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	SPIRAL WIND TECHNOLOGIES	NEW VERSION AUGUST 2005

1 0VERVIEW

Spirally wound lining proceses include methods whereby a pipe or liner is formed in-situ by helically winding a UPVC strip into a pipe form within a host pipe normally from an existing access or manhole, which reduces or eliminates the need for a lead-in trench. To increase its stiffness, the strip ‘joint’ is ribbed with 'T-beams' on what becomes the outer surface of the new lining. In some systems the edges of the strip lock together to form a watertight seal, whilst in others a separate sealing strip is used to join together the adjacent turns of the helix. To strengthen the liner further some systems offer a steel banding addition to the jointing for addition ring stiffness

Spiral wound lining can be viewed from two different viewpoints within the renovation technology sector. First it can be viewed as a sliplining technique where the spiral liner is installed into a pipe and the annulus between it and the host pipe is grouted to complete the lining. Second it can be viewed as a close fit liner, using versions of the process tat allow the insalled liner pipe to be expanded in diameter to fit against the inner surface of the host pipe. There are also two methods of installation that can be employed. One utilises a winding machine to form the liner shape within the host pipe, the other is to form the liner manually using a man-entry operation within the host pipe. The former is generally used for ‘smaller’ diameter pipelines, although the winding rigs can operate up to what might be considered man-entry sizes. The mechanically wound systems offer diameters ranges from 150 mm up to 1,800 mm. The manually constructed liners tend to be applicable to generally larger diameter pipe sizes from 1,200 mm to 3,600 mm diameter.

The most recent development uses a profiled HDPE strip instead of UPVC. After winding the junctin between adjacent strips is heat fusion welded to ensure a high strength water tight joint. The profile incorporates a steel reinforcing strip

2 MECHANICALLY WOUND SLIPLINING

Often known as spirally wound lining, the tube is formed by a hydraulically driven winding machine which is normally position in a manhole or small access excavation. The lead end of the tube travels down the host pipe as further turns of the helix are added.

Since the whole tube is rotating during installation, a limiting factor can be the friction and weight of liner that the winding machine is capable of turning. Flotation may be used to reduce the load.

Production of a spirally wound liner, showing the tube emerging from the winding machine

An alternative spirally wound technique uses a winding machine that travels through the host pipe as it creates the tube, thereby removing the need to rotate the liner itself. By using a winding cage shaped to suit the host pipe, non-circular sections can be lined, including ovoid, egg-shaped and rectangular.

After installation of the tube, annulus grouting is carried out in the same way as for sliplining with other pipe materials, and the outer ribs provide a mechanical key between the liner and the grout.

3 MANUALLY WOUND LINING –MAN ENTRY DIAMETERS

Manually wound liners comprise a similar material to that used in mechanically wound systems but are designed for easier construction at larger diameters from within the host pipe.

Picture courtesy of Danby International Ltd

The PVC strip is fed into the man-entry sized pipeline from surface along with the required joint sealing strip. Operators in the pipe form the liner to the diameter and shape required to the line the pipe by hand inserting the spiral jointing strip as they progress. The advantage to this system is that many abnormalities in the host pie shape can be allowed for during construction, minimizing the grouting necessary to lock the new liner into the host pipe.

Normally lengths of host pipe can be lined and grouted in a single shift, however a section of a pipeline only may be completed to the point of grouting which means that the whole pipeline need not be completed in one ‘hit’ allowing long pipe lengths to be lined completely over time.

4 MECHANICALLY WOUND CLOSE FIT LINING

Some versions of the spirally wound lining technique for gravity pipelines offer the facility to expand the installed liner to provide a close fit within the host pipe. During installation, the joint between adjacent turns of the helix is prevented from slipping by a locking wire. Once the liner is in position over the whole host pipe length, the winding machine continues to operate, and the locking wire is pulled back progressively to allow the joint to slip and the helix to increase in diameter.

