MAXIMIZING POTENTIAL - HOW CONVERTING AND UPGRADING EXISTING DREDGERS CAN HELP YOUR COMPANY

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ABSTRACT

We live in an era during which new technologies are being developed more rapidly than ever before, thus providing a constant stream of new solutions and options for our customers (or users), enabling them to become even more efficient and meet the ever growing demands of our industry.

The modification, conversion and upgrading of existing dredgers are proving to be good solutions for users to increase their capacity and capabilities within reasonable investment budgets.

Companies seeking an alternative to investing in a new dredger now have the options of converting their existing dredgers or barges, making them more functional and efficient. Modifications or upgrading can vary from replacing a single pump with one with higher efficiency to replacing the whole suction/discharge system of the dredger.

This paper will highlight various projects completed by Dredge Yard in upgrading existing dredgers and the impact of those modifications.

Keywords: dredger, upgrading, modifications, improved capabilities

INTRODUCTION

Upgrading of equipment, modification of dredging system and conversion of existing dredgers has become the new trend in the dredging equipment market as it is a good solution for users to increase their capacity and capabilities with a reasonable amount of investment. Companies which cannot invest in a new dredger due to multiple reasons can convert their existing dredgers, barges and other equipment to a more functional and efficient dredger.

All types of dredgers can be subject for modifications that can vary from replacing a single pump with more efficiency to the whole suction/discharge system of the dredger or literally converting existing barges and vessels into dredgers.

There have been some successful conversions or upgrading of old dredgers in the recent times and the results after conversions were more than expected.

Another important reason for modifications of old dredgers is the environmental effect. Many countries have set certain constraints for the equipment being used due to wrong impact on environment.

Recently the International emission legislation for the shipping industry in US has set forth strict conditions in the International Maritime Organization and EPA (US Environmental Protection Agency) due to the growing environmental awareness and social challenges like air quality, climate change and energy scarcity.

This emission legislation also challenges the dredging industry. It calls for action from both the dredge operators as well as manufacturers of dredging equipment, since dredging equipment is the source of the emissions.

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A large contribution can be achieved by better focusing, not only on the emissions per installed kW, but on the total energy consumption per dredging project or per cubic meter (m³) or cubic yard of dredged material.

In this paper, a few examples of successful upgrading of dredgers will be discussed with results before and after modifications of the equipment.

**IMPACT OF UPGRADING EQUIPMENT**

**Upgrading Dredge Pumps**

![Dredge pump of Dredger Al Qadisiyah.](image)

Dredge pump or sand-slurry pump is considered as the heart of the dredger and plays the most vital role in the efficiency of a dredger.

Latest tools in the market like CFD (Computational Fluid Dynamics) simulation and optimum design calculating software have increased the possibilities of having an efficient pump design for the same old pump without changing any installation dimensions or connections like the pump flanges.

Above picture shows a dredger whose old pump was replaced by a pump with an optimized design which was developed using the latest CAD tools.

Figure 2 below shows a schematic diagram of the pump impeller for the same dredger.
Figure 2. Dredge pump impeller sketch.

Figure 3 below shows the cad model of the impeller and impeller under production process.

Figure 3. Dredge pump impellers.
CFD and design calculations were performed on the pump to determine the best possible solution.

Figure 4 below gives a representation of the CFD calculation.

![Figure 4. Dredge pump CFD simulation.](image)

Achieving the final design of the pump, it was manufactured using the latest production techniques, molding software for casting, and strict metallurgical testing. Figure 5 below shows the final picture of the pump case produced.

![Figure 5. Dredge pump case](image)
Results

Table 1 below shows the results of the pump before and after modifications:

<table>
<thead>
<tr>
<th>COMPARISON</th>
<th>OLD PUMP</th>
<th>NEW PUMP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Efficiency</td>
<td>72 %</td>
<td>84%</td>
</tr>
<tr>
<td>Power</td>
<td>1,800 kW</td>
<td>1,540 kW</td>
</tr>
<tr>
<td>Difference</td>
<td></td>
<td>260 kW</td>
</tr>
<tr>
<td>Fuel Consumption reduction??</td>
<td></td>
<td>55 KG / Hour</td>
</tr>
<tr>
<td>Saving on a yearly basis</td>
<td></td>
<td>297 ton / Year</td>
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<td>0</td>
</tr>
</tbody>
</table>

The simulation of the pump was done using CFD software Simerics which is one of the best known for its accurate results. Simulations were carried before and after the design modification of the existing pump.

