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Workshop on
Indigenisation of Dredgers

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WORLD DREDGE CONSTRUCTION MARKET

- Significant share of the dredge construction especially the larger CSDs & TSHDs is carried out in Netherland by global players like IHC Merwade, Damen Shipyard, etc.
- In the case of smaller & mid-sized CSD segment, builders such as Ellicot of USA have a significant world market share.
- European dredgers are very sophisticated and expensive. The repairs & maintenance of the equipment is high due to exorbitant cost of spare parts. None the less, they are dependable with good availability and operational efficiency.
- China has also entered in a big way into dredge construction. They have built & supplied small & mid-sized CSDs & TSHDs. However their design & technology are inferior and the equipment including propulsion systems are unreliable and operational life is short.

Indian Dredging Market

- The dredge construction by various Indian Shipyards has been on since early 70s - it was carried out on one-off basis by transfer of design, construction drawings & supervision by foreign dredge builders like IHC Holland, Vosta LMG, etc.
- GRSE, HSL, CSL, MDL have constructed TSHDs/CSDs/Grab Dredgers, etc. with Technology from Foreign Dredge Builders.
- The results were not upto mark.
- DCI & Adani Group are so far the largest importers of dredgers and both have depended largely on Dutch Builders.
- Several Private port developers & private dredging companies have imported Chinese CSDs/TSHDs. Performance of most of these dredgers is unsatisfactory especially with difficulty in procurement of spares and technical support from OEM.

Indian Manufacturers of Small CSDs

- Dredge building is technically demanding and there are few shipyards in India that can build dependable dredgers.
- Following are some of the dredge Builders In the organised sector:
 - 1) Tebma Shipyard Pvt. Ltd., Chennai/Malpe.
 - 2) Startek Shipyards Pvt. Ltd., Chennai with IHC.
 - 3) Santosh Boat Builders, Kakinada.
 - 4) Navgathi Marine Design & Constructions, Cochin.
 - 5) Safeway Dredging Enterprises, Nagapattinam.

The Indian shipyards build dredgers only against specific orders from buyers.

Besides above, there are several less known small dredge builders in Mumbai, Kolkata, Cochin, Nagapattanam, etc.

DREDGE CONSTRUCTION - I

- Dredge construction consists of:
- Development of the design to cater to operation and stability of the equipment and generation of construction drawings.
- Meet the requirements of the Classification Society, Governmental / IMO Regulations.
- Selection of the right equipment such as diesel engines, gear boxes, dredge pumps, cutter drive, jet pumps, suction mouth for CSDs and draghead for TSHDs and other auxiliary equipment.
- In a modern dredger, the dredger production monitoring systems and operational control systems, etc contribute as much as 20% of the cost of the dredger.
- Meet the design requirement for the TSHD / CSD and enable her to dredge the type of soil that is meant to be dredged and relocate the same to the designated location at sea / shore.

DREDGE CONSTRUCTION - II

- Dredge construction can be summed up as construction of the hull, installation of the dredging equipment and integration of the various systems & sub-systems to enable reliable function of the overall dredger in a safe and efficient manner.
- The dredge builder is an expert designer of the hull owns a team of engineers who design the dredge components such as draghead, cutter head, turning gland, etc. and manufacture / identify the vendors who manufacture the equipment designed by the dredge manufacturer.
- The dredge builder also studies the client requirement related to deployment of the dredger for capital or maintenance dredging works and identifies the critical equipment such as propulsion system for TSHD, dredge pump, dredge pump and its gear box and integrates the same.
- Leading dredge manufacturers are adopting standard designs for small and mid-sized CDSs (IHC Merwade & Ellicot) and small sized TSHDs (Easydredge from IHC). This results in a significant cost saving by way of design & identification of various equipment such as diesel engines, dredge pumps, etc that go into manufacture of the dredgers. This will also reduce the cost of the dredger and lead time for manufacture .

Design of Dredge Parts

- Reliable equipment with high accuracy and precise dimensions to fit the purpose.
- Most optimal shape and lowest stress in material.
- Reaction of the structure to certain loading conditions.
- Designed to optimize and ensure low stress forces in the material.
- Design for longer life time of the equipment.
- Selection of appropriate material: (i) carbon steel for easy welding and hard facing; (ii) carbon manganese steel for improved hardening, strength and toughness; (iii) alloy steels for providing wear resistance.
- Individual testing of components and testing of the unit after all parts are assembled and tested under pressure and maximum movements. Simulation under worst case scenarios.
- For development of wear parts, study the worn out parts from a dredger and design the dredging components for the longer life by improving the design and material specifications where necessary.
- Reduce the cost price.

