

Pigging Industry News

the newsletter of the Pigging Products & Services Association



PPSA seminar: 19 November, 2008, Aberdeen

THE PPSA is holding its annual pigging seminar and exhibition in Aberdeen on 19 November, and once again it is proving very popular with delegates. Bookings are coming in well and already the Marcliffe Hotel has filled all the rooms we reserved for delegates. However, we have reserved extra rooms at nearby hotels, details of which are available from the Secretary.

To book your place please visit our site at www.ppsa-online.com and click on the PPSA Seminar box at the top left hand side of the home page. ●

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Industry news

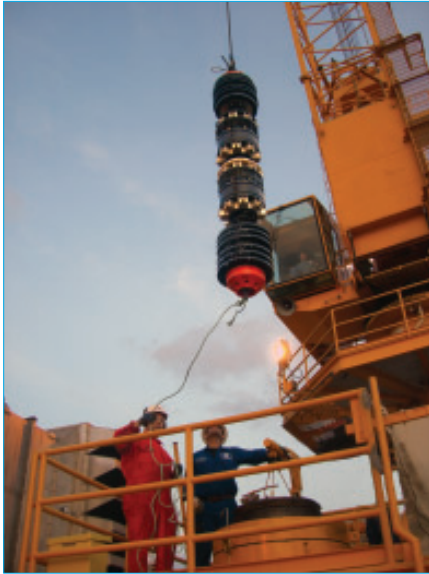
Expanding horizons: NDT extends its services

HOUSTON-based **National Oilwell Varco** (NOV) and **NDT Systems & Services AG** of Stutensee, Germany, have announced that NDT has purchased the global pipeline inspection business of NOV's affiliated company, **Tuboscope Pipeline Services** (TPS), and will integrate it into its global pipeline inspection activities. NDT and TPS have been co-operating in a very successful strategic partnership since 2002, and have now decided to take this co-operation to the "next level" in order to meet future market requirements.

Bringing together the expertise and experience of both companies provides NDT Systems & Services with the resources and capabilities to excel and show its full commitment to the global pipeline industries. TPS' experience extends well over 40 years, and NDT Systems & Services – founded in 2000 – is well respected in the industry for its technology, focus on quality, and strong commitment towards research and development. The newly-expanded NDT Systems & Services remains fully committed to being a technology leader, providing a full range of quality in-line inspection and related services and building long-term relationships with its customers and suppliers.

Speaking as the new arrangement was finalized, Alfred Barbian, CEO of NDT Systems & Services AG, said: "This is an extremely good way forward for all

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TDW's SmartPlug being lowered into the riser.

Mississippi Canyon Block 920 that had begun to leak in April.

Safe and timely repairs were essential on the leaking subsea joint due to the important role of this export riser. The platform has the capability of handling more than 10% of the gas transported from the Gulf of Mexico. Located approximately 26m below sea level, the flex-joint allows the riser to withstand the movements of the platform. In order to facilitate the riser repair, Enterprise engaged TDW to isolate this flex-joint assembly, with its piggable, tetherless, SmartPlug isolation tool.

The platform riser had previously been assessed by TDW for possible isolation with its remote-controlled high pressure pipeline isolation tool, which allowed TDW quickly to mobilize a double-block module 20-in tool to the platform where it was temporarily installed in early May. The tool was launched and pigged (pumped by water) into the riser just below the flex-joint, and this allowed Enterprise to maintain pipeline pressure downstream of the joint. With ambient pressure above the flex-joint, divers then replaced the O-ring gasket subsea and then after resealing, the entire riser was successfully pressure tested, after which Enterprise was able to resume the gas flow through the riser. The entire isolation operation was completed in just 10 days.

"This was a challenging situation for Enterprise, especially in view of the 134-mile length of the pipeline and the fact that the steel catenary riser is operating in a depth of 8,000ft of water," said

Mark Roberts, General Manager Americas for TDW Offshore Services. "The flex-joint repair was achieved without degassing and flooding the riser, and recommissioning it post repair, which would have been far more costly in terms of production downtime and marine spread cost," he added. ●

PSI news

PSI was founded in March, 2006, and it is pleased to report that its newly-developed and built equipment for hydrostatic testing, cleaning, and drying, is exceeding expectations. In particular, the company's multi-channel caliper tools for internal pipeline inspection have produced excellent results from a number of projects that have now been completed.

