Neofit Case Histories from Europe

Report

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Summary

The Neofit® system was developed in the early 1990s by Wavin, the leading European producer of plastic piping systems, as the solution to provide existing lead water supply service lines with a barrier between the lead pipe material and the drinking water.

This report sets out the Neofit® system in general, including the product range and the installation process and illustrates the experience with a number of case histories in different countries in Europe. In these case histories the installation process is further illustrated and the effectiveness of fighting lead contamination of the drinking water is demonstrated by comparing water test specimen before and after lining.

It shows that Neofit® is very much capable of doing the job it is supposed to do: protection against lead contamination of drinking water.

1 Introduction

In the 1980s, water companies around the World were generally required to not supply drinking water with a lead concentration higher than 50 µg/l. In Europe this was reflected in the European Council Directive 80/778/EEC, 1980 and similarly on a national level, e.g. in the UK in the Water Supply (Water Quality) Regulations 1989.
Around the time, the Word Health Organisation was in the process of revising its guidelines for lead in drinking water, resulting in a strong recommendation to significantly reduce lead concentration in drinking water.

The European Commission adopted this recommendation and included for lead a maximum concentration of 10 µg/l [*]) in their new Directive 98/83/EC, 1998 [1]). By default, this Directive required the European Member States to meet this value, latest within 15 years.

Meanwhile, Wavin had started in 1990 to tackle the lead issue and to start developing a technique to create inside the lead service pipes a barrier between the lead and the drinking water. This technique encompassed the use of a PET tube to be inserted in the existing lead service and to be expanded to form a very thin, but effective lining to prevent lead contamination of the drinking water. First actual installations took place in 1991.
Somewhat later, this technique was launched under the name Wavin Neofit® and as such applied in many countries in Europe and beyond.

This report presents the Neofit® system and the experience with some European installations of the early days of the system.

[*]): 1 µg/l (microgram/litre) is the same as 1 ppb (parts per billion)

[1]): The Council of the European Union,
"Council Directive on the quality of water intended for human consumption 98/83/EC", Nov. 3, 1998

2 Neofit® Method

2.1 System description and applications

Neofit® is a lining method especially developed and owned by Wavin in the Netherlands, for lining potable water service pipelines of various materials such as lead, copper, galvanised iron and steel, that still have enough structural capability to resist the inside pressure. It is of particular interest, where lead service pipes are still common place.

The Neofit® principle is very simple: A small flexible pipe made of PET material, provided with longitudinal ribs on the outside, is inserted and subsequently inflated approx. 2 times the original size to form a closely fitting thin walled liner.
A small-sized installation unit and a compressor are used to provide hot water and compressed air for the reversion process.

An effective barrier between water supply and pipe material is thereby provided.
Furthermore, the thin liner provides leak tightness in bridging socket gaps and holes in the wall, i.e. it is a true interactive pressure pipe liner.

The operation is very quick. From disconnection of water supply to end of treatment takes one hour. Complete housing estates can be renovated in a few weeks.

2.2 Product data

Product range

The Neofit® pipes, provided are available in 4 sizes. They are supplied on coils.

Neofit diameter	Pipe length on a coil	Diameter of a coil	Weight of a coil	Range of internal diameters (ID) of existing service pipe*	Minimum wall thickness of expanded pipe
mm	m	mm	kg	mm	mm
7	200	540	3.1	10 – 16	0.15
10	200	590	6.5	14 – 22	0.20
15	100	930	7.2	21 – 33	0.30
20	100	1160	13.0	30 - 45	0.40

Material

The liner pipes are made from PET: polyethylene terephtalate,
a thermoplastic polyester, known from various packaging applications in the food industry.

The PET material of the pipe provides the following benefits:

- flexibility during insertion
- stretch-ability for expansion
- strength for operational use

The colour of the pipe is natural opaque.

Hygiene & Approvals

From a toxicological point of view, Neofit® is very much suitable for contacts with potable water and food stuffs. The directives, different per country, e.g. NSF/ANSI 61 [2]) in USA, are fulfilled by Neofit®.
PET material, like many of its fellow polyesters, is resistant to many hazardous fluids.

