uponor

Uponor Infra renovation systems

Renovation of pressure and gravity pipelines, manholes, tanks and road culverts

Renovation in Uponor Infra technology

Most of the water and sewage infrastructure in Europe are nearing the end of their service life. Numerous investment projects in 1970s and 1980s were based on reinforced concrete, steel and cast iron pipes, which now need continuous repair, renovation or replacement. While repair is a temporary solution and replacement an expensive one, renovation seems a reasonable compromise. Such projects involve, among others, different renovation methods by means of polyethylene pipes.

Uponor Infra is one of the most experienced manufacturers and suppliers of polyethylene pipes since its history goes back to 1950s. Since 1976 the company has also developed pipe systems for renovation of damaged pipelines, used for repairing water pipelines as well as sewage pressure and gravity systems, manholes, tanks and road culverts.
Our contribution to the development of trenchless technologies in Poland was confirmed by TYTAN 2004 Award in the COMPANY OF THE YEAR category and TYTAN 2016 Award in the PRODUCT OF THE YEAR category for jacking drainage VipLiner.

Contents

Preparatory work

Inspection and analysis of technical condition of a collector

Recent years have shown a considerable development of pipeline inspection technology by means of CCTV, sonars and radars. CCTV inspection has become a commonly applied method of the analysis of non-man-entry pipeline condition. If a pipeline is filled with liquid, the inner pipe profile and density of sediment is determined by a sonar – a device using high frequency sounds. If presence of void cavities around the pipeline is suspected, a radar is used to identify their location. It also facilitates identification of leaks.
Evaluation of the condition of an existing pipe often requires a separate expert opinion, specialist tests and calculations. Another element is the choice of technology, which ensures long-term and failure-free operation of the system, guaranteeing reasonable safety.

Preparation of a pipeline for renovation

Once a decision to renovate a pipeline section is made, preparation and cleaning phase starts. Mechanical or hydrodynamic cleaning aims at removing tree roots growing into the pipe as well as solid sediment or remains of concrete mortar. We should remember to use an appropriate cleaning head and pressure value not to aggravate the collector condition. When initial cleaning is completed, another CCTV inspection is performed and – if necessary – cleaning is repeated.
The entire inner surface of the pipeline should be free from sharp edges.

Selection of material

Material selected for renovation should help us to avoid in the future the kind of damage which occurred in the past. Pipes and modules made by Uponor Infra have numerous advantages, owing to which they can be used for the construction of both pressure pipelines and gravity collectors as well as for renovation of endangered pipelines. Uponor Infra renovation systems are ones of the most reliable technologies available in the sector. The use of polyethylene in their production gives to a reconstructed canal all advantages which derive from such qualities as resistance to corrosion and abrasion, long life operation, impact resistance and low roughness coefficient. The offered solutions ensure the construction of structures which will withstand all external loads should the pipeline under repair be totally degraded.
Renovation methods require only digging auxiliary trenches, ensuring minimal disruption to pedestrian and vehicular traffic.

Legionowo 2005. Inspection of the channel before and after renovation with VipLiner modules dn560 mm

ADVANTAGES OF PE PIPES

- Very high abrasion resistance
- Very wide range of chemical resistance
- Very low and long-term absolute roughness index k=0.01 mm
- Considerable flexibility:
  - resistance to water hammer
  - pipes can be freely bent, which eliminates bends
- Homogenous joints of pipes and fittings
- 100% leak tightness of joints
- Easy installation regardless of weather conditions
- Considerable lightweight in comparison with traditional materials
- UV resistance
- Long service life
- It is possible to manufacture non-standard pipes (out of standard range), customized to suit the needs of different projects.

Parameters of pipes slipped into the old collector

In order to determine the parameters of the new pipe we should first define the technical requirements which the new pipeline must meet.

- **Maximum outer diameter** of the new pipe is finally determined during calibration phase, i.e. when a several meter long pipe, whose outer diameter equals the diameter of the pipe to be introduced, is passed through the renovated pipeline.

