THE FUTURE IS TRENCHLESS – REHABILITATION OF PRESSURE INFRASTRUCTURE IN NELSON, NZ

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ABSTRACT

Over the past decade, municipalities have expanded gravity and pressure pipe infrastructure to meet growing demand. With rapid population growth straining existing systems, maintenance is critical. While UV - Cured in Place Pipes (CIPP) is an established technology in non-pressurised wastewater applications, the need and demand for trenchless rehabilitation of pressure applications has grown.

SAERTEX multiCom® GmbH has developed a UV-cured fiberglass-reinforced pipe liner, which is a close fit CIPP product for the trenchless rehabilitation of pipes in pressure applications such as sewer rising mains and potable water pipes. This liner is pressure resistant and fully structural, meaning it is an independent pipe after installation which can withstand up to 33 bar in accordance with the diameter of the pipe.

TDG Environmental has successfully installed SAERTEX-LINER® MULTI in Nelson, New Zealand, for the trenchless rehabilitation of pressurised mains. This pipe was decommissioned 15 - years earlier due to insufficient capacity and has now been updated to meet future needs of growing population and mitigate wet weather overflows. The project involved two sections of DN450 underneath a highway. This paper focuses on the benefits and use of UV-CIPP for pressure applications from planning to execution of the project.

1. INTRODUCTION

Aging pipe infrastructure is a key concern for the Nelson Regional Sewerage Business Unit (NRSBU), which is a joint committee of the Nelson City Council and the Tasman District Council. Together they are managing the treatment facilities and network which includes 16.8 km of rising mains, 5 pump stations, 712 m outfall, a wastewater treatment plant and a biosolids application facility [cf. NRSBU, About NRSBU, 2022, last access: 16/07/2024].

The NRSBU is responsible for the extensive, multi-year works and rehabilitation of the Rising Main duplicate project, which in total includes 4.0 km of DN 450 asbestos cement pipe. The rehabilitation was crucial as the pressurised pipe, decommissioned 15 years earlier due to insufficient capacity, was necessary to meet the future demands of the growing population and mitigate wet weather overflows. A new pipe had been managing the outflow of the Richmond area to the Bell Island Wastewater Treatment Plant.

The project was managed by the client, NRSBU, with support from Beca as the consultant/designers. Hunter Civil were selected as the main contractor for the project (part of the overall works, from the Beach Rd pump station to Saxton Creek) with TDG Environmental subcontracted to Hunter Civil to handle the critical structural lining sections under and adjacent to State Highway 6. These two segments, 252 m and 140 m long, were running operating

pressures between 5 bar and 6 bar. TDG Environmental selected SAERTEX-LINER® MULTI Type S+XR Pressure, from German manufacturer SAERTEX multiCom® for the project. This UV-cured fiberglass-reinforced (GRP) pipe liner is a close fit UV-CIPP product used for the trenchless rehabilitation of wastewater and supply pipes. Selecting this solution was considered critical to mitigate costly and highly disruptive trenching under the main transport route between Nelson and Richmond, as well as reducing the overall project costs.

2. PLANNING

Every project begins by analysing existing assets and their urgency for repair, rehabilitation, or renewal. This helps to identify threats to operational safety, leaks, or structural weaknesses. Once identified, the asset and jobsite details are thoroughly examined.

NRSBU's extensive planning ensured the project's safe execution with minimal impact to the adjacent Waimea Inlet – which is widely regarded as ecologically significant. Early consultation with the 8 Te Tau Ihi iwi ensured that iwi were well informed, and understood the objective of quickly reducing the frequency of waste water overflows.

The deteriorated state of the host pipe required a fully structural solution for these two sections to ensure that the new pipe would be independent of the host pipe. The operating pressure of the pipe was 5 to 6 bar with a flow rate up to 500 l/s. The design of the new pipe aimed to provide sufficient capacity for the expanding region. Given these predefined requirements, SAERTEX-LINER® MULTI for pressure applications was chosen to rehabilitate the rising main.

