Successful Pipeline Cleanouts Using Jointed Pipe

WORKSTRINGS™

Challenge

Paraffin and asphaltene deposition, along with hydrate formation, can often lead to expensive and time-consuming efforts in attempts to cleanout pipelines and restore flow assurance. Multiple cleanout runs and remediation efforts are often needed to adequately cleanout the pipeline, costing the operator millions of dollars through the cost of equipment, rig time, and loss of production.

Coiled tubing is often the first deployment for cleaning out pipelines due to the initial associated cost, ease of rigging up the coiled tubing unit, and the less complicated setup compared to a snubbing unit/hydraulic workover unit (HWO). Though coiled tubing is slimmer, smaller, and more flexible than jointed pipe, it also has limitations that can prevent a successful cleanout run including the limited circulation ability due to the smaller ID, lack of stiffness leading to buckling, and difficulty in rotation, all of which can affect the ability of the coiled tubing in achieving a successful cleanout and reaching the total depths required.

Solution

Over the past 15 years, Workstrings International has designed and modeled numerous successful pipeline cleanout strings for operators and snubbing/HWO service companies looking to use jointed pipe to cleanout their pipelines. By using jointed pipe in conjunction with a snubbing unit, many of the limitations of coiled tubing can be avoided and the cleanout can become a more cost-efficient operation due to the speed and efficiency in reaching the desired cleanout depths which are 4-5 miles laterally with the ability to snub, push, and rotate the pipe.

Working in consultation with the operator and snubbing/HWO service workover teams to ensure operational demands are met while allowing for the greatest safety factor, Workstrings Engineering cleanout string designs have been used to cleanout pipelines with actual depths reaching as far as 28,789 ft. and with pipeline internal diameters as small as 4.0 in. For several of the pipeline cleanout designs, calibration work was done by Workstrings to improve accuracy of the modeling, allowing for a greater degree of certainty when modeling the pipeline cleanout string, and determining optimal operational parameters. This calibration modeling has supported operators during real time operations.

Common challenges when designing pipeline cleanout strings using jointed pipe include diameter limitations of the pipeline, trajectory of the pipeline, torque capacity issues if reaming through hydrate and paraffin accumulation is necessary, riser to pipeline transition, and limiting the degree of buckling as much as possible. These pipeline cleanout operations have been successfully performed from both platform facilities and intervention vessels.

> **"Use of HWO Units and jointed pipe have saved operators millions of dollars in service costs and getting production back online as quickly as possible."** - John Hardy, VP of Operations, International Snubbing Services

Results

Across all pipeline cleanout string designs provided by Workstrings Engineering, each design has proved successful with positive feedback being generated by the operator and snubbing/HWO service company, with the most recent pipeline cleanout string designed by Workstrings Engineering being used to set a new offshore snubbing/HWO world record for the longest subsea pipeline cleanout by reaching 28,789 ft. actual depth, using a 2-7/8" CTM26 and 2-7/8" PH6 tapered cleanout string and conducted onboard the Helix Q4000 Intervention Vessel. The highlight of this operation was to successfully clean out the flowline from the Q4000 rather than cutting the flowline up into sections which has been performed previously on long flowlines such as this one. This significantly reduces the number of critical subsea lifts, the HES exposure and overall timeline for the flowline abandonment. The flowline was lowered subsea with the deployment rigging and drill string where it was laid back in the original trench on the sea floor. This is another benefit of being able to perform the full cleanout in a single lift and requires the least amount of onshore disposal of flowline components

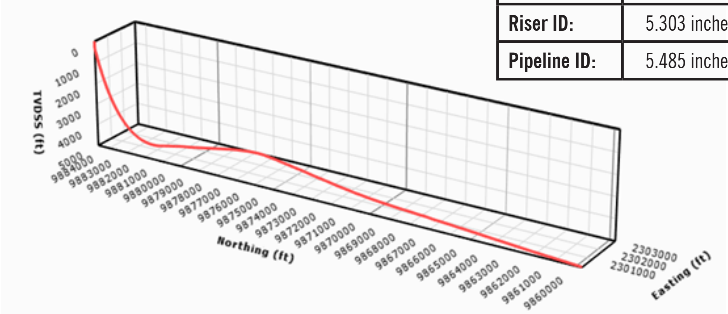
Common Workstrings International pipe used for pipeline cleanout operations is shown below in **Table 1**, with tapered strings often being used to provide the optimal design.

Workstrings International Pipe Used for Pipeline Cleanout Operations						
OD (in)	**Connection**	**Grade**	**Wall (in)**	**Nominal Weight (lb/ft)**	**Max MUT (ft-lbs)**	**Premium Tube Tensile (lbs)**
2-3/8	PH-6	P-110	0.254	5.95	3,400	145,371
2-7/8	PH-6	P-110	0.276	7.90	4,400	194,099
2-7/8	CTM26	V-150	0.362	10.40	10,100	333,070
2-7/8	XT27	S-135	0.362	10.40	7,100	299,763
3-1/2	NC38	S-135	0.368	13.30	12,100	381,870
4	XT39	S-135	0.330	14.00	21,200	403,526
5	NC50	S-135	0.362	19.50	30,700	560,763

Table 1 - Workstrings International Pipe Used for Various Pipeline Cleanout Operations

An example of a pipeline cleanout string designed and modeled by Workstrings Engineering is shown below.

