Choosing the trenchless renovation methods and trenchless underground methods of pipelines refitting

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Výber bezvýkopových renovačných metód a bezvýkopových podzemných metód opravy potrubia

The authors describe causes of carrier pipe ageing and methods of their inspection and renovation. The technical aspects of choosing the renovation methods are also presented. The paper includes a decision-making flowchart for choosing the carrier pipes renovation.

Key words*: pipe, renovation*

Introduction

It can be undoubtedly stated that trenchless renovations of carrier pipe are most advantageous, still the choice of the optimum method remain an open question. A good decision can be taken only on the basis of a sound knowledge of the present state of the renovated pipeline.

Trenchless methods of pipelines renovation

Trenchless technologies lie in the deposition, fixing or renovation of underground infrastructure with a little or even zero digging operations. Fixing operations are a special case of renovation, when the technical capacity of the pipelines is restored through sealing or local repairs. A sealing up operation lies in filling undug or leaking places with a sealing material or injecting liquid sealing materials inside the pipeline. Thus, external and internal sealing up methods can be distinguished.

The world's technology offers a number of replacement, renovation and sealing up methods, which satisfy branch safety standards. The most frequently used trenchless renovation methods are presented in table 1.

Tab. 1. Basic sealing techniques and trenchless pipeline refit methods [1, 3, 4, 5, 6].

Exemplary method of a type	Short description	Will the refitted pipeline diameter diminish?	Advantages	Disadvantages
SLIPLINING				
Sliplining	Insertion of one long section of lining of lower diameter, made of artificial material	Yes	Noninvasive for regular operations, short time of performance, relatively low cost. Simple in performance. Usually self-bearing method. No accurate sealing up needed..	Pipeline ductibility limitations, limited availability of diameters, can't be used for sharp curves, complex process of connection reconstruction, may require sealing up
Shortlining WIR	Ca. 0.5 m long, lower diameter pipe modules are introduced to the pipeline	Yes	Apart from the above options for refitting underground installment	Limiting ductibility of pipeline, can't be used for sharp curves, injection needed
CLOSE FIT LINING				
U, C, H, ΩLiner	Make use of longitudinal deformation of U, C, H, These are reduced linings. PE and PCV pipes can be used.	To a small degree	Protected by the old pipeline, short time of refit, high durability, length of refitted sections up to 1000 m long, wide range of diameters.	Needed pressure or increased temperature treatment. Slightly reduced ductibility.

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Neofit	Small, elastic pipe made of PET is introduced to the pipeline. Then it is enlarged.	To a small degree	Provides good tightness, fastness of refit,, expands 2.2 times the initial diameter size, easy to perform.	Does not transmit loads, used only for water connections
Swagelining	PE lining is tightly disposed in the pipeline; the pipe is dragged through a reductor decreasing the diameter. Material memory, paradigm inserts are used.	To a small degree	Minimal number of trenches, lower cost, performed quickly. No interpipe injection needed. Connections are easy to perform.	The state of the pipeline determines the type of installed lining; capable of transmitting loads it can be disposed.
Soft lining	Special epoxy or polyester resin impregnated sleeve is dragged to the pipeline. Then it is pressure-adjusted to the pipeline wall, and hardened with hot water, water steam or UV	To a small degree	Transmits external loads, can be used for refitting curvilinear sections, local contractions, small deformations of the pipeline.	Needs detailed cleaning, specialist equipment, high cost, TV inspection needed.
ON-LINE REPLACEMENT				
Static burstlinig	Refitting of steel pipes; steel pipe is cut and deflected underground.	No, it can be higher	Applicable for refitting of steel, cast iron and artificial pipelines .	Limited range of diameters, requires specialist equipment.
Hydraulic burstlining	Old pipeline is hydraulically crushed with a segment reaming head under the influence of hydraulic pressure	No, it can be higher	No dynamic environmental impact, vibration, it can be used for compact developed civic areas, small operation area.	Needed specialist equipment, special head or HP dragging device.
Pneumatic burstlining	Old pipeline is crushed by a pneumatically-driven head, after which new pipes are dragged. Old and crushed pipeline is driven in the ground.	No, it can be higher	Does not limit the ductibility of pipeline; a larger diameter pipeline can be installed .	Dynamic influence on utilities of other networks.
SEGMENTAL LINING				
Sanlinick 2000	Cast iron pipeline is sealed up by a multilayer sleeve, stuck inside the pipeline.	No	Durability, tightness, perfect adhesiveness of lining to the pipe.	For diameters over 0.2 m, this methods is unprofitable; has to be done off-line.
Avonseal Two	Sealing up external bell connections with artificial bands.	No	Short time of performance.	The surface must be clean, gland rings are used.
Encapsulation serie 6	Sealing up the bell surface with a tight gland band. Cast iron pipelines.	No	Short time of performance.	Gland band is used.
SPRAY LINING				
Subterra method	Various resins or cement slurries are disposed on a clean surface with a rotary head.	Slightly	Controlled thickness of sprayed material. Connections are easy to perform.	Specialist equipment and detailed cleaning of the pipeline are needed.
LIVE INSERTION				
Stive Vick International Method	New pipe is driven in and out with a choking seal	Yes	The medium is being constantly transmitted through the space between old and new pipeline	Specialist equipment needed. Dangerous.

