

Sand and Gravel Deep Recovery

The most common technology for recovering material from sand and gravel pits submerged below the water table is to use a dragline set up on the shore with a long boom. The useful life of many of these pits is determined by the capability of the dragline which generally is not able to recover material which is more than 30ft deep.

If you really push it, it is possible you will lose the machine in a slide into the pit.

Attempts have been made to use a fixed hoist mounted on a barge with a powered clamshell bucket. The problem with this arrangement is that the bucket has only one degree of freedom, that is, the bucket can only go up and down. The barge must be constantly shifted to avoid digging pits.

Using a two rope clamshell crane is not the answer if you have to go more than 20 ft below the crane base.

The answer is to use a PLM Pit Dredger with a conveyor chain and stacker, capable of digging to 100ft depth in standard configuration and deeper if needed.

PLM Pit Dredger

The PLM Pit Dredger is designed for shallow and deep recovery of material from submerged sand and gravel deposits. PLM 4-rope clamshell cranes are built for shallow and deep recovery dredging operations and are used almost exclusively throughout Europe for dredging canals, harbours and waterways. More than 200 units are in operation.



Overview

The system consists of a PLM 4-Rope Clamshell Crane which is capable of digging to a depth of 100ft with the standard setup mounted on a pontoon. The pontoon is made up of modular units transportable as container pieces and have container lugs built in. The main platform on which the crane sits consists of 10 containerized units. The crane can be mounted on a pedestal or may be equipped with a crawler base. Crane sizes range from 4yd to 12yd. Rates of 300 to 1000 tph are normally achieved.



In order to get material from the digging platform to shore, the crane platform is fit with a hopper and feeder conveyor. Containerized floating conveyor modules are used to form a “conveyor chain” running from the main platform to the shore. Modules are pinned together allowing them to move independently and articulate horizontally as well as vertically. In this way, the digging platform can be positioned anywhere and the conveyor chain follows along behind. Conveyor modules are interconnected electrically using a very simple disconnect arrangement.

Conveyor modules may be added or removed at any time to suit the operation. Power is provided from an electric generator on the shore or on the main platform.

At the shore end of the conveyor chain the final link is a stacker which lands material well up on the shore or feeds additional stackers, conveyors or screening / crushing plant.



Crane Details

At the heart of the system is the PLM 4-Rope Clamshell Crane. PLMs are extreme duty cycle cranes built exclusively for dredging and barge/ship unloading. PLMs use three drums with two wire ropes from each drum. One drum is holding, one is closing and the third is for the boom.

One rope is right lay, the other is left lay with two wires for holding and two wires for closing. Using this system, the clam is able to be lowered to more than 100ft below the base of the crane without spinning and without any tagline.

PLM cranes use only one layer on the drum for holding the wire ropes, including the boom hoist. This ensures that wire ropes will last for more than 1000 hours of use. The drums are driven hydraulically using Mannesman Rexroth pumps and motors. Final drives are Lohman.

PLM cranes have the following features:

1. High power using Cat or Cummins diesel engine.
2. 5000 psi hydraulic system running at 2500 psi.
3. High capacity hydraulic cooler, 50% of the engine horsepower.
4. No frictions, no brakes...crane drives like an excavator.
5. Oil filtering on pressure and low pressure side.
6. Closed loop hydraulics, one pump for each function of the crane.
7. Well oversized slew bearing with large rolling elements.
8. Automatic lubrication systems.
9. Self-contained to retain any spilled fluids inside the machinery house.
10. Cast steel sheaves with aluminium bronze bushings.
11. All wire ropes contained on one layer on the drums.
12. Enhanced cab with heating, A/C and CD player.
13. Dredging Management System.
14. 260 fpm hauling up speed under full load.
15. 350 fpm lowering speed.

Of primary importance is the ease of operation. With only two joysticks and no brakes or pedals

to worry about, a totally inexperienced person can become very proficient in a short period of time. If you can drive an excavator, you can drive this crane.

Full specifications and details about the cranes are available on request.