Example Pipeline	
TD:	29,300 feet
Riser ID:	5.303 inches
Pipeline ID:	5.485 inches



Date of Design	Vessel	HWO Unit	Type of Cleanout	TD (Designed or Actual)	ID of Pipeline
13 April 2020	Helix Q4000	SBS Energy	Pipeline Decommission	29,000' Planned 28,789' Actual	4.775"
14 May 2019	Spar	ISS	Spar Column/ Pipeline	29,283' Planned	5.125"
27 May 2015	Spar	ITS	Pipeline	21,000' Planned	5.410"
08 April 2014	Spar		Spar Column/ Pipeline	18,077'	4.000"
06 Sept 2011	Spar	ISS	Pipeline	20,555'	5.625"
04 June 2010	Spar		Export Pipeline	21,806'	16.000"
28 Sept 2005	Helix Q4000		Pipeline	25,000' Planned 23,800' Actual	6.893"

Test 3

For Test #3, twenty test coupon samples were evaluated: 10 coupons were S-135 MYS grade material and 10 coupons were V-150 MYS grade material. Test #3 used only the higher-grade materials for the coupon samples without the weld area; used a controlled method of damaging the coating; and tested one sample from each category at a lower temperature (4ºC/39°F) equivalent to the sea floor temperature which would be a harsher environment than room temperature ~21ºC/72ºF.

Testing was performed using test Solution D 7.0% H_2S. Stress level was set to 80% of minimum yield strength. Half of the coupons in each group were tested at room temperature (NACE testing is typically 21ºC/72°F). The other half were tested at 4ºC/39°F to simulate temperature at the sea floor. Total test time of 720 hours with elapsed failure time documented where applicable.

Test #3 Results V-150 MYS 7% H_2S

Specimen	Type of Coating	Coating Condition	Temp (F)	80% Stress Level (ksi)	Test Results	# Hours at Failure
1	Uncoated (Control)	NA	39	120.0	Failed	343.3
2	Uncoated (Control)	NA	70	120.0	Passed	N/A
3	Rust Grip®	Perfect	39	120.0	Passed	N/A
4	Rust Grip®	Abraded 6.3%	39	120.0	Passed	N/A
5	Rust Grip®	Perfect	70	120.0	Passed	N/A
6	Rust Grip®	Abraded 6.3%	70	120.0	Passed	N/A
7	TK-34XT™	Perfect	39	120.0	Passed	N/A
8	TK-34XT™	Scratched 3.8%	39	120.0	Passed	N/A
9	TK-34XT™	Perfect	70	120.0	Passed	N/A
10	TK-34XT™	Scratched 3.8%	70	120.0	Passed	N/A

NACE Test #3 Results. V-150 Samples, Solution D (7% H_2S)

Test #3 Results S-135 MYS 7% H_2S

Specimen	Type of Coating	Coating Condition	Temp (F)	80% Stress Level (ksi)	Test Results	# Hours at Failure
11	Uncoated (Control)	NA	39	108.0	Passed	N/A
12	Uncoated (Control)	NA	70	108.0	Passed	N/A
13	Rust Grip®	Perfect	39	108.0	Passed	N/A
14	Rust Grip®	Abraded 6.3%	39	108.0	Passed	N/A
15	Rust Grip®	Perfect	70	108.0	Passed	N/A
16	Rust Grip®	Abraded 6.3%	70	108.0	Failed *	12.4*
17	TK-34XT™	Perfect	39	108.0	Passed	N/A
18	TK-34XT™	Scratched 3.8%	39	108.0	Passed	N/A
19	TK-34XT™	Perfect	70	108.0	Passed	N/A
20	TK-34XT™	Scratched 3.8%	70	108.0	Passed	N/A

NACE Test #3 Results. S-135 Samples, Solution D (7% H_2S)
* Mechanical failure caused by poor threads

Conclusion

This NACE testing project proved positive results for the tested coatings in that all Rust Grip™ samples passed and all TK-34XT™ samples passed even when scratched or abraded*. The #3 test using coupons from higher grade material, 135ksi MYS and 150ksi MYS, and at a lower test temperature 4ºC/39ºF demonstrated a harsher environment and resulted in all samples passing. These results show that the coatings create a barrier between the metal and the environment. In all 3 tests, there were failures in the Uncoated Control coupons. For milder sour service environments, Region 1 and Region 2, the coatings could be beneficial for deploying higher grade tubulars for operations, especially in conditions where higher strength tubulars are required, and no sour service options are readily available. This can lower the total cost of ownership for the operator by using available tubulars with proper coating protection.

These coatings have proven themselves extremely successfully as barriers to corrosion in standard environments of salt-based fluids from seawater to heavy completion fluids with no additional chemicals. With the benefit of both the internal and external proven coatings, the NACE testing demonstrates additional benefits as a barrier when exposed to a sour service environment. When the environment is controlled by pH and scavengers, the potential for improved mitigation is increased.

Note: The coating manufacturers are not promoting these coatings as sour service products. There will always be imperfections in the coating process and imperfections due to normal handling and operations. The operator must always evaluate the risk in these environments. The testing will benefit the operator in developing the risk analysis.

**Specimen #16 failed due to poor threading and was noted by the test lab early in the test and should be disregarded.*

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