Willard Says……

Controlling Pipeline Velocity

is the *most important* factor among several that affect sand and gravel hydraulic dredge production and system efficiency.

Case History

Company "A" bought a "new, reconditioned" dredge. This collection of used, abused, ill-matched, obsolete components was slapped together by a bunch of carpenters and covered with a coat of new paint. (Remind me to tell you what I really think about "reconditioned" dredges sometime.) The first year, production was disappointing when not interrupted by persistent breakdowns of the "new, reconditioned" equipment. The next year, determined and desperate to improve production, "A" shortened the discharge pipeline and put a newer impeller in the pump. (They would have put in a new impeller until they found them to exist in the same abundance as the extinct dodo bird.)

Surprise, surprise, production did change…it went down—from poor to pitiful.

We were invited to take a look at the problem. An engine guru blamed the dredge pump for overloading the engine. A pump "expert" said that the engine was laying down on the job. As it turned out, both parties were correct in their observations.

"A's" operator, heeding the instructions of the same incompetents who sold them the dredge, was using the "hotrod theory" of dredge operation. This, not uncommon recommendation, teaches that the only way to pump is to run the engine wide open under any and all conditions. In this case, the engine would not go over 1500 rpm, which was slower than before with the worn impeller and longer pipeline. Also, now the velocity was over 23 feet per second, the clear water vacuum was a whopping 16 inches and production sputtered along at about 75 tph. The solids arrived at the plant riding in a veritable flood of water.

It was obvious that the pump was moving much too much water; the cause of engine overload. After being put into practice, the solution to the problem caused engine and pump to become a matched team working in complete harmony. The dredge began to operate within its capabilities and produce sand and gravel at a rate sufficient to fill the process plant.

What was the magical solution? They i*nstalled* and *use* a velocity meter to control pipeline velocity.

> Using the new velocity meter, “A’s” operator was able to slow the engine down to 1350 rpm and maintain a target velocity between 12 and 14 fps. This resulted in the reduction of clear water vacuum to about 7 inches, enabled production to rise to about 300 tph and reduced the torrent that previously poured into the plant to a manageable flow. All of that good news was accompanied by a substantial decrease in energy consumption and pump/pipeline wear rate.

This is not an isolated case. Sadly, many dredge owners suffer for years from problems caused by high-velocity operation. They are dissatisfied with production, assume that that is just the way it is, seek and get bad advice, miss out on a ton of profit, become discouraged (or broke) and sell their dredge. It happens time after time. It is impossible to over-emphasize the importance of good pipeline velocity management.

Velocity Facts:

- Sand and gravel dredge operation is most efficient and productive when pipeline velocity is maintained at a target velocity, a rate that is about 20 percent faster than the critical velocity.

- Critical velocity is the flow rate at which solids start to fall out of the flow and form a bed on the bottom of the pipeline.

- There is <u>no</u> one, rule-of-thumb, critical velocity that fits all situations. Critical velocity in a pipeline varies with:
  Slurry density.
  Solids particle size.
  Pipe size.

- Pipeline length does not affect the critical velocity. The critical velocity remains the same whether the pipeline is 60, 600 or 6,000 feet long as long as the three conditions listed above remain constant.

- When the pipeline length becomes so long that the pump(s) cannot maintain the target velocity the only solution is to reduce production (density). This change lowers the critical velocity so that production can continue at a reduced rate and a slower target velocity.

- The critical velocity for a particular dredge system must be determined by experimenting and that cannot be done without a velocity meter.

- The velocity meter is an operating instrument. Borrowing a velocity meter to “check the velocity” is fruitless exercise. Velocity is dynamic—it varies constantly—so the operator must have a full time velocity indicator.

Operating Rules of Thumb:

A. Pipeline velocity varies with pump speed if density and particle size distribution remain constant.
B. Pipeline velocity varies with slurry density if pump speed and particle size distribution remain constant.
C. Solids production remains nearly constant if pump speed and velocity and particle size distribution remain constant.

Velocity Meters

Doppler type velocity meters are relatively inexpensive (less than $3,000), widely used and entirely suitable for use on most sand and gravel dredges. Do not waste money on models with two or more sensing heads. Do not buy a meter that offers the means to calibrate the instrument. It is difficult to calibrate an instrument when there is no standard to calibrate against.

Doppler type meters are not particularly accurate, however, their repeatability is adequate for sand and gravel production.

Magnetic velocity meters are relatively accurate, subject to wear and expensive ($9,000 or more depending on pipe size). Use a magnetic meter when precise flow control or solids production measurement is required.

Velocity Indicators (meters)

<u>Always</u> provide the operator with an ANALOG indication of velocity. That means a dial with a needle or a bar graph display.

<u>Never</u> provide a digital (numbers only) readout for use as an operating instrument. Digital is OK for a fuel tank gauge, hour meter, depth gauge or similar non-dynamic indicators.

Velocity is a critical operating factor and the operator should be constantly aware of the rate as well as any changes in the rate of flow. A glance at an analog display shows whether the rate is steady, increasing or decreasing without performing any mental gymnastics. Not so with digital displays: they require mental gymnastics.

Currently, anything digital is the cat's pajamas; cutting edge; better; faster than what was before…but not for this application. Digital readouts require the operator to calculate if or how much the indicated value differs from the desired value each time he refers to it. Repeated, frequent calculation is needed to detect each change in the rate of flow; the direction of change; and the speed of change.

Do not burden the operator with a digital display—he may choose to ignore it to avoid cerebral exercise.

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