



Reinhart
Hydrocleaning SA



Dewaxing Case study



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1. Introduction

Mid-2010 RHC SA was contacted by a client in order to clean a heavy waxed 16" crude oil transport line in the south of the UK.

The first cleaning campaign took place early 2011, the second cleaning campaign was performed mid-2015.

The following case study will demonstrate the efficiency of HMC (Hydro Mechanical Cleaning) using RCT (Reinhart Cleaning Technology).

Background

The transport line was formerly cleaned in 2002 by using pigs.

The client informed that he had "difficulty" to remove all the wax.

The MFL inspection pig was recovered with torn off sensors due to the huge amount of wax. No data of pipeline was recorded.

Main purpose

The main purpose of the cleaning campaigns was a bare metal cleaned pipeline to ensure a quality ILL inspection.

2. MCTs (Mechanical Cleaning Tools)

For the dewaxing of a pipeline, RHC SA uses 3 different types of tools.

2.1 BAT - Reinhart Basic Tool

The RHC SA Basic Tool was developed in the 50's of last century. The capacities of the cleaning tool had such a great feedback that the concept was imitated by the pigging industry and other competitors. In the end, copies never reached the quality of the original.



The RCT improved the BAT over the decades to maximize the cleaning effect and capacities.

Evaluation of the tool condition after each run gives an indication of cleanliness.

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Cleaning capacities

- The arms on the front of the BAT work on the ID of the pipeline. Spring loaded, they allow flexibility and the force to break up the layer of wax simultaneously. This type of tool should be run as long as larger amount of wax are brought out of the pipeline.
- The propulsion elements propel the tool

through the line using the flow of the pipe medium. At the same time the natural bypass flushes the pipe wall and floats the debris in front of the tool.

2.2 SMT - Scraping Module Tool

The SMT will remove the hard wax of the pipe wall.

Regarding the length of launcher and receiver, it is possible to increase the number of modules.



Running this type of tool several times will clean the pipeline back to bare metal. Evaluation of the tool condition after each run gives an indication of cleanliness.

Cleaning capacities

- Equipped with spring steel scrapers, each module covers the full circumference.
- Oversized, the scraping springs will scrape into the wax and remove the layer progressively.
- Different scraping designs are used regarding the pipeline parameters.
- The propulsion elements propel the tool through the line using the flow of the pipe medium. At the same time the natural bypass flushes the pipe wall and floats the debris in front of the tool.

2.3 TMT - Tiger Module Tool

The TMT will re-move the remaining thin and hard layer of wax.

The oversized design and the adapted spring forces of the Tiger Springs will clean out corrosion pits.



It is possible to increase the number of modules regarding launcher and receiver length.

Evaluation of the tool condition after each run gives an indication of cleanliness.

Cleaning capacities

- Equipped with Tiger Springs, each module covers the full circumference.
- The Tiger Springs will :
 - remove thin hard layer
 - clean out corrosion pits
- The propulsion elements propel the tool

through the line using the flow of the pipe medium. At the same time the natural bypass flushes the pipe wall and floats the debris in front of the tool.

3. Pre-cleaning activities

Prior the first MCT run, the client executed 3 pig runs. The used pigs were operational 4 PE cup pigs. After each run, the collected weight of wax in front and on the pigs was between 5kg - 15kg.

4. Cleaning campaign 2011

Early 2010, with basic information from clients' side, RHC SA proposed a cleaning proceed of 6 MCT's. After receiving more information about the flow and the pigging history, the tool quantity was increased to 9 MCT's.

4.1 Pipe information

Internal diameter: 16" – 387mm
Pipeline length: 90km
Cleaning medium: crude oil
Medium Flow: from 0.16 to 0.21m/s
Pipeline status: very waxy

4.2 BAT cleaning

Mid-March the first MCT was launched. The 90km were performed in about 5 days with a tool speed of app. 0.2m/s.



A single BAT brought out 150kg of wax which is 10x more than a traditional operational pig.

For run n°2 a double BAT was used which resulted in 350kg of wax in front and on the tool.

Experience has shown to run BAT's until the amount of wax decreases.

Run n°3 was a triple BAT which resulted in 400kg of wax in front and on the tool.