These include a 42-km 48-in diameter pipeline in Sicily, and the 120-km 40-in diameter pipeline from Lauterbach to Scheidt in Germany, where the company has undertaken cleaning, hydrostatic testing, drying, and caliper-surveying. Currently under progress is a project in Lingen, Germany, where the company is working on the biggest gas storage pipeline (56-in diameter, 16-km long) in Europe. ●

Flare line cleaned with nitrogen

A FLARE line at a major UK oil refinery had not been cleaned since the refinery opened in 1964 and, although the refinery operator had considered high-pressure water jetting, it required a safer and more efficient cleaning technique if possible.

For many years the flare line at this plant had been effectively

stakeholders. The greatest assets of both companies are their people, and NDT Systems & Services' new structure will provide substantial opportunities for our employees. Bringing the Tuboscope Pipeline Services activities into the NDT family ensures for us all that we can do what we do best: provide leading inspection technologies and premier services for our customers."

The Tuboscope Pipeline Services activities will be integrated into **NDT Systems & Services (America) Inc.**, a 100% subsidiary of NDT, Germany. ●

TDW completes riser isolation operation

HOUSTON'S **TDW Offshore Services** has completed a subsea flex-joint isolation operation on the Independence Trail gas pipeline for **Enterprise Products Partners** in the Gulf of Mexico. The isolation operation allowed critical repairs to be made on the flex-joint assembly of the 20-in export riser on Enterprise's Independence Hub platform in

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transporting volatile gases and sludge. When it was realized that it needed cleaning, the refinery operator engaged **Tube Tech International** to provide a solution. The flare line is 30ft above the ground, and as it is used to carry gas and sludge, its supports would have been overloaded if required to support the 1t/m of water if traditional water-pigging methods had been used. Many access points would also be required for high-pressure water jetting.

The 1.3-km long, 36-in diameter, flare line reduces to 32-in diameter at around 200m from the receiving tank termination. There are also a number of 90° 1.5-D minimum radius bends incorporating in its the thermal-expansion loops.

Tube Tech International has developed its *DrifTT* technique specifically for this type of cleaning challenge. The system uses a specially-made pig that is moved through the flare line by nitrogen. As an inert substance, nitrogen did not pose any risks when it makes contact with the pyrophoric deposits within a line. Once the system had passed through the line, a foam swab was sent down the line to clear out the loosened debris. As well as increasing the safety aspects of the cleaning, the Tube Tech system also eliminated the need to dispose of large volumes of contaminated water/oil mixture. ●

Inspection for shallow internal corrosion

OFFSHORE PIPELINES are different from their onshore equivalent, not only with regard to their design and operation but also with regard to the deterioration process of these structures. While onshore pipelines are threatened by third-party damage and external corrosion, the main threat for offshore pipelines, besides occasional anchor damage, is internal corrosion. Naturally, the accessibility of offshore pipelines is more restricted than their onshore counterparts, and these circumstances are taken into account during the design and construction of the offshore pipeline. Heavy-wall pipe – a wall thickness of 30mm is not uncommon – is used to withstand a high-pressure regime but also to allow for controlled reduction of the wall thickness during the lifespan of the pipeline.

These developments in design, construction, and maintenance of this particular sub-group of offshore pipelines have triggered the deployment of a new in-line inspection technology by the **Rosen Group**, who has developed an eddy-current-based sensor technology that is designed to provide a high-resolution and accurate image of the internal pipeline surface. Additionally, the system provides very detailed information about the internal

diameter and the internal shape such as ovality and dents in the pipe wall.

The company says that corrosion of any size with a diameter of at least 10mm and a minimum depth of 1.0mm can be detected, and internal shallow defects with a maximum depth of 10mm are sized with an accuracy of +/- 0.5mm. The compact design of this inspection tool is advantageous with regards to its pipe passage performance. The robust but flexible sensor suspension works in challenging bore or multi-diameter pipelines, and the absence of a magnetizer unit enables a low-friction application. This can be a low-flow or low-pressure autonomous pigging application, as well as a tethered tool operation. ●

Real-time pipeline monitoring

HOUSTON-based **El Paso**, one of the largest gas pipeline operators in North America, is the first Texas transmission company, and the second US firm, to install **GE Oil & Gas' PII's** advanced acoustic sensors to reduce the risk of third-party damage on an 17-km section of its pipeline system. The *ThreatScan* equipment is also designed to detect accidents involving construction machinery.