- **Minimum inner diameter** for which the required capacity is maintained. Not only the old design parameters but also the observations and current development plans of the pipeline user are analysed. For instance, the actual exploitation of the sanitary collector once the ground water infiltration is eliminated may be much lower than before renovation, despite reduction of the inner diameter. Very low absolute roughness index "k" for polyethylene pipes makes a difference as well.

- **Resistance to internal pressure** for pressure pipes determines the minimum pressure value PN of a solid wall WehoPipe.

- **Cross-section resistance** of the pipe against stress occurring when the pipe is pushed to the old pipeline. For WehoPipe pressure pipelines, it has to be checked whether the cross-section of the pipe wall for a given pressure class and type of material as well as lengths of pipes to be slipped inside (taking bends into consideration) can transfer stress coming from the pulling force.

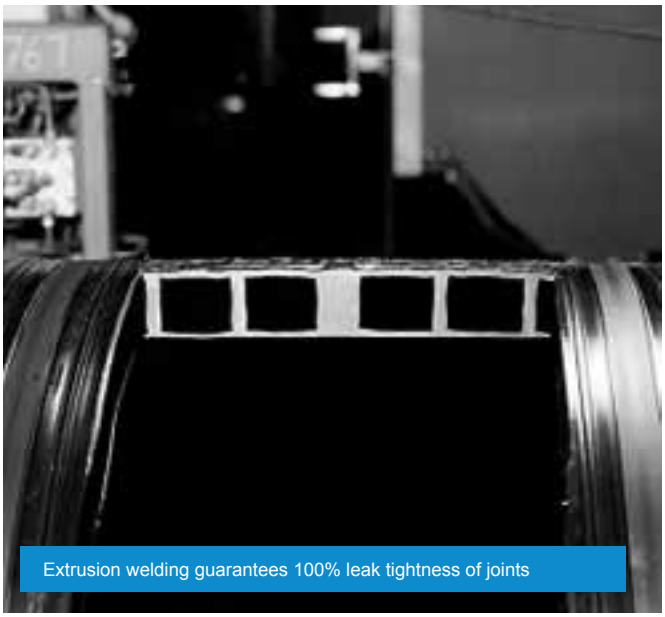
For Weholite structural pipes, it has to be checked whether the cross-section of the pipe is sufficient to transfer stress caused by the pulling force.

- **Minimum bend radius** of the selected pipe (depending on SDR and type of PE) must be sufficient for the pipe to be slipped into the renovated pipeline using the trench of pre-defined dimensions.

- **Resistance of the new pipe to external load** is determined on the basis of an analysis of the condition of the old pipe, of water and ground conditions, traffic load and the kind of planned injection. In many cases the new pipe must be selected in such a way that it is able to transfer all external load. For solid wall pressure pipes a short-term necessary ring stiffness is determined on the basis of the kind of material and wall thickness. For structural Weholite pipes an appropriate ring stiffness SN class is selected.

- **Resistance of joints of the new WehoPipe and Weholite pipes**

Pressure pipes are joined by butt-welding. Owing to this method the joints are as resistant as the other parts of the pipeline. Structural Weholite pipes are joined by extrusion welding, which ensures the same resistance of the joint as of the other parts of the pipeline.



Extrusion welding guarantees 100% leak tightness of joints

Test checking resistance to external loading of a Weholite pipe

Butt welding guarantees homogeneity of the material

Introducing long lengths of WehoPipe and Weholite pipes using starting trenches

Once the inspection, cleaning and calibration of the old pipe is completed, the location where the new pipe will be introduced has to be chosen. Usually such locations are situated at the points of change of direction. A starting trench is constructed there. Its length depends on the depth of pipeline and maximum bend radius of the pipe.
From one starting trench the pipeline may be run in two directions.