The selected liner is a UV-cured fiberglass-reinforced pipe liner, which is a close fit UV-CIPP product for the trenchless rehabilitation of pipes in pressure applications. It is a fully structural product classified as a Class A liner according to DIN EN ISO 11295, meaning it is independent of the host pipe and can withstand all internal and external pressures on its own. This product has proven its reliability in multiple projects worldwide.

2.1. TECHNICAL QUESTIONAIRE

To assess the technical feasibility of using GRP liners for pressure pipes in a project, installers or water authorities are required to complete a technical questionnaire supplied by SAERTEX multiCom® to capture all the project’s general details such as location and medium, as well as data about the host pipe including inner diameters, operating pressures, rehabilitation length and more.

TDG Environmental completed this technical form in April 2023, including the two sections and other documentation available for an initial analysis of technical feasibility. After verifying general data such as diameter, operating pressures, and length, the project engineer at SAERTEX multiCom® calculated structural designs according to ASTM American standards, considering project loads such as from traffic due to a crossing highway as well as further external and internal loads that are having an influence on the pipe. This design determined a

necessary wall thickness of 6.3 mm for the SAERTEX-LINER® MULTI Type S+ XR Pressure in DN 450.

2.2. PRELIMINARY PLANNING

Project Planning commenced with the collection of all available data and documents about the sections of the network planned for the rehabilitation, including detailed plans from 2023.

TDG Environmental conducted a CCTV inspection before installation to check the internal condition of the host pipe. The inspection revealed the pipe's inside was in better condition than initially expected. However, thorough cleaning was necessary before proceeding with the installation. Some minor bends in the pipe were identified and it was necessary to determine how to navigate around existing connections. All these factors needed consideration to devise an effective installation plan.

The inner diameter, wall thickness, and lengths of the host pipe were rechecked and compared with the initial documents provided about the sections. This step was crucial to ensure the feasibility of the liner with the project and verify all planning data. Additionally, the internal and external loads were reevaluated to ensure that the structural designs were correct and based on real data. As a close-fit CIPP product, the liner heavily relies on the inner diameter of the host pipe, so the installer paid meticulous attention to ensure all measurements were accurate.

2.3. IN THE MEANTIME

Before conducting any jobsite installations, it is mandatory to become a certified installer for SAERTEX-LINER® for pressure applications which TDG Environmental completed in March 2023 in New Zealand.

Once all the necessary information and data was available, TDG Environmental proceeded with the next crucial step of placing the order for the required liners. With the order in the system, the focus shifted to maintaining the timelines of the project. An additional challenge was updating their UV-unit as the cable length for the light source used to cure the liner was too short for the installation of the longer section of 252 meters. Therefore, a new cable was ordered and replaced during the installation of the two liners.

As the liners and additional equipment were sourced from Europe, shipping was carefully coordinated by TDG Environmental to optimise the efficiency of the project. Significant emphasis was placed on the planning of the installation phase. The team worked diligently to plan and organise the upcoming project. Therefore, TDG Environmental addressed proactively the potential challenges such as bends or long sections to devise effective strategies and allocate resources appropriately, ensuring a smooth and successful installation that met highest quality standards.

3. INSTALLATION

The installation of SAERTEX-LINER® MULTI for pressure applications is similar to other installation methods of UV-cured fiberglass-reinforced pipe liner but includes specific

additional installation steps to ensure full connection to the network, and to allow it to withstand operational pressures and ensure safe work practices during the installation.

The process begins with creating the excavation pits for the rehabilitation. It is necessary to cut out a piece of the host pipe to gain access to the network. Hunter Civil has conducted excavation works, facing significant difficulties in accessing the pipe due to its degradation.

A new piece of pipe must be mounted on the host pipe to prepare the ends of the liner. This can be done by different methods such as welding on a new piece of pipe, connect it with a coupling or using a CIP JOINT from NovaSiria®. This is necessary to ensure a proper end connection of the liner with the existing network to ensure a leak tight system. For this project, a CIP JOINT from NovaSiria® was preferred for the end connection due to its ease of handling and maintenance of the same inner diameter as the host pipe. This is a combination of a coupling and a new piece of pipe either with or without flange, which will be slipped over the host pipe and secured with the integrated coupling. Picture 1 shows an example of a mounted CIP JOINT on one of the sections of the project.

