



**21ST ANNUAL
LEAKAGE CONFERENCE**

8-9 FEBRUARY 2021

.....
VIRTUAL
.....

Find and Fix Forum – Soapbox Challenge



Find and Fix Forum – Soapbox Challenge

- Chaired by Jeremy Heath, Innovation Manager, SES Water
 - AquaPea and AquaNav: utilising the flow of escaping water
 - Michael Quinn, Sales Director, Qinov8
 - In-pipe solutions for the efficient identification and resolution of leakage in large diameter mains
 - Glen Mountfort, Senior Consultant, WRc
 - PIPA ‘in-pipe’ leak detection and leakage solutions
 - Fabio Orlandi, Commercial Director, PIPA
 - Pipebots: micro-robots revolutionising the management of buried pipes
 - Nicole Metje, Professor of Infrastructure Monitoring, University of Birmingham and Deputy Director for Sensors, UKCRIC National Buried Infrastructure Facility
 - Kirill Horoshenkov, Professor, University of Sheffield
 - Aqua-tite
 - Jez Parker, Marketing Manager, MW Polymers
 - Mike Wild, Managing Director, MW Polymers
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QINOV8

21st ANNUAL LEAKAGE
CONFERENCE

UTILIZING THE FLOW
OF ESCAPING WATER



INTRODUCTION

- QINOV8 WAS FORMED IN DECEMBER 2016
- CSL - UP TO 40% OF TOTAL LEAKAGE
- 1.2 BILLION LITRES DAILY
- OUR EUREKA MOMENT – A BIC PEN
- AQUAPEA AND AQUANAV

WHAT IS THE AQUAPEA

HAND MADE AT OUR FACILITY

WRAS APPROVED

TWO PART POLYMER

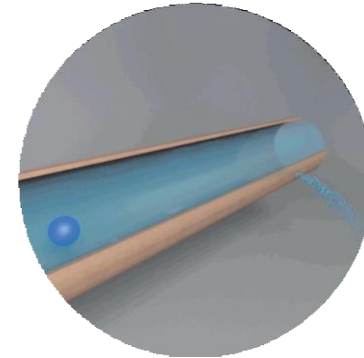
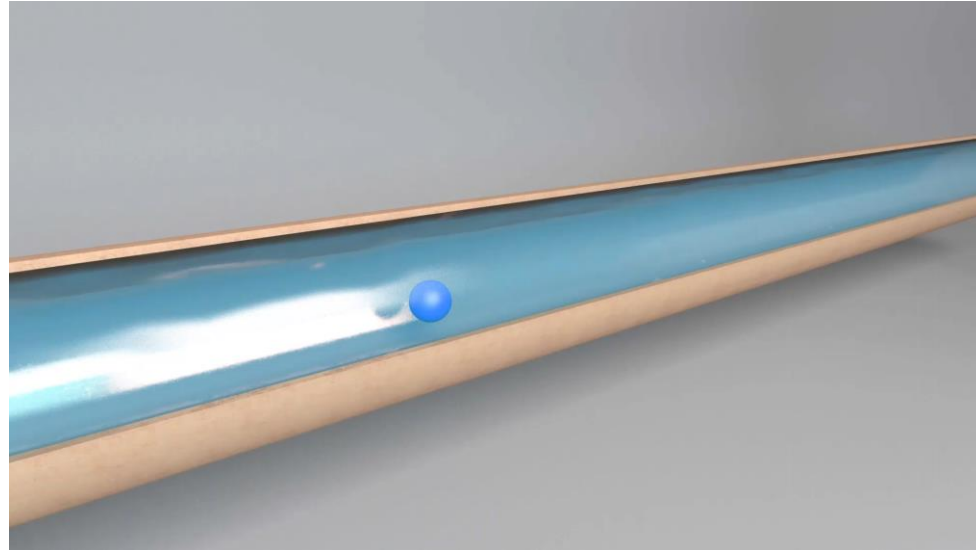
BUOYANT CORE

4 SIZES

CRITERIA



HOW IS THE AQUAPEA USED



The advanced flow control
around the damage
area is using the cap.

STATISTICS

- PROCESS TAKES 30 MINS TO 1 HOUR
- THE AQUAPEA REDUCES WATER LOSS BY 70%
- SAVINGS OF 10,000 LITRES PER DAY PER APPLICATION
- MEDIAN REPAIR TIMES OF APPROX. 21-28 DAYS
- 1 MLd SAVED PER 100 JOBS
- ENOUGH ENERGY SAVED TO POWER 50 HOMES EVERY DAY
- **ZERO EXCAVATIONS**