Solid wall pressure WehoPipes are offered for renovation of pressure pipelines: water systems, pressure sewage systems, technological pipelines. They may also be used for renovation of gravity collectors: sanitary, rain water and combined systems.
Range of nominal DN (equal to outer diameter): 63 mm – 1600 mm.
Range of nominal pressure: PN3.2 – PN20.
Before pulling inside the old pipe, the new pipe lengths are butt-welded. Once they are pulled in, individual pipe sections are joined by means of flanges.
For renovation of pipelines operating under internal working pressure close to the nominal pressure value of the proposed pressure WehoPipe, where cleaning and accurate calibration may be insufficient to eliminate a possibility of considerable scratching of the surface of the pipeline which is pulled inside, WehoPipe RC class pipes should be considered.

Warsaw 2011. Relining of a pipeline with WehoPipe RC dn800 mm

Wrocław 2008. Renovation of water mains by means of a special PEHD Ø1033 mm pipe

Chmielów 2012. Relining of technological GRP collector with Weholite pipes dn800 mm

Structural Weholite pipes are used for renovation of the sanitary, rain water, combined and technological gravity collectors.
Range of nominal DN diameters (equal to inner diameter): 350 mm - 3000 mm
Range of ring stiffness (as per ISO 9969): SN2, 4, 6, 8 kN/m² and other available on request.
Pipes, depending on diameter, may be joined by extrusion welding, snap joints or threaded joints with external extrusion weld.
One of the renovation methods described below may be used.

Long relining (sliplining) by means of pressure WehoPipe

In this technology a PEHD pipe of outer diameter smaller than the actual inner diameter of the old pipes, taking into consideration narrowings, deformations and shifts, is slipped inside the old pipe. It is applied wherever reduction of diameter will not affect negatively the hydraulic conditions of the system. For this renovation method, pipes of DN 63 mm – 1600 mm are used.
Depending on the condition of the old pipeline and the parameters of the new pipe (DN, SDR, PE), it is possible to slip pipe lengths even longer than 1000 m.

After a WehoPipe is slipped inside, it is recommend to fill the space between the pipe walls with concrete mass or mortar made of cement with an addition of ash. This will additionally stabilize the system. Moreover, ground water will not be able to fill the space between the pipe walls, which could result in creating cavities around the pipeline. In special cases it is possible to leave free space between the pipe walls (using points stabilizing the system) and – for short, straight lengths (practically up to 100 m) with sufficient space between the pipe — to place distance skids.

Warsaw 2000. Relining of rain collectors at Okęcie Airport with WehoPipe dn355 and 450 mm

Swagelining by means of pressure WehoPipe

This installation technology, as in the case of traditional long relining, is based on slipping long lengths of a PEHD pressure pipe into an old pipe. The difference is that the outer diameter of the new pipe is equal or only slightly greater than the inner diameter of the renovated pipeline. Pipe within the range DN 75 mm – 1600 mm are used for this renovation method.
Depending on the condition of the old pipeline and parameters of the new pipe (DN, SDR, PE) it is possible to slip lengths exceeding even 1000 m.
The swagelining method involves reducing the outer PE pipe diameter (by a “hot” or “cold” method) and slipping the pipe through a special reducing matrix using the continuous, controlled pulling force. Deformed PE pipe is pushed inside the renovated pipeline, where, once the pulling force is released the pipe comes back to its original shape, which makes it fit tightly. This way, there is no need to fill the space between the pipes.