Picture 1: CIP JOINT of NovaSiria® mounted on the host pipe

Next, a gliding foil is pulled through the rehabilitation section to ensure a smooth and protected path for the liner into the host pipe. The liner ends must each be positioned in the middle of the trench and are closed with clean end cans. It is now possible to generate air into the liner for its calibration. This air pressure will be increased until the liner is in a suitable position to the host pipe and the glass and resin laminate of the SAERTEX-LINER® is fully compressed.

Before inserting the UV-light chain into the trench, the lamps are checked for functionality. The UV light chain is then inserted into the liner and pulled from the excavation pit to the starting point of the curing. Curing starts when the UV light bulbs are turned on and the light source is gently pulled backwards through the liner at a prescribed speed. The curing of one of the sections is shown in Picture 2.

Picture 2: Curing of the SAERTEX-LINER®

A visual inspection and monitoring of technical parameters is conducted via the UV Unit and is continuously documented during the curing. The protocol has a crucial role in ensuring that the installation is executed in strict accordance with the installation manual and parameters prescribed by SAERTEX multiCom®.

After the liner installation, end seals are installed to connect the liner to the network and prevent groundwater from penetrating the cut edged of the composure material. These seals consist of an EPDM rubber band with 3 to 4 steel bands depending on the pipe diameter. The cured liner is cut back about 10 cm to fit the rubber, which is secured with the steel bands. After 24 hours, the bands are retightened as the rubber settles. The installation is completed by installing seals on both ends, as shown in Picture 3.

Picture 3: Installed Liner and Liner End Seals

The final stage involved several critical tasks to ensure the pipe could be securely reconnected to the network. This included a CCTV inspection to visually assess the liner's condition and placement within the pipe and a pressure test to assess the integrity, stability and leak tightness of the installed liner. For this project, pressure testing was done for both sections each, providing an additional layer of documentation and quality assurance for the entire system. The two liners installed in Nelson have been pressure tested successfully at a set test pressure of 9 bar.

The project concluded when the liners were reconnected to the network system and excavation pits were closed by July 2024. However, the pipes are not in operation yet, as the complete project includes several other stages. The rising main is predicted to be online approximately beginning of 2026.

4. CONCLUSION

The team of TDG Environmental worked diligently and efficiently over 8 days to rehabilitate the two segments of the sewer rising main. This work on the rising main duplication project has contributed to the NRSBUs goal of removing wet weather overflows from the nearby Beach Rd pumpstation. Once the overall project is completed not only will the risk to public health from contact with untreated wastewater be vastly reduced, the amount of ongoing environmental and cultural harm inflicted on the Waimea Inlet as a result of pump station overflow due to insufficient capacity will be virtually eliminated. The use of trenchless pipeline rehabilitation technologies, such as SAERTEX-LINER® MULTI Type S+ XR Pressure liner has future-proofed the region's infrastructure against population growth.

The advantages of SAERTEX-LINER® MULTI are highlighted through the success of this installation. There are many benefits, especially in areas where open trench methods are not economically practical or technically feasible. Trenchless technology offers major advantages, requiring less space and causing minimal traffic and environmental disruption. It's also cost-effective, with minimal earthwork preserving tree roots and plants. [cf. RSV Rohrsanierungsverband e.V., Information Nr. 11, 2011]. The completed linings are fully structural pipes after installation and can bear all internal and external loads as an independent pipe once cured. Furthermore, the products' high mechanical properties result in low wall thicknesses of the liner, which leads to minimal reductions of the inner diameter of the rehabilitated pipe and therefore does not compromise the crucial flow capacity.

In conclusion, glass reinforced UV cured lining when used for pressure applications offer a multitude of advantages that positioned the product as a preferred choice for NRSBU. The ability to effectively rehabilitate degraded, and previously un-usable, lengths of pipe has significantly contributed to the cost effective and timely delivery of this regionally significant project.

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