

Pipe pigging: James Bond's favourite cleaning method

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Introduction

Every company with pressurised piping in its production system is familiar with the problem of internal contamination and accumulation of material on the inside the pipeline. This can cause various problems, from a loss of efficiency to blockages and corrosion. A common cleaning method is chemical technical cleaning where the piping is cleaned with chemicals. In some cases, however, the 'pipe pigging' method is an environmentally friendly and effective alternative. This Technical Bulletin takes a closer look at this cleaning and inspection method that has even made the big screen.

The pig

Pigging uses a flexible cleaning plug, the so-called 'pig', that is forced through the pipe by a particular medium. The diameter of the pig is slightly larger than the inside diameter of the pipe. As a result, the pig scrapes the pipe wall clean and carries the contamination to the end of the pipe. The first documented use of this technique dates from around 1870, when a crude oil pipe of Colonel Drake in Titusville (Pennsylvania) began to silt up after two years in use. At the time, use was still being made of a plug consisting of rags bound together. Later the rags were replaced by leather. The cleaning pig owes its name to the screeching sound that can be heard when passing through the pipe. From approximately 1960 developments with the introduction of the 'polly pig' progressed quickly. This is a spherical plug of strong but easily deforming polyurethane. Various sizes and types are available nowadays: covered with a special coating or finished with a steel, stainless steel or Teflon wire brush. Which type is most suitable depends on the pipe material and the contamination.



Fig. 1: Pipeline pig demo Trans-Alaska Pipeline (source: www.wikipedia.org)



Fig. 2: Pipe pigging launcher

Installation

The pigs are always introduced into the piping system to be cleaned from a pig station or launcher. The launcher has at least a connection for the medium with which the pig is pushed forward. Normally this is a gas such as nitrogen or air, but it can also be a liquid such as water.

At the end of the pipe the pig and the medium are collected in a so-called receiver, the second pig station. The pig is separated from the medium in the receiver. If the medium is water or product, this is separated with an extra connection. These pig stations either form part of a fixed system or mobile installations that can be connected.

There are different reasons for using the pig method:

1. Cleaning a pipe
2. Emptying a pipe
3. Inspecting a pipe

1. Cleaning a pipe

Cleaning piping using pigs can be done in different ways depending on the contamination to be removed and the reason for cleaning. To remove loose dirt, etc. from a pipe mechanical cleaning with 'brush' pigs is in principle adequate. Pigs are pushed through until the pigs appear clean. Then, the pipe is usually checked for cleanliness with a boroscope. Mechanical pig cleaning is always done with propulsion by air or nitrogen. To propel a pig it is particularly the volume of air or nitrogen that is important.

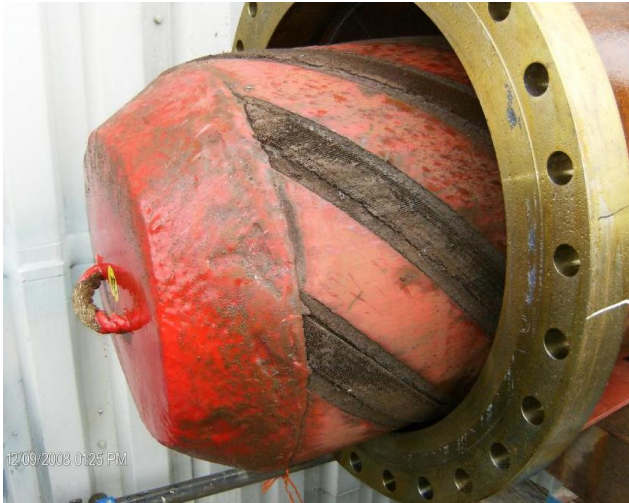


Fig. 3: Pig shooting out of the pipe

Chemical cleaning using pigs is often carried out to save chemicals, to reduce the release of hazardous waste and to protect the environment.