WIA
WATER INDUSTRY AWARDS
2019
Birmingham | May 2019

WINNER

**Most Innovative
Water and Wastewater
Technology of the Year**

Qinov8UK LTD

Heat Winner



water dragons™
2020



QINOV8

hosted by
**Future Water
Association**
Informing, Innovating, Influencing

AWARD WINNING

TRAINING

200 TECHNICIANS

60 ONLINE

FREE OF CHARGE



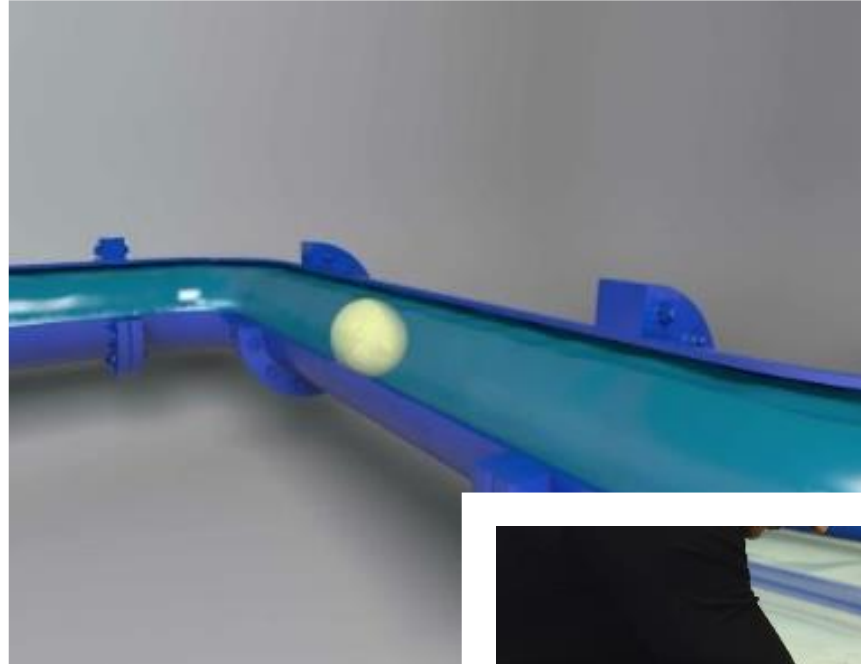
WHAT IS THE AQUANAV

LEAK LOCATING TECHNOLOGY

NON-METALLIC WATER MAINS

EMITS A SIGNAL RECEIVED BY A HAND-HELD
RECEIVER ABOVE GROUND

PINPOINTS LEAKS



AQUANAV BENEFITS

- Avoiding unnecessary excavations
- Reducing disruption to traffic, pedestrians, and customers
- Reducing your carbon footprint
- Rapid leak detection
- Reduction in utility strikes
- Cost effective method of leakage location

HOW THE AQUANAV IS USED

- TRANSMITTER IS INSERTED INTO A HYDRANT
- EMITS SIGNAL ABOVE GROUND
- FOLLOWED USING RECEIVER
- STOPS AT THE LEAK INDICATING ITS PRECISE LOCATION
- HYDRANT OPENED FURTHER DOWNSTREAM
- AQUANAV DRAWN TO LARGER FLOW
- EXTRACTED FROM HYDRANT



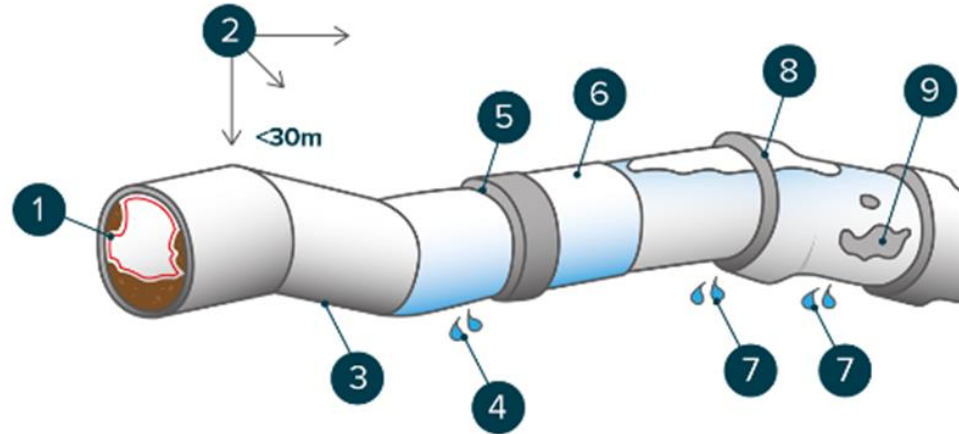
AQUANAV REDEVELOPMENT

In pipe solutions for the efficient identification and resolution of leakage in large diameter mains

Glen Mountfort, Senior Consultant
February 2021

Large diameter mains – what’s happening?

1. Internal laser / sonar profiling and CCTV
2. Pinpoint location
3. Map bends
4. Locate leaks and infiltration on non metallic pipes
5. Locate repairs
6. Identify change of material
7. Identifying if leaks are on the joint or barrel
8. Locating gas or air pockets
9. Corrosion mapping & wire breaks



Why large diameter mains?

- Where companies report total leakage based on DMA leakage plus trunk mains/service reservoir leakage (aka “upstream losses”) managing these upstream losses starts to become more important.
- Where companies use a bursts and background methodology (BABE) for upstream losses, there hasn’t historically been the same driver to put greater effort in looking for hidden leakage.
- In the BABE methodology, finding and fixing more leaks increases the reported leakage volume.
- Companies are moving towards flow balances/tile analysis approaches, driven in part by the new Ofwat reporting guidance, but mainly from the requirement to reduce overall demand through both leakage and PCC with stretching Performance Commitments.
- This puts greater focus on how to manage large diameter networks, particularly upstream of DMAs.
- Rehabilitation of large diameter mains is expensive – understanding condition & performance

Solutions

Sahara



Capability

- Acoustic**
 - Leak pinpointing and quantification
 - Air pocket location
- Conductivity**
 - Leak and repair detection (non-metallic)
- CCTV**
 - Inspection
- Sonar**
 - Internal profiling
- GML (Gross Metal Loss)**
 - Wall loss assessment
- EM Tracing**
 - Deep tracing up to 30m and GIS validation

Deployment

Tethered; inserted under pressure through a 50mm tapping
Range up to 2km

Diameter

Minimum diameter: 150mm
Maximum diameter: no limit

Fluid/Asset Type

Potable and raw water mains
Waste water rising mains

Experience

10,000 surveys completed in the UK



SmartBall

Capability

- Acoustic**
 - Leak location and quantification
 - Establish if leaks are on the pipe joints or barrel
 - Air pocket location
- Inertia Tracing**
 - GIS data validation

Deployment

Free swimming; inserted and extracted under pressure through 100mm tappings
Range up to 40km

Diameter

Minimum diameter: 250mm
Maximum diameter: no limit

Fluid/Asset Type

Potable and raw water mains
Waste water rising mains

Experience

7,000km inspected globally



PipeDiver

Capability

High resolution pipe wall analysis and remaining life assessment for metallic mains
Wire break detection and remaining life assessment for pre-stressed concrete mains

Deployment

Free swimming, inserted and extracted under pressure through a 300mm (min) tapping
Range up to 40km
Will flow past butterfly valves

