The Importance of Pipeline Cleaning: Risks, Gains, Benefits, Peace of Mind

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1. Increased pipeline failures
Time, deterioration and corrosion of the world’s ageing pipeline infrastructure increase the overall likelihood of pipeline failures, according to industry trends. At the Pipeline & Integrity Conference in Houston, USA beginning 2005 impressive data was presented regarding this topic. It appears that 65% of all pipeline failures are caused by corrosion (see figure 1). The consequences of these pipeline failures can include:
- environmental impact
- worker and public safety issues
- clean-up costs
- unscheduled downtime due to repair(s) and
- maintenance costs

Figure 1: Pipeline failure causes

World governments are putting pipeline integrity laws into place that regulate the pipeline business. In the USA, the Pipeline Integrity Bill requires regulated pipelines to be inspected for integrity every five years if transporting liquid, and every seven years if transporting natural gas. Europe will rapidly follow that trend. The UNECE (United Nations Economic Commission for Europe) countries are currently drawing up safety guidelines/ good practices to prevent, control and reduce the impact of pipeline failures and accidents on the terrestrial and aquatic environment, including transboundary waters.

2. Deposit formation
The type of deposit that is formed over time in a pipeline is based on the composition of the material that is transported in the pipeline, the pipeline
material itself and the level of proper functioning of process equipment upstream. Deposits that one may encounter in pipelines are for example iron sulfate, mineral scales, bacteria, paraffin, black powder, asphaltene, degraded compressor oil, amines and glycol.

Figure 2: Pipeline deposit formations, crystals, powder and tacky sediment build up

2.1. Two ways of cleaning

2.1.1. Mechanical cleaning
The commonly agreed and accepted practice among pipeline owners to remove such deposits is by *mechanical pigging*. The pig is repeatedly sent through the pipeline to swap deposits from that pipeline until hardly any deposit can be found in the pig receiving station. It is, however, hard to determine if this implies that the pipeline is clean.

When a pig moves through a pipeline, it will feature some carry over of deposit material, as shown in figure 3. The debris will be displaced from the 6 o’clock position to 360° around the pipe wall, coating the pipeline wall with a thin deposit layer. Additional mechanical pigging will compact this deposit layer and grind deposit particles into sub-micro particles. This will not only cause nuisances downstream but may also initiate a corrosion mechanism in case harmful material gets trapped under the compacted deposit layer (e.g. CO$_2$ corrosion under deposit).

Figure 3: Deposit carry over of mechanical pigs

Modern technologies in intelligent pigging, such as magnetic flux leakage (MFL) and the new optical inspection (Opto-Pig), yield superior readings, some of them
allowing for three-dimensional, almost visual inspection of the total interior of the pipeline. However, the readings from these modern intelligent pigs are even more accurate, the results are easier to interpret and reruns are not necessary when the pipeline is clean and the bare steel can be tested with the sensors of the intelligent pigs.

A typical indication for inefficient pipeline cleaning is when the inspection company reports “sensor lift off” in specific pipeline segments. This occurs in pipeline areas where deposit is still present, even after cleaning and as such compromising to the pipeline integrity.

2.1.2. Advanced chemical cleaning

The second type of pipeline cleaning, ‘advanced chemical cleaning’, is quickly becoming an industry standard. Chemical cleaning in conjunction with the use of mechanical pigs removes a greater volume of debris with fewer runs. Chemical cleaning, by definition, means the use of liquid cleaners mixed in a diluent (water, diesel, methanol, iso-propyl-alcohol and the like) to form a cleaning solution that can be pushed through a pipeline by pigs. There are various manufacturers of cleaners. However, a careful choice of designed pipeline cleaners should be based upon the following characteristics:

- A neutral pH
- Deposit permeating and penetrating capabilities
- Original design parameters of the cleaner and its case histories
- HSE awareness

Brenntag developed advanced chemical cleaning agents (branded N-SPEC®), to provide a more effective and environmentally friendly solution than most current chemical cleaners such as diesel, toluene or xylene. It consists of highly concentrated liquid surfactants, polymers and dispersants designed to penetrate and remove solids such as paraffin, asphaltene, compressor oil deposits, waxes etc. It works rather differently than traditional cleaning agents. Rather than dissolving contaminants, the N-SPEC® chemical mixtures mainly have three purposes (see figure 4):
1. To penetrate between the wall of the pipe and the contaminant
2. To reduce the adhesive forces of the contaminant
3. To emulsify the contaminant into a slurry to make it pumpable so that it can be moved forward with a specially designed pig.

Figure 4: N-SPEC® technology, reduction of adhesive forces instead a brute mechanical power
N-SPEC products have no effect on any metallurgy. Caustic flushing is not required, thanks to its neutral pH. Another great advantage of N-SPEC® is that cleaning can be done ONLINE, without interrupting operations and thereby eliminating downtime and production losses.

The N-SPEC cleaning methodology has proven to be very efficient, removing up to three times more deposit in one run and as such reducing the number of cleaning runs. N-SPEC has surprised customers about the volume of deposit being removed from pipelines that were perceived to be clean. Figure 5 shows an example of a crude oil pipeline that was mechanically cleaned and put out of service over a period of twenty years. The N-SPEC team was requested to perform a cleaning run to remove some dust before the pipeline would be inspected as it was to be taken into service for CO2 transport. It turned out that 71m³ of deposit was removed from a 86km pipeline, that was supposed to be clean, by applying N-SPEC.

3. Financial savings N-SPEC

In summary, N-SPEC® advanced chemical cleaning offers many benefits compared to mechanical pigging that will lead to cost reductions, more reliable integrity checks and increased operating capacity, all thanks to a much cleaner pipeline.
Brenntag recorded sales of 4.6 billion euros (5.7 billion US$) in 2004 through the efforts of the company’s 8,800 employees at around 300 locations around the globe and offers an unrivalled extensive and state-of-the-art distribution network to its suppliers both in Europe and the Americas. Brenntag supplies industrial and specialty chemicals and offers a wide range of value-added services for companies that manufacture and process chemicals. The Brenntag Oil & Gas Team manages a full line of products and services to the oil and gas producing and processing industries.

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