Advantage to Importers vis-a-vis Domestic Builders

- Union Budget for 2012: FM Stated: “In the last Budget, excise duty exemption on ships and vessels including dredgers was withdrawn. Accordingly, CVD of 5 per cent became leviable on their imports. As the intention was not to levy this duty on the import of foreign going vessels, I propose to exempt such vessels from CVD retrospectively.
However, to ensure that ships, vessels and dredgers manufactured in India do not face disability vis-à-vis foreign-going ships converting into coastal vessels, necessary safeguard is being provided.” Unquote
- Union Budget 2013-14: FM stated: “As a measure of relief to the ship building industry, I propose to exempt ships and vessels from excise duty. Consequently, there will be no CVD on imported ships and vessels”.
- Presently, the dredge owners need not have to pay any import duty for dredgers.
- ***Subsidy for domestic dredger manufacture is unclear and not being implemented.***
- Domestic Dredge manufacturers have to pay several taxes.
- There is neither an incentive to domestic dredge builders nor a level playing field vis-à-vis foreign builders.

NEED FOR INDIGNATION

- Dredging equipment is cost incentive.
- Dependence of foreign OEMs will increase the lead time and may affect project schedule.
- The volatility of USD/Euro will result in increased CAPEX and higher outflow to meet interest payments. This will reduce the RoI for the Indian dredge owners.
- The economic slow down in Europe may result in bankruptcy of the dredge builders and may affect the supply of spares to meet the future requirements of the dredge owners.
- Most dredge manufacturers do not pass on the construction drawings to the dredge buyers and make them depend on the OEM suppliers for spare parts and related services.
- The present economic crisis may result in retrenchment of engineers who render technical support and may be difficult to get the services support on urgent basis.
- Down time due to non-availability of spares & service support will lead to loss of revenue for the dredge owner.

Backhoe Dredger - Model



Load transfer of excavator to Steel Deck & Hull of the Barge

Liebherr Rubber Mountings in steel cylinders



De- Donge Foundation Bolts



Backhoe Dredger - Indigenisation

- The backhoe dredgers is a stationary dredgers that can be used for capital & maintenance dredging.
- Design of the Backhoe Excavator involves the following:
 - (i) Design of circular pedestal for transferring the load of the marine excavators (without the crawl mounting system) on to a steel deck & hull of the barge.
 - (ii) During dredging operations, the reaction coming through the bucket, arm & boom gets transferred to the hull of the barge and thence on the sea bed through the Spuds.
 - (iii) The Spuds should have required shape, strength and weight.
 - (iv) All the above three aspects require application of FEM by an expert naval architect and the calculations along with drawings need to be submitted to IRS for their approval.
- The design of the barge & spud hoisting system & thrusters if any is to suit the weight and capacity of the backhoe excavator.
- *Indigenisation can be carried out and the rate of success is significant.*

CSD Equipment - Cutter Head



- The cutter head is the most important part of the CSD.
- It determines the production of material that is excavated & transported.
- Production is related to the dimensions of the cutter head, cutter drive power, speed of the cutter head for mixture forming process
- The reaction of the cutting process will determine the swing winch and ladder winch.

CSD – Other Important Equipment

- Suction Mouth
- Dredge pump – double walled/single walled
- Booster pump
- Spud Carriage
- Swing Boom for Anchors
- Cutter ladder and its hinge pin system
- Swivel Bend to connect to floating pipeline
- Production Monitoring devices.
- Position Fixing System & Dredge Automation System.
- Deck Crane
- Sluice Valves
- Rubber Articulation Pipe on Suction Pipe

Each of these above equipment is individually important for safe and efficient functioning of the CSD.

CSD INDIGINATION – STEP I

- The Indian Dredge Contractors / Owners can tie-up a shipyard and opt for import of component & engineering packages offered by leading dredge builders.
- In the case of CSD, the critical equipment such as dredge pump and its gear box, cutter head, cutter drive, the complete hydraulic units, dredge monitoring systems, etc along with construction drawings & requisite spares as a package can be imported.
- The dredger can be built in an Indian shipyard under supervision of classification society. The steel for the hull, diesel engines can be of Indian make. Installation and integration of the dredging equipment including tests & trails are carried out under the expert supervision of the engineers from the foreign dredge builders.
- There will be significant cost saving by way of reduction in construction of the hull and voyage / transportation of the dredger to India.
- This method of selection of the design & equipment will render a reliable dredger with warranty support from OEM.

