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IN CO-OPERATION WITH CEMENT DISTRIBUTION CONSULTANTS

BARGE UNLOADING ON THE MISSISSIPPI - MISSOURI WATERWAYS SYSTEM

John Krejci
Market Manager – Distribution Systems
Fl Smidth – Fuller Bulk Handling
USA

Biography

John Krejci
Market Manager
FLSmidth – Fuller Bulk Handling
USA

- 1983 Graduate of The University of Nebraska, BS Agricultural Engineering
- 1983 to 1989 Grain Handling Systems Engineer, Mechanical and Pneumatic Bulk Handling of all types of grains
- In 1989 John joined Cyclonaire as the Electrical and Process Systems Engineer for the Docksider product line
- John Followed Docksider to Nicholson Manufacturing when it was sold in 1992, serving as the Chief Engineer, and Director until Docksider was sold to Fuller Bulk Handling in 1998
- Currently John serves as Market Manager for Fuller Bulk Handling, directing product line development for ship and barge unloading systems.
- Fuller Bulk Handling Is A Major Supplier Of Pneumatic and Mechanical Ship and Barge Unloading Systems Worldwide

Cement Transportation On The Central US River System

John Krejci
Market Manager, Distribution Systems
FLSmidth - Fuller Bulk Handling Division

Project Scenario

During the economic expansion of the 1990's in the USA, the increased demand for cement created a need for more imports. With a majority of these imports coming in by water, they could most easily distributed by water. During this same period, attractive barge freight rates (cement as backhaul) instigated the switch from dedicated cement transport barges to "grain barges". The drawback to transporting cement in grain barges is that it required the use of different unloading technology than what had been used with dedicated cement transport barges. These many changes in the requirements for cement transport meant that choices needed to be made. Either add more terminals, or modify and better utilize the existing terminals.

Solution: Same Terminals But:

The high cost of constructing a new terminal, along with all of the associated permits, made remodeling existing terminals very attractive. The sum effect of all of these new requirements is to design a terminal upgrade that will keep the capital and operational cost as low as possible, while maximizing the throughput. When there is a need to increase the annual throughput of a terminal, combined with the complicated logistics that result from handling multiple cement types, you need flexibility and innovation. Incorporation of the correct unloading systems for grain barges was a critical step in the terminals evolution. Higher unloading rates where also required, but this needed to be done while still utilizing existing pipelines. Barge and cover handling equipment also became a critical cog in the efficiency that could be applied. Finally yet importantly was the critical need for all of the equipment to be durable and dependable to achieve the highest possible capacity utilization for the entire terminal system at the lowest possible cost per ton. This paper describes the goals of a typical upgrade that has been successfully implemented at several cement terminals.

Maximizing Operational Flexibility Minimizing Cost

A natural result of an increase in imported cement is that a terminal may need to handle more types of products, possibly including Flyash, and slag blends. For a terminal with limited storage volume and number of silos, this can create major hardship. In a terminal where this scenario exists, there are two options, one is to have adequate storage to house the various types of cement, and two is to use barges as the storage medium. These two scenarios will also be applicable while implementing an increase in the annual tonnage of a terminal.

Option one is capital intensive, but allows time periods for equipment shutdowns for maintenance, and also may offer the possibility to unload 24 / 7 and at lower unloading capacities. This option is much more convenient for the operator because they will not need to juggle which barges are being unloaded in anticipation of which product will be in demand for that day

Option 2 requires less capital expense, but it may add additional operating costs. The capacity of the unloader will have a positive effect on the terminal storage requirements. It is possible that less permanent storage will be required at the terminal with a higher capacity unloading system. In effect, the barges themselves become the short-term storage mechanism, but extra operating cost will be needed to cover demurrage for the transport barges. It may also require the use of a higher capacity barge unloading system since the cement is unloaded “just in time”.

Another way to increase flexibility and reduce operational costs is to take advantage of “Off Peak” power incentives that are offer in many areas. These programs can dramatically reduce the power bill at the end of the month. The problem with this is that it will reduce the available unloading hours per week. Substantial power bill savings are realized, but additional capital cost per ton unloaded increases, because extra unloading capacity is required, and not fully utilized. Thus, this may not be a cost effective basis for sizing a new barge unloading system. However, another benefit of the reduced daily hours of operation is reduced labor costs. When combining the saving from these two benefits, it may add easily add enough extra money to the capital budget to pay for additional storage, as well as a higher capacity unloading system.