"Third-party damage is the most significant integrity threat to both

The PPSA Aberdeen Seminar 19 November 2008

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liquid and gas networks globally," said Jesus Soto, vice president of operations services for El Paso. "Installing *ThreatScan* sensors on our Houston-area pipeline underscores our continued commitment to protecting the integrity of our assets."

In 2007, **Southern Star Central Gas Pipeline** became the first US operator to install the sensors on a pipeline sector in northern Wichita, Kansas.

PII's sensors are installed at specific locations along a pipeline in order to detect vibrations that could potentially signal an actual impact or a possible encroachment along a pipeline's right-of-way. When a sensor detects vibrations, the data is immediately transmitted via satellite to GE Oil & Gas' *ThreatScan* call centre in Houston, where the vibrations are quickly analysed. The pipeline operator is then notified to investigate whether there has

been an actual impact that requires remediation or if there is a potential threat from an encroachment.

GE operates a similar call centre at its headquarters site in Florence, Italy, to support European pipeline operators who have installed the sensors. ●

Psychrometric principles of pipeline drying

by Peter Vemmelund, PSE International

THE PRINCIPLES in the dry air method of drying pipelines are simple. By blowing a low dewpoint air into the pipeline, moisture will be absorbed in the dry air stream since low dewpoint air has a low moisture vapour pressure. It is this vapour pressure difference between the air moisture content in the pipeline and the dry air moisture content which is the driving force for drying. The greater the difference, the faster the pipeline will be dried. Since the ground temperature varies, this temperature becomes the determining factor in the length of the drying period because the pipelines are in the ground. Since the pipe wall will be at the same temperature as the ground, the dewpoint of the air inside the pipe will be at the same temperature of the pipe. Therefore, the air inside the pipeline can contain more moisture when the ground temperature is higher. Pipelines can be dried faster when the ground temperature is higher.

To obtain low dewpoint air, it is necessary to use both refrigeration and desiccant technologies. Figure 1 shows the total dehumidification process. Dehumidification is defined as the removal of moisture from the air. Since ambient air is used in the dry air system, the actual moisture content of the air can vary from low in the winter to very high in the summer.

The first part of the dehumidification process uses refrigeration to chill air below its dewpoint. In the summer, ambient air has a high temperature and high moisture content, point 1 (Fig.1). Dehumidification by mechanical refrigeration is very efficient at these conditions. By passing air through the refrigeration cooling coil, which first sensibly cools the air from point 1 to point 2 (Fig.1), moisture is then removed by condensation, from point 2 to point 3 (Fig.1). Normally the air is cooled to approximately 2°C: below this temperature, condensed moisture

would freeze up on the cooling coil and the dehumidification would stop.

The mechanical refrigeration process occurs in a closed, pressurised loop in which a refrigerant such as Freon is circulated through a compressor, condenser, expansion valve and evaporator. A schematic of this system is shown in Fig.2.

The final part of dehumidification is accomplished by using a desiccant dehumidifier in which the desiccant – HPS – is used to absorb moisture from the air stream after it passes through the cooling coil. Since the air stream is cool and saturated, the desiccant is very efficient at removing moisture and this reaching the final dewpoint of -40°C. This part of the dehumidification process is shown in points 3 to 4 (Fig.1). Moisture is removed from the air stream in a vapour phase and is not condensed as in the refrigeration process; therefore, the desiccant dehumidification can work at any temperature without freezing up.

HPS is impregnated into a 'honeycomb' wheel that rotates at 8 to 10 revolutions per hour. The wheel rotates continuously between the process or