CSD- INDIGENOUS MANUFACTURE - ToT from OEM

- The manufacture of **Portable Cutter Suction Dredgers** with design & technical support from the technology partner comprises the following:
 - (i) Indigenous manufacture of steel fabrication items such as the hull for the pontoons, suction pipe & cutter ladder, spuds, discharge pipe, etc. Use of main & auxiliary diesel engines for dredge pump & hydraulics respectively.
 - (ii) Components which are critical in nature such as dredge pump and its gear box (to suit the Indian engine) hydraulic power system (complete unit), cutter drive & cutter head, etc. need to be procured from the OEM supplier say for the first 10 Nos. of the portable cutter suction dredgers.
 - (iii) Items other than (i) and (ii) above which can be sourced from vendors in India and abroad based on technical and commercial consideration.

The progressively indigenisation of items at (ii) above will be either through manufacturing the components in-house or procure them from qualified and reliable Indian vendors in a time bound manner so as to maintain a competitive edge in the Indian Market.

The technology partner will render technical & engineering support and technological upgrades to the Indian dredge builder on longterm basis.

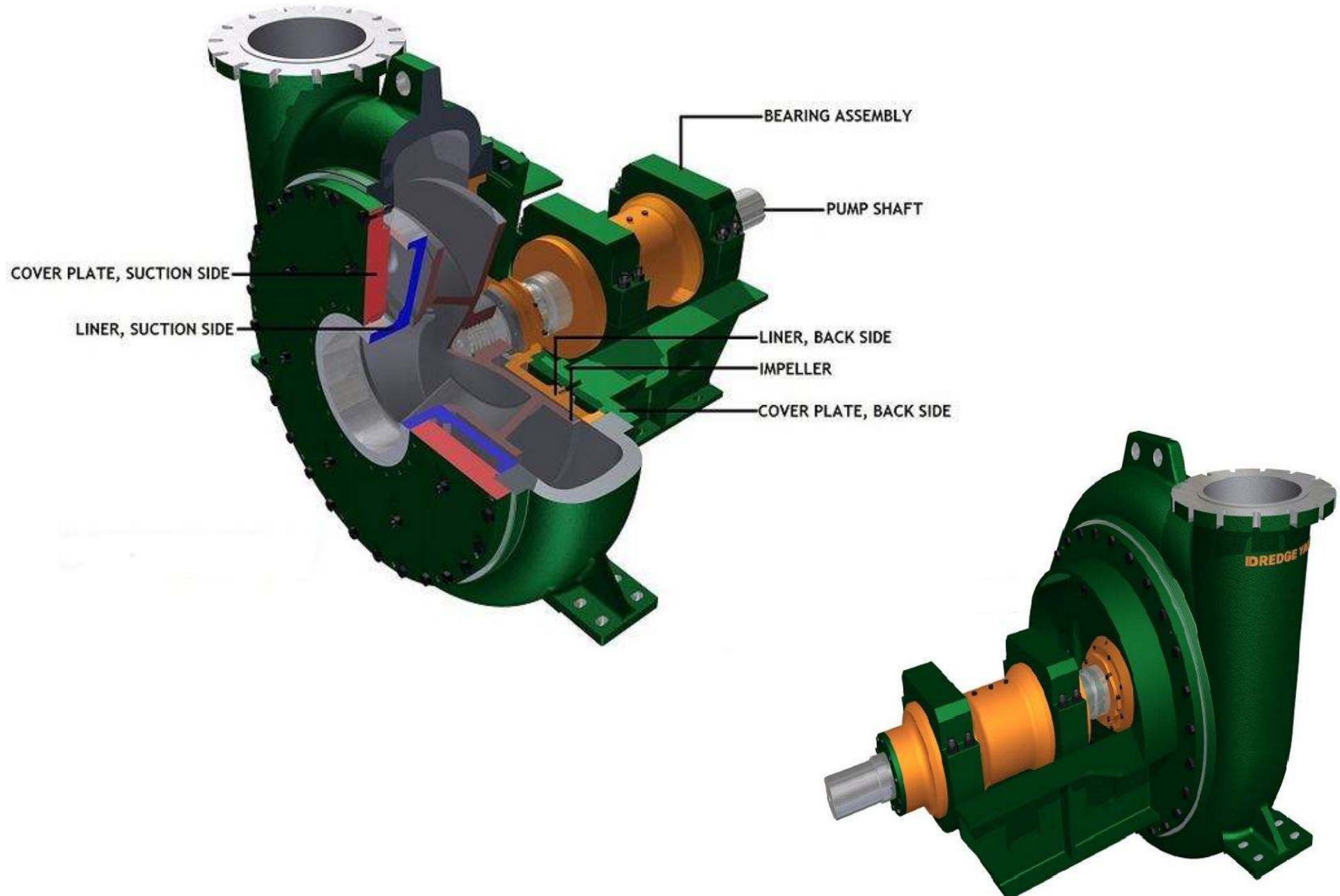
TSHD – Design Issues & Indigenisation

- TSHD is by far the most difficult dredger for Indigenisation.
- The overall design of hull & stability calculations requires a skilled naval architect with in-depth knowledge.
- The structural design of a TSHD is more complex than that of a bulk carrier / tanker since ***the loading is fast and the unloading is very rapid***. As such the design is complex.
- The design of the propulsion system and dredge pump power mover for carrying out design dredging work. Power sharing between propulsion & dredge pump, if any.
- Design of the hydraulic system for dredging / dumping operations.
