Head Office – The Netherlands
Sliedrecht

Shipyards – The Netherlands
Hardinxwold-Giessendam
Heusden
Kinderdijk
Krimpen aan den IJssel
Sliedrecht

Shipyards – P.R. of China
Dalian

Shipyards – Serbia
Belgrade

Sites – The Netherlands
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Raamsdonksveer
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Regional IHC Organisations
Dubai – United Arab Emirates
Kinderdijk – The Netherlands
Lagos – Nigeria
Mumbai – India
Singapore – Republic of Singapore
Tianjin – P.R. of China

IHC Systems B.V.
Industrieweg 30, 3361 HJ Sliedrecht
P.O. Box 41, 3360 AA Sliedrecht
The Netherlands

T +31 18 443 19 22
F +31 18 443 15 05
sales.sy@ihcmerwede.com

The technology innovator.
IHC Systems
Dedicated to Efficient Dredging

Draught and Loading Monitor
(IHC DLM®)

an IHC Merwede company

The technology innovator.
‘Efficient Dredging’ helps contractors to make the most of their dredging equipment: to generate high economic and ecological benefits, achieve optimal utilisation rates, reduce dredging time, make the dredging process smoother, simplify fault diagnosis, reduce downtime and wear, prevent under- and over-dredging, and maximise crew satisfaction.

Even after a shipbuilder has built reliable and efficient equipment, and even after contractors have optimised equipment utilisation, the Efficient Dredging concept continues to make a significant contribution, providing dredgers with extra ‘senses’ and ‘hands & feet’.

Relatively modest investments in instrumentation, automation, surveying and simulation techniques produce major improvements in efficiency and accuracy. Automation under dredge master supervision can enhance production by up to 30%.

IHC Systems draws on all kinds of conventional and innovative control, automation, communication and presentation technologies. We also make the most of the knowledge and resources of the entire IHC Merwede group.

The concept is honed in close alliances with contractors and worked out in specific products, systems and services for every category of dredger and in every field. The products can cope with all dredging and mining conditions.

Our knowledge, expertise and experience are dedicated to reducing over-dredging, spillage, energy consumption, emissions, turbidity, ecological side-effects and operational costs. They represent our contribution to a sustainable future for all our stakeholders.

...our contribution to a sustainable future
Efficient Dredging involves transporting the maximum amount of soil from the sea floor to the intended dumping or reclamation location, while minimising energy consumption and emissions, and preventing lost time and soil wastage. Every other transportation mode involves major energy wastage and costs, and may have a considerable negative impact on the operational and environmental aspects of the dredging job.

These requirements have implications for the operations of trailing suction hopper dredgers (TSHDs):
- efficient excavating and pumping the soil into the hopper
- prevention of overflow losses
- finding the maximum hopper loading and unloading times in relation to the cycle time
- efficient unloading of the soil by dumping or discharge pumping.

The first and the last of these parameters are dealt with effectively by IHC Systems pressure and vacuum sensors, density and velocity measurements PRM®, and the suction tube position monitor STPM®. These features are presented in other brochures that are available from our website.

In terms of instrumentation and automation, the combination of all the parameters means operators must also know the weight of the vessel, i.e. the hopper load and payload over time. They can also turn to an ‘advisory indicator’ to decide whether to stop or to continue loading, particularly in the final part of the loading cycle, when overflow losses usually increase. And it would also seem desirable to have a few automation routines that can help operators to achieve these goals so their performance is not impaired by fatigue, lowered attention levels, or other dredging process parameters.

IHC Systems’ Draught and Loading Monitor (DLM®) seamlessly matches these requirements. It supplies graphical and numerical information about the vessel’s draught, the load of the hopper, the position of the overflow and other related parameters.

The DLM® provides both adequate and ergonomic basic presentation, and optional presentation and automation routines. Alone or in combination, they enable TSHD operators to just get on with dredging as efficiently as possible. This is evidenced by the fact that nearly every sizeable TSHD in the world has an IHC DLM®.

**Benefits**

Efficient dredging involves superb equipment and its outstanding presentation to the operator.
Typical System Architecture

The IHC Systems DLM® function draws on proven hardware and software, including a programmable logic controller network (PLC) monitored by a fast PC-based, server-client, supervisory, control and data acquisition (SCADA) network.

The core of the system is a separate, dedicated PC containing the DLM® algorithms and models. These run on a shared Microsoft Windows and IHC Systems’ Digisys platform. The software is dongle-protected to prevent unauthorised use.

The PLCs manage the standardised signal isolation and signal processing to and from the connected instrumentation and sensors, and – depending on the eventually specified configuration and extent of options – the drives for the suction pipe winches, gantries and swell compensator.

The supervisory control and data acquisition system (SCADA), also referred to as the Human-Machine Interface (HMI), is the link between the operator and the automation, control and instrumentation components. Touch-operated TFT screens present coloured process values and statuses on functionally designed screen pages using standardised diagrams, symbols, bar graphs, imitated analogue indicators, numbers and words. Functions are also initiated and controlled on these touch screens.