Prague 2006. Renovation by means of a swagelining method using a special PEHD Ø1120 mm pipe

Long relining (sliplining) by means of pressure WehoPipe

Linear exchange of pipeline by breaking the old pipe and slipping in a pressure WehoPipe

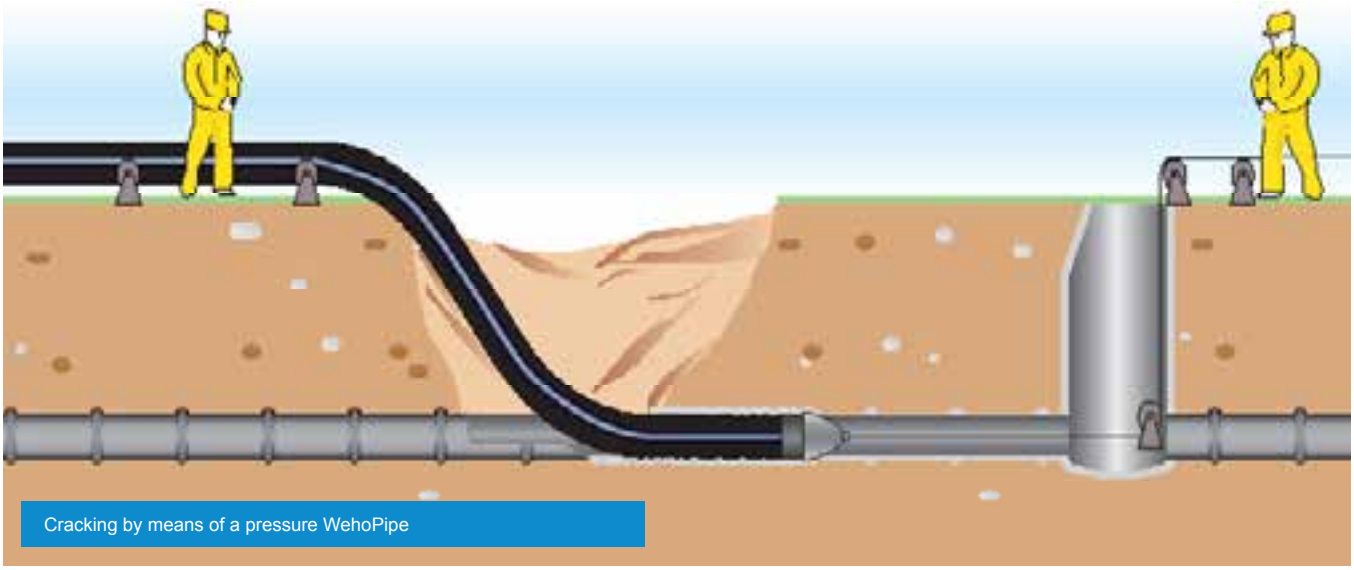
If – after the inspection, cleaning and calibration of the old pipe – it appears that due to its technical condition, the pipeline should be reconstructed or if a new pipe would cause considerable reduction of pipeline capacity, one of the linear replacement methods which involve breaking or cutting the old pipe, is used. The choice of an optimum method depends on:

- the material and diameter of the old pipe
- planned diameter of the new WehoPipe
- infrastructure under and above the ground near the pipeline.

Cracking consists in breaking the old pipe by hammer equipment or hydraulic expanders and introducing the new pipe directly after the crushing device. Once the work is completed, the new pipe takes over all the functions of the old collector.

In pneumatic cracking the hammer device (hammer hitting a steel cone) is driven pneumatically.
It moves along the old pipe, crushing it and pressing its fragments into the surrounding ground while the new PE pipe is simultaneously slipped into. This method is used for renovation of pipelines made of brittle materials.
Usually the new pipe has a diameter of DN 100 – 500.
Since the hammer frequency is big, a possible impact of renovation process onto the underground and ground infrastructure should be taken into consideration.
If the neighbouring pipelines, foundations, buildings or roads are endangered, **hydraulic cracking** may be used.
In this method hydraulic expansion of head segments breaks the old pipe. Once the head comes back to its original shape, it moves forward and the new PE pipe is simultaneously slipped inside. This process is cyclically repeated until the whole length is replaced.
This method can be used for WehoPipe lengths up to DN 1000.
If the old pipeline is equipped with steel flanges, which are impossible to remove before renovation, **hydraulic cracking with a cutting-expanding** head may be used.
This head is fitted with special knives which cut the old pipeline while the new PE pipe is slipped inside.

