Reinhart
Hydrocleaning SA

DESCALING OF HARD DEPOSIT

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Hard deposits in brine pipelines

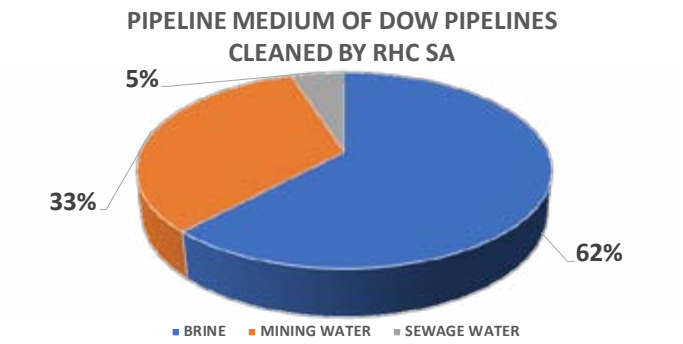
The challenge of descaling and extending pipelines lifetime

INTRODUCTION

The relationship between company Dow Deutschland Anlagengesellschaft mbH (DOW) with its underground brine chamber sites around Ohrensen, Germany and Reinhart Hydrocleaning SA (RHC SA) is a success story in itself.

Prior to explaining the different ways of mechanical cleaning brine pipelines one has to know that RHC SA has worked with DOW since 2007 providing cleaning solutions for different pipelines.

Approximately 91 km of DOWs' pipeline network in the area around Ohrensen is cleaned by RHC SA.



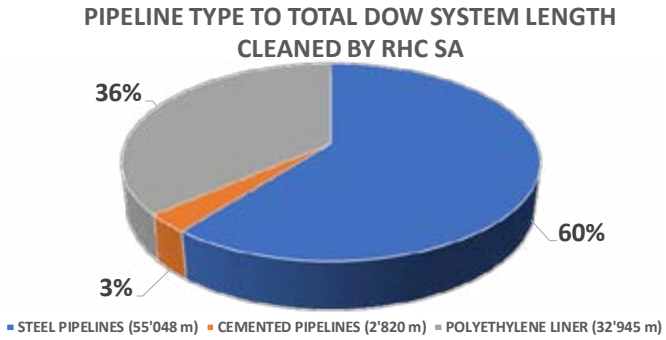
PIPELINE TYPES

Cleaning solutions were provided for pipelines sized 6" – 24" used for transporting brine water, mining water or sewage water from the underground caverns around Ohrensen either to the production facility in Stade, the distribution field in Ohrensen or in between the single underground fields.

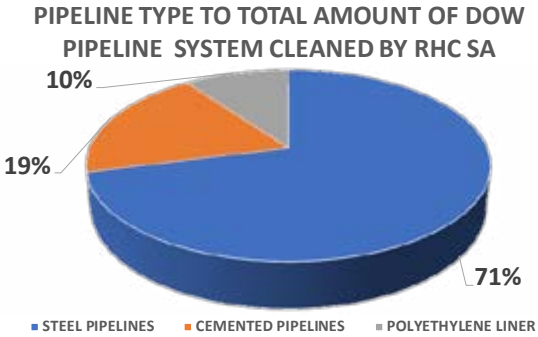
The pipelines maintained by RHC SA have a total length of approximately 91'000 m ranging in length from 188 m to 27'000 m and are in most cases brine water pipelines (62%), mining water pipelines (33%) or sewage water pipelines (5%).

DOWs' pipeline system is piggable by design and typically feature 3D bends, pig launch and receive facilities along with a draining system to manage the fluids containing scale debris removed by the RHC SA Mechanical Cleaning Tool (MCT).

In order to reduce cost, reduce time and maintain throughput, the cleaning tools are driven by the pipeline fluids under normal operating conditions. Roughly 60% of the above-mentioned total pipeline system length is steel pipeline, followed by polyethylene lined pipelines at around 36% of the total length.



A small percentage of pipelines, 3% are cement lined.
Compared to the quantity of pipelines cleaned by RHC SA in the Dow Ohrensen system, approximately 71% of the pipelines are made from steel, 19% have a cemented liner and 10% have a polyethylene liner.