Table shows:

1. The best efficiency of the old pump design was 72% at the power consumption of 1800 kW.
2. The best efficiency of the new pump design is 84% at the power consumption of 1540 kW.
3. New pump design consumes 260 kW less power than old design.
4. Fuel consumption reduced by 55 kg/hr.
5. If calculated on yearly basis, new pump design gives a saving of 290 tons of fuel consumption.
6. All the above changes were done with zero investment as it was done during the replacement of the pump.

UPGRADING SUCTION AND DELIVERY LINES

Suction and delivery lines of a dredger are the means of transport of slurry and the pipeline design and components vary between dredgers. The efficiency of the dredger depends on the pump and the pump’s efficiency certainly depends on the pipe line. And the maintenance cost depends on the quality and design of the components.

The major components involved in the pipe lines are:

Pipe pieces, Gate valves, Suction mouth, Swivel bend, Bow coupling, turning glands, Ball joint Couplings, etc.

Each and every component plays its own role and there is possibility to get the best out of them by modifying them as per the needs. Few new trending components are discussed below:

Pipe Pieces

New trending product in the market is the double wall dredge pipe. In the pipe lines, it’s the material of the pipe that plays a major role to withstand the rough slurry movements. Double wall pipes are highly wear resistant due to their special design where three layers of material have been used. It consists of wear liner, concrete and steel pipe where wear liner being the layer that will be in contact with the sand or slurry.
The wear liner is inserted in a normal steel pipe and a layer of concrete is poured in between them for further strengthening and for positioning.

![Double wall dredge pipe](image)

**Figure 6. Double wall dredge pipe.**

Figure 6 above shows a picture of the double wall pipe.

**Benefits:**

- Increased life span of the pipes.
- Replacement of pipes after long intervals.
- Reduced maintenance.
- Reduced downtime.
- Is available in any type like straight pipes, bends, elbows, etc.

**Dredge Valves**

![Dredge gate valves](image)

**Figure 7. Dredge gate valves.**

Dredge Gate valves are highly sophisticated components and for proper functioning and maintenance, it is very important to select the right type with the right material and pressure handling capability for long life.
There are different types of dredge valves designed in three different working duties varying between 10, 20 and 30 bars according to the customer’s requirements and applications.

Regarding the production of the dredge valve, a casting simulation it is always needed to be done in order to verify that the thickness, curves and radii will be according to the right parameters and the material will cool down in a good way preventing internal and external shrinkages.

CONVERTING DREDGER SYSTEM

Upgrading of existing dredger systems is quite practical as it offers re-usability and the functionality of the old dredger with low investment. Conversion of existing vessels into dredgers can help in increasing the capacity and the capabilities of the dredging companies in much lesser time with a huge saving in investment.

Another reason where modification of dredger is needed is when the dredger supplied may not meet up the requirements and slight changes in the parts or system can make it appropriate for the project requirements.

Following segment will take you through few conversion and upgrading projects of Dredge Yard.

UPGRADING SPLIT SUCTION TRAILING HOPPER DREDGER

Figure 8 shows a schematic diagram of the vessel. This dredger didn’t have a discharge line and could only offload the material through its bottom doors.

Dredge Yard developed the complete suction and discharge line on the ship which included several pipes, bends, dredge valves, and bow coupling. The nominal diameter of pipe is 750 mm.
Results

The dredger will be able to offload the material using rain-bowing technique or the on-site pumping of the sand using a floating pipeline. Figure 9 shows the system of the suction discharge line on ship.

Figure 9. Suction discharge system on dredger.

CONVERTING HOPPER BARGE INTO TRAILING SUCTION HOPPER DREDGER

Figure 10 below shows an existing self-propelled vessel in Brazil, capacity 800 m³, which is in process of being upgraded and converted into Trailing Suction Hopper Dredger.

Figure 10. Hopper barge.
This complete trailing suction hopper dredger system is going to be installed on the old self-propelled vessel, consisting of a drag head, turning gland, gantries, sliding piece, pipes, bends, valves, dredge pump and bow coupling.

**DISCHARGE LINE ON TSHD**

Figure 11. TSHD system.

Figure 12. TSHD at dock yard.
Here is another example of upgrading two hopper dredgers by adding a complete discharge line on the vessels. The line included pipes, bends, valve and bow coupling structure. Figure 13 show the discharge line.

The discharge line was successfully installed on the dredgers, without any complications, on time and ready for operation.
CONCLUSIONS

Modifying or converting old vessels will always be considered the most convenient alternative due to lower costs, less time needed than building a new vessel and the possibility of customizing the vessel according to the customers’ needs.

CITATION