Przyjma - Janikowo 2013. Renovation of brine pipeline by cracking using a special PEHD Ø670 mm pipe



Cracking by means of a pressure WehoPipe

Sliplining by means of Weholite pipe

Gravity structural Weholite pipes are used for this renovation method. They are joined depending on the diameter.
Weholite pipeline, which has been joined before, is slipped through a starting trench inside the old pipe. From one starting trench renovation can be performed in two directions. Usually an approx. 200 m long pipeline is slipped. However, depending on the class of modules and conditions of work, it is possible to renovate lengths up to approx. 400 m.
Once a Weholite pipe is slipped inside, it is recommended to fill the space between the pipes with concrete mass, cement-ash mortar or with foamed concrete.
Thanks to it the whole system is additionally stabilized and ground water does not get into the space between the pipes, which could create cavities around the pipeline.

Joining method	Diameter range [mm]
External and internal extrusion welding (or, alternatively: internal)	700 – 3000
Threaded joint + external extrusion weld	350 – 1200
Machine extrusion welding	1200 – 3000
External welding	to 700
Weholite snap joint	600 – 1200

Toruń 1999. Renovation of a sewage collector by sliplining using Weholite dn1400 mm pipes

Chełm 2013. Renovation of a sewage collector by sliplining using Weholite dn1000 ÷ 1200 mm pipes

Relining by a gravity Weholite pipe

Short relining

Once inspection, cleaning and calibration of the old collector is completed, locations at which a new collector will be introduced must be defined. If it is impossible to prepare starting trenches of lengths depending on the depth of the pipeline and radius of pipe bend (which depends on PE type and SDR of the pipe), then short relining is performed, using the existing manholes or chambers through which short VipLiner or Weholite modules are introduced. For renovation of sanitary, rain and combined collectors we can use:

Structural Weholite pipes
Nominal diameter range DN (equal to inner diameter) 400 mm – 3000 mm.
Ring stiffness range (as per ISO 9969) SN4, 6, 8 or 10 kN/m².
Depending on the diameter, the pipes may be joined by extrusion welding, snap joints or threaded joints combined with external extrusion welding.

Extrusion welding of large diameter Weholite pipes ensures seamless joint, which is monolithic and durable

Weholite snap joint

dn=id mm
600
700
750
800
900
1000
1100
1200

Threaded joints

dn=id mm
350
400
450
500
600
700
750
800
900
1000
1100
1200

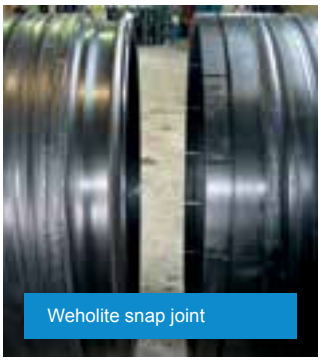
Extrusion welding

dn=id mm
700
750
800
900
1000
1050
1100
1200
1250
1300
1400
1500
1600
1800
2000
2200
2400
2500
2600
2800
3000

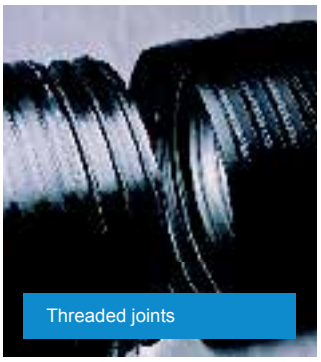
VipLiner modules

dn=de mm
90
110
125
160
180
200
225
250
280
315
355
400
450
500
560
630

de - outer diameter
dn - nominal diameter
id - inner diameter



Weholite snap joint



Threaded joints

Short VipLiner modules
Nominal diameter range DN (equal to outer diameter) 90 mm- 630 mm.
They have ring stiffness (as per ISO 9969) not lower than 8 kN/m².
Modules are joined with snap joints.