Unloading systems for grain barges

Presently, there are three types of open top barge unloaders being used in the USA today. The most common of these is the vacuum type, but a couple screw type and grab bucket type are still being used on a limited basis. During the last decade, there have been approximately 19 new vacuum barge unloaders placed into operation in the USA. These types of systems have been used since the early 1980’s but their popularity has greatly increased in the last 10 years. Vacuum unloaders are the most popular for barge unloading because they are efficient in their unloading capabilities, and they are most environmentally friendly of the choices available today. An example of one companies investment in unloading systems for river transport of cement is shown below.

Example – Holcim USA
Docksider Barge Unloaders: 3 Years – 6 Unloaders

- 1997 Summit Illinois 280 MTPH
- 1998 Nashville Tennessee 350MTPH
- 1999 New Orleans Louisiana 350MTPH
- 1999 Houston Texas 350MTPH
- 1999 Cincinnati Ohio 350MTPH
- 1999 Vicksburg Mississippi 350MTPH

Increased annual throughput

The ultimate goal for the upgrade of all of these terminals was to increase the annual throughput that was driven by an increase in demand. This high capacity per year requirement can "theoretically" be handled at any given terminal. The higher capacity unloading system is necessary when looking at a high throughput terminal. The high capacity can help to adjust for the shorter length of the unloading season that is experienced in the cold climates, allowing stockpiling for the off-season. The higher capacities make it easier to adjust for varying cement demand during the season. The high unloading capacity also has an effect on the daily unloading hours, and staffing required meeting the lower demand in the off season. The high capacity unloader will help by not creating additional strain on the available storage facilities. In effect, the terminal operation becomes an "unload as you need it" scenario.

Maximizing Unloading Rates Using Existing Pipelines

Our main method of improvement was the implementation of the latest improvements in pneumatic technology. These improvements result in less power for both pressure and vacuum conveying systems. The information that we have gathered in our laboratory and in the field has led us to many ways of making a more efficient pneumatic unloader. These combined improvements account for as much as a 30% reduction in the power required unloading one ton of cement when compared to the same ton of cement 10 years ago.

Improvements for the vacuum system have encompassed several innovations. We made several modifications to our vacuum nozzle and piping designs to streamline them and minimize losses bends and hoses. The R&D resulted in changes in the pneumatic design which resulted in reductions in the air required and increased the amount of product that can be moved in a given diameter vacuum pipe. We have also made several changes that are helping to optimize the operational sequencing of the unloader. These improvements have resulted in much higher vacuum system phase densities, which account for as much as a 25% increase for product that can be conveyed in same diameter vacuum line, with less air.

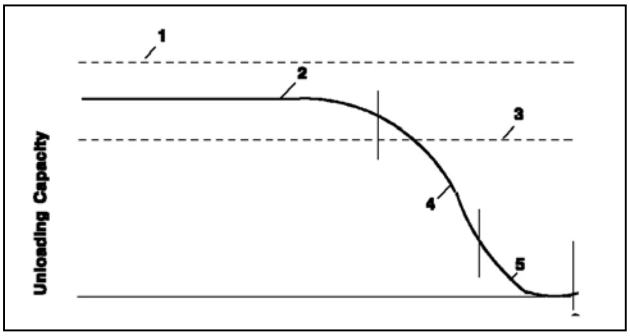
Dockside Transfer Vessel

Even larger steps have been made through R&D for the pressure conveying systems. Our improved discharge system design has started almost 10 years ago when we implemented a new transfer vessel design that revolutionized the amount of product that we could feed into a pressure convey line. We found that the main limitation that restricted the capacity of a given pipeline was the limited amount of cement that could be fed into the pipeline. Since then, we have learned how to use improved air distribution within the transfer tanks that allows us to have complete command of this critical function. We now even see others copying this innovation. This capability allows for optimization of the discharge system for the specific site where it is being operated. This design, along with other recent developments, has helped us to minimize the air requirements of the conveying system, and achieve much higher phase densities. To date, we have been able to convey as much as 50% more product in same diameter pipeline, as we were only 10 years ago.

No matter what type of unloading system you are using, or what Rated capacity it may have, the rated capacity is not attainable unless it is used efficiently. There are so many factors that affect the Through-The-Barge capabilities of an unloader, and many of them are difficult to overcome or improve upon. The following chart gives an indication of the capacity trend that occurs during the unloading of a ship or barge.

TYPICAL CAPACITY GRAPH

1. Rated Capacity line
2. Maximum Capacity phase of unloading. (No obstacles are encountered)
3. Average Capacity line.
4. Clean-up phase, End of the barge is reached.
5. Total unloading time, including clean up



Barge & cover handling equipment

Of all the operations that affect the unloading efficiency of a barge unloading, none of them is as critical as the losses due to the type of barges. Barge cover removal and replacement can consume a large portion of the total time for unloading a barge.