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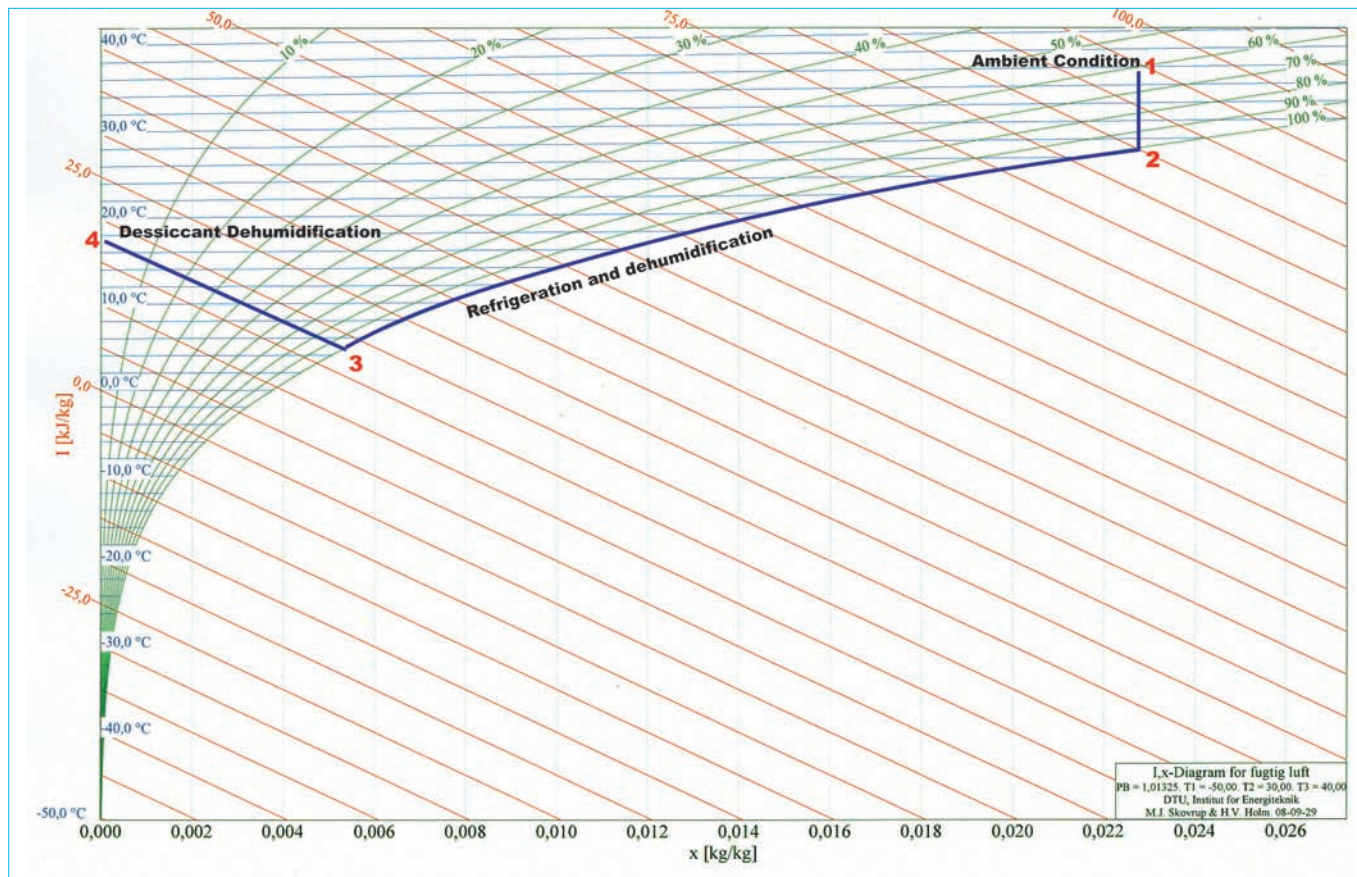


Fig.1. Process air in I-X diagram.
 Point 1: ambient condition.
 Points 1-2: refrigeration (cooling the down to dewpoint temperature).
 Points 2-3: dehumidification by refrigeration.
 Points 3-4: desiccant dehumidification to a dewpoint -40°C to -50°C

dehumidifying sector and the regeneration sector, which uses electric heaters to dry out the wheel.

Moisture removal performance/drying time

A calculation of the performance of the dry air system and total drying time required was determined:

Dry air system (outlet):

$$V_r = 28,000 \text{ m}^3/\text{hr}$$

$$X_{out} = 0.33 \text{ g/m}^3 \text{ (-30°C dewpoint)}$$

Pipe wall temperature = 15 °C.

The air dewpoint inside the pipeline was assumed to be the same pipe wall temperature; therefore, the moisture content of the air was $X_m = 12.8 \text{ g/m}^3$.

The moisture removal capacity of the dry air system was calculated as:

$$V_m = V_r (X_m - X_{out})/1000$$

$$V_m = 28,000 (12.8 - 0.33)/ 1000$$

$$= 349 \text{ kg/hr}$$

The remaining water in the pipeline after successful

dewatering which means that the water film is 0.1 mm.