Crane Controls and Management System

Control of the clamshell is very simple and is designed for blind operations. The right joystick controls the clam, the left joystick controls the boom and swing. In order to open the clam, the right joystick is shifted to the right. The closing line then pays out until the grab is open and then automatically stops. This is controlled by drum rotation counters feeding information to a PLC controller. The driver cannot overpay the closing line.

To lower the grab, the right joystick is shifted forward and both drums automatically pay out together. To lower blind and ensure the grab is fully open when it hits bottom, the joystick is pushed to the top right corner. The closing line will not overpay any more rope than is necessary to open the clam no matter what the driver does.

When the clam touches down, pressure sensors in the winch circuits stop both the holding and closing drums automatically. The holding drum automatically makes some slack line to allow the grab to "dig". The driver is now unable to lower the winches any further.

To close the clam, the driver pulls the joystick back to the left bottom corner. The closing winch then hauls in until the drum rotation counter senses that the grab is closed. The holding winch then automatically hauls up and the two winches work together to haul up the payload. 60% of the load is carried by the closing and 40% by the holding. A weight sensor is provided to inform the driver if he has a full grab.

If the clam does not fully close, the PLC will not allow hauling up. In this way, the driver is certain that when he is hauling up, the grab is closed without having to use tell tales. The grab cannot open inadvertently on the way up unless the driver shifts the joystick to the right past neutral.



The operation is simple. Top right corner to open and go down, bottom left to close and come up. That is all the driver needs to know. The rest is automatic.

The driver may luff and slew at any time during the operations using the left joystick.

Two screens are in front and to the left of the driver. One is a tv monitor with a camera viewing the winches. At a glance the driver can see if the wire ropes are laying properly.

The second screen gives digital readout of depth of the grab, boom angle and load. Total material moved, number of cycles and time of day can also be read. A computer onboard records and stores this data for every cycle of the crane

This information is also available for downloading by wireless modem to the shore or by direct connection with a notebook computer.

A Manager in Chicago can dial up the crane in Pennsylvania and see how many cycles it has made that day and how much material it has moved. The crane has enough memory to store months of data.

Luffing is controlled by limit switches at the heel of the boom and by drum rotation counting. The crane driver does not need to be aware of boom angle and he is prevented from operating outside the approved range.

Dredging Management

Navguard management system is provided to keep a record of every crane cycle. Data is recorded every time the crane lifts a load. Depth of the clam is measured by the drum rotation counters and position of the grab is determined by GPS.

A complete topographical map including isometric views can be produced from the data. The data can be downloaded into a computer at any time through a wireless modem in the crane. This allows complete management of the pit without having to conduct costly bottom surveys and allows the pit to be taken down uniformly to avoid digging big holes in the bottom.

The load lifted on each cycle can also be recorded. The computer records time, date,

depth, longitude, latitude and load for each crane cycle which can be downloaded, printed and mapped.

Operations

The crane is able to sweep a very large area and is not restricted to “straight up, straight down “ motion. With the range of motion of the crane and the management system, the driver can easily achieve a very flat bottom profile and is never in risk of digging a pit which may collapse and bury the clam.

The PLM 65 crane is able to achieve 500 tph from a depth of 80 ft. The PLM 80 is able to achieve 800tph.

For modest operations, the PLM 40 or 50 are very suitable when the expectations are 2000 or 3000 tons per 8 hours operating.

Once the pontoon has been positioned, only one man is needed thereafter, the crane driver. Everything else can be left unattended.

The crane pontoon may be anchored and shifted using anchors or it may be tied to shore and shifted using wheel loader or truck. It is possible to put positioning winches on the main platform controlled from the crane cabin to obtain true one man operation.

Video cameras can be positioned along the conveyor chain with output in the crane cabin to enable the crane driver to monitor the system when he shifts positions.

The conveyors are equipped with start warning lights and bell, pull chord switches and belt-running detection. If one belt stops, all belts behind will stop.

The entire system can be dismantled and moved by road transport with only a few days work using four men. All components are made to be shipped as container pieces to allow shipping the system world wide.

Summary

With a very modest investment, the PLM Pit Dredger can give extended life to pits and can result in re-opening old pits where the material has been too deep to recover.