adjustments or configurations. Its geographic data presentations and reports are particularly designed to serve the operator.

Consequently, the operator is provided with an adequate picture of the vessel and 'tool' in an automatically updated DTM, related to in-surveys, various chart datum and projection methods, and current status. DTPS has the capability to exchange data with usual modern survey packages (*figure 4*).

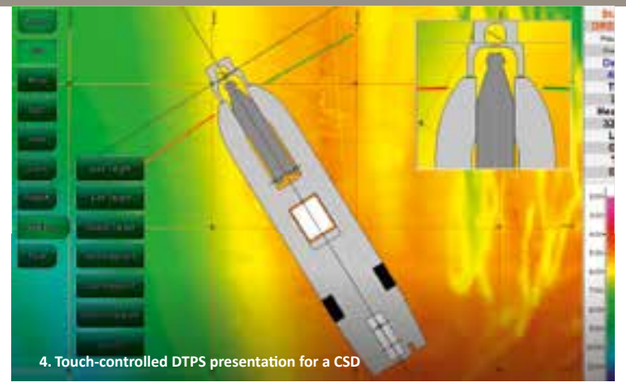
Just as with any other survey package, the site's DTM 'as is' is usually loaded into DTPS online or offline. However, beyond other survey systems, DTPS continuously updates the DTM using the results of the subsea activities in real time, eliminating the need for intermediate surveys – DTPS directly testifies to the performance of the job.

The DTPS package was adopted by DEME as its hydrographical programme on dredging and offshore vessels. DEME also made considerable efforts in the joint design of the system.

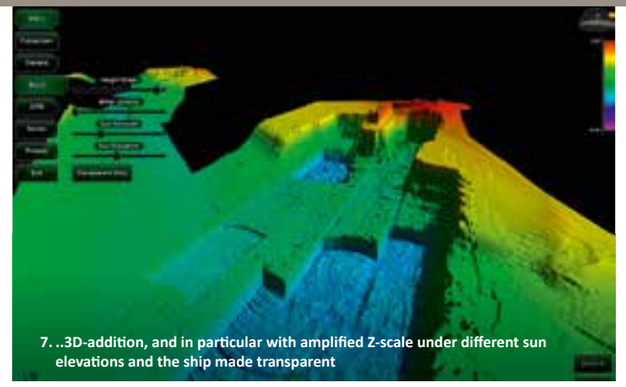
Advanced equipment



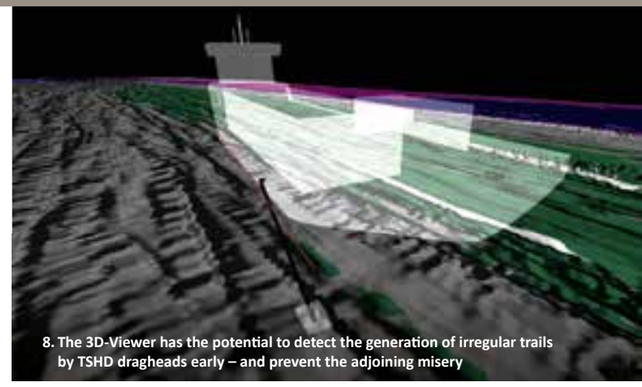
3. ..involved in a template-positioning operation with the template in hoisted position. Note the touch controls for height scale, sun elevation and 'camera' position, among others (Courtesy DEME)



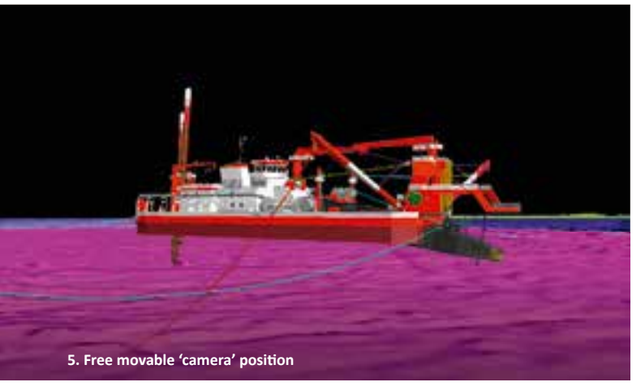
4. Touch-controlled DTPS presentation for a CSD