Example: 100 km DN 1200

$$\text{Remaining water} = W$$

$$= 3.14/4 (D1 \times (D1-D2) \times D2) \times L$$

$$\times 1000 \text{ kg water}$$

$$W = 3.14/4 (1.2 \times (1.2-1.1988) \times 1.1988) \times 100 \times 1000 = 37.70 \text{ kg water}$$

The total drying time for this project was calculated as:

$$T = W/V_m$$

$$T = 37.70/349$$

$$= 108 \text{ hours}$$

$$= 4.5 \text{ days}$$

where:

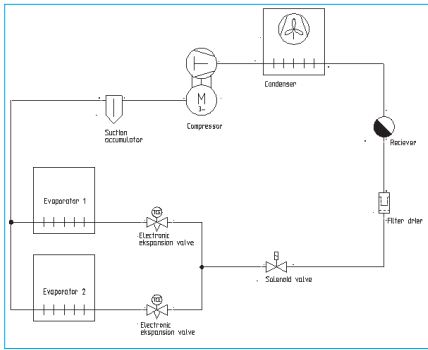


Fig.2. Refrigeration system schematic.

- V_m = moisture removal by dry air system (kg/hr)
 W_r = dry air volume (m³/hr)
 W_r = amount of water in pipeline
 X_m = moisture content of saturated air in the pipeline (g/m³ air)
 X_{out} = moisture content of dry air outlet (g/m³ air)
 D_1 = internal diameter of the pipeline (m)
 D_2 = D_1 - 2 times thickness of the water film (m)

Technical points

Dry air is blown through the pipeline by a low pressure system. In this system the air is dried at atmospheric pressure and blown through the pipeline by a root

blower. Maximum pressure for this blower is 1 barg. Most of the pipelines only require a pressure between 0.2 to 1.0 bar to blow and press foam pigs through the pipelines (special pipelines with big diameter).

Upon entering the pipeline, the air has a dewpoint of -40°C or less. The dry air absorbs the water in the pipeline due to the difference in partial pressure between the air and the vapours. The temperature of the air in the pipeline determines the amount of water that can be absorbed. To achieve efficient drying, the following is necessary:

1. High velocity, because the velocity of the air is related to the evaporation
2. Low dewpoint at inlet
3. High ground temperature
4. Large surface of the water film by using foam pigs to spread the water in the pipelines

Dry air provides effective corrosion protection in the pipeline as a relative humidity of below 50% halts corrosion. However, this does not apply to polluted air.

This drying system has many

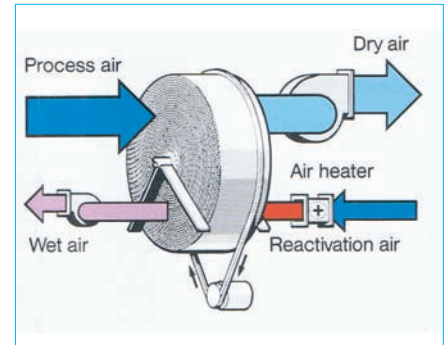


Fig.3. The Honeycomb wheel.

advantages compared to the (conventional) compressor system.

Comparison

A customer needs to dry a pipeline to a dewpoint of -25°C. Air capacity for the job is 6,000 m³/hr. The system requirements will be as follows:

PSE Int system

- 1 x MDU 6000 (more safety, max. 1 barg, small footprint, low fuel costs, 100% oil-free air).

Conventional system

- 5 - 6 x 1500-m³/hr compressors
- 2 x 3000-m³/hr desiccant
- air after coolers and manifold

Movement of black powder in pipelines - Part 1

by Dr John Smart

BLACK POWDER, or sediment in pipelines, can move from fluid drag in pipelines, or can be swept clean by pigging. Knowing the velocity required to move loose

powder can help plan the cleaning of a pipeline, helping to prevent sticking of pigs by solids accumulation in front of a pig. This paper presents some design

information on movement of black powder in oil, water and gas in pipelines, and gives a velocity criterion to indicate when progressive pigging, jetting devices or gel pigs are required to allow safe passage of pigs through a pipeline in oil, water or gas pipelines.

Introduction

Deposition of solids in a pipeline will occur if there are solids in the pipeline fluid and the velocity is not high enough to drag the

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particles along by viscous flow forces. Sediment deposits will cause increased pressure drop through the pipeline and can lead to blockage of the line, especially during pigging.