VipLiner modules

Short relining

Short relining with Weholite modules

In this method short modules are introduced into the renovated pipe, which are joined directly in the starting chamber. Depending on the size of the starting chamber and pipe diameter, the following joining methods are used:

- snap joint with a seal which ensures leak tightness
- thread and external extrusion weld
- external and internal extrusion welding
- one-sided internal extrusion welding.

dn=id mm	de			
	SN4 mm	SN6 mm	SN8 mm	SN10 mm
300	-	-	341	345
350	-	-	406	401
400	455	456	455	458
450	511	511	511	514
500	568	565	569	573
600	679	677	679	681
700	797	794	793	796
750	857	836	853	851
800	909	913	907	911
900	996	1009	1016	1026
1000	1107	1121	1130	1135
1050	1162	1177	1190	1193
1100	1232	1232	1250	1249
1200	1328	1344	1355	1364
1250	1397	1401	1417	1424
1300	1452	1456	1477	1480
1400	1551	1573	1583	1591
1500	1659	1681	1697	1705
1600	1773	1797	1809	1817
1800	1990	2016	2036	2046
2000	2214	2248	2259	2272
2200	2433	2465	2487	2501
2400	2661	2661	2708	2740
2500	2768	2783	2822	2842
2600	2874	2918	2940	2958
2800	*	*	*	*
3000	3329	3353	3385	3409

dn – nominal diameter
id – inner diameter
Other ring stiffness on request

de – outer diameter
**on request*

The length of Weholite modules depends on the size of the starting chamber and may be arbitrarily determined. Manual equipment is usually used for introducing the modules. If longer lengths are renovated, mechanical equipment facilitates installation.
Once all the modules have been introduced, the space between the old and new pipe is filled with a “special”, light filler, which fills the space thoroughly, penetrating cavities and stabilizing the whole system.

Warsaw 2000. Renovation of rain water collectors at Okęcie Airport by means of short relining using Weholite dn500 mm modules

Wrocław 2003. Renovation of a cast iron pipe 2500 mm with Weholite dn2000 mm modules

Short relining

Short relining with VipLiner modules

In this method short modules joined by means of special snap joints with a seal guaranteeing leaktightness are introduced into a starting chamber. Thanks to the special structure, the joints have very high mechanical strength and 100% leaktightness.
The length of a VipLiner module depends on the diameter of the manhole. The standard length of a module is 0.5 m. Such modules can be introduced even from manholes of 800 mm diameter. If chambers of greater diameter are used, we can even apply longer modules.

Ruda Śląska 2012. Renovation of strorm water system with Vipliner dn200÷630 mm modules

Tomaszów Mazowiecki 2014. Renovation of stoneware canal dn250 and dn400 by means of cracking method using VipLiner 2RC+ dn355/20 mm and dn450/25 mm modules

Manual equipment is usually used to introduce a VipLiner module into the old pipe. In the case of longer sections, installation is facilitated by hydraulic equipment which pushes the modules one after another.
Once all the modules are slipped into the old pipeline, the space between the pipes is filled with a “special” light filler, which penetrates the space thoroughly stabilizing the system.

Installation methods

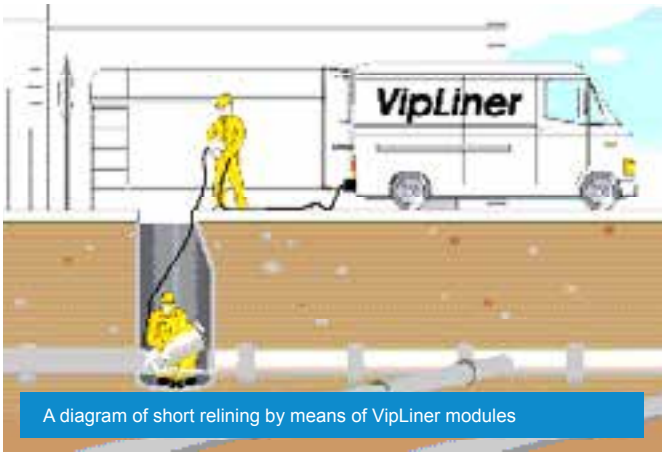
Method I – by means of hydraulic machine

