

Cumulative Pressure Induced Stress for Characterising Pressure Transients and Variability in Water Supply Networks

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In this paper, we introduce and apply novel metrics to quantitatively characterise and account for the broad spectrum of pressure cycles, variations and transient events that continuously occur in operational systems. The Cumulative Pressure Induced Stress (CPISTM), which builds upon advances in fracture mechanics and fatigue induced failures, includes all pressure cycles irrespective of their amplitude and frequency within a moving 24-hour time window. Pressure is continuously sampled at 128S/s. Embedded signal processing algorithms combined with cycle counting methods allow for CPISTM to reduce a spectrum of varying pressure variations into a set of stress reversals. In this way, quantitative metrics for characterising the cumulative pressure induced stress and individual transient events are continuously available to network operators within a risk-based “pipe stress” warning system. The described metrics and methods and their implementation enable utilities to prioritise interventions and repairs (early asset stress warning) in order to maintain steady-state (“calm”) hydraulic conditions, and assess the long-term impact of the dynamic hydraulic behaviour on assets failures (pipes, pumps, control valves, air valves, surge vessels etc).

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