PIPELINE CHALLENGES

Whether it is brine water, mining water or sewage, pipelines need to be cleaned, and the challenge is always to clean the pipeline to clients' need or specification.

Having a closer look to the individual pipelines to be cleaned one can see that besides clients' requirements, the MCT needs to be constructed according pipeline specification.
Especially in cases where the internal surface of the pipeline is not steel but coated with cement or a polyethylene liner.

The challenge with these types of pipelines is to clean the pipeline to the required standard e.g. for internal metal loss inspection (ILI) without causing damage to the internal polyethylene or cemented coating.

The RHC MCT's are designed to meet this challenge and to clean the pipeline in full accordance with the operators' specification to ensure successful ILI.

SCALE BUILD-UP AFTERMATH

Scale build-up, in brine water pipelines typically calcium carbonate (CaCO3), can lead to several issues which have a significant effect of the productiveness of the plant, economically and environmentally:

- Increased pumping pressure needed to maintain acceptable fluid throughput.
- Increased pumping speed (RPM) increasing energy consumption and equipment wear.
- Ever decreasing throughput of amount of pumped pipeline fluids with reducing bore.
- Increased turbulence inside the pipeline resulting in scale build-up "hot spots" close by e.g. welds, controls and instruments, etc.

The above-mentioned examples caused scale build-up in the pipeline are real scenarios which all pipeline owners try to counteract.

Comparison of the thicker scale plates to a mobile phone

Hard scale build-up can be removed, mitigated and effectively managed by using the range of Reinhart Hydrocleanings' pipeline specific Mechanical Cleaning Tools enhance.

PIPELINE INTEGRITY

The RHC SA technology is used for two different applications by DOW in Ohrensen.
The first is to clean the brine water, mining water and sewage water pipelines to the required standard to ensure production and successful ILI.

Inspection can be with MFL (Magnetic Flux Leakage) in steel pipelines and pipelines with polyethylene liner or DMG (Direct Magnetic Response) technology in steel pipelines with cemented liner.

A combined mechanical cleaning/inspection campaign is planned and executed usually with a time frame of approximately 1 – 1 ½ months for 10-15 pipelines, depending on length.
Main transport brine water and mining water pipelines are cleaned on a higher frequency for maintenance.

For current production figures as e.g. loss of CaCO3 (mg/l) during production in the pipeline, flow, pressure, etc., these pipelines are cleaned three times per year.
This ensures continued pipeline performance and integrity.

Scale build-up is kept to a minimum level, reducing fatigue of the pumps, controls and instruments whilst maximising production flow ensuring a successful ILI at the next planned intelligent pig run.

EXAMPLE

The difference between a brine water and mining water pipeline is the amount of CaCO3.
The concentration of CaCO3 in a brine water pipeline is, understandably, much higher than in a mining water pipeline.
The example is the comparison and evolution of each of the pipelines when cleaning with RHC SA mechanical cleaning tools.

The brine water pipeline is made from steel, sized at 24" with an internal diameter of 596 mm and a total length of 19'425 m.
This pipeline is cleaned using RHC descaling tools on a regular base three times per year.

The type of MCT used for this job is a pulling tool with attached 180° pipeline surface coverage plough arm basic tool with integrated rotating element pin pointing into the scale as well as two modules fitted with

Picture showing retrieval of 24“ MCT flushing forward powdered scale

two-layer scraping springs that effectively scrape off the scale and reducing it to a powder.

The amount of scale taken out of the pipeline with each run is controlled by the level of mechanical cleaning and the unique integrated bypass that is matched to suit the pipeline size and operating parameters.
Most of the powdered scale removed from the pipe wall is flushed forward and captured directly in the plant filtration system.
During retrieval one recognizes that the scale is directly pushed in front of the cleaning tool head.

In theory, based on calculation, approximately 3 - 3.5 mg of CaCO3/l is left in the line during production causing the scale to build-up.
Assuming, the build-up is uniform through the entire pipeline length, the scale would be determined at 0.55 mm per year.
The regular MCT scale removal cleaning runs three times per year shows that the hard scale fragments removed (often called “chips”) are thicker than 0.55 mm. This couples to one of the consequences arising by scale build-up.