Build-up of solids in front of a pig can cause the pig to become stuck. For a 12-in pipeline with ½-in (1.25-cm) deep deposits, the volume of solids is about 22 ft³ per mile, weighing over 4000 pounds per mile (1130 Kg/KM). If the depth of the deposit were 1 inch, the weight of iron oxides/sulphides would be over 18,000 pounds per mile (5000 Kg/KM). Build-up of solids in front of a cleaning pig can cause a plug to develop in the line which can stick the pig.

Knowledge of whether or not the flow conditions can sweep solids through a pipeline ahead of a cleaning pig is thus of great importance when using pigs to clean a line, and of fundamental importance in designing the pig cleaning process. Sticking a pig in a pipeline is a great problem on land, but absolutely cannot be tolerated in offshore lines. In deep water, it would be extremely difficult to handle these solids accumulations and would likely require replacement of the line if they could not be removed. Further, when an offshore platform loses its sales line, the platform must be shut in, cutting off production.

Cleaning of pipelines

Pipelines must be cleaned for a number of reasons, including the need to maintain operating efficiency, to be able to successfully run ILI tools, and to distribute corrosion inhibitors over the entire internal wall of a pipeline in wet multiphase gathering systems. The definition of what “clean” means in a

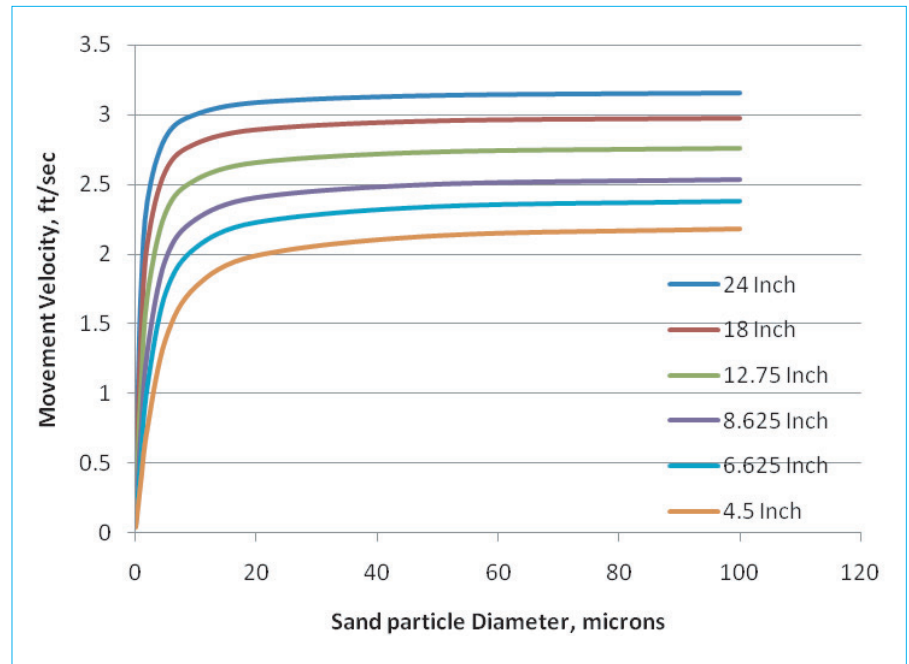


Fig.1. Water velocity to move sand in a pipeline at 60°F.

pipeline varies between pipeline operators. Some define it as being able to run ILI tools, others to maintain a hydraulic flow efficiency, to have clean pigs arriving at the end of a cleaning program, and/or to meet product quality requirements.

Transport of solids in pipelines

Solids can include produced sand, corrosion products such as iron carbonate, iron oxides and iron sulphide, metallic iron, weld spatter, salt, asphaltenes and scale. The term “black powder” is a good generic name for these solids, as sometimes they don’t seem to have a lot in common other than being black. Typically, solids are sub-micron up to 50+ microns in diameter, and tend to fracture and break down when moving.

When a disc, scraper, or wire brush pig is run inside a pipeline, solids are scraped off the wall of

the pipe and pushed in front of the pig. Whether or not these particles fall to the bottom and stop moving or are swept along by fluid velocity determines the extent that of solids will accumulate ahead of the pig. An hydraulic model to calculate the velocity required to sweep solids through horizontal pipelines by fluid drag has been developed by Wicks (1,2) which can be used to calculate the entrainment velocity for black powder in oil, water, and gas.