Stainless steel piping is often chemically treated with the purpose of removing undesired weld discoloration and hence restore corrosion resistance. This is normally done by chemical cleaning consisting of different stages; degreasing, pickling and passivation. Degreasing takes place with a slightly alkaline cleaning agent, pickling stainless steel is done with a highly acid cleaning agent based on nitric acid and hydrofluoric acid, whilst passivation takes place using a passivating agent containing nitric acid.

Such cleaning in stages can also take place with a so-called chemical 'cleaning train' whereby the pigs are used to complete the separate stages individually. The chemical cleaning agent is applied between the different pigs, with sufficient water between the different cleaning steps to rinse the chemicals off the surface. The pushing medium for such chemical cleaning is preferably demineralised water. The chemical is introduced in the pipe with the pig launcher. After the introduction of the pig the chemical cleaning agent is pumped into the pipe with a pump. The next pig is then inserted with a certain quantity of rinsing water before the next cleaning chemicals can be introduced. This is how the chemical 'pig train' originates. At the end of the pipe the different chemicals are separated and collected in waste containers. Analyses of the medium give a picture of the progress of the chemical cleaning.

Large quantities of chemicals can be saved using this method. A 500 metre-long DN250 pipe has a volume of 25 m³. Chemical cleaning of this pipe in different phases and rinsing stages could result in a waste quantity of over 125 m³. A chemical train using pigs reduces the total quantity of waste to 10 m³, which is equivalent to a reduction in waste of over 90%.

2. Emptying a pipe

Fixed pipes to tanks often have standard fixed pig stations to fully empty the piping with a product change, with possible cleaning before a different product load is transported. This method prevents the contamination of products in fixed piping.

3. Inspecting a pipe

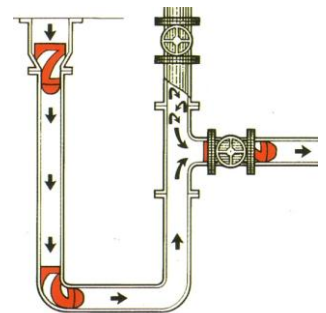
So-called 'intelligent pigs' can be used in places where the inspection of piping is difficult (for example under the ground or below the sea surface). These types of pigs contain various kinds of measuring equipment with which, for example, the wall thickness, corrosion and location can be examined.

Restrictions

Not all piping can be treated using the pig method. If a pipe has too many or too long branches there is the likelihood that the pig will become stuck. Short branches are not a problem for the pig (see figure below). The pipe must also have the same diameter along its whole length. If a pipe narrows it cannot be pigged. Narrowings can occur because the pipe is made up of sections with different diameters, or because the pipeline contains thermowelds or orifices, for example. The pipe must only contain full-passage valves. Butterfly valves will block a pig.

Vecom and pigging

Besides the technical chemical cleaning we are all familiar with, Vecom Industrial Services B.V. also offers pigging as a cleaning service worldwide. The basis here is offering a client-specific cleaning solution. Vecom deploys the following procedure:



1. Laboratory analysis of the contamination to be removed and determining the appropriate cleaning products;
2. Analysis of the system to be cleaned, determining the cleaning circuits, pig types and engineering documents including safety aspects;
3. Course of the offer;
4. Carrying out the cleaning;
5. Removal and processing of the resulting waste material flows and used pigs;
6. Inspection of the cleaned piping and reporting on the cleaning.

Pigging on the big screen

A pipe pig has appeared in a James Bond film no fewer than three times. The first time was in 'Diamonds are Forever' in which James Bond removes a pig to be able to escape from a pipe.

Then in 'The Living Daylights' the Russian general Georgi Koskov (indeed played by Jeroen Krabbé) was smuggled on a pig through a gas pipeline under the Iron Curtain. And in 'The World is Not Enough' a pig was used again, this time to smuggle nuclear weapons through a pipe. So we can see how a specialised cleaning method can enjoy the wide attention of a large audience.