PLANNED AND EMERGENCY REPAIRS OF GRAVITY SEWERS

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City sewer pipelines, with diameters up to 3500 mm, built 40–50 years ago, mainly of reinforced concrete and steel pipes, require special attention and constant condition monitoring. The aggressive nature of domestic and industrial waste has significantly increased in the last few years. According to the research, the average emergency-free operating life of sewers in Russia is no longer than 15–18 years.

Analysis shows that 70% of the emergencies in sewer pipelines are caused by microbiological and gas corrosion of the concrete pipeline crown, which leads first, to a loss of structural properties and then destruction. Sewer pipeline failures often compromise the ecological and technogenic safety of the community, and can cause significant damage to the environment and to regional budgets.

In most cases, the renovation of sewer pipelines is carried out in the last stages of wear, when the crown loses its structural properties due to corrosion, leading to a danger of collapse. Moreover, the hydraulic properties of the pipeline at this stage, particularly flow velocity and capacity, are significantly worse. This is caused by silting; deposits that increase the unevenness and roughness of the inner pipe surface increase flow turbulence at the pipe bottom, which is prone to abrasive wear, especially at the concrete pipe joints.

The methods and materials used to renovate worn sewer pipelines must ensure structural properties without decreasing the flow capacity. Structural elements used for renovation must withstand ground load at the depth of the pipeline, have good hydraulic properties, and aggressive wastewater resistance.

In this article, we will describe a gravity sewer renovation method, which provides full structural properties and increases operating life by 50 years, without reducing the flow capacity.

Renovation of the pipeline using SPIROLINE PE thread modules means there is no disruption. Work is carried out live, while the pipeline remains in operation. This does not interfere with normal day-to-day city life, and can reduce the costs related to excavation works and bypass provision. This is the only renovation method where bypasses are impossible to arrange.

Opening of the pipe is done in small sections, normally, next to the manholes where compact pits are excavated. All repair works are done via these pits. In cases where pits are impossible to arrange, the works are done through the existing manholes and chambers.

Depending on the load at the depth of the pipeline, thread modules with hoop strength from SN2 to SN8 are chosen. The length of the thread modules depends on the manhole or pit size and can be from 1 to 13.5 metres.

The whole process of pipeline renovation can be split into four stages:

Stage 1 – technical inspection of the pipeline

Specialists examine existing pipeline design and construction documentation, carry out CCTV inspection of the internal pipeline to check its condition, study the route of the pipeline and choose the best location for the start pits. In some cases, mechanical and hydrodynamic cleaning might be required, and CCTV inspection can be carried out live. Service disconnection and pipeline drying is not required in this case. The bottom part of the pipeline is not exposed to gas corrosion, and, as a rule, will still be in a satisfactory condition. Consequently, the top of the pipeline and pipe joints are studied more carefully (pic.1) to evaluate the condition of the inner surface, any misalignment

Pic. 1. CCTV of gravity pipeline

Pic. 2. Opening of the crown of pipelines

Pic. 3. Pipelines bottom cleaning

of pipes, the presence of foreign objects, and the possibility of collapse.

A report showing the general technical condition of the pipeline and recommendations on renovation is compiled upon completion.

Stage 2 – project planning

As we are talking about current renovation of the pipeline where there are no changes to the position plan and technical characteristics, there is no need for costly and extensive design.

The work schedule includes:

– A description
– Drawings of the site layout
– Work stages
– The layout of the pits

Stage 3 – construction and installation works

At this stage, after all necessary approvals have been granted, the start and receiving pits are arranged. The crown of the reinforced concrete pipes is removed and the equipment for pipe cleaning is prepared (pic. 2).

Cleaning is done using a special metal tool pulled through the pipe by the winches set in the starting and receiving pits. It collects all deposits and large debris in just a few passes (pic. 3).

Then calibration of the pipe section is done. One of the thread modules (gauge) is pulled through the pipe from the start to the receiving pit. The gauge is checked for unacceptable damage. If no damage is detected, the pipe made of thread modules is pulled.

Pic. 4. Screwing-in of thread modules

The first thread module is fixed in the start pit using jacks. The second module is lowered, aligned to the first one. The modules are screwed using special tools (pic. 4). The made pipe is pulled inside the repaired pipeline for the length of the module using a winch. Next, the remaining modules are lowered and screwed in place. After the pull-through, preparation for gap filling begins. It is carried out from the start pit to the receiving pit using cement mortar type M-200, with additives providing high plasticity and inhibition (pic. 5).

Mortar injection into the void between the pipes is done from top to bottom, starting from the pipe end at the start pit. The stopper plugs are installed – a grouting plug in the start pit and a dead plug with level tappings in the receiving pit. The grouting is done in two stages to prevent the pipe floating-up from the bottom of the pipeline. The gap is filled to 60% of the height of the outer diameter of the thread modules. After the solution is set, the gap is filled in.

The receiving pit is prepared for backfill when the solution is 50% set (about two days). The start pit turns into the receiving pit for the next renovation section. Auxiliary equipment is dismounted in the receiving pit. The mould is set around the existing concrete reinforced pipe with the replacement pipe made of modules at the bottom. The grouting concrete casting of the pipe top is carried out above the pipe using wire mesh.

The backfill of the pit is achieved with layered compaction.

The process is repeated on the next section.

Final stage – return of the repaired section into operation

Pipeline renovation using SPIROLINE PE thread modules solves the following problems:

1. The renovation process involves thread modules with relevant hoop strength (not including the residual strength of the existing pipe) enough for load resistance at the given depth. The structural properties are completely restored for the whole operating life.

2. The pipeline renovated using PE thread modules is resistant to aggressive wastewaters, gas and microbiological corrosion, and has high abrasive resistance. The total operating life of the pipeline is extended for not less than 50 years.

3. Thread modules joint integrity is achieved by gap grouting between the pipes, which solves the problem of soil pollution with aggressive sewer drains, soil erosion around the pipeline and ground water infiltration.

4. The flow capacity of the pipeline is not reduced by the smoothness of the inner surface and great hydraulic properties of PE pipes, despite the insignificant reduction of the inner diameter.

The described technology has been used in Russia since 2008. Over 28 km of worn pipelines with diameters from 500 mm to 3500 mm have been repaired since then. The popularity of the method is due its simplicity and reliability. There is no need for extensive design works, enabling more efficient renovation of a pipeline, without damaging other utilities or the landscape.

Pic. 5. Filling of the void between the pipes.