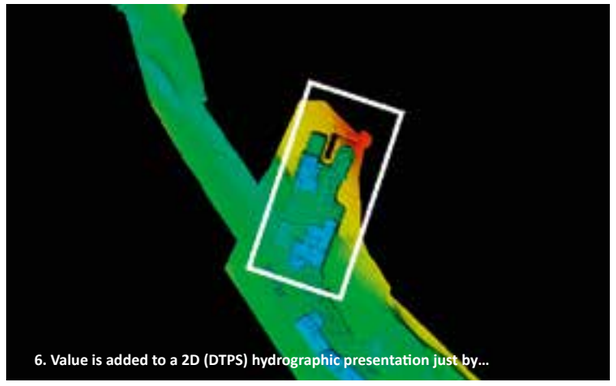
7. ..3D-addition, and in particular with amplified Z-scale under different sun elevations and the ship made transparent



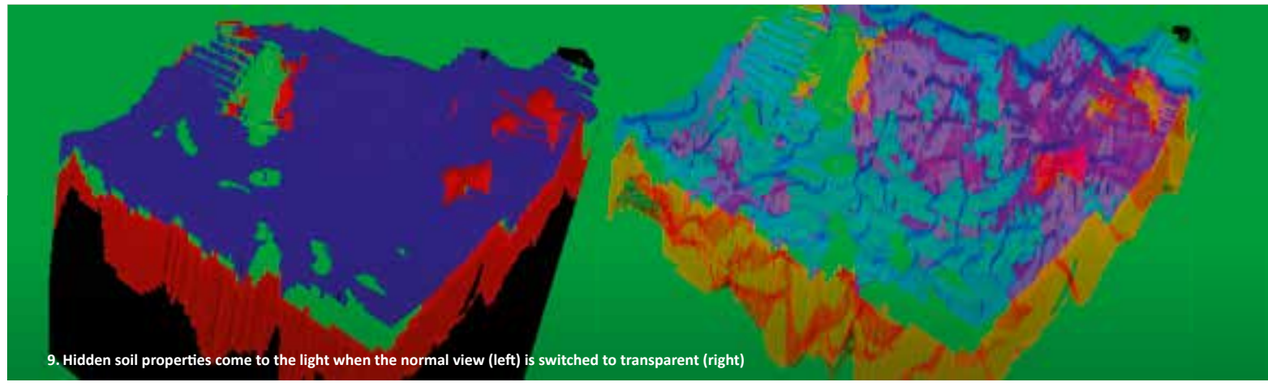
8. The 3D-Viewer has the potential to detect the generation of irregular trails by TSHD dragheads early – and prevent the adjoining misery



5. Free movable 'camera' position



6. Value is added to a 2D (DTPS) hydrographic presentation just by...



9. Hidden soil properties come to the light when the normal view (left) is switched to transparent (right)

From 2D to 3D with DEME

After some years of experience, DEME realised that 2D presentation was not sufficient to fully present the wealth of information conveyed into DTPS – and other survey packages. As the head of DEME's survey department, Lorentz Lievens explained, the company's management felt the need for a 3D presentation of sea-floor models in order to have a better insight into the consequences and end results of proposed work and plan alternatives. The management wished also to look *into* the sea bottom instead of simply looking *at* it. DTPS has of course provisions to do so in the 2D models by different colours, representing depths and layers. However, rebuilding this data in the mind into a complete vision, requires much imagination.

In addition, DEME soon realised that the next generation of operators trickling into the firm are the people who have grown up with computer games, smartphones and tablet computers. These people have a fantastic 3D-interpretation capability, and subsequently develop great process awareness and self-confidence if they are guided using 3D presentations of the work to be carried out. This of course, improves the efficiency and accuracy of the operations. Moreover, 3D sea-bottom information gives operators a greater awareness of 'unexpected' actions of, for example, automatic cutter controllers (ACC) in reaction to soil properties, in particular if this information presents hidden soil and rock deposits.