Chlorinating the pipes, as often applied in water networks (with NaClOx), does not cause any problem.

[2]): NSF/ANSI 61 – “Drinking Water System Components - Health Effects”’ 2016

Structural capability

In general Neofit® is applied as a semi-structural, interactive, class B liner as defined in ISO 11295 [3]).

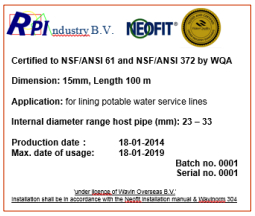
From a strength point of view, an unsupported, expanded Neofit® pipe on its own (without support of the existing pipe) can resist an internal pressure of 8 bar for 50 years, comparable to that of a PE service pipe. The existing pipe is needed however, to provide stiffness. The lining would collapse under external loading when not supported at least in part by a surrounding host pipe.

The lining does have the capability to span gaps, e.g. because of pit corrosion. The capability of the expanded pipe to withstand internal pressures has been thoroughly analysed in simulated host pipes with holes, 2/3 x internal diameter of host pipe (e.g. a hole of 20 mm in a 30 ID pipe). The expanded linings then have to withstand pressures of at least 25 bar.

Marking

Neofit® pipe is manufactured in the Netherlands and is marked with a label on the coil with the following: manufacturer, trade name, manufactured diameter, length, application, internal diameter .range old pipe, production date/max. date of usage, certification.

Example:



2.3 Installation process

The lining operation is quick and simple. The small sized Neofit® products and installation equipment enable very small working areas.
Access is required at each end of the service pipe that is to be lined. After cleaning, the liner pipe is simply pulled in by hand until it is completely inserted.

A compact, custom-built automatic expansion unit is connected to the pipe, and a specific cycle of hot water and compressed air is passed along the length of the liner.
This has the effect of expanding the liner pipe to provide a smooth continuous tight-fit liner to the host pipe. Because of its high flexibility the pipe can easily be inserted through bends. The small longitudinal ribs on the outside of the pipe create a venting possibility for trapped air when expanding. The lining system in its basic form can deal with lengths of up to 25 metres so that even long supply pipes can be treated. With an additional booster unit even lengths up to 100 metres can be accomplished satisfactorily.

When reversion is completed, the protruding liner ends are simply cut off.
Compression fittings are used at each end of the service pipe to make a mechanical connection to the outside of the existing pipe and to seal against the liner. An effective barrier between the water supply and the wall of the existing pipe is thereby provided. The system is not critical towards the type and make of compression fitting. Many commercially available and commonly applied fittings are compatible with Neofit®.

[3]): ISO 11295 – "Classification and information on design and applications of plastics piping systems for renovation and replacement", 2017

3 Experience with installed Neofit®

Since its first applications in actual circumstances in 1991, the Neofit® system has been applied successfully in several countries in Europe, amongst other the UK, France, the Netherlands, Germany and Ireland.

Initially applications focussed in Europe on lining lead water services, to tackle the problem of lead contamination of drinking water. The lead pipes varied in size between ½" and 2" with internal diameters ranging from 11 to 44 mm. It appeared that these and all in-between sizes could be adequately covered with 4 sizes Neofit® : 7mm, 10mm, 15mm and 20mm.

Outside Europe, Neofit® has been applied successfully in Australia, USA, Canada and South Africa.

Next to lining lead services, the system appeared to be excellent to tackle problems in water services of other materials, in particular leakages through joints and pit corrosion. The ability of the lining to span holes and gaps proved to be a big advantage.

In the annexes to the report, some case histories from Europe, mostly from the early days of the application of the system, demonstrate the versatility of Neofit® to deal with a wide variety of conditions and circumstances. It also gives ample evidence that the lead barrier characteristic of the PET material is excellent.