- A hydraulic cylinder set up in the starting chamber of a manhole, min. DN1000 mm
- If the collector changes its angle in the manhole, its base unit must be dismantled
- Advantage – installation from one manhole – pushing the modules
- It is possible to rent a Uponor Infra hydraulic machine

Method II – by means of a winch placed in a receiving chamber:

- Line hoists are used to pull the head
- It is necessary to place a steel line between the chamber, to which an element pushing the modules is attached. The modules are pushed by a force which is greater than friction force, on average between 1- 3 tonnes
- The winch is located on the ground level
- Installation can be performed from starting chambers from dn800 mm
- No need to dismantle the manhole base unit.

Static cracking consists in crushing the old pipe by means of a special head connected with a hydraulically driven head by means of steel rods and simultaneous pushing in of a new pipe. In this technology trenches are necessary only at the locations where house sewers directly join the pipe. An advantage of this method is that a hydraulic winch can be installed in Ø800mm and greater chambers through the manhole. As the old pipe is crushed and new modules are introduced, it is possible to maintain the present diameter of the pipe or even to increase it by approx. 10% of the cross-section.



A diagram of short relining by means of VipLiner modules

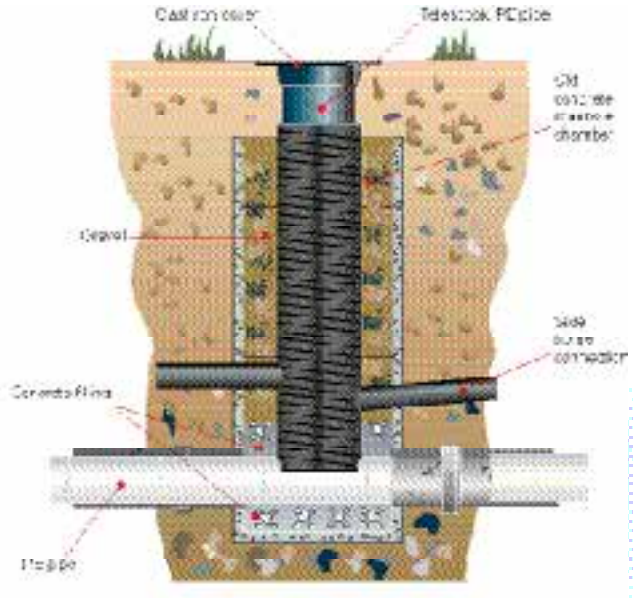
Renovation of manholes by means of WehoPipe or Weholite

The analysis of technical condition of a collector should comprise the manholes along its route. Their technical condition may also pose the same threats as the collector itself. Even if, before renovation, no infiltration of ground water in the manhole was found, after the collector is tightened, the ground water level may rise and leaks may occur. That is why in the areas characterized by a high level of ground waters, it is worth renovating not only the collector but also the manholes. Depending on the collector diameter and dimensions of existing manholes, their renovation can be performed using the existing range of PE pipe diameters.