Block diagram of selecting refit methods

In the case of a bad technical state of pipelines, the most suitable renovation method can be selected on the basis of the inspection results. The use of trenchless methods of pipelines renovation, as compared with the traditional ones, gives the following advantages: a minimization of earth work and traffic disturbances, a comparable, or even lower cost and a short time of completion. To select the best renovation method, an attention should be paid to the number of pipelines data (fig. 1).

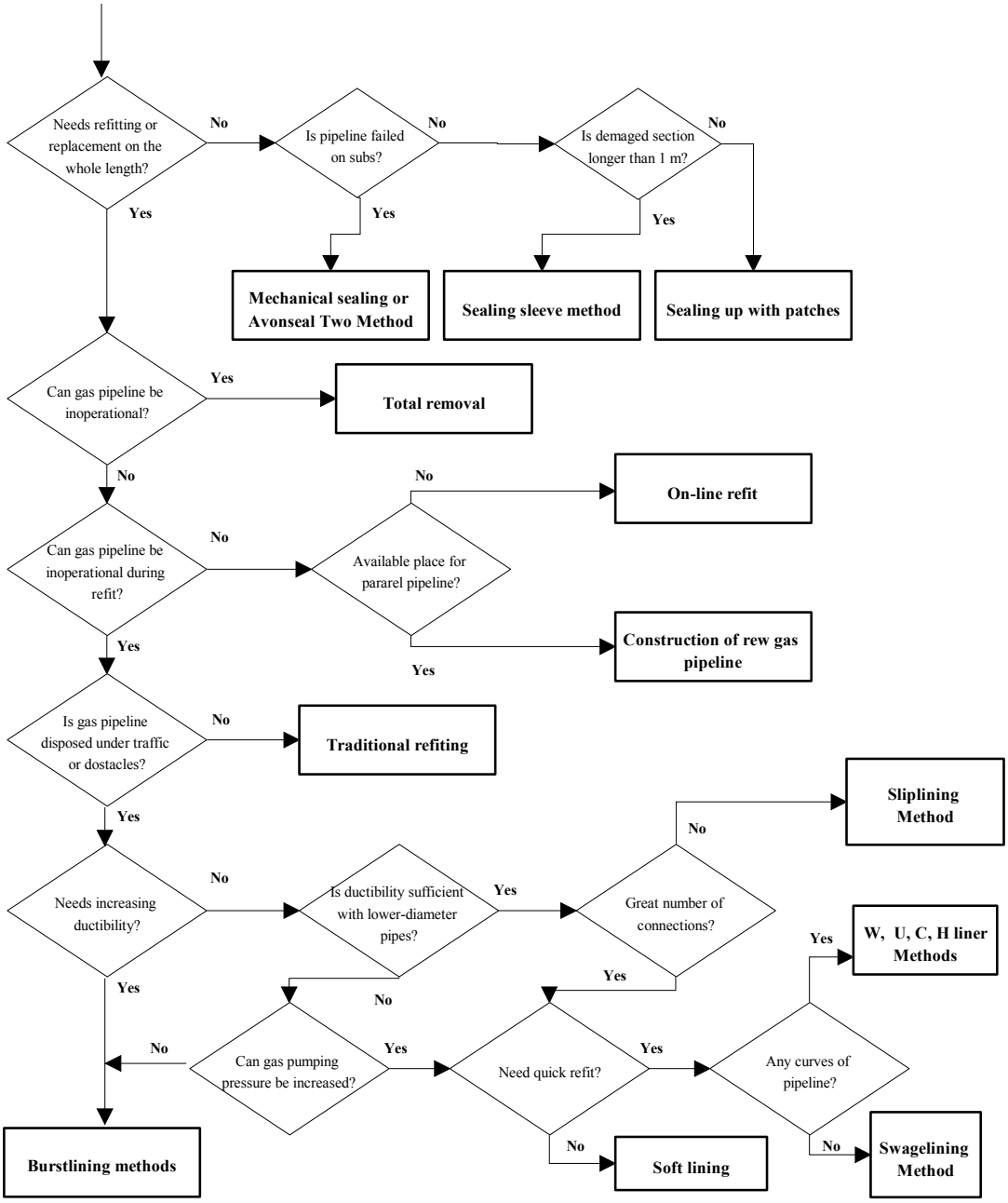

Fig. 1. Block diagram of selecting refit methods.

The trenchless technology method should be justified with respect to the profitability and the safety. Thus, a number of factors have to be analysed in detail:

2. direct costs:
   - o maintenance – frequent replacements of damaged parts,
   - o gas losses through damaged pipes and connections,
   - o gas losses through connections caused by, e.g. increased gas pressure,

2. indirect costs:
   - o technical supervision,
   - o cost of equipment needed for the maintenance or repairs,

2. other costs:
   - o safety,
   - o qualitative services,

A quick renovation operation has the following advantages:

- reduced losses,
- reduced environmental pollution,
- better safety parameters.

Maximization of flow capacity is vital for renovation methods in the case of tight concentric pipe arrays.

Conclusions

2. Pipelines renovation techniques are more and more commonly applied in Poland. Among the most important advantages of these techniques are:
   - o minimized noxiousness for the citizens,
   - o little or zero chance to damage cables and other underground utilities,
   - o minimum environmental impact,
   - o little co-operation with other technical services,
   - o time and money savings.

2. Each pipeline renovation method has its advantages and disadvantages, possibilities and limitations, depending on the application.

To conclude, the trenchless renovation of pipelines certainly will be more readily used in the future because of the mass aging them. The other reason is the lack of space for new utilities, increasing costs and road-surface restoration requirements.

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