Pipe Friction Loss Testing of 6-Inch Steel Pipes With and Without DragX

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Abstract

Utah Water Research Laboratory (UWRL) was commissioned to perform independent 3rd party friction loss performance testing on 6-inch standard, uncoated steel pipe followed by testing on samples of 6-inch standard steel pipe with DragX. The testing was completed to determine the friction loss characteristics of the pipe and make comparisons of the surface conditions. **At a Reynolds number of 10^6, DragX reduced the friction loss in the pipe by 20% when compared to new carbon steel.** Non-pristine bare pipe would yield an even higher friction discrepancy.

Description

Oceanit provided the samples to test which included 60 feet of uncoated 6-inch standard schedule steel pipe, and 60 feet of DragX-treated 6-inch standard steel pipe.

The pipe sample was installed in a test line with the following set up.

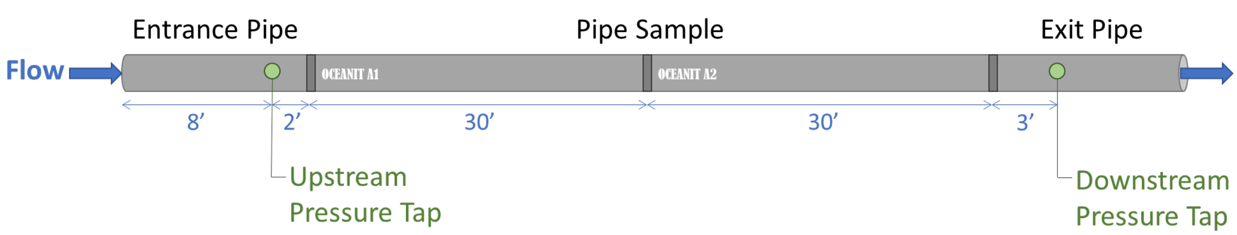

Figure 1. 6-inch steel pipe test installation (flow left to right).

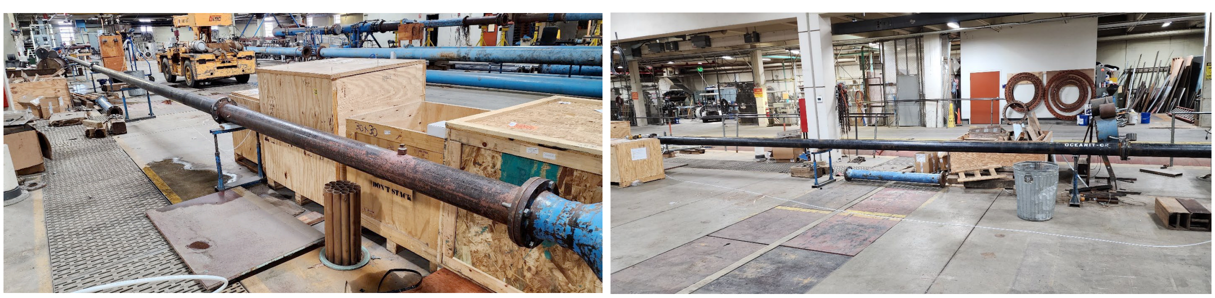

Figure 2. 6-inch steel pipe test installation (flow left to right).

Flow was provided using a 100-horsepower pump and was measured using a calibrated flow meter. The pressure in the line and head loss due to friction were measured using Rosemount differential pressure transmitters. The water temperature was measured using a traceable thermometer.

Each installation was tested over a range of flows sufficient to generate approximately 3 ft/s to 30 ft/s average velocities in the pipe. 10 data points were taken over this flow regime. The Reynolds number and the friction factor were calculated and plotted.

The relationship between the Reynolds number (*Re*) and the friction factor was assessed. The Reynolds number is given by:

$$Re = \frac{VD}{\nu}$$

Where *V* is the velocity in the pipe and *D* is the diameter of the pipe, and *v* is the kinematic viscosity of the test fluid.

And the friction factor by:

$$f = \frac{2gDH_f}{LV^2}$$

Where *g* is the acceleration of gravity (32.174 ft/s2), *D* is the inside diameter of the tubing, *Hf* is the head loss between the pressure taps, *L* is the length between the pressure taps and *V* is the average velocity in the pipe.

DragX showed a significant reduction in the friction factor resulting in less friction than the bare sample by approximately 20% at the maximum Reynolds number. Furthermore, it is evident that the friction factor was continuing to be reduced with increasing Reynolds number. What this implies is that, with DragX, the pipe is performing as though it were hydraulically smooth. It is expected that until the wholly rough condition prevails in the pipe, that the friction factor would continue to reduce.

At the smallest Reynolds number range, there is some variability of the pipes. However, due to the small velocities and subsequent low pressure loss, this data does not carry as much weight as data at the higher Reynolds number where high velocities and subsequent friction losses are much greater. It is at the higher velocities where energy consumption and losses increase relative to the velocity of the flow squared.

Table 1. DragX in comparison to pristine pipe for friction reduction.

	% Friction Reduction with DragX Compared to:
Extrapolated Pipe Reynolds Number	Pristine Steel
$1x10^6$	20.03%
$5x10^6$	33.44%
$10x10^6$	38.50%
$40x10^6$	47.49%

Typically, new steel pipe has a pipe roughness of approximately 0.0018 inches. The new steel pipe roughness using the Colebrook-White equation to match the laboratory data resulted in a roughness of 0.0016 inches which is consistent with published values. Using this equation, **DragX yielded a pipe roughness of 0.00028, an 82% improvement over bare steel.**