Both motives were sufficient for DEME to participate in intensive cooperation with IHC Systems to enrich DTPS with another dimension. After a period of close mutual collaboration, a magnificent product came into existence: the IHC Systems 3D-Viewer. Extremely easy to operate, there is a version for keyboard/mouse control as well as a touchscreen version, which can be operated in a similar way to famous 3D applications such as Google Earth. The touchscreen version is expected to become the prevailing type of the future.

Main features of the 3D-Viewer

In addition to DTPS features, the 3D-Viewer has an adjustable 'camera' position (*figure 5*), which can be freely manipulated during operation. For example, it can be kept stationary on a geographical position, or connected to a point above the vessel, or to a 'tool' such as the draghead or cutterhead. In the latter case, another property derived from IHC Systems' training simulators – the possibility to virtually drain the surrounding water – generates a 3D view of the dredged track 'as built'.

The challenge to 3D presentations in dredging and offshore operations is the poor resolution capability of the Z-scale (height scale) as it is coupled to the X-Y scales, which can encompass several hundreds of metres. On that scale, a depth deviation of, say, 20cm, cannot be distinguished by the human eye, but it can be fatal for a project.

For that purpose, the 3D-Viewer has an adjustable Z-scale amplifier that greatly enhances the Z-resolution. Using this feature, underwater properties that could not previously be seen can now be observed. In addition, the 'sun' elevation can also be altered, generating shades that in another way feature the observation of surface irregularities (*figures 6-7*). This feature has the potential to be extremely useful in detecting the generation of irregular trails by TSHD dragheads (*figure 8*) at an early stage – and prevent the following necessity of cleaning up hills and valleys (Dutch-Flemish: *bulten jagen*).

It is also possible to introduce transparency, allowing the operator to take full advantage of the results of soil samples, multibeam sounder maps and borehole information, i.e. to look *through* surface bottom layers and to see hidden lumps of rock, soft or hard soils, or whatever may influence works and equipment load (*figure 9*).

Other features are more common in PC wonderland, such as the configurability of the grid mesh dimensions, the freely configurable colours and the multiple operator preferences that can be stored and summoned at will. It is advisable to study the illustrations with this article, especially in the digital edition of this issue available on the IHC Merwede website – they reveal more than words can express.

Armed with a basic knowledge about DTPS, it was amazing when interviewing Mr Lievens to find out that the 3D-Viewer is used on top of DTPS in offshore applications as easily and with as much benefit as in dredging operations, as the *figures 1-3* prove. These concern a template-positioning operation by DEME's IHC Merwede-built self-propelled, self-elevating heavy-lift jack-up vessel NEPTUNE (*figure 2*) [1].

Figure 1 in particular highlights the added value of the 3D-Viewer. Study the left 'DTPS' half of the figure and try to imagine the terrain contours and depths below the waterline. Then turn to the right half, as well as to *figure 3*, and discover whether you could picture it accurately in your mind, or whether you were greatly helped by the 3D-Viewer!

A new perspective

The 3D-Viewer is a principal tool serving dredging and offshore operators in the execution of efficient, accurate and safe missions. In this way, it is an instrument that *can* help reduce spillage, fuel consumption, emissions and risks of disaster on the sea floor. Everyone agrees such issues *must* be reduced and this is the societal contribution of the package.

DEME is the launching customer to benefit from the 3D-Viewer, and also profits from the knowledge and experience gained during its cooperation with IHC Systems. However, the package is also available to other companies using DTPS. The first example is the 23,545kW cutter suction dredger currently under construction for Huta Marine Works, which will have a dedicated version of the 3D-Viewer. A whole new perspective is now open to customers of IHC Merwede, using DTPS!

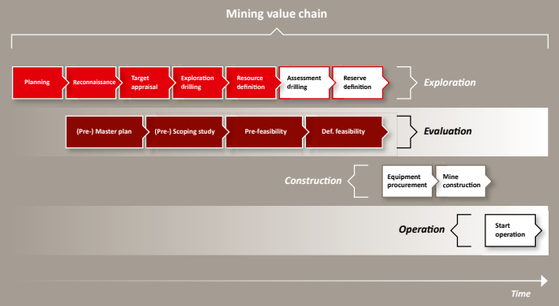
References

[1] "NEPTUNE: turbine transport and installation self-elevating heavy-lift jack-up vessel". *IHC Merwede Insight 1*. IHC Merwede, Sliedrecht, The Netherlands, 2012. 12-19.

