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Development of an optimised tube liner for trenchless pipe rehabilitation

Objective

For the rehabilitation of brittle and cracked sewers, so-called "tube liners" have been inserted or rolled up into these sewers and pipes for many years to avoid excavation work. The basic concept of the tube lining method is the insertion of a textile tube soaked with a resin and length and internal diameter (DN 50 to > DN 2000) of the selected section of the damaged pipe to be renovated via the manholes. In the sewer, the tube is pressed against the pipe wall by means of air or water pressure and cured by steam, warm water or UV light to form a liner. The textile tubes consist of nonwoven fabrics, stitch-bonded nonwoven or knitted plush made of polyester fibres or fabrics as well as nonwoven fabrics/composites made of glass fibres. In addition, the liner structures are reinforced by inserted filaments or seams, since the pulling in or rolling up of the tubes results in high longitudinal forces.

The aim of the research project was the development of an improved tube liner system combining advantages of the systems available on the market as well as eliminating disadvantageous properties. Thus, we wanted to increase the force absorption in the longitudinal direction to optimise the use of materials and the pore volume of the textiles for the best possible impregnation with the resins and to improve the tightness of the liner and bendability without wrinkling. Due to adapted properties, the production should be more cost-effective.

Approach and results

The solution of the project included the development of nonwoven fabrics made of polyester fibres or fibre mixtures and their consolidation into stitch-bonded nonwoven of the type Kunit and Multiknit. The focus was on adapting the textile-physical properties to the intended use. An airtight and media-tight coating was applied so that the tube liner can be inserted into the pipes using the inversion procedure. Adapted UV-curable resin formulations were developed on the basis of acrylates.

Tube liner resined and UV cured in a damaged sewer pipe (left), assembled (right)

In this research project, various nonwoven fabrics were produced from polyester fibre mixtures and processed into stitch-bonded nonwovens using the Kunit and Multiknit processes. The textiles were coated media-tight with silicone (knife coating) and thermoplastic polyurethane (extrusion coating, film lamination). A polyester acrylate-based formulation was developed for curing using UV LED lamps. The produced tube liners were characterised in particular by their high longitudinal strength and ability to bend (without wrinkling).

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