Wim Elzink *)

*): qualified and independent consultant in the field of international pipeline rehabilitation

Neofit® installed in Salisbury, United Kingdom – May 1991

The very first (!) actual installation of Neofit® in an operational setting after its initial development, took place in May 1991 in the town of Salisbury in South England. The installation equipment was still in prototype form but considered suitable for the basic installation process.

The test installation was done at a house at Australia Avenue, where, because of health problems, an elderly couple had been advised by their doctor to have their drinking water investigated.

Water authority Wessex Water had at the time the experience that houses with similar lead services had concentrations of lead in tap water usually in the range 75 – 110 µg/l.
The dwelling in question was serviced by a lead pipe with OD 26mm and ID 16mm.
. Length from main to stop tap (public): 2m.
. Length from stop tap into the house (private): 16m
(13.5m alongside the house, then a square bend, followed by a 2.5m piece until under the washing machine).

With the support of Wessex Water, Wavin Neofit® was used. The size (d_n) of pipe, 6mm, was originally chosen to line the smallest services. The expansion rate was 2.7. *)

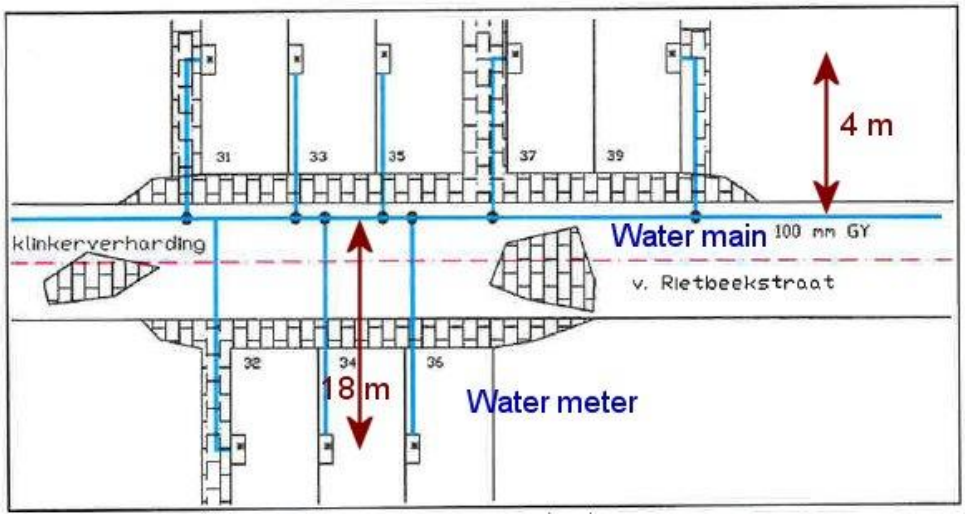
The short section of 2m was installed without any problem.
The long section of 16m turned out to be more difficult. It proved that the pipe was severely dented/buckled and encrusted, requiring extremely high pull-in forces. At the re-trial the day after, with the service pipe cut in two, insertion was ok, but reversion was somewhat problematic because of high temperature fall in the installation water supply hoses. *)
In the end, both sections were treated to the full satisfaction of the water company.

The water quality at the tap was monitored (weekly at first). At each visit, the first litre of water was drawn off from the drinking water tap and analysed for lead. Initially still some lead was present in the water, but after some months the lead concentration was close to the limit of detection: < 5 µg/l.
Between October 1991 and June 1993, 16 out of 17 samples were at or below 5 µg/l and one was at 7 µg/l.
Bacteriological colony counts were checked (one day 37˚C and three days 22 ˚C) and numbers were low and no different from those for houses on the same source of supply.
Wessex Water expressed in writing that the performance of the liner had been very satisfactory since it was installed.

*) Later on in the development of the system it was realised that it is recommendable to limit the expansion rate to 2.2 (unless a special booster unit is applied to keep up the temperature at the entry point of the installation). The 6mm pipe was replaced by a 7mm pipe then.
Also later on, the installation unit and the insulation of the hoses was significantly improved, reducing the temperature drop to a minimum.