Run n°4 and run n°5 were triple BAT's.

Run n°4 brought out 550kg and run n°5 350kg.

The decrease of the wax amount led RHC SA switch to SMT's.

4.3 SMT cleaning

Run n°6, n°7 and n°8 were double SMT tools, which brought out wax amounts of 300, 100 and 80kg.

At this stage the client wanted to stop the cleaning campaign because of the small amount of wax of run

n°8.

RHC SA insisted to run at least one TMT tool to clean out corrosion and scrape off the potential thin layer of hard wax.



4.4 TMT cleaning

Run n°9 was a double TMT.

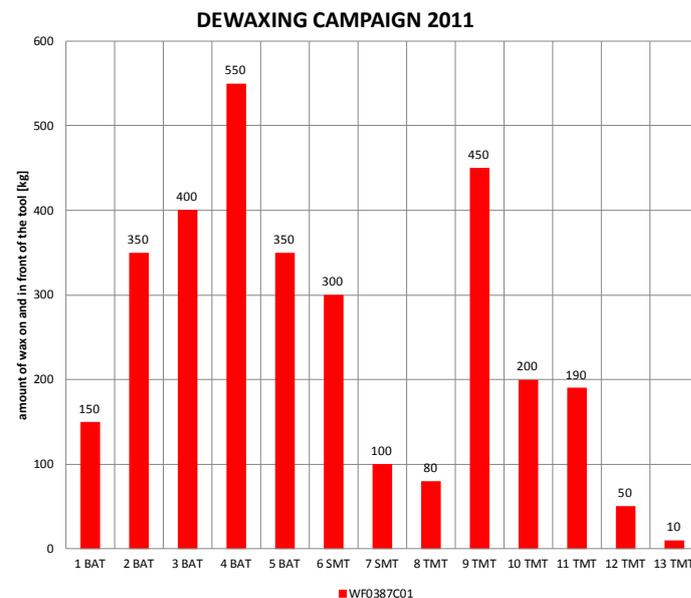
The result confused the client but was expected from RHC SA. An amount of 450kg of very hard and dry wax was brought out of the receiver. Run n°10, n°11 and n°12 brought out 200kg, 190kg and 50kg of wax. Officially, the cleaning campaign was completed.

The inspection run took place 3 weeks later. To overlap the time, 3 magnetic vehicle pigs were sent through the line. A final MCT contingency double TMT run was performed which brought out about 10kg of wax.



The MFL inspection was a success due to the quality cleaning campaign.

4.5 Collected data



4.6 Conclusions of the 2011 cleaning campaign

Run n°9 demonstrated that each MCT design has different capacities and limitations. The progressive removal of the wax layers demonstrated the importance of the RCT.

The color (brown) and texture (dry) indication of the removed wax by the RCT is a result of years of operational pigging.

Pigs are able to remove and float out soft wax but with each run, operational pigs compress a certain volume of wax to the pipewall.

This continuous build-up over the years results in heavy, hard and dry wax. The wax properties (quality, amount, hardness, etc.) differ among pipelines depending of the oil nature and the pipe environment.

The only way to clean a line to bare metal as efficiently as possible is with the usage of the RCT.

Finally, we can say that the efficiency of HMCs was from 15x up to 55x more productive as a traditional operational pigging.

5. Cleaning campaign 2015

Early 2015, RHC SA was contacted by the client. An UT inspection was scheduled for the end of June 2015. Based on previous cleaning experience, RHC SA decided to propose a 6 MCT's cleaning proceed. The tools were modified to mix the RCT's used in 2011.

5.1 BAT and SMT

Run n°1 and run n°2 were a BAT and double SMT tool. The amount of wax in the receiver in front and on the tool was 300kg and 350kg.