Diameter

Minimum diameter: 400mm
Maximum diameter: 3,000mm

Fluid/Asset Type

Potable and raw water mains
Waste water rising mains

Experience

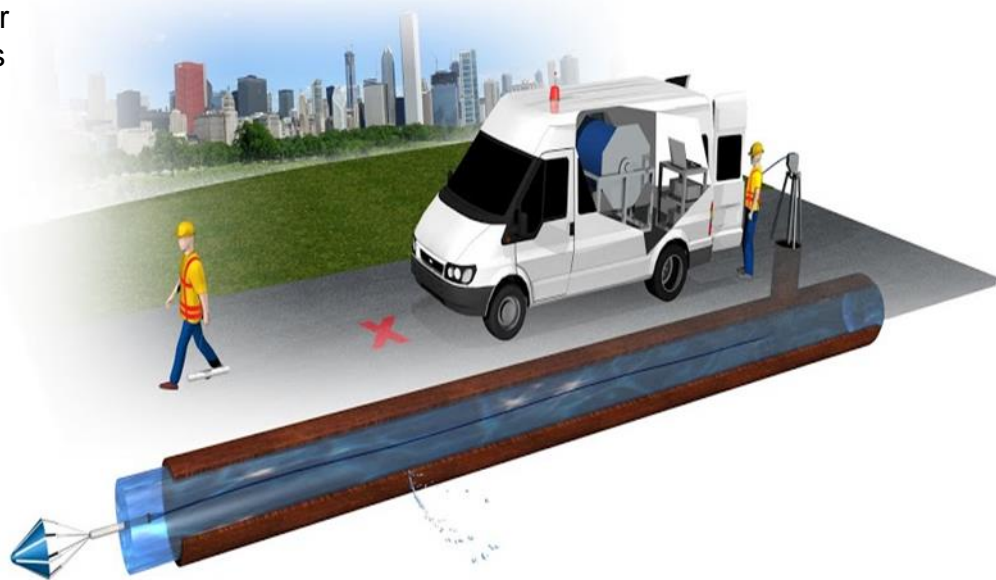
1,000km inspected globally



In this short presentation we will cover a range of in-pipe solutions

Sahara

- ✓ LIVE precise indication when in-pipe sensor passes any leak, allowing reliable decisions on the nature of the noise detected to confirm it is from a leak.
- ✓ The tracking system used to pin-point the sensor is highly accurate (< 300mm) and inherently resistant to “false-positive” location readings.
- ✓ Each of our operatives undergoes approximately 18 months training before they are allowed to conduct a survey.
- ✓ Indication of depth to improve location and footprint planning
- ✓ Over 15,000 Sahara surveys completed in the UK



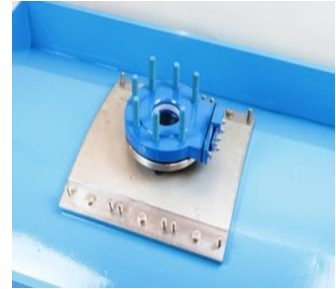
Sahara Pushrod



- Survey against the flow or where no flow is present
- Identify leaks and resulting unaccounted for water (acoustic)
- Pinpoint the precise position of leaks
- Monitor general pipe condition through leakage and CCTV
- Locate leaks in newly-laid mains
- Aid risk assessment of mains near dams and embankments
- Prove pipe integrity at critical network crossings (e.g. road and rail)
- Locate the line and depth of water mains
- "First level" condition assessment
- Locate lost assets

Enabling works

- Using existing assets such as Air valves or hydrant points direct onto the main can be removed to enable surveys.
- Hydrant Wizard can be used where no isolation valve is fitted.
- Bond and Bolt can be used to reduce excavation costs for new live tappings.
- We can insert through Throughbore hydrants.
- WRc can advise on suitable techniques to reduce the enabling costs where possible



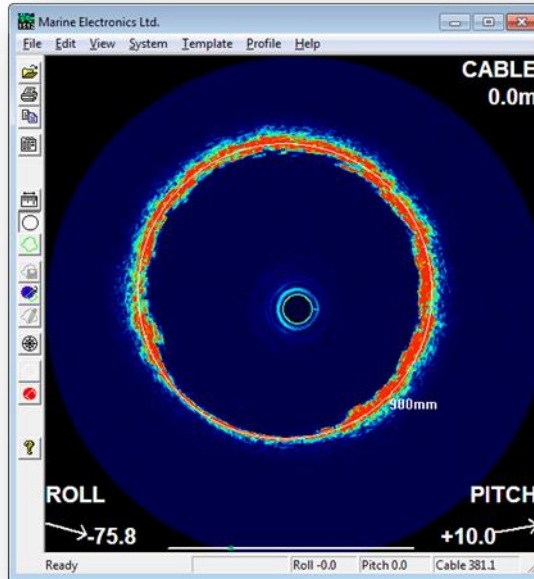
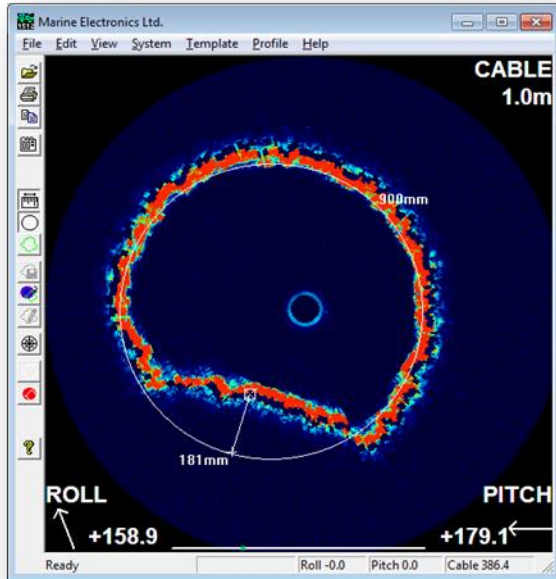
Sahara – case study (Guernsey, March 2020)

During an eight hour window a fire main with no flow was;

- Isolated from the pumps and depressurised
- Sahara inserted
- The fire main re-pressurised
- Survey undertaken to coincide with low tide at 14:30
- Leak found and marked up
- Survey equipment retrieved and extracted
- Fire main put back in service for a fuel boat arriving at 18:00 hrs.

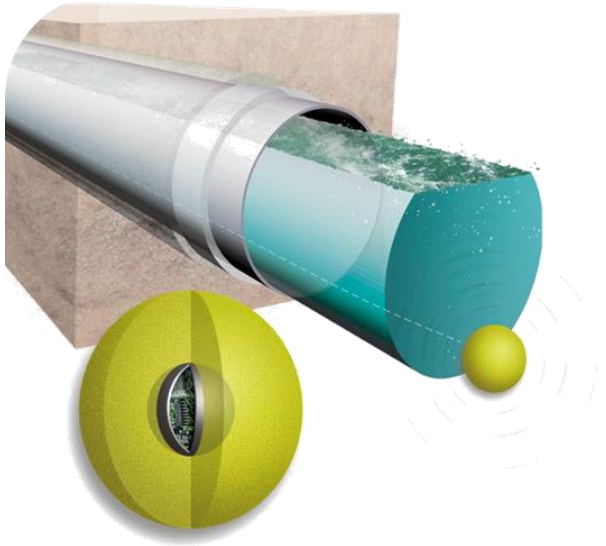


Sonar profiling



900mm raw water main with infestation of zebra mussels, surveyed using CCTV and sonar profiling. CCTV demonstrated the presence of mussels and the sonar tool demonstrated the level of blockage arising from their presence. A build up of sediment/dead mussel shells is evident in the before picture (left).

SmartBall®

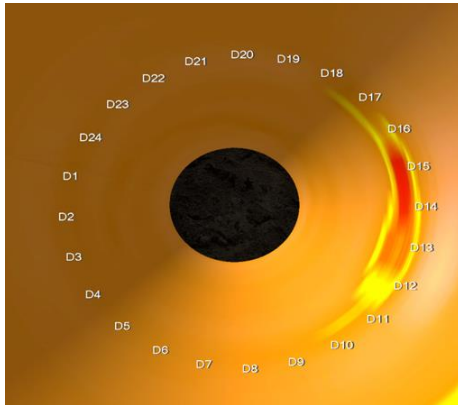


In a single deployment up to 40km, SmartBall® can provide a range of useful information about a pipe. It contains acoustic and magnetic sensors along with a gyroscope, allowing location of air pockets and validation of GIS data. It can differentiate between leaks occurring at joints or the barrel of a pipe.

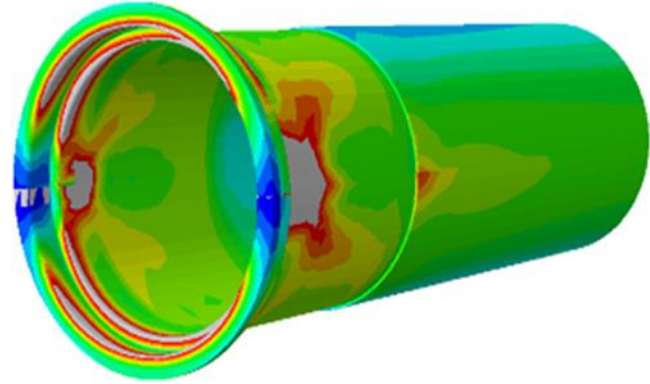
Typical leak location accuracy is within 1-2m

Minimum diameter 250mm mains, no upper limit

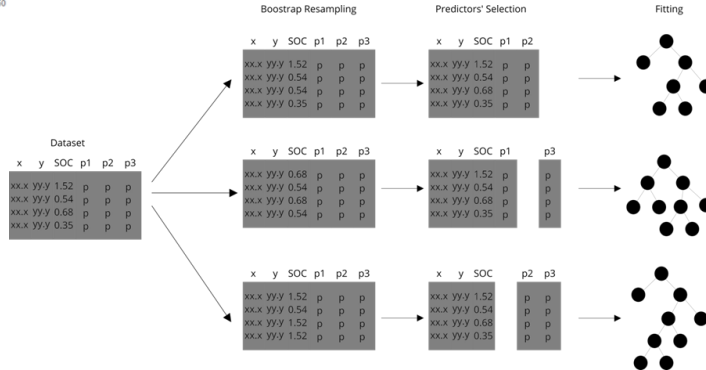
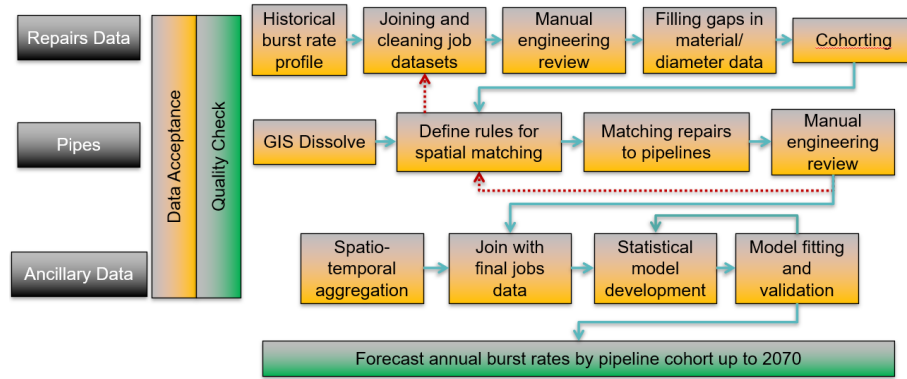
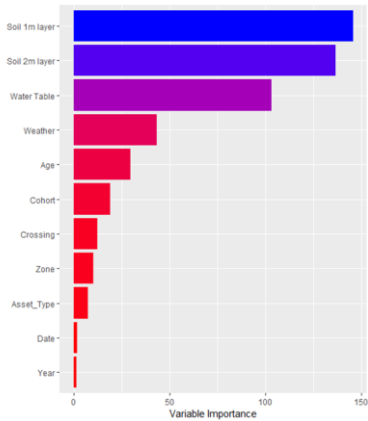
PipeDiver



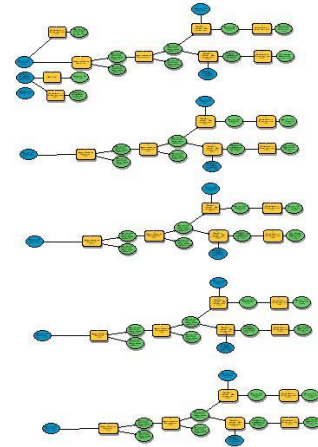
Why does it all matter?



Asset management solutions & advice



Spatial and cohort analysis – “asset management lite”



ArcGIS process using historic data, highlighting the Potential benefit of a data led approach.

Intended to offer a relatively quick and low cost assessment of asset performance, without getting too concerned about the reasons behind failure, and long term forecasting

Video links

SmartBall

<https://youtu.be/wLq8JyVo4nE>

PipeDiver

https://youtu.be/1_R97UdauA4



Fabio Orlandi
Commercial Director API and PIPA Ltd



PIPA Ltd

Company Background



API is our pipe inspection service company and approved trainer. PIPA is a Technology company that designs, develops and manufactures pipe inspection products for global use with experience in the implementation of specialist pressurised pipe inspection Technology





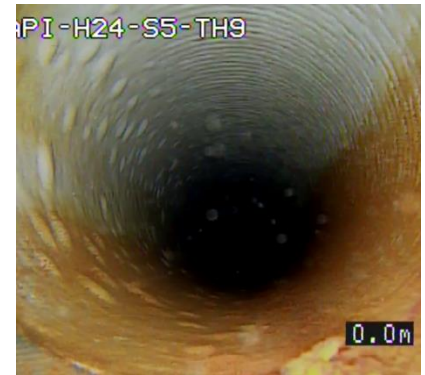
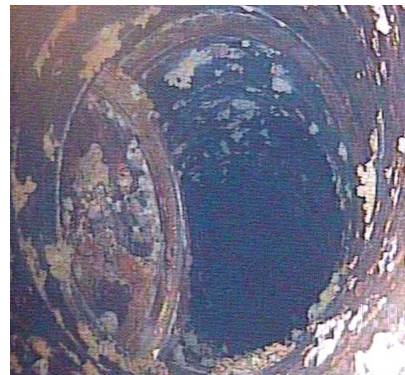
**ALL PIPA PRODUCTS PRESENTED ARE NOT
PROTOTYPES, BUT PROVEN COMMERCIALY
AVAILABLE SYSTEMS READY FOR GLOBAL USE...**

All technology products are designed, tested and approved using materials for safe potable water contact use, DWI MIC and regulation 31 compliant.



PIPA Technology covers all sized pipes

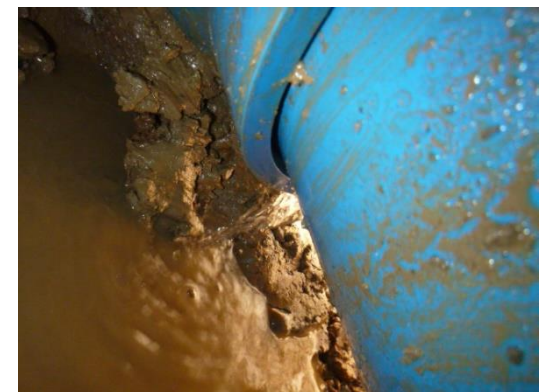
- ✓ Small diameter service pipes (customer side leakage)
- ✓ Medium diameter DMA pipelines (district metered areas)
- ✓ Large diameter Trunk mains
- ✓ Extra large diameter transmission mains
- ✓ Newly installed pipelines



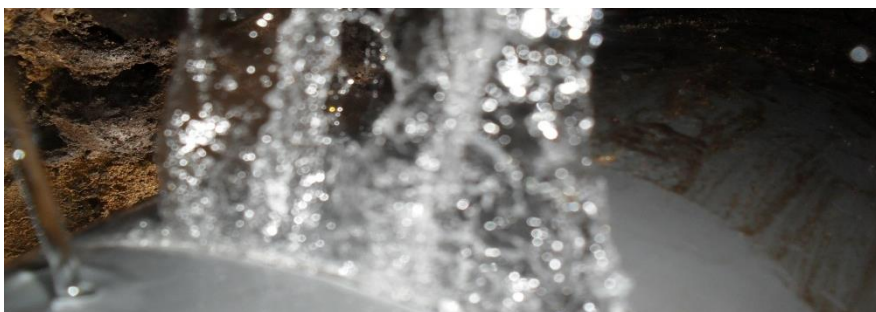
Traditional Leak Detection

There are many traditional techniques for leak detection, however there are also many limiting factors:

- Pipe size
- Pipe material
- Pipe configuration/change of material
- Pipe pressure
- Ground structure
- Ground conditions
- External sound
- Location
- Consumption



