Willard Says……

Positioning Systems

enable operators to maneuver their suction inlets as required to dredge efficiently and productively. Components include winches, cables, hydraulics, electronics, gearboxes, control levers, blocks, anchors and spuds.

The ideal positioning system makes it possible to obey Dredge Commandment VI, *Thou shalt keep pumpable solids always before thee.*

Contract Dredging

Contract dredging is a whole other world compared to sand and gravel dredging. Contract dredges have features make them suitable for removing solids from navigation channels, harbors, lakes or other waterways to make water deeper. The solids may be silt or sand and gravel that can be easily loosened. More often, the solids are muck or clay or compacted stuff that is really tough to dig. Contract dredges use powerful, fast-turning rotary cutters to chomp most solids into chunks small enough to pass through the pump.

Contract dredges are almost always fitted out with spuds. Spuds provide the means to accurately locate and advance the dredge through the cut area in a manner that will remove unwanted solids only. Contract dredgers do not get paid for removing extra material.

The working spud establishes a pivot point about which the dredge swings in an arc crowding the cutter into the solids at a controlled rate to feed solids into the suction inlet. The cutter is forced to cut because the swing cable is pulling sideways, the weight of the ladder is bearing downward and the fixed spud pivot prevents movement in any other direction outside the arc. The contract dredge operating procedure closely resembles the manner in which milling machines are used to remove metal or wood.

Starting at the top of the solids bank and working downward, the cutter loosens solids layer by layer in successive passes. Usually, production takes place while swinging in only one direction because the cutter basket cuts in only one direction. Production on the backswing is zip, nada, zero. When the desired depth is reached, the dredge is advanced about one cutter basket length and the procedure repeated.

I gather that the background and experience of most dredge manufacturers is what prompts them to recommend contract dredging procedures to their sand and gravel mining customers. To put it charitably, the results are often less than satisfactory.

Sand and Gravel Dredging

Sand and gravel mining is best conducted by keeping the digging device at the bottom of the bank of solids to cause a thorough mixing of particle sizes as they tumble down to the suction inlet. This procedure insures that a relatively uniform mixture of solids particles will be fed into the process plant.

The mining of sand and gravel from the bottom of the deposit contrasts markedly with contract dredging. Unless the solids bank has a very uniform particle distribution top to bottom, removing solids in layers will cause a wide fluctuation in the size of particles flowing to the process plant. Process plants are most efficient when they are fed with a mixture containing a relatively constant gradation of particle sizes. For this reason it is preferable to mine sand and gravel by pumping it all from the bottom of the a deposit.

How Not to Mine Sand and Gravel

Attempts to utilize contract-dredging procedures to mine sand and gravel from the bottom of the material bank poses difficulties. Operators are instructed to use the same swing-in-an-arc about a spud or a tail line anchor procedure while keeping the suction inlet at the bottom of the solids bank. They are supposed to vary swing speed as required to support the desired rate of production and make a uniform cut. The problem occurs because cave-ins do not fall in uniform quantities with the result that the toe of the material bank is very irregular which frustrates the operator because he cannot develop a smooth and constant swing. A constant swing is impossible when the cutter has to work close enough to undercut the bank to cause cave-ins and at the same time work through the sometimes large banks of material lying in the cutter's path.

Using a spud-equipped dredge to mine sand and gravel from the bottom of even a relatively shallow deposit —20 feet or so—is…well...awkward. As explained above, cave-ins make the cut area uneven and prevent the smooth swinging procedure from being used. Production is uneven and therefore less than it could be. Advancing a spud-equipped dredge wastes time that would be used to pump solids if a 3 or 5-wire positioning system was in use. All that stumping around to position the dredge seems such a waste.

The automated dredges that I have observed are programmed to mimic the contract-dredging procedure. The operator does not have to do much but I have not seen any remarkable rates of production either. Appears to be rather hit and miss.

If the contractor dredge has a three-wire positioning system, production will increase immediately if operators are instructed to forget about trying to swing more or less continuously. Instead they should concentrate on keeping the suction inlet in the solids bank always working the cutter down to the floor depth, then crowding the cutter sideways perhaps only a few inches to maintain vacuum. They should pick up the suction when they cannot swing sideways and then work it back down. This solution requires little more than a change in procedure.

There are a few situations where spud-equipped dredges work well for sand and gravel mining. See *Willard Says……***Spud-Positioning** for more information.

Continuous, peak production requires that suitable positioning system components be located and used effectively. In this and related papers about positioning systems we will explore what works and what doesn't. As always, the goal is to cause the continuous flow of a high-density mixture through the discharge pipeline at the target velocity. Accomplishing that goal means that the suction inlet must always be positioned where it needs to be to take in solids at the required rate.

A high-density mixture will enter the suction inlet only if:

- An effective digging device is fitted to the suction inlet.
- A continuous, ample supply of pumpable solids is available at the suction inlet.
- An effective positioning system can move the suction inlet as required.
- Positioning system controls are convenient to the operator and easy-to-use.
- The dredge is fitted with instruments that inform the operator when and how much to move the suction inlet.
- Dredge operation follows a mining plan.
- The dredge is capable of delivering the flow to discharge.
- The operator understands the instruments.
- The operator knows how to use the positioning system to maneuver the dredge properly.
- The operator actually does what is required.

*Willard Says……***Winches** explains why hydraulic-powered winches are preferred for dredge positioning systems.

Mining Plan

Productive dredging requires that a mining procedure be developed and followed. Positioning procedures should be studied to determine which will be the most effective. Experiment to find the best distance to advance the dredge. How deep should you go? A plan should be written down and communicated to all operators so that everyone can proceed toward a common goal in the most efficient manner. What area is going to be mined next? Are all operators following the plan? A successful mining plan depends on selecting and using the correct positioning system.

Cave-in material from high banks will flow out behind the suction inlet so it is desirable to use a positioning system that makes it convenient for the operator to back the dredge up and mine this material.

*Willard Says……*Positioning Systems

Take the following factors into account when selecting a position system:

1. Short advances provoke small cave-ins. Often these cave-ins require little or no reaction by the operator, only to wait for the material to be pumped away, perhaps lifting the cutter slightly.

2. Short advances provoke small cave-ins. Safety and production benefits result when the possibility of large, suction-burying, ladder-sticking cave-ins is reduced.

3. Using the appropriate positioning system and following a precise digging pattern will help assure that most of the desirable material will be recovered from the deposit.

Several positioning systems are discussed in other papers:

> *Willard Says……***Stiff-Pipeline Positioning** tells why this system causes more problems that it is worth.
>
> *Willard Says……***Three-Wire Positioning** describes the most popular and effective system.
>
> *Willard Says……***Five-Wire Positioning** details how this arrangement can be used to overcome some of the problems that limit the effectiveness of the Three-Wire System.
>
> *Willard Says……***Spuds** explains the good and the ugly about how this system often actually prevents productive sand and gravel mining.

Study the benefits of each system and see if you are using the one that is most productive for your dredge and deposit. The correct system, properly used, will enable your operator to keep the suction inlet in the solids without interruption. Good production will follow.

Comment, question, criticism, information on products mentioned? Contact
willard@willardsays.com