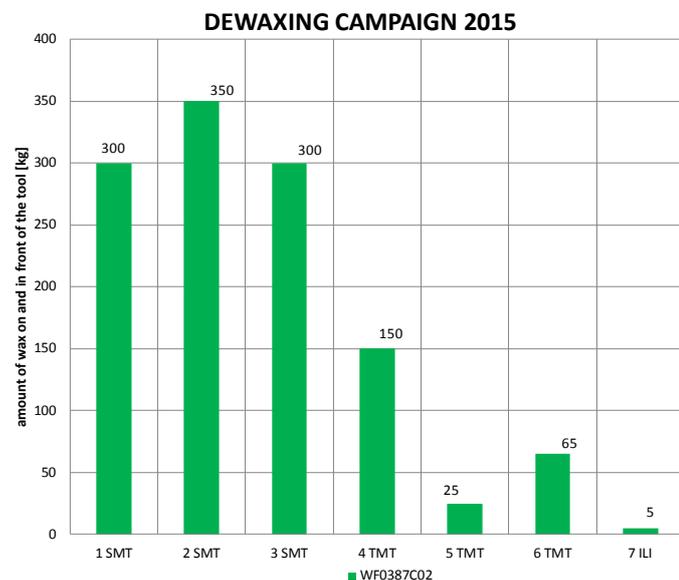
5.2 BAT, SMT and TMT

Run n°3 and n°4 were a BAT, a SMT with a TMT at the rear. This kind of tool is a mix of all 3 Reinhart dewaxing technologies. The collected amount of wax was 300kg and 150kg.

5.3 BAT and TMT

The last two runs of the campaign were a BAT and double TMT tool. The aim of the last runs was to clean and flush out corrosion pits. The collected amount of wax was 25kg and 65kg.

5.4 Collected data



5.5 Inspection run

The UT inspection run was successful.

The collected amount of wax was 5kg of soft wax in front of the tool. All of the sensors were clean and worked without any problem.

5.6 Conclusions of the 2015 cleaning campaign

Once a pipeline is cleaned to bare metal, the amount of cleaning runs decreases and the wax properties are less extreme. The knowledge about the pipeline condition and the previous cleaning experience enabled RHC SA the ability to mix the cleaning modules to optimize the cleaning performance of the tools.

The cleaning campaign of 2015 was shortened from 13 to 6 runs. The inspection run was a success, both in terms of data quality and logistics.

6. ANALYSIS

During the 2011 campaign it was clear that a heavy waxed line which has never been cleaned with the RCT will not be clean in 6 runs like it has been done in 2015.

The graphic, shown in 6.2, demonstrates that during the 2011 campaign, each type of tool has its own way to remove a certain type of wax. The amount of wax removed by tool n°9 was a huge shock for the client.

During the 2015 campaign, we could observe the same curve in the graphic. The deepest point was reached with tool n°4 but the next run brought out more wax as the previous run. The curve is less stunning as in 2011, but the similarities are obvious.

6.1 Wax properties

The table, shown below, summarizes the runs, tool setup, wax amount and wax quality. Obviously, the amount and the properties of the removed wax have changed between both cleaning campaigns.

The 2015 wax was not as hard as in 2011 and the bare metal point was reached by a faster way.

2011 Campaign

RUN	TOOL SETUP	WAX AMOUNT	WAX QUALITY	
		in kg	IN FRONT	ON TOOL
1	BAT	150	S	HHH
2	BAT+BAT	350	S	HHH
3	BAT+BAT+BAT	400	HH	HHH
4	BAT+BAT+BAT	550	HH	HHH
5	BAT+BAT+BAT	350	HH	HHH
6	SMT+SMT	300	HH	HHH
7	SMT+SMT	100	HH	HH/HHH
8	SMT+SMT	80	HH	HH/HHH
9	TMT+TMT	450	HHH	HH/HHH
10	TMT+TMT	200	HH/HHH	HH/HHH
11	TMT+TMT	190	HH/HHH	HH/HHH
12	TMT+TMT	50	H/HH	HH/HHH
13	TMT+TMT	10	H	HH/HHH
Total wax		3180		