Neofit® installed in Enschede, the Netherlands – Sep. 1994

The water company WMO (now Vitens) carried out pilots in 1994 from which this one in the van Rietbeekstraat in Enschede, where 56 lead water supply services where lined with Neofit®, is the most detailed and evaluated case. The figure below shows the layout of the project.



In the project the contractor managed to renovate 8 to 10 lines per day, which comes down to about one per 50 minutes. The work was well organized and a few men were occupied with the opening of the pit at the point where the service line has to be disconnected from the main and the dis-connection of the water meter. Then two others carried out the actual renovation and reconnections, after which the pit at the water main was closed by another person. In total 7 people have been involved in the project, from which 2 were doing the actual lining work.

The water company also made an analysis of the costs of the lining in comparison to the traditional open cut replacement. In this specific case in The Netherlands they came to costs savings on the installed costs in the range of 5 to 30 %. It shall however be noted that the actual saving depends very much on the actual layout of the site. Depending on the depth of the service pipe, the type of pavement, cost of local labor, etc. In much deeper installations, for example in cold winter climate locations savings well in excess of 30% should be very achievable

Much more important than these costs are the risks that open cut replacements are bringing to the scene. Customers more and more claim repairs and recovering damage done to their private possessions like gardens, trees, plants etc. But also the chance of damaging an existing service is big in case of open-cut replacement and next to the costs of the repair of it, the related costs can be rather high for the utility.

NB: More detailed information about this case history is provided by an independent study by the Dutch independent water authority KIWA *)

*) KIWA, “Applicability of PET-lining for the renovation of lead service pipes”, 1995

Neofit® installed in Freital, Germany – Dec. 1995

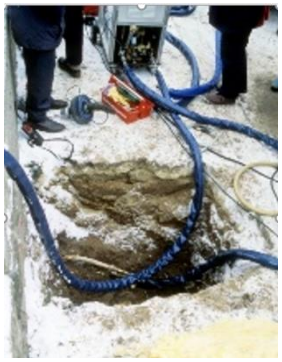
The ¾" (OD 32mm, ID 21mm) lead service pipe to a house in the Bannewitzerstrasse in Freital was used as a demo with Neofit for local water supply company Trinkwasserzweckverband Weißeritzgruppe (WVW)

The service pipe with a length of 15m was located between the main in the street up into the cellar of a four family house 5m higher. The pipe was cleaned rinsed & dried with foam plugs under air pressure. A Neofit tube of 10mm was easily inserted without any problem. Even although the weather conditions were harsh because it was snowing at an ambient temperatures of -4˚C, the expansion process went very well.

Some impressions of the installation:








As per date of this report (23 yrs later) the with Neofit lined lead service pipe is still in operation, with very satisfactory performance, supplying 140-160 m^3/yr.

The water quality is monitored by WVW on a regular basis and made available to the end users.
Lead content is one of the parameters registered and was < 1.0 µg/l.

Neofit® installed in Dublin, Ireland – February 2017

Dublin County Council (DCC) is still faced with numerous lead services in its older city districts. Like in many places the split responsibility for the services (from the main to the meter and from the meter to the tap) makes it still difficult to tackle the lead problem efficiently.

In February 2017, DCC, in a joint effort with Irish Water, wished to try out the Neofit® system and approached the installation company All-Brite Environmental Ltd from Kilrush for this.
The lead services of two houses in Cabra, Dublin 7, were lined. Both were ½" in diameter and each 16 m in length. For the lining 7mm Neofit pipe was used.

Prior to the installation, in July 2016, water samples were taken (after 30 min. stagnation) of the respective taps in the houses. This was repeated in March 2017, approx. 1 months after the lining took place.
The lead contents were significantly reduced in both houses:

- from 17 µg/l to 0.65 µg/l; and:
- from 8 µg/l to 0.21 µg/l.

Both services now supply water with a lead content well below 10 µg/l as per the EU Drinking Water Regulations. DCC was very happy with the results.

Impressions of the lining work: