



Workshop for HIC 2018 participants at University of Palermo, Palermo (Italy) Friday 6th July 2018

The Workshop is immediately following the Hydroinformatics Conference at University of Palermo.
Weblink: www.hic2018.org and www.leakssuite.com/upcoming-events/

Realistic modelling of pressure-dependent leakage in water pipes. Applying FAVAD concepts to testing of pipe samples, with fast-track practitioner approach in distribution systems; practical prediction of pressure:burst frequency relationships

Presented by **Marco Fantozzi (ISLE Utilities)** using original material provided by Professor Kobus van Zyl (UCT) and Allan Lambert (WLRandA Ltd)

Workshop Agenda

- 09.30 Registration
- 09.45: Opening Remarks: Un. Palermo representative
- 10.00 **Session 1:** Pressure & Leak Flow Rates: Research into FAVAD concept at University of Cape Town
- 10.45 Tea/coffee Break
- 11.00: **Session 2:** Leakage Practitioner Fast Track approach for distribution Zones
- 12.15 **Questions and Discussion**
- 13.00 Lunch
- 13.45 **Session 3:** Targeting pressure management to reduce burst frequency: Case Studies
- 15.00 **Questions and Discussion**
- 15.30 Finish

Overview of Workshop

This is the 4th in an ongoing series of Workshops presenting the results of collaborative research to improve the understanding of pressure:leak flow relationships and pressure: burst frequency relationships, seeking to bridge the gap between academic research and fast-track applications by practitioners.

Professor Kobus van Zyl and colleagues at University of Cape Town have researched pressure:leak flow rates through laboratory testing of holes and cracks in pipes for several years, with some input by Allan Lambert of Water Loss Research & Analysis (UK) and Dr Richard Collins (University of Sheffield).

Their jointly authored open access peer reviewed paper in [ASCE Journal of Hydraulic Engineering / Vol 143 Issue 9 – Sept 2017](#) , which has attracted around 1300 downloads, provides robust academic validation of the authenticity of John May's 1994 concept of Fixed and Variable Area Discharges (FAVAD) [Article 1994M](#), that areas of cracks and splits in pipes vary linearly with pressure, to greater or lesser degrees. The 1st Workshop Session describes, step by step, the evolution of the hydraulic theory

The increasing international application of pressure management of distribution systems, to reduce excess pressure, leak flow rates and bursts, has meant that the generally used simplifying assumption that leak flow rate varies with pressure to a fixed power $N1$ (between 0.5 and 1.5) needs to be modified in some circumstances, notably in systems with lower pressures.

If the concept is to be widely applied to improve the reliability of current methods for assessing hourly, daily and annual leakage in thousands of distribution zones, many having complex pressure management, fast-track approaches for practitioners based on the full FAVAD concept are needed.

The conversion of the full FAVAD concept into fast-track applications was developed by Water Loss Research & Analysis Ltd, liaising with Professor van Zyl and practitioner consultants Marco Fantozzi, Mark Shepherd and Julian Thornton. The methods were initially summarized in 'Pressure Leak Flow Rates using FAVAD – an Improved Fast-Track Practitioner Approach, published in the CCWi2017 Conference Proceedings as article F100.

https://figshare.com/articles/CCWi2017_F100_Pressure_Leak_Flow_Rates_Using_FAVAD_An_Improved_Fast-rack_Practitioner_s_Approach_/5365078

The 2nd Workshop Session provides a historical perspective on pressure:leak flow rate relationships from 1980 onwards and shows how a good quality N1 field test can be used to quickly define the equation relating N1 and measured AZP pressures, and the equation relating leak flow rate and AZP pressure, for the mix of fixed and variable area leakage paths at the time of the test. Leak flow rate can then be continuously predicted if the AZP pressure is continuously measured, with automated recalibration by N1 tests at an appropriate frequency – comparable to going to the Doctor’s for blood pressure tests. The calculation of Night-Day Factors, relating leak flow rate per hour at night to daily average leakage, is also considerably simplified with improved accuracy.

The 3rd Workshop Session covers the evolution of understanding of practical pressure: bursts relationships since 1995. International examples were used to develop the initial simplified ‘Straw that breaks the Camel’s back’ approach in 2006, to identify Zones with high potential for reductions in burst frequency on mains, or services, or both. Large scale implementation of pressure management in Australia during the millennium drought (2000 to 2011) as part of the WSAA (Water Services Association of Australia) PPS-3 Asset Management Program has provided much of the data to further improve the understanding of pressure:bursts relationships which are now used internationally for such predictions.

Additional info and comments about the previous edition of the course held at the CCWI 2017 Conference in Sheffield in September 2017 are available at: <http://www.leakssuite.com/realistic-modelling-of-pressure-dependent-leakage/>

Workshop Trainer



Marco Fantozzi is a registered professional Civil Engineer and Head of Italy of ISLE Utilities, a leading catalyst advancing adoption of emerging technologies and innovative practices in the water industry. He has more than 30 years experience dedicated to the field of water leakage management and Non-Revenue Water reduction. He is a Fellow of IWA and IWA Water Loss Specialist Group Regional Representative for Europe. He has both worked and presented papers and workshops in his

field of speciality around the world. He has specialised in pressure: leakage relationships as well as assisting water companies from an institutional strengthening perspective to ensure sustainability of water efficiency

interventions. He is actively engaged in assisting both the University of Cape Town and WLR&A in promoting the dissemination of specialist knowledge within the water sector.

Workshop Concepts developers



Allan Lambert has 55 years' experience in the UK and international water industry, split in almost equal parts between Water Resources/Hydrology, and Non-Revenue Water management, with experience in more than 40 countries. A Past President of the British Hydrological Society and special advisor on water resources and leakage to the UK Government during the 1995-1996 drought, he developed Component Analysis (Background and Bursts Estimates) when he was Technical Secretary to the UK National Leakage Control Initiative in 1992-1994. He chaired the 1st IWA Water Loss Task Force (1995-1999) which developed the Best Practice IWA Water Balance and Performance Indicators. A Fellow of the IWA, he has been researching and applying the many benefits of pressure management for over 20 years, after being inspired by John May's ideas in 1994. As a leading international authority in leakage management, over the last 4 years he has developed the LEAKSSuite website to disseminate his knowledge, free-to-all, to over 20,000 users in 175 countries. Readers of Water & Wastewater International magazine voted Allan in the top 25 for global thought leadership in the water industry in 2016 and 2017.



Kobus van Zyl is a professor in the Department of Civil Engineering at the University of Cape Town. He has been involved in research on the behaviour of leaks in distribution systems for more than 15 years using a range of techniques that include hydraulic, FEM and CFD modelling, mechanics theory, laboratory studies and field work. He collaborates closely with leakage practitioners and has published 11 peer-reviewed papers on the behaviour and modelling of leakage in distribution systems. He is a professional engineer, an associate editor of the ASCE Journal of Water Resources Planning and Management and a member of the Editorial Board of the Urban Water Journal. He currently chairs the ASCE Environmental and Water Resources Institute's standing committee on Water Distribution Systems Analysis.