- Suction Pipe – suction bend (trunion), gymbal ring, fork arms, turning gland, swell compensator & hoisting gantries are all very important to enable smooth dredging operations.
- The soil loading system in the hopper and the location & design of the overflow system requires extensive knowledge and model studies.
- As such, the cost involved in design & Indigenisation of a TSHD are very high and it may not be viable at present to Indigenise them.
- ***It is more appropriate and serves the interests of India to indigenise the spares such as suction pipe parts - turning gland, gymbal ring, fork arms, draghead, etc.***

TSHD – Indigenisation through ToT

- TSHD Construction requires large investment for infrastructure such as construction facility with slip ways, fitting out jetty, etc involving an estimated capital expenditure of approximately Rs 400 Crores for dredgers upto 7000 cubic meter hopper capacity.
- The Indian partner can enter into a technology cooperation agreement with any leading foreign builder and seek construction drawings approved by IACS member so as to obtain IRS approval with ease.
- *During construction, if any changes are made in the structural drawings, the same needs to be taken into consideration for review of the stability calculations.*
- *All the critical equipment such as dredge pump & its gear box, etc needs to be imported from OEM.*
- *Automation and dredge production monitoring systems should be procured and fitted only to cover the essential requirement.*
- *Installation & integration of the dredging equipment must be carried out under the guidance of foreign experts.*
- ***It is more appropriate and serves the interests of Indian dredging industry to indigenise the spares such as suction pipe parts - turning gland, gymbal ring, fork arms, draghead, etc. and proceed step-by-step towards indigenisation of a TSHD through a Transfer of Technology from an experienced partner.***