Typical Total Unloading System Layout

Typical cover handling times for roll top barges are about 1/2 to 1 hour per barge (if the covers are in good condition!) and 1.5 to 2 hours per barge for lift off covers. The effective time required to perform these operations can be reduced by optimizing the physical and operational arrangement of the unloader and the entire unloading system to maximize operational efficiency.

The complete system layout is an important factor in the effectiveness of the overall unloading operation. The proper layout should incorporate many different features, but a prime factor is to reduce the amount of time spent removing covers, and moving the barge. The proper layout starts with proper placement of the unloader. Barge mooring winch placement and operation patterns need to be fully analyzed to insure effective and efficient movement of the product barge resulting in little lost time. Selection of the proper hatch cover crane placement is a very important factor in minimizing lost unloading time. In addition, having an efficient way for the discharge hose to transition from the unloading platform to the shore pipeline, while at the same time allowing for fluctuation in water level, can be helpful in adjusting to the constantly changing river environment.

Barge Clean Up Operation

Another operation that affects the Through-The-Barge unloading capacity is barge clean out. If this operation is done concurrently with the unloading operation, the time lost from clean out can be cut to a very short period. On the other hand, if clean up is left to the very end, it can consume a large amount of time, and create a lot of dust because of the need to push the remaining cement longer distances.

Durability: Minimizing Maintenance, Maximum Availability

One major area of importance to the unloader operators is maintenance. We were glad to hear this since proper maintenance is important to the operation of any piece of equipment. Many times equipment of this type is used 24 / 7 and does not get the maintenance that we would like to see. When this is combined with the difficult environment that the equipment operates in it can spell disaster. In order to "allow" for this type of operation, we decided to take several steps to minimize the required maintenance time needed to properly maintain the equipment.

One way to minimize maintenance cost and lengthen the time between the required maintenance periods is to use quality components. The problem with this philosophy is that using quality components usually tends to increase the cost of the equipment. We made the decision that it was worthwhile to use these quality components and the operators and terminal management personal have agreed with our decision in almost all cases. One of the most important components, but also most expensive are the vacuum filters. In 1989, Docksider began using PTFE Membrane Filtration in all of the unloaders that were built. These filters have many design advantages, but the most notable one is the lack of visible dust emissions. The maintenance benefit of using this type of filter includes a longer operating life when compared to felt or spun bond polyester. Longer vacuum pump life and lower maintenance can be expected because of the reduced particulate passing through it.

Selection of high quality and properly applied valving can substantially reduce maintenance frequency. We continue to use pinch valves on the discharge side of the unloader, and well protected butterfly valve on the machine inlets. The pinch valve is used because it gives quick actuation and 110% open area during the discharge cycle of the unloader. The result is minimal pressure drop, lower velocities, and lower wear. The inlet valves are protected by an anti wear device which doubles as a trash collector, keeping debris such as rope and tarp from being caught on the valve and keeping it from closing.

Because of the input from our unloader operators, we use a radio control joystick pendant control for the vacuum arm. We found that the normal cable type pendant systems have a bad habit of being caught between the barge and the dock and getting "pinched" causing a failure. By applying some of the latest technology, this can easily be overcome by using a wireless pendant control. In addition to eliminating the cable pinching problems, it also gives the operator the freedom to move around to a location that is best to operate from, even down inside the product barge if needed. The unit also has the advantage of having a cable back up built in, just in case the radio transmitter failed, or experienced too much interference.

The inclusion of equipment for diagnostics via remote computer has been a standard practice on all Docksiders since 1992. The remote link has only been used a few times but when the need arises it can be a critical factor in finding a small problem with an unloader and having it back operational within a few minutes. It can also be helpful because it allows connection to an unloader that is almost anywhere in the World, and its operation can be observed so that it is possible to make suggestions about settings or other operational changes.

Conclusion

The process of designing and installing Docksider barge unloading systems is a very rewarding one. These projects stretch the envelop of bulk handling technology. Of course, it is important to work with a team that has the advantage of having developed many such unloading systems for our customers over the years, which helps to avoid the lower end of the learning curve. Consequently, you will get the best understanding of how to design and build better barge unloading systems. By listening to the operators of this type of equipment, along with understanding, analyzing, developing, and implementing the best solutions to meet the projects needs and goals, you will get the best possible system solution. Our customers are not afraid to think outside the box and push past "Accepted" limitations. This allows us to use "Other" available technology and apply It to barge unloading. In the end, we have found that we could push the pneumatic conveying technology envelope and supply a barge unloading system that far exceeds the expectations of our customers.