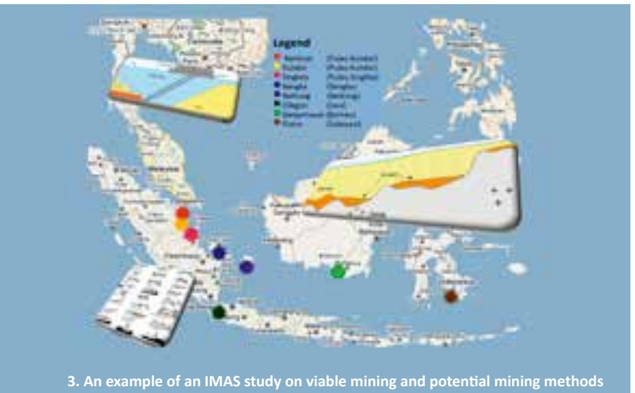
IHC Life-cycle support: concept appreciated by customers

Since IHC Merwede adopted the concept of life-cycle support (LCS) in 2007, it has developed a large number of useful services and products that are highly appreciated by its customers. IHC Life-cycle support is not only a collection of existing and new products and services, but also the expression of the company's ongoing commitment to its customers and markets. It is a powerful concept to support vessel and equipment owners in their daily operations, and help them continue working without problems.

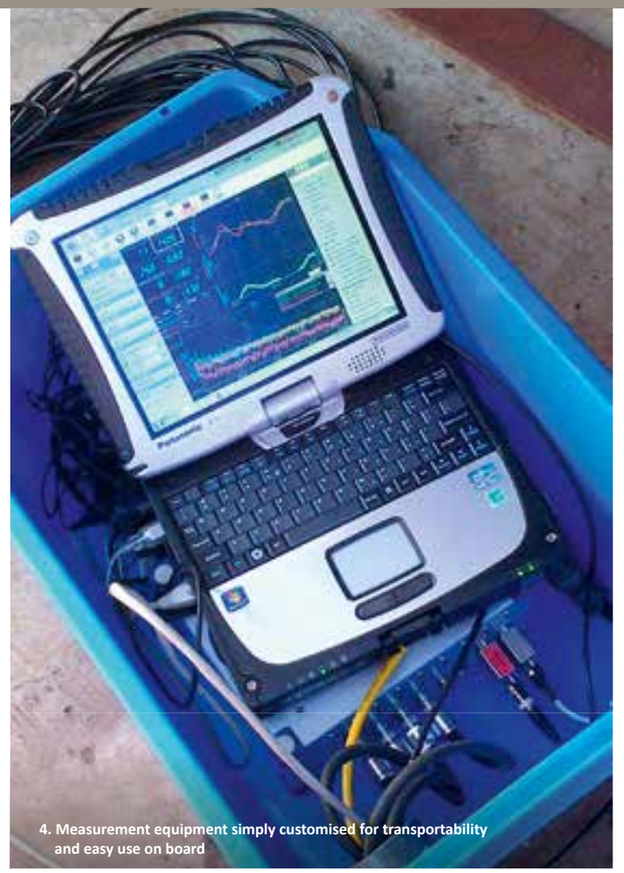
Life-cycle support



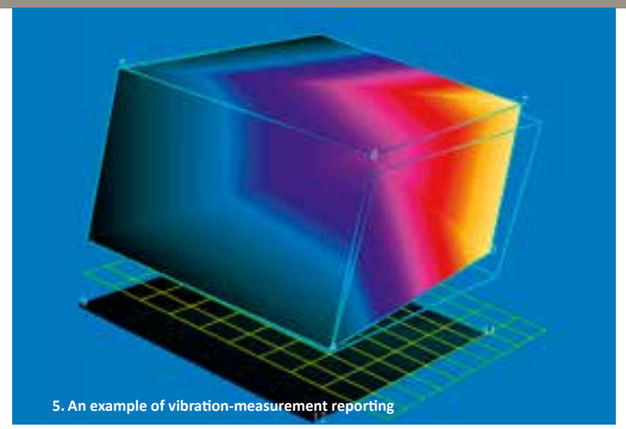
2. The greatest risks of a mining operation have to be established and solved in the 'design' stage



