# *Willard Says……*

Good stuff to know about hydraulic dredging.

## The Discharge Pipeline—Steel or Plastic?

"Plastic" pipe is HDPE (High Density PolyEthylene)—the black stuff.

There are several factors to consider before deciding which type of pipe to select:

- Slickness
- Wear life.
- Cost.
- Flotation.
- Inside diameter.
- Pressure rating.

### Which is slickest, steel or plastic?

Several "authoritative" sources maintain that plastic pipe is slicker and offers less resistance to flow than steel. Some old dredgers opine that they have seen for themselves that plastic "pumps" easier than steel because that was their experience after they changed out steel for plastic pipe. What they failed to note was that the inside diameter the two pipes was not the same—the plastic was larger. Pipe diameter has a much greater effect on friction loss than the material used to manufacture the pipe. If the inside diameter of the plastic pipe that replaced the steel pipe was larger, the plastic pipe did indeed "pump" easier.

On the other hand if, as frequently has happened, the inside diameter of the plastic pipe is smaller than the old steel pipe (the outside diameters being the same) the old dredgers will be swearing a blue streak about how "hard" the plastic pumps.

"Slick" plastic is a misnomer and I will tell you why.

According to the "bible" of hydraulic flow, *Cameron Hydraulic Data*, the Hazen and Williams Formula is widely used to calculate the pressure (head) loss due to friction of water flowing through pipes made of various materials. To use this formula one has to enter a value for the Friction Factor "C". The value varies to account for the roughness of the inside wall of the pipe being considered.

The "C" number for clean new plastic pipe is 150, 130 for clean new steel pipe and just for your information: 60 for corrugated pipe. The larger the "C" number the smoother the pipe wall. These numbers can be entered into a formula to calculate the friction loss in a pipe. The frictional resistance to flow is less in pipes with high numbers so plastic pipe would seem to be the best choice since its "C" number is higher than that for steel. Note that the values are for flowing clear water.

New, slick plastic soon loses its slick because dredgers insist on putting gritty sand and sharp rocks in the water before running it through the discharge pipe.

Run your hand along the inside of a new HDPE plastic pipe. Slick huh? Now run your hand along the inside of a used HDPE plastic pipe. Rough huh? That once-shiny surface is now scraped and scarred. Snippets of flow-impeding plastic protrude from the wall which means that the slickness "C" number is now somewhat less that it was when the pipe was new.

Run your hand along the inside of a recently used steel pipe. Note how smooth it is. Smooth as a baby's butt. There is no way the plastic pipe is slicker than steel after it has served to transport sand and gravel.

My view is that the friction losses are practically the same in plastic as they are in steel pipe assuming that the inside diameters are the same. I think that a "C" number of 120 is about right for dredge pipe steel or plastic.

## Plastic Pipe Wear

The best way to determine if there is an economic advantage to using plastic pipe is to actually try a section of it in the dredge system pipeline. The following conditions tend to shorten plastic pipe wear life:

- A large percentage of oversize (plus 1-inch) rock.
- Sharp-edged sand and rock particles.
- Higher than necessary flow velocity.

## Steel or Plastic Pipe?

**Plastic pipe advantages:**
Large selection of sizes.
May not require expensive floats to support it in the water.
Flexible so fewer dredge sleeves are needed.
Cost?

**Plastic pipe disadvantages:**
Requires a fusion machine to join the sections
May not resist wear as well as steel.
Limited pressure rating.
Cannot be repaired.
Disposal problem.
Cost?

## Pipe size selection

Plastic pipe offers the advantage of a wider selection of inside diameters than is available using standard steel pipe. Table 1, page 2 in **WillardSays**…*Pipeline…How Far Can a Pump Pump* lists a selection of steel and plastic pipes with diameters that are commonly used for dredge pipelines.

Usually, increased production and efficiency can be obtained by using a dredge pipe that is up to about 20 percent larger in cross-sectional area than the dredge pump discharge nozzle.

## Steel Pipe

If conditions prohibit the use of plastic pipe on a small dredge (10-inch and under), it is best to use steel pipe that has the same inside diameter as the dredge pump discharge nozzle. The cross-sectional areas of steel pipes are:

| | |
|---|---|
| 6”—29 square inches | 8”—50 square inches |
| 10”—79 square inches | 12”—113 square inches |

Jumping from steel 6-inch to and 8-inch pipeline would require that the flow of water through the pipeline be increased 73% (50/29) to maintain velocity equal to that in a 6-inch pipe. Few 6-inch dredges have enough power to make that happen.

It is not recommended that an 8-inch dredge discharge be jumped up to a 10-inch steel pipe because that would require a 58% (79/50) increase in flow. Likewise, jumping from 10-inch discharge to 12-inch would call for a 43% (113/79) increase in flow. Using 14” steel pipe on a 12” (an area increase of 22%) pump discharge is usually OK, however, jumping from a14” discharge port to 16” steel pipe, an area increase of 33% is usually not successful.

## Plastic Pipe

One frequent mistake dredgers make is to buy the wrong sized HDPE pipe. They end up with pipe with the wrong inside diameter because they buy pipe with the wrong outside diameter.

The mistake comes from not knowing how HDPE pipe is sized.

HDPE pipe is specified by its outside diameter followed by an SDR number. The nominal outside diameter of a given size HDPE and steel pipe are the same.

The SDR (Standard Dimension Ratio) number specifies the wall thickness of HPDE pipe. HDPE pipe wall thickness is found by dividing the outside diameter of the pipe by the SDR number.

As an example, 8-inch, HDPE SDR13.5 pipe has the same outside diameter as steel pipe—8.625 inches. The wall thickness is the diameter 8.625" divided by the SDR number 13.5. In this case the wall thickness is 8.625"/13.5 = 0.639 inches. The outside diameter minus twice the wall thickness gives an inside diameter of 7.35 inches. If you buy this pipe to replace 8-inch steel pipe, a very common error, you end up with a pipeline that is about 19 percent smaller in cross-sectional area.

Be especially attentive to the pressure rating when selecting a plastic pipe. The pressure rating is associated with the wall thickness. Dredge pipeline pressure can exceed 100 psi and many of the thinner-walled plastic pipe sizes may not be rated for use at that pressure. Be aware that wear will diminish the wall thickness of plastic pipe and reduce its pressure rating.

Selecting a plastic pipe is more complicated than choosing a steel pipe. Buying a plastic pipe of the same nominal diameter as the pump discharge nozzle is almost always a mistake. Almost always the correct choice is to buy plastic pipe one size larger than the pump discharge nozzle and select a wall thickness (SDR) that will provide an inside cross sectional area that is about 20% greater than the pump discharge port.

The most important factor is the ***inside diameter.***

## Tailor-Made Steel Pipe

Naylor Spiralweld steel pipe is available in numerous combinations of diameter, wall thickness and alloy to meet specific needs that cannot be met using standard steel or plastic pipe. Naylor pipe is available with their Wedgelock grooved pipe ends and connecting collars. Pipe connection is simple requiring only a hammer to assemble or disassemble.

Contact willard@willardsays.com with questions, comment or criticism.