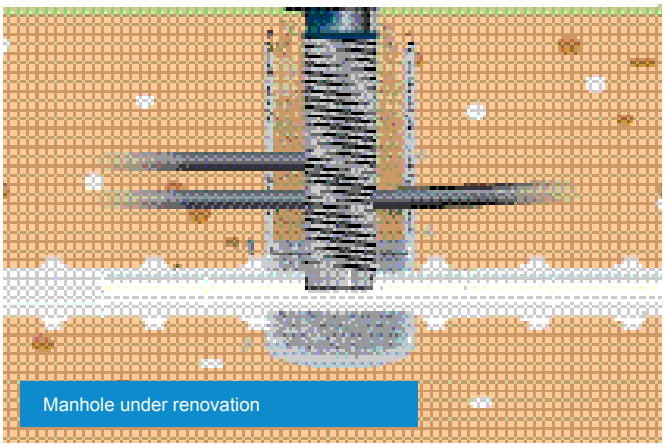
Manholes are connected with the renovated collector by extrusion welding. Manholes are either replaced or their upper part is removed and dismantled and a chimney of a shorter diameter is introduced, while the space between the chimneys is filled with sand or cement mortar, depending on the structural condition of manhole.

Sewage manholes can be also renovated by means of readymade Weholite manholes, suited to the size of repaired chamber. Weholite manholes are manufactured to an individual project and may be customized to atypical orders. Weholite manholes allow to create in result a complete, unified system of pipes, manholes and fittings.

Rzeszów 2015. Renovation of concrete dn1200 manholes with dn1000 manholes



Busko-Zdrój 2015. Renovation of concrete manhole with Weholite pipe dn1400 mm



Manhole under renovation

Renovation of tanks by means of Weholite tanks

The recent years have also seen the need for renovation of damaged tanks made of materials such as steel, reinforced concrete, concrete, cast iron or GRP resins. The most frequent reasons for defects include: corrosion, loss of integrity and cracks due to improper choice of tank parameters which do not match land and water conditions, loads and increasing transport intensity. Considerable operating problems are also caused by expansion joints in concrete and reinforced concrete tanks.

The Uponor Infra renovation method consists in introducing a ready-made tank built of Weholite pipes or tank segments joined by extrusion welding into the damaged tank's interior. For the sake of stabilisation, the unoccupied space may be filled with concrete mass or mortar made of cement with an addition of ash.

The Weholite tanks used for renovation purposes differ in diameters, ranging from 1000 to 3000 mm, in ring stiffness, ranging from SN2 to SN8, as well as in capacity tailored to the needs of the ordering party, the land and water conditions and transport loads. The tanks are manufactured according to customised designs and so they may feature non-typical solutions. For tanks combined in assemblies or those whose length exceeds the permissible transport limits, they are joined on site from segments by means of extrusion welding. The tanks may be used underground, on the surface or partially sunk.

Sample Weholite tanks


Gruta 2015. Renovation of drinking water tanks using Weholite tanks

Renovation of road culverts by means of Weholite pipes

For purposes of road culvert renovation, we recommend gravity Weholite pipes introduced into the culvert being repaired by sliplining. For the sake of stabilisation, the free space is filled with concrete mass or mortar made of cement with an addition of ash.

Road culverts constructed using the Weholite technology have very high dynamic load resistance, and additionally they are characterised by long service life and complete lack of corrosion. The extrusion welding capability is a guarantee of tightness of joints and efficient transfer of forces. Having removed gaskets from connections has ensured material homogeneity and chemical resistance (e.g. to petroleum derivatives, salts etc.). Weholite culverts are typically installed under roads, whereas in Northern Europe, also under railway tracks, providing an alternative to traditional materials. In Scandinavia and North America, Weholite culverts have already become widely used on account of their high resistance to low temperature and frost penetration.

While designing culverts and making a choice of appropriate ring stiffness of pipes, one should account for the road type, land type and hydrological parameters as well as conform with the applicable regulations in force in the given country. Weholite culverts can be installed with both small and very large overburden. Culvert ends may be formed as needed in order to match the inclination of slopes. Weholite culverts form a wide range of products offered with diameters ranging from 300 to 3000 mm, with ring stiffness of up to SN16 as well as with any chosen length.

Possibility of free culvert end forming to match individual needs

Toronto 2009. Renovation of steel culverts in the 407 ETR motorway by sliplining using dn2700 mm Weholite pipes

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