3. An example of an IMAS study on viable mining and potential mining methods and tools



4. Measurement equipment simply customised for transportability and easy use on board



5. An example of vibration-measurement reporting

7. The QUIBIÁN I is one of the first vessels to have a dedicated Superintendent Technical Services

6. Customised and temporarily installed propeller shaft load measurement

IHC Life-cycle support is served by the complete dedication of many IHC Merwede employees. Over the past seven years, they have expanded their knowledge and experience of LCS, its content and processes. In other words, much has been learnt from putting LCS into practice. Everybody involved strives for perfection in the development of these services to customers. This ongoing commitment is demonstrated by the new logo (*figure 1, see previous page*) and the revised description in the next section, followed by five recent examples – one from each stage of the cycle, which IHC Merwede has identified as the concept has evolved.

IHC Life-cycle support summary

IHC Merwede customers rely on the unrivalled level of commitment that is offered to them through dedicated and comprehensive life-cycle support services. These help to maximise the equipment's availability and the return on investment, and therefore reduces the total cost of ownership. The cycle can be entered at any of its five integrated stages.

The technology innovator's highly qualified experts **design** and **build** innovative vessels and advanced equipment based on their vast worldwide experience of the dredging, mining and offshore industries.

The company offers a complete spectrum of high-quality and up-to-date services to ensure that crews **operate** in a highly skilled and efficient manner to achieve optimum levels of productivity. IHC Life-cycle support also allows operators to **maintain** the durability and reliability of their systems through a range of specialist services.

Furthermore, an **upgrade** by means of renovation, modification or update of the existing systems, components and/or software can extend the working life of the vessel and equipment. With the expertise to research, engineer and install to the highest possible standard, the IHC Merwede team will also utilise complex processes, knowledge and experience to maintain the correct and safe operation of all its products on board.

DESIGN:

IHC Mining Advisory Services (IMAS)

The life cycle of a mining project from planning to rehabilitation of the mining area usually extends over lengthy periods of time, sometimes even decades. The 'design' stage of this period, involving exploration and evaluation, is very important and runs for several years. During this time, risks must be assessed and the investigation of geological resources should lead to the proof of economically and technically viable mineral reserves. Only after this stage is completed, responsible investments for the procurement and construction of mining equipment – of which the features again influence about 20 years of exploration – can be initiated.

This lengthy design stage requires the mutual influence and combination of typical geological, exploration and equipment knowledge, especially when wet mining is involved, as this is rather unknown in mining circles. For that reason, IHC Merwede has established IMAS, a comprehensive service accommodated by scientific institute MTI Holland.

IMAS accumulates, manages and combines the above-mentioned integrated knowledge with the know-how of dedicated external specialists in the field, with which alliances have been established. It enters the mining value chain very early, without having the prospect of equipment delivery, but instead contributing to studies, as displayed in *figure 2*. In this way, IHC Merwede can contribute to the future success of mining operations, and the determination of the optimal equipment – which it can hopefully produce.

Proof of the usefulness of this service is the study delivered to mining company PT Timah in Indonesia. This report informed the company about viable cassiterite (tin ore) mining at larger depths than usual, as well as potential mining methods and tools for the purpose (*figure 3*).

This design stage had started years earlier with an initial investigation. As equipment selection can be a consequence of such design studies, PT Timah opted for the IHC Merwede-supported modification of the bucket ladder dredger KUNDUR I into a wheel dredger, suitable for the anticipated depths.

BUILD:

MTI Measuring & Diagnostics

MTI Measuring & Diagnostics (MTI M&D) has long-standing expertise in pump performance, noise, vibration, FEM validation, shaft power, suction pipe force and customised measurements. These can be performed both in dredging and offshore environments.