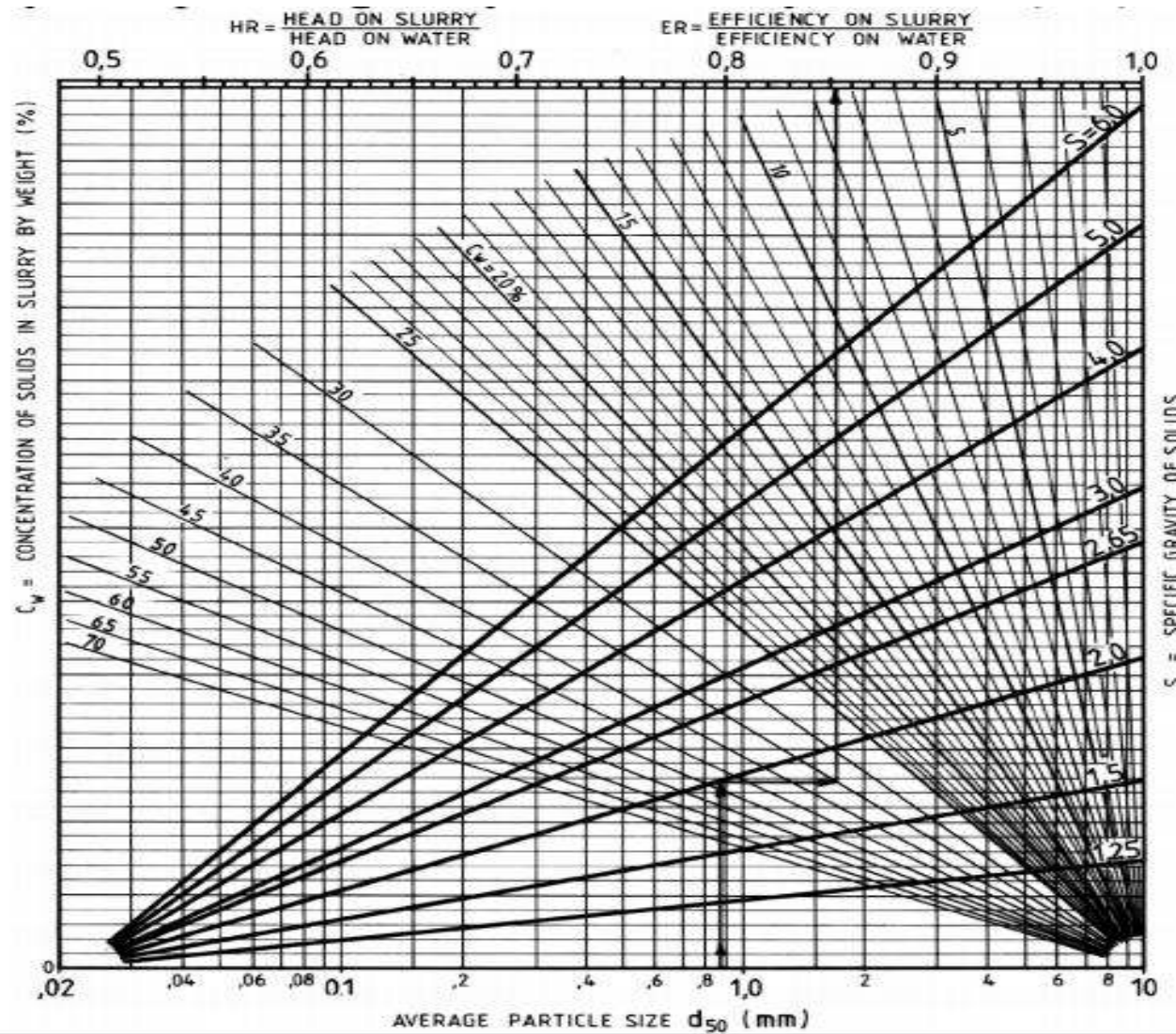
CSD & TSHD - CRITICAL ITEMS I - DREDGE PUMP



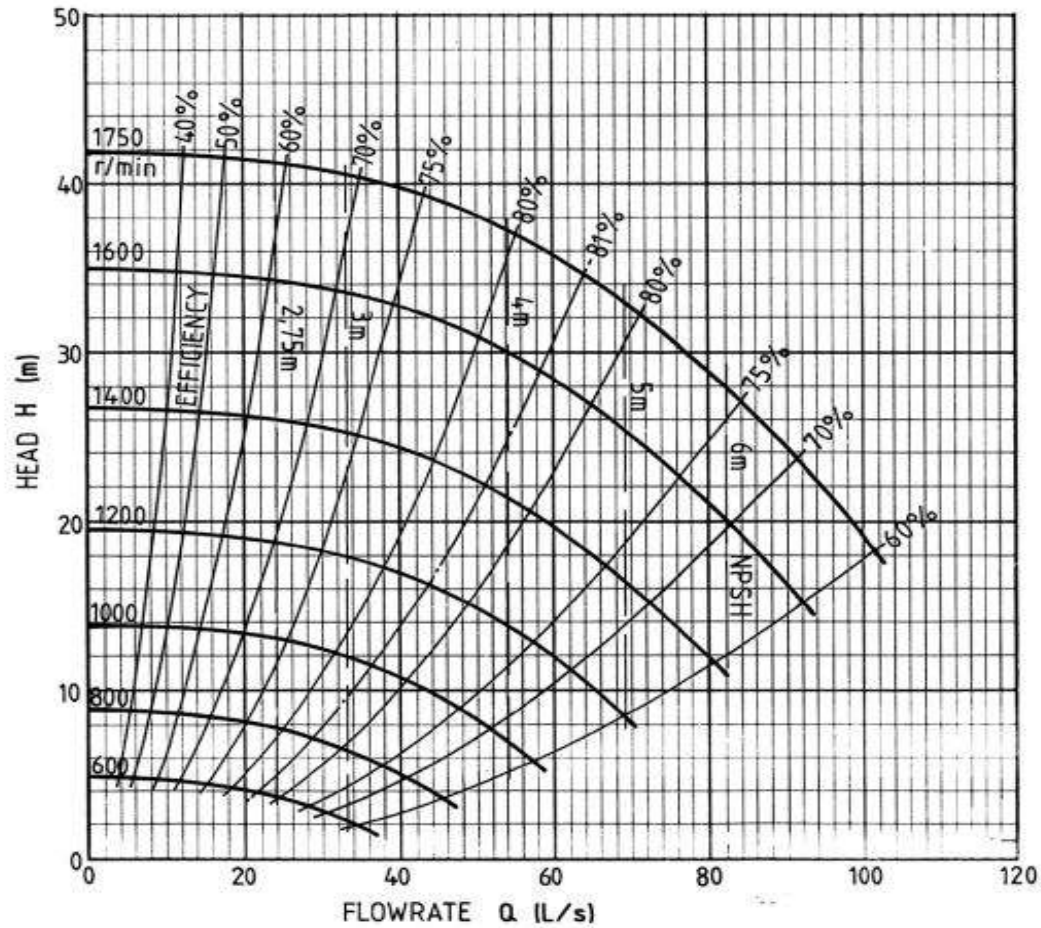
DESIGN & SELECTION OF DREDGE PUMP, ENGINE & GEAR BOX

- Dredge pump selection is a systematic process involving:
 - (i) Specific Gravity & Volume of Solids to be transported per hour.
 - (ii) volumetric concentration of slurry.
 - (iii) Total Dynamic Head considering the total pipeline dimensions, characteristics including suction & discharge ,frictional losses, etc.
 - (iv) Based on approximate pump power thus selected, Head vs Discharge(H-Q) curves of probable pumps will be selected.
 - (v) The intersection of the pump performance curve (H-Q curves) and the pipe **system resistance curve** (generated from pipe layout & frictional factors) determines the actual pump **duty point** at which the pump will operate and enable us to arrive at preliminary value of engine power.
 - (vi) Coupling and gear box losses will be then added in arriving at engine power.

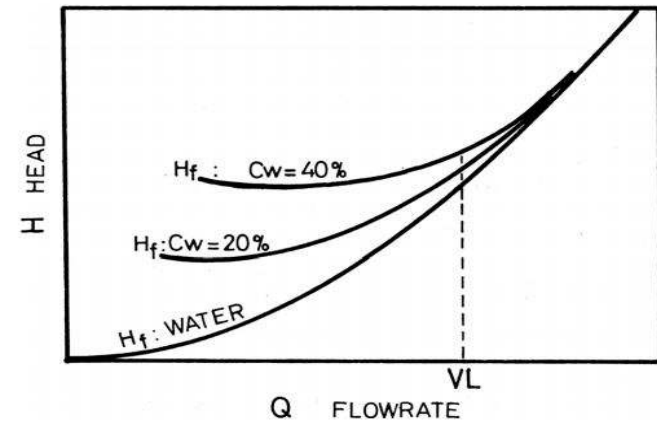
Dredge Pump Performance Graph



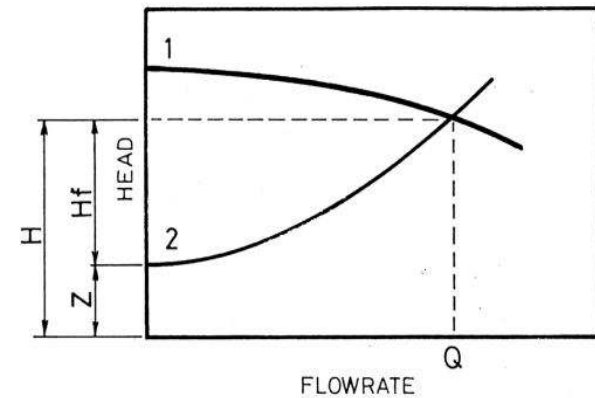
Dredge Pump Performance Curves- II



TYPICAL PUMP PERFORMANCE GRAPH

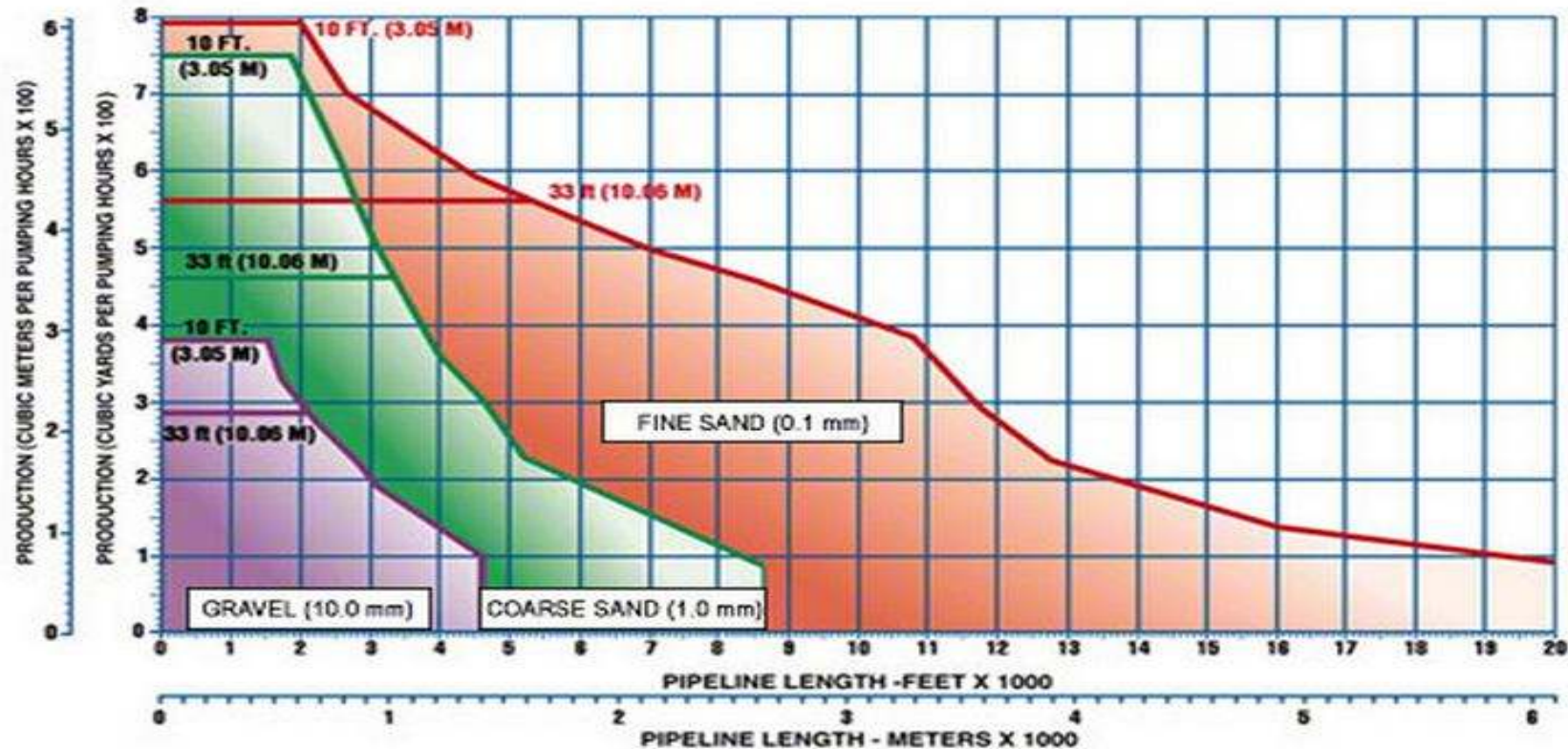


TYPICAL SYSTEM RESISTANCE CURVE



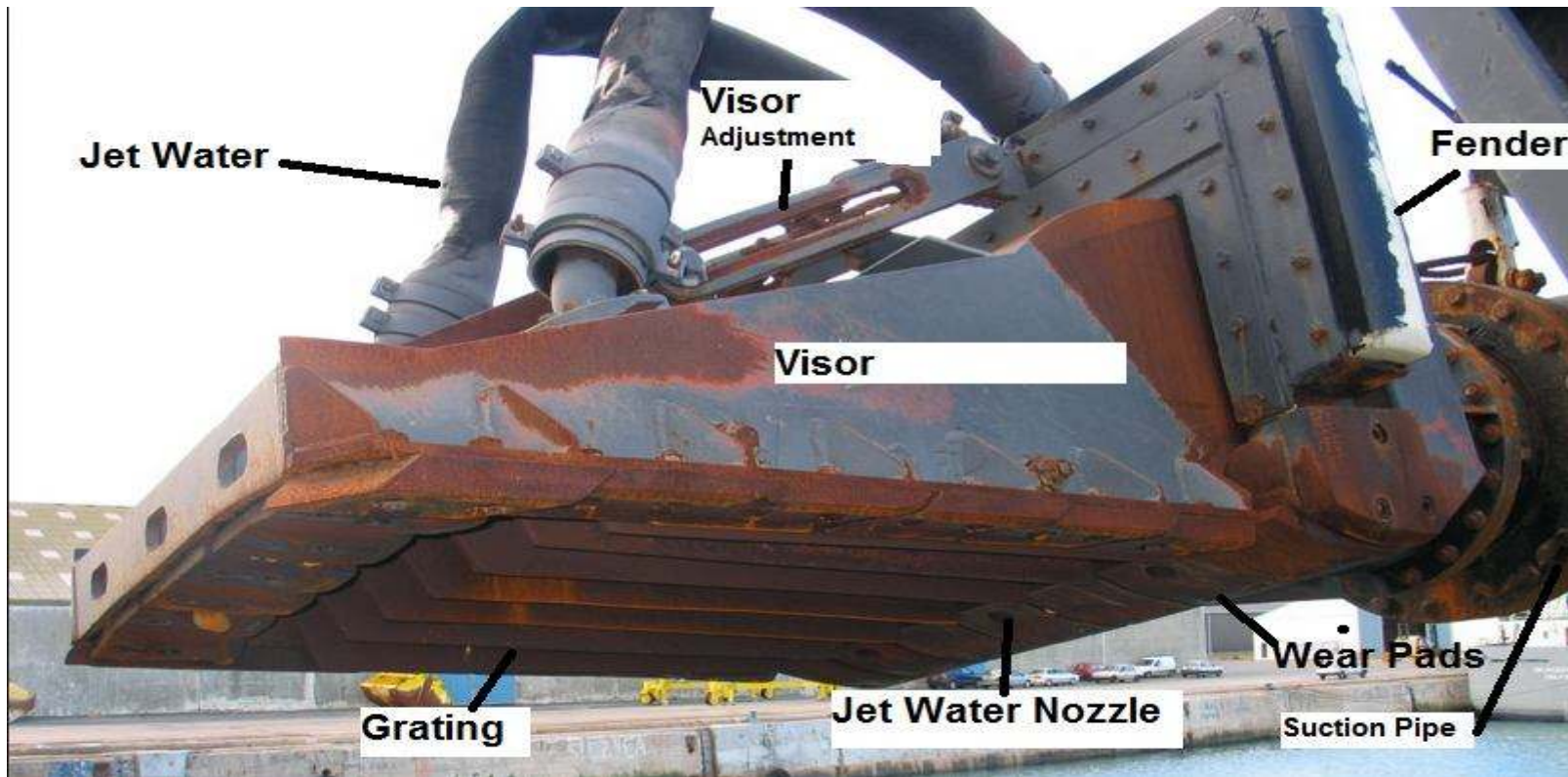
TYPICAL DUTY POINT CURVE

DREDGE PUMP - PRODUCTION CURVES



- Actual production depends on nature of dredged material such as free flowing sand, compacted sand, stiff clay, silt stone, etc.
- Specific gravity of in-situ material, suction / discharge pipelines, pump impeller dia, max. speed and power of the pump and terminal elevation for discharge of the dredges slurry.
- If the actual specific gravity of the in-situ material is less than the assumed value, the production will be higher.

CRITICAL ITEMS II - DRAGHEAD



- A draghead is well designed with a venturi effect to facilitate creation of vacuum & flow of soil water mixture into dredge pump.
- All the soil touching parts such as wear pads, jet water nozzles, gratings, etc have to be wear resistant.
- In case of hard strata, replaceable teeth are fitted to the draghead to cut and break-up the soil.

Thank you