'in pipe' Leak Detection



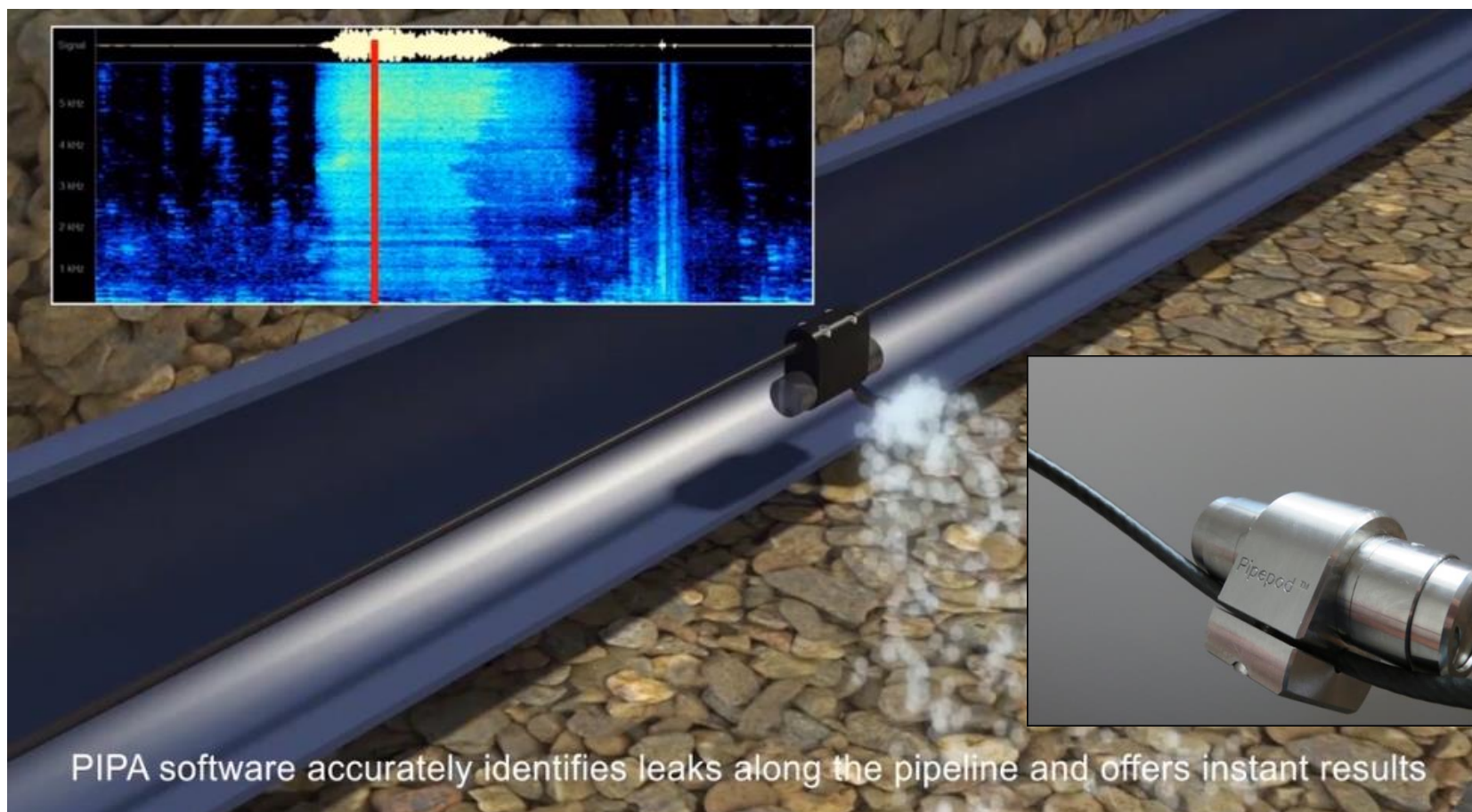
- Covers all pipe materials
- All pipe sizes
- More accurate
- Quick results
- No more dry dig excavations
- Less labour intensive
- Solution for old and new mains
- More client data to update GIS records

Top Sound Leak Detection



**Water showing at surface on a PVC main, with no top sound present
Leak detected 22 metres away from area by using an internal camera
and hydrophone system (The Hydrocam LS).**

Internal Acoustic Inspection

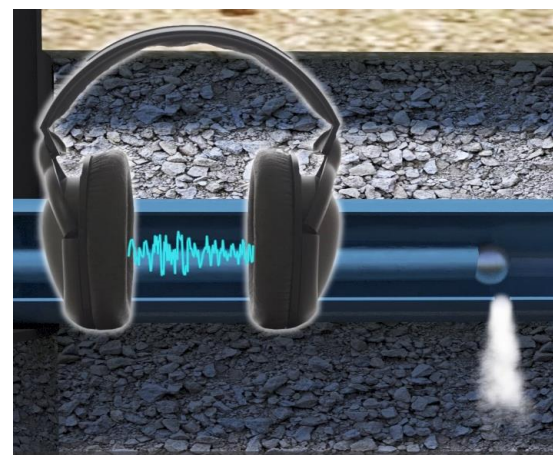
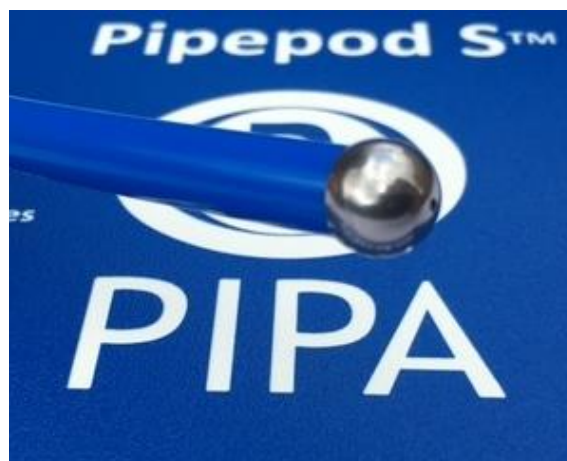


PIPA software accurately identifies leaks along the pipeline and offers instant results



The Pipepod Platform™

Leak Detection Technology for Service and DMA Pipes



- The unique system enters a water pipeline through a meter box outlet or direct pressure fittings
- Leaks are immediately identified using an acoustic hydrophone probe
- Unit is sanitised through a specially designed seal and chlorination house
- Mains tracing feature
- A true no dig technology

Pressurised CCTV & Acoustic Technology



**Pressurised water pipe 'Zonal Studies' surveys
undertaken via existing fire hydrants
1000's planned in Welsh Water over the next 2 years**