MTI M&D is known for its state-of-the-art measuring equipment (*figure 4*) and techniques, broad range of experts, confidential and prompt reporting (*figure 5*) and its 24/7 worldwide availability. It is not bound to existing measurement equipment, but can also produce dedicated sensors (*figure 6*). Moreover, it is backed by the whole MTI Holland organisation and the knowledge located there. A testimony to the department's competence is the fact that it is acknowledged in the dredging market as an independent provider of pump performance certificates.

Life-cycle support


8. Customer and builder working closely together


9. The BEACHWAY in the dry dock


11. Rewarding: the BEACHWAY ready for a new life in salt waters (Courtesy Boskalis)


12. Trailing suction hopper dredger ANDROMEDA V...


10. Sand-carrying components were also repaired


13. ..and her 'new heart'

In this capacity, MTI M&D is often invited during basin and sea trials of vessels on the point of delivery to the owner, for evaluation and verification of specific features to the contractual specifications. In the cases of the 12,000m^3 vessel CHANG JIANG KOU 01, built in The Netherlands, and her twin CHANG JIANG KOU 02, built in China, the efficiency of the dredge pumps was measured and testified. In addition, sound, vibration and propeller shaft power measurements were carried out in order to compare them to the contractual and legal standards. The results were properly reported and provided to both the builder and the Chinese customer.

OPERATE:
Superintendent Technical Services

After a vessel is handed over to the customer, its real working life starts, which is when teething problems and warranty issues can be encountered. Coping with these issues requires adequate support from the builder. IHC Merwede has always committed itself to full support during the warranty period and beyond. To emphasise this and to ensure ongoing adequate support, IHC Merwede appoints a Superintendent Technical Services (STS) to work alongside the Account Manager. The STS remains the technical point of contact during the vessel's lifetime.

The STS is accessible via the vessel's project e-mail inbox, which is established at the start of construction. There is no communication discontinuity, neither at handover, nor after the guarantee period. Having grown accustomed to the ship during the building stage, the STS can often advise customers himself, or adequately provide follow-up with the help of specialists. The service history of the vessel is registered, so everything can be tracked during her lifetime. And above all, questions are answered quickly.

ACP's cutter suction dredger QUIBIÁN I (*figures 7-8*) was one of the first to benefit from this approach: 16 service events have been processed up until now, most of them solved within days, inclusive of the coordination of six parties involved, and ACP received advice on adequate spare parts. ACP has expressed its satisfaction with this service.

MAINTENANCE:
repair of TSHD BEACHWAY

IHC Parts & Services (IHC P&S) recently provided dry-dock assistance to the Boskalis-owned TSHD BEACHWAY (*figure 9*) in Buenos Aires, Argentina. The role of IHC P&S during the docking was repair supervision of the sand-carrying components, such as bottom doors, dragheads (*figure 10*), sliding pieces, trunnion gantries etc.

The 3,400m^3 BEACHWAY was built in Germany in 1971. She features sliding bottom doors by which she can dump in very shallow waters, which is ideal for beach replenishment. The BEACHWAY has maintained waterways at the Rio de la Plata in Argentina for many years, dredging mainly silt in fresh water, so corrosion was no big issue. However, she is currently facing a three-year capital dredging project in salt water. To prepare for this challenge, an overhaul of the engines, propellers and rudders was performed. The other major repair concerned the dredging equipment, mentioned above.

Prior to the repair, IHC P&S and Boskalis extensively discussed the basic idea and direction of the repair, enabling both parties to share a vision on its execution. IHC P&S performed the repairs within time and budget, and with good results. This required a lot of creativity and flexibility from all parties, but made the job challenging and rewarding (*figure 11*).

UPGRADE:
heart surgery for TSHD ANDROMEDA V

By 2012 the 20,000m^3 TSHD ANDROMEDA V, built in 1999 by IHC Merwede as QUEEN OF PENTA OCEAN (*figure 12*), faced potential risks for her electrical 'heart', the 6kV, 60Hz main switchboard. Therefore, IHC Singapore Pte Ltd RIO was ordered to carry out an operation and it entrusted the work to IHC Drives & Automation. It did the engineering, cable engineering, programming, project management, testing and commissioning on board. The manufacturing was outsourced to a leading Italian supplier.