Currently, the DLM® function is in most cases an integrated and/or distributed part of a larger monitoring and automation system such as IHC Systems’ dredging control system (see brochure DCS, available on the website). However, the function can also be supplied in a stand-alone version and it is then described as a DLM® system. In both versions the content and extent of sensor equipment varies with the functionality that is ultimately specified.
Reliable overflow-duct position measurement is one of the DLM® tools for reducing overflow losses.

**Contactless radar sensors**

Depending on the specific DLM® configuration, vessel configuration and installed options, IHC Systems-made rugged sensors and other connected equipment may include:
- water-hammer-resistant bottom-pressure measurements, retractable without dry docking
- contactless, radar-based hopper level measurements
- analogue overflow-duct position measurements
- a network connection to the vessel's tank sounding system/function
- a network connection to the production monitor/function PRM®
- relevant solenoids, pressure switches, level switches and hydraulic pump starters for the control installations of the hydraulic overflow ducts and gate valves, and limit switches for the connected gate valves.

**Retractable without dry docking**

**Reliable overflow-duct position measurement is one of the DLM® tools for reducing overflow losses**
Typical functionality

The DLM® function presents the vessel’s draught and loading status in a graph accurately and continuously, together with a tangential line for advice on useful loading time in relation to the total cycle time. The load calculation is derived from the displacement and trim of the ship, obtained using bottom-mounted pressure transmitters in conjunction with a table calculated from the carene diagram and stored in the memory of the Digisys computer. If more than two bottom sensors are installed, the vessel’s list is also included in the algorithms.

The touch screen allows for the online adjustment of operational parameters, while configuration parameters can be entered off-line. Transgressing set points generates audible and visible alarms. Presentation colour preferences, zoom and shift functions are available. In the DCS-integrated version, screen pages are available for fault diagnosis and alarms.

IHC DLM® options

Hopper volume and dry solid mass (TDS) measurement
Hopper level measurements enable calculation of the hopper volume from tables. The derived value of these calculations is the mass of dry solids (TDS) gathered in the hopper. A tangential line touching the TDS curve delivers improved recommendations for continuing/ending the loading cycle. This option is often required by authorities for payment purposes.

Automatic light mixture overboard (ALMO)
Particularly in finer sands and silt, overflow losses can reach considerable values. This can be mitigated by directly pumping overboard mixtures with densities that are too low. This process is familiar as “ALMO”. The option provides adjustment and control sequence options.

Automatic draught control (ADC)
This is probably the most popular option with operators, as it means they don’t need to continuously observe the allowed vessel deadweight during the loading process. ADC performs this action by controlling the available overflow ducts on the basis of the draught calculations. Several adjustment and control sequence routines greatly enhance user-friendliness.

Artificially intelligent overflow loss estimator (OLE)
OLE is a further addition to the TDS option and uses artificial intelligence technology and model-based algorithms to calculate the overflow losses in general and to provide an indication of overflow density.

Tank weight correction
This option allows for the adjustment of DLM calculations with information from the tank sounding system, if connected. The effect is that the presentation of the mass in the hopper is more realistic.

Load recorder
This option meets the demands of some authorities for a hard copy showing the draught of TSHDs operating under their supervision based on pure, non-calculated signals. A calculated load rate signal can be added.
Combinations

DLM and STPM
The IHC DLM® may be combined with one or two functions for monitoring the position of the portside and starboard suction pipes – IHC STPM® – in the same hardware and software environment. No significant additions are required, except for specific STPM sensors and I/O capacity.

The STPM® function delivers the presentation of the dredging depth and/or lateral position of the suction pipe(s) of the vessel in ‘dressed wire models’ on the touch screen with respect to the waterline and the vessel’s centreline. The top, side and back views of the ship, with suction pipes and gantries, are presented together with detailed draghead and bathymetric information in a digital terrain model (DTM) of the dredge area. The DTM is updated continuously with the draghead depth of the latest vessel track.

STPM® itself comes with an automatic draghead winch control (ADWC) function. This option relieves the operator of routine tasks and helps prevent fatigue with the following functionality:
- monitoring and control of the swell compensator position by control of the draghead winch
- keeping the draghead at the desired dredging depth, as inputted manually or obtained from DTPS
- maintaining either a constant angle of the lower pipe with respect to the sea floor, or a constant angle between the two suction pipe main parts by controlling the intermediate winch
- lifting the draghead when lateral angle limits are transgressed.

DLM, STPM and PRM
If accompanied by PRM®, an integrated and comprehensive presentation of the entire loading and unloading process of a TSHD is provided. In this case, the PRM® sensors should also be connected, which is often already the case when the ALMO and/or OLE options have been installed.

For a detailed overview of the benefits of these combinations, see the IHC Systems STPM® and PRM® brochures.