Pressurised CCTV & Acoustic Technology



Cement lined pipe

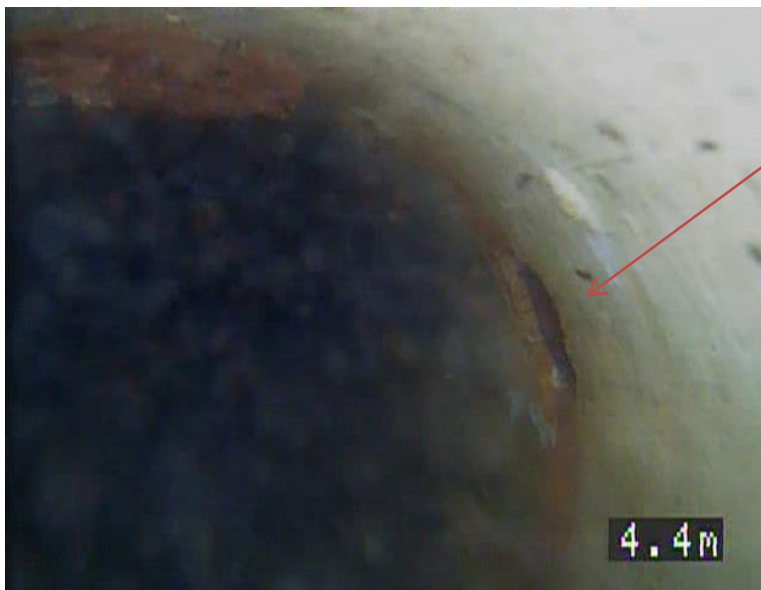


Unlined pipe

**Pressurised water pipe sample images 4 & 6 inch
Pipe surveys via hydrants and direct tappings**

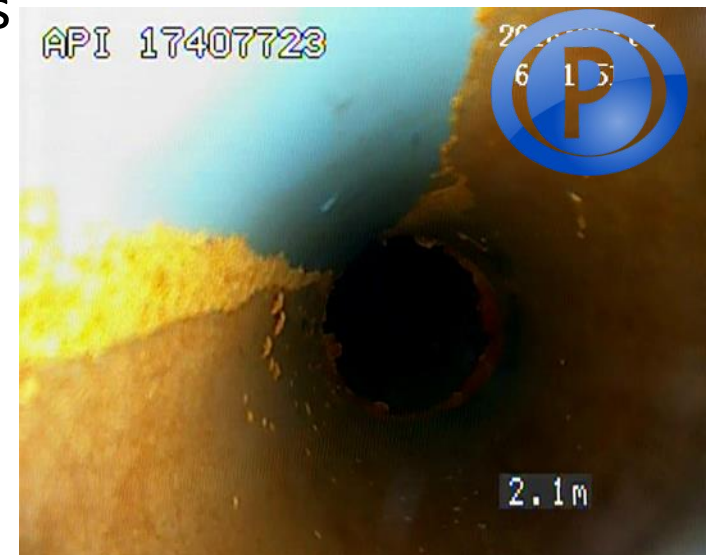
Applications to the Water Sector

- CCTV Identify and locate illegal pipe connections NRW
- Hydrophone enables leak detection



Applications to the Water Sector

- Material validation
- Lining validation
- Location of blockages or closed valves
- Investigate the source of dirty water prior to customer complaints (DWI)
- Asset management budget validation (zonal studies)
- Identify illegal connections
- Accurate leak location

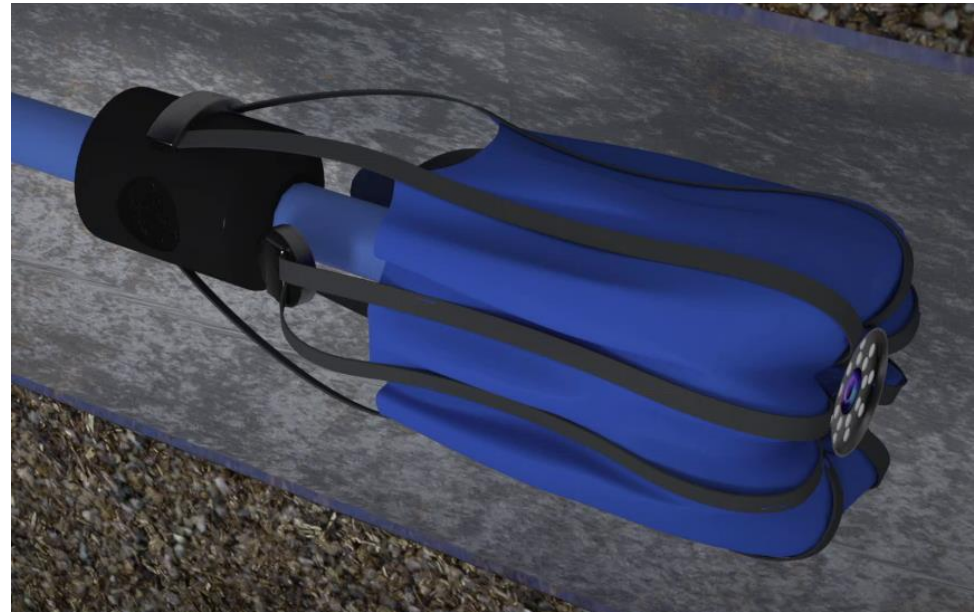
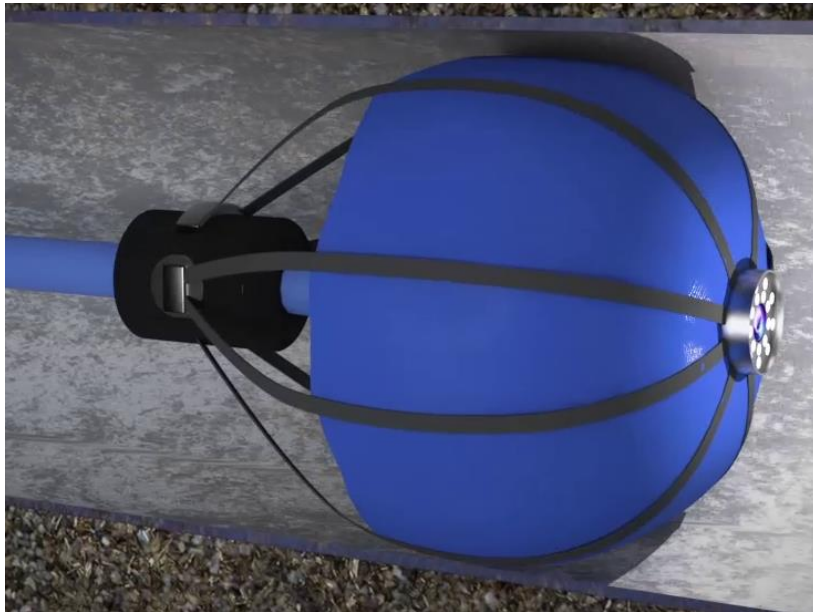