The velocity to move rounded sand particles in water at 60°F is shown in Figure 1. Nominal pipe diameter is given in inches. The velocity required depends upon pipe diameter but is fairly constant for sand particles greater than about 20 microns. For 8-in pipe, the required velocity is just over 2 ft/sec, increasing to over 3 ft/sec for 24-in pipe. This velocity must be increased by 10-15% to be able to push sand uphill in water

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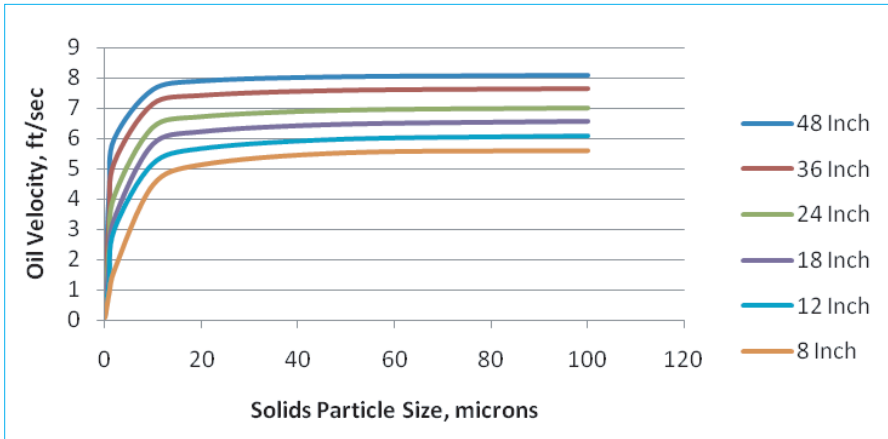


Fig.2. Iron oxides, sulphide and carbonate in 40°API oil.

to be able to sweep sand through the pipeline by velocity alone for particles.

The meaning of this velocity is that for a pipeline being pigged, if the fluid velocity is greater than that shown, solids in front of a pig will not pile up to form blocking deposits.

Sand particles moving in water that have a diameter less than 1 mil require a slightly lower velocity for movement. Thus very small diameter solids would be swept through the pipeline at lower velocity at the other end in the pipeline fluid. This is not always beneficial, since product pipelines have quality requirements which include lubricity and color requirements.

Of more practical interest to pigging are the velocities shown in Figure 2. Iron oxides, sulphide and carbonate can be lumped together due to the closeness of their densities, ranging from 3.8 for Iron Carbonate, 4.82 for FeS, 5.1 for Fe₃O₄ and 5.24 for Fe₂O₃, with a density of 4.82 gms/cm³ used in the calculations. Pipeline operators report that most black powder is iron sulphide. A much higher velocity is required for these compounds, nearly 6ft/sec in 8-in pipe and 8ft/sec in 48-in pipe. Due to its lower density, iron carbonate would move at a slightly lower velocity. Movement uphill still requires an additional 10-15% velocity increment.

Many pigging operations in liquid lines do not reach this value, so iron compounds represent a potential problem in pig cleaning operations. Therefore, iron

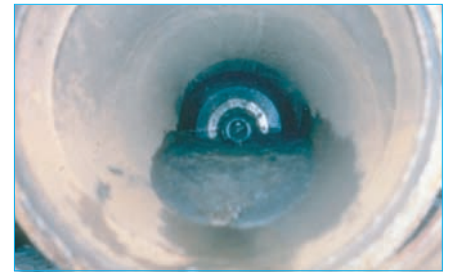


Fig.3. Iron compounds found in a pig receiver in front of a pig.

compounds can be expected to accumulate in front of a pig more than sand. Very small particles, less than 1 micron, can be carried at lower velocities, for instance as low as 1 ft/sec for 1 mil particles in 8-in lines to over 4 ft/sec in 48-in lines.

The higher velocity for iron compounds means that pipelines containing iron oxides and sulphides (black powder) should not be attempted to be cleaned in one pass unless either Progressive Pigging, a by-pass pig, a jet pig, or gel pigs are used. Regular pigging is strongly recommended to keep the pipeline clean if corrosion or solids in the fluid is a problem.

Part 2 of Dr Smart's paper will be published in the February, 2009, issue of Pigging Industry News.



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