Picture showing scale chips from a 14“ Brine Water Pipeline

Since implementing regular maintenance cleaning of the pipeline in 2015 using the RHC SA Mechanical Cleaning Tools, the volume and size of chips has decreased whilst the amount of powdered scale increases confirming the controlled and efficient removal and management of hard scale.
This pipeline is compared with a mining water pipeline with polyethylene liner, sized at 14” with an internal diameter of 346mm and a total length of 26’620m.

Picture showing crushed scale chips after the third MCT cleaning run in a 14“ Brine Water Pipeline

The type of MCT used for this job is an adapted modified basic tool head with seven ploughs equipped with rollers.
The MCT was designed with a rolling head and propulsion unit. It has no sharp edges and in total 3 propulsion discs with an adapted bypass with respect to the possible scale existence based on previous cleaning runs by RHC SA.

The challenge in cleaning this pipeline is to achieve maximum effectiveness in removing existing CaCO3 scale with zero damage to the polyethylene liner. During design and manufacture of the mechanical cleaning tool, previous RHC experience and cleaning history was considered.
Previously in the past, to eliminate any risk of damage to the liner, the MCT was engineered using wood component parts.

The tool body and internals were made from steel with component parts that were in direct contact with

or had the potential to contact the pipe wall/liner were made from wood.
This MCT design was used twice to clean this pipeline.
To maximize the efficiency of this MCT, the cleaning history and pipeline production data was taken into account.
The challenge was not only to construct a cleaning tool that would not damage the liner but also be weight reduced with a maximised bypass to be more effective in terms of scale removal.

Picture showing receiver of the mentioned 14“ Mining Water Pipeline

This new tool configuration performed extremely well and was so impressive that it was agreed that it should be run three times per year to maximise cleaning efficiency, manage scale removal and build up during normal operations.
The amount of scale plates brought out by the MCT made a great visual impact.

As no scraping springs were used, the amount of powdered scale was zero but the amount of thick scale plates taken out was remarkable.

PROGRESSIVE EFFECTIVENESS

Pipelines carrying various products whether these are oil, gas, chemicals, water, utilities etc. have different cleaning requirements, specifications and challenges.

A progressiveness approach to the cleaning of these kinds of pipelines with a range of mechanical cleaning tools, often standard off the shelf pigs, is common.

In most cases, the pipeline owner will run standard pigs for maintenance but will often not know internal condition of the pipeline in terms of cleanliness.

A typical cleaning program, using cleaning tools designed, developed and implemented by RHC SA can be described as progressive.
How-ever, compared to the traditional approach employed by others, it can be described as a more effective and efficient approach that guarantees results.

A key difference to traditional pipeline cleaning programs is that RHC SA uses their mechanical cleaning tools initially from the first run onwards. The use of multiple poly pigs (bare and coated), gauge plate pigs and cup pigs prior brush pigs are unnecessary.

RHC SA start to clean from the very first run and increase cleaning performance by adding and combining different cleaning elements to the mechanical cleaning tools.
Using this procedure, the total amount of cleaning runs decreases with a simultaneous increase in cleaning efficiency and performance reducing not only the costs per cleaning run but also reducing the risks of potential exposure to people and environment by limiting the amount of pipeline pig launch and receive trap operation.

Besides the descaling of pipelines from hard deposits such as CaCO3, the mechanical cleaning method of RHC SA could also be of interest when it comes to pre-commissioning gas pipelines that transport e.g. oxygen, nitrogen and hydrogen.
Other areas of expertise are in dewaxing oil pipelines and cleaning water injection pipelines subject to MIC (Microbiologically-Influenced Corrosion).

RHC SA adapt their Mechanical Cleaning Tools’ to achieve the required level of cleanliness necessary to ensure safe continuous operation, manage pipeline integrity and performance whilst maximising throughput.

In the end it is ***“not the number, but the quality of cleaning runs”*** that is important.

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Thinking out of the box
...still not in it!

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