University of Canterbury – Pipeline Condition Assessment Technologies

The condition assessment of pressurized pipelines is central to the management of water systems but is only conducted sporadically due to the limited range and practical constraints of current technologies. Since most water pipelines are buried alongside traffic routes, regular pipeline condition measurements should be carried out quickly, non-intrusively and with minimal disruption to traffic/water flows. This combination of requirements poses significant challenges for many commercial technologies in the field.

The Department of Civil Engineering at the University of Canterbury has 20 years of experience in the field of non-destructive testing of pipeline systems and have developed technologies for measuring pipe wall deterioration and faulty flow isolation valves for live water pipeline networks during peak water demand and traffic conditions. The university is looking to develop joint projects with water asset managers in NZ to further develop NZ-based technologies to carry out a range of testing, including transient testing of large trunk pipes, live pressure monitoring (burst/incident detection) and pipe wall deterioration measurement in networks.

The latest technology from the University of Canterbury uses a piezoelectric actuator capable of generating customized, perfectly repeatable, small amplitude (≈ 0.1 m) pressure signals without any loss of water. The method can be applied directly on a live water network and does not require any system isolation or traffic diversion and there are no system base flow, topology or pressure requirements. The self-powered system easily attaches onto existing hydrants without any physical alteration to the system. On average, each test takes 15 -30 minutes to conduct with a two person crew and 20 to 150 m of pipe can be tested at a time. The condition of the pipeline can be determined in situ without additional analysis time. The system developed at Canterbury is a significant improvement over existing transient-based commercial methods for pipeline diagnostics, where often a large and potentially damaging transient is created from manual closures of valves, often with a large loss of water.

With funding from the Royal Society of NZ, the University of Canterbury has carried out an extensive field test of the piezoelectric pipe condition diagnostic system in the pressurised water supply pipe networks of New Zealand (Auckland, Christchruch) and China (Shanghai, Shenzhen). In total, 34 sites with steel, cast iron, ductile cast iron, reinforced concrete, asbestos cement, fibrebond, medium/high density polyethylene and polyvinyl chloride pipes were tested with diameters ranging from 100 mm to 600 mm. The field trials were conducted over a 17 month period from May 2013, and included over 1600 individual tests.

The results of the condition assessment were independently confirmed using hydrant tests, low frequency transient tests, and direct inspection through excavation. Through this testing program the UC technology has provided an indicative measure of pipe wall deterioration for 34 different pipelines under live demand and traffic conditions. This measure of pipe deterioration is used to provide a remaining life estimate for these pipes. Pipes identified as at risk through this technology were excavated during this pilot testing program and these pipes show significant pitting and deterioration, verifying the accuracy of the technology. The UC technology has also identified six faulty isolation gate valves in the field under live demand and traffic conditions.

The results of this study are published in the Journal of Hydraulic Research (International Association of Hydraulic Research):

Pedro Lee, Jeffrey Tuck, Mark Davidson & Robert May (2017) Piezoelectric wave generation system for condition assessment of field water pipelines, Journal of Hydraulic Research, 55:5,721-730, DOI: 10.1080/00221686.2017.1323805

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