2015 Campaign

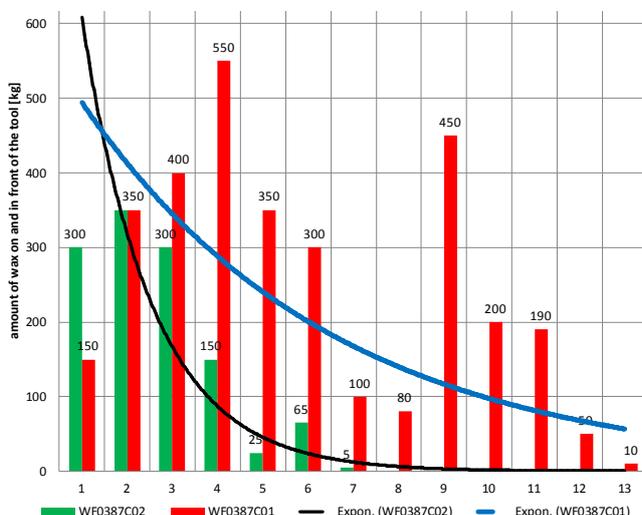
RUN	TOOL SETUP	WAX AMOUNT	WAX QUALITY	
		in kg	IN FRONT	ON TOOL
1	BAT+SMT+SMT	300	H	HHH
2	BAT+SMT+SMT	350	HH	HHH
3	BAT+SMT+TMT	300	H	HHH
4	BAT+SMT+TMT	150	S	H
5	BAT+TMT+TMT	25	S	S
6	BAT+TMT+TMT	65	HH	HH
7	ILI	5	S	S
Total wax		1195		

After more than 4 years of service a bare metal cleaned pipeline reached the same cleanliness faster than a heavy waxed pipeline.

Wax grades

Grade	Properties
HHH	Very hard, large lumps, cold plasticine consistency, dry
HH	Quite hard, large/medium lumps, cold butter consistency, sticky, moldable between fingers
H	Hard. Medium lumps, margarine consistency, sticky, can squash between fingers.
S	Quite soft, small lumps, soft butter consistency, easily squashed between fingers, coats shovel / gloved hand
SS	Soft, grainy but smooth, coats tools / gloved hand and pours off slowly.
SSS	Very soft, very few small lumps, very smooth, pours easily off shovel / gloved hand.

6.2 Compared data from 2011 and 2015



6.3 Cleaning effectiveness

During the 2011 campaign, 13 runs brought 3180kg of wax out of the line. This volume represented only the wax gathered on and in front of the tool. The wax which was bypassed prior cleaning tool arrival is not included. During the 3 pre-cleaning pig runs, only 30kg of „S“ wax were counted. Assuming that an operational pig would be able to clean a line to bare metal, we calculated hypothetical 318 pig runs. On this particular job, one run with a speed of app. 0,2 m/s took about five days. Assuming 318 runs with each a 5 day duration equals 1590 days or 4 years, 4 months and 10 days. That was approximately the time between both cleaning campaigns. Using operational pigs on a regular basis will remove loose wax in the line but never clean the line. The usage of metal brush pigs will maybe increase the clean effect compared to cup pigs but these pigs

leave a certain amount of brushes in the line. To remove „H“, „HH“ or „HHH“ the RCT is the only effective solution on the market.

6.4 Comparing what should be compared

A sensitive issue during discussion with clients are the tools manufacturing costs.

After the analysis of the cleaning efficiency of HMC's, it is obviously not possible to compare a catalogue price of a pig with a tailored mechanical cleaning tool.

Unfortunately, company buyers have to make decisions based on prices stated in the offers.

What should be compared is the operational time of a cleaning campaign with all the costs that are usually ignored during the evaluation of pipe cleaning solutions.

The feedback RHC SA received from clients is that a normal pigging campaign contains at least 20 pig runs. Unofficially, run numbers of 30, 40, 50 or even more are no exceptions.

By simplifying the calculation in 1 run per day, a RHC SA cleaning campaign should be performed between 6 for a waxy line and 13 days for a heavy waxy line.

By using pigs, the amount of days would be between 20 and 30, 40, 50 or more days.

Taking into consideration the loss of productivity, personal costs and scheduling of involved companies as well as stand-by costs, the RHC SA tool manufacturing costs are more than covered.

Usually, to avoid stand-by costs for inspection tools during pigging campaigns, the inspection run is performed without any assurance of pipeline cleanliness. The result is a failed inspection run or bad inspection results resulting in extra costs to cover the re-run.

7. Conclusion

The cleaning with RCT is:

- Effective
- Cost saving
- Time saving
- A cleaned line for optimal inspection results

As RHC SA say:

„To clean or not to clean?“

That should be the question.

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Since 1952
Thinking out of the box
...still not in it!



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