The vessel's 'heart bypass surgery' included the delivery of a new, double-bush bar main switchboard (*figure 13*) that manages and distributes the 6kV, 22,350kW of the generators to the dredge pumps, bow thrusters, jet pumps and inboard power grid transformers. It involved the complete engineering, building, programming, replacement, cable re-routing, testing and commissioning. Despite the tight time-frame and the restricted space for manoeuvring on board, the switchboard was commissioned in time, enabling the dredger to continue for several years and produce millions of tonnes of sand.

Perspective

The achievements of IHC Life-cycle support, as proven by the case studies above, highlight its beneficial features and help the company to differentiate itself from the competition. IHC Merwede believes the LCS concept will enable its customers to continue their activities with the optimum results possible, year after year.

On order

Yard number	Name	Specifications	Country
TRAILING SUCTION HOPPER DREDGER			
1275		21,000m³	China
STANDARD CUTTER SUCTION DREDGER			
02806	IHC Beaver® 1200		India
SELF-PROPELLED CUTTER SUCTION DREDGERS			
02800	AL BAHAR	23,545kW	Saudi Arabia
1276		23,684kW	The Netherlands [2]
GRAB HOPPER DREDGER			
11010	ITALENI	750m³	South Africa
PIPELAYING VESSELS			
728	SAPURA DIAMANTE	550t	Malaysia [1]
729	SAPURA TOPÁZIO	550t	Malaysia [4]
730	SAPURA ONYX	550t	Malaysia
731	Pipelaying vessel	550t	UK
732	Pipelaying vessel	550t	Malaysia
733	Pipelaying vessel	550t	UK
734	Pipelaying vessel	550t	Malaysia
735	Pipelaying vessel	550t	UK
-	Pipelaying vessel	300t	Malaysia
WORK BOAT			
11052	DMC 1400		Saudi Arabia

1


2


3

Recently delivered

Yard number	Name	Specifications	Country
TRAILING SUCTION HOPPER DREDGERS			
1266	DCI DREDGE XXI	5,500m³	India [3]
1272	ALBATROS	1,500m³	The Netherlands
STANDARD CUTTER SUCTION DREDGERS			
02479	IHC Beaver® 65DDSP		Russia
02715	IHC Beaver® 5020		Mexico
02745	IHC Beaver® 300		Cameroon
02754	IHC Beaver® 40		India
02755	IHC Beaver® 40		U.A.E.
02769	IHC Beaver® 65DDSP		Saudi Arabia
02788	IHC Beaver® 1200		Indonesia
02792	IHC Beaver® 50		Gabon
02793	IHC Beaver® 50		Asia
02805	Booster Station	638 kW	Indonesia
02809	IHC Beaver® 300 SE		Ecuador
02810	IHC Beaver® 300 SE		Ecuador
PIPELAYING VESSEL			
727	SEVEN WAVES	550t	UK
WORK BOATS			
11051	DMC 850		Indonesia
11050	DMC 1050		Asia
11036	DMC 1400		Saudi Arabia


4

Main features

- ✓ AMBIORIX: self-propelled mega CSD
- ✓ ALBATROS: low-profile, high-potential TSHD
- ✓ IHC Hytech: masters in hyperbaric technology
- ✓ 3D-Viewer: innovative tool for subsea operations
- ✓ IHC Life-cycle support: ongoing commitment to customers

IHC Merwede is focussed on the continuous development of design and construction activities for the specialist maritime sector. It is the global market leader for efficient dredging and mining vessels and equipment – with vast experience accumulated over decades – and a reliable supplier of innovative ships and supplies for offshore construction.

IHC Merwede has in-house expertise for engineering and manufacturing integrated standard and custom-built vessels, advanced equipment and also providing life-cycle support. This integrated systematic approach has helped to develop optimum product performance and long-term business partnerships. The company's broad customer base includes dredging operators, oil and gas corporations, offshore contractors and government authorities.

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