Diagram courtesy of Subterra

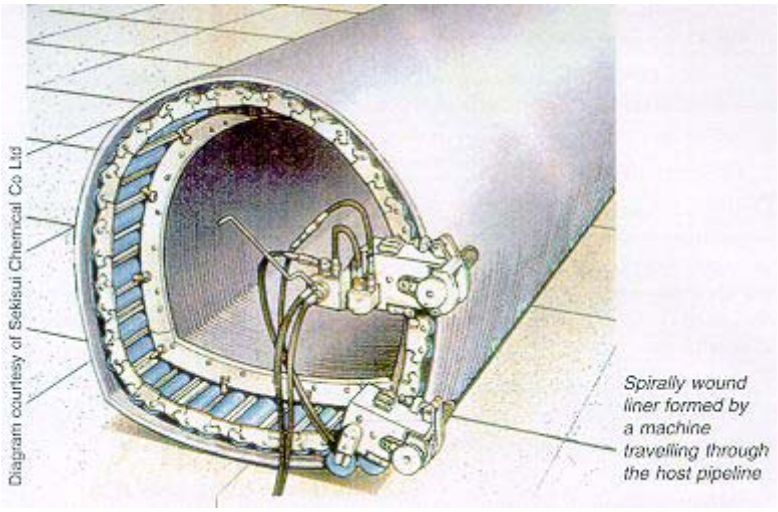
The spirally wound liner is expanded after insertion by allowing slippage between adjacent turns of the helix

As with the standard form of spiral liners, low flows in the pipeline can be accommodated during installation without the use of overpumping or diversion. Since there is no grouting, groundwater may enter manholes by following the path between the outer T-beams. It is therefore essential to provide a good seal between the liner and the host pipe at chambers. Sealing must also be carried out at any lateral connections.

The structural properties of the liner are governed by the need to wind the PVC strip into a helix, and spirally wound liners may not be able to resist high external loads transported in coils and is fed into the pipeline through existing access points. In some systems, the profile is arranged into a helix within the host pipe, in contact with the pipe wall, and a separate locking strip is hammered into the joint between adjacent turns of the helix. Integral rubber seals produce a watertight joint. H-section plates may be used to join the end of the profile from one coil to the leading end of the next coil, allowing any length of tube to be installed in one operation.

Spirally wound liner being installed in an egg-shaped pipeline

Other systems have interlocking profile edges rather than a separate locking strip, and one variant uses a self-powered winding machine, similar in concept to that used for spirally wound non-man-entry liners, which travels through the host pipe as it forms the liner. The system can create non-circular liners, the shape being determined by the configuration of the winding cage.



Spirally wound liner formed by a machine travelling through the host pipeline

The profile has a ribbed outer surface in the form of 'T-beams' which increase the structural strength of the tube and also provide a mechanical bond with the grout injected between the liner and the existing pipe wall. The inner surface of the tube has a low roughness coefficient, and the material resists most chemicals. In some systems, steel reinforcement can be inserted between the profile ribs prior to winding, to increase the strength of the tube.

The profile has sufficient flexibility to accommodate slight or gradual changes in the size and shape of the host pipe. Where the variations are more severe, manually installed tubes can be tailored to fit by making longitudinal V-shaped cuts, and then sealing these with H-section jointing plates bonded with a solvent adhesive.

Once the tube is installed and sealed, a standard PFA/cement grout is injected through holes drilled at intervals around the perimeter and along the length of the liner. Bracing may be fitted within the tube to prevent distortion from grouting pressure or flotation forces, and grouting is carried out in several stages depending on the dimensions of the liner. The holes are sealed with PVC plugs when grouting is complete. Lateral openings are cut out as the tube is installed, and rapid-hardening mortar is used to seal around the connection between the liner and the pipe wall.

Spirally wound liners are suitable for circular or non-circular man-entry pipes up to 3000 mm diameter, subject to safety regulations regarding the minimum size for man-entry, and can be installed in limited flows without over-pumping.