The Flowrider™



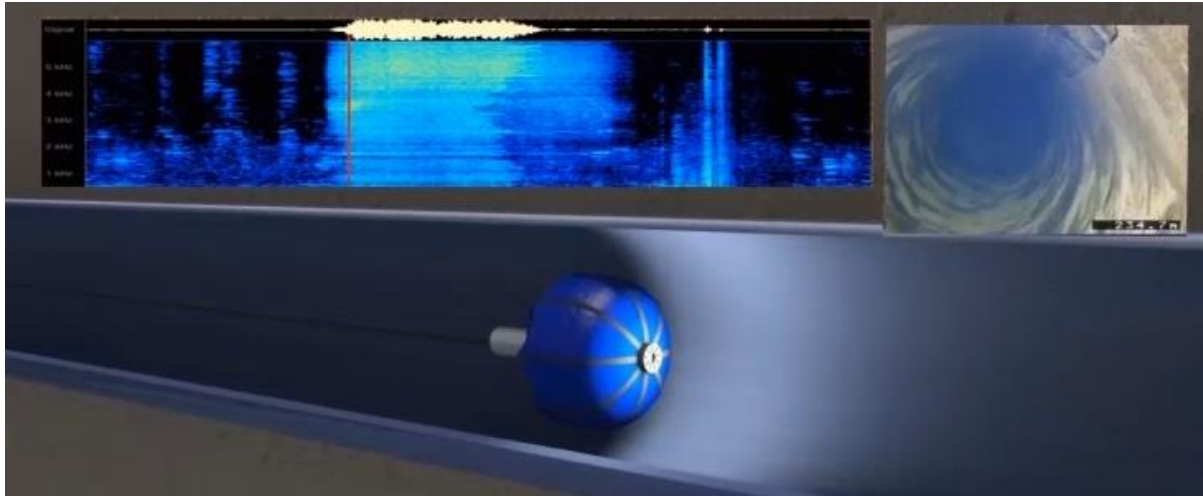
A 1000 metre floating system for long range
pressurised Trunk main CCTV and leak detection
Sensor includes hydrophone and ultra bright COB lights

The Flowrider™



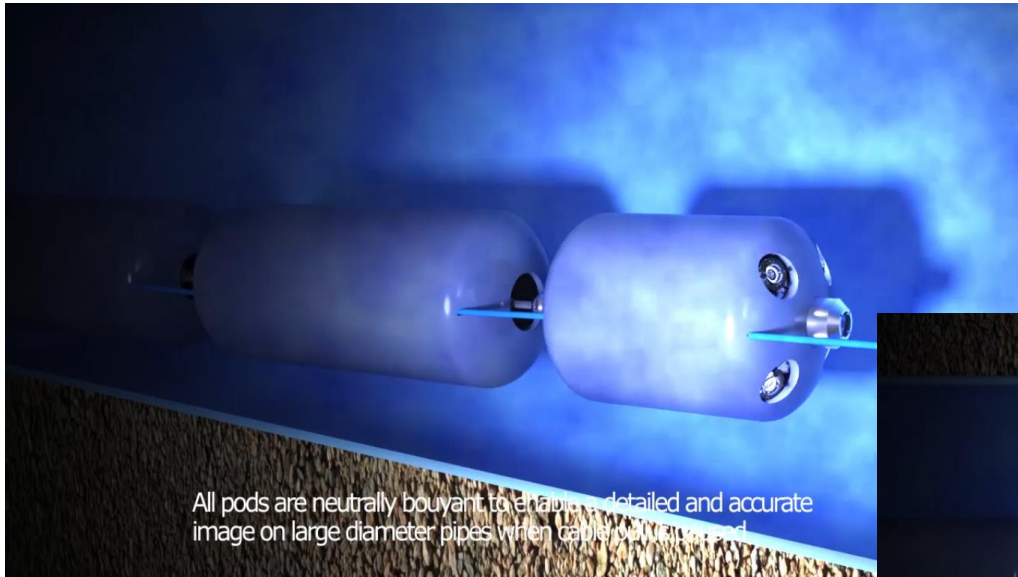
Remote Hydrochute closing system for low and high flow rate pipe inspections

The Flowrider™



- Single entry point at ground level (no expensive chambers)
- Small footprint means less traffic lane interruptions
- System can be launched in all depth pipes
- Accurate leakage sweeps are undertaken and product is a tethered technology
- Battery powered unit for silent operation

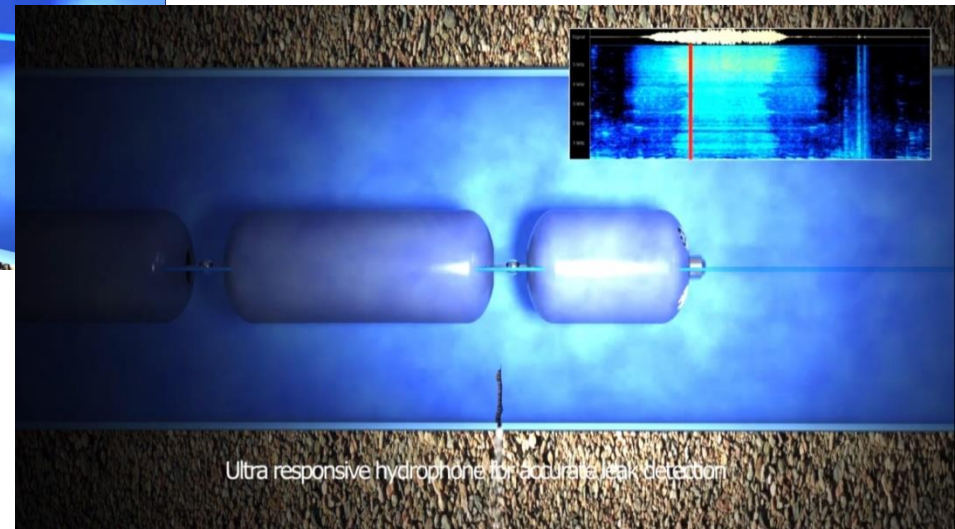
The next generation PLUTO™



All pods are neutrally bouyant to enable a detailed and accurate image on large diameter pipes when cable is under tension

Large diameter pressurised pipe inspection 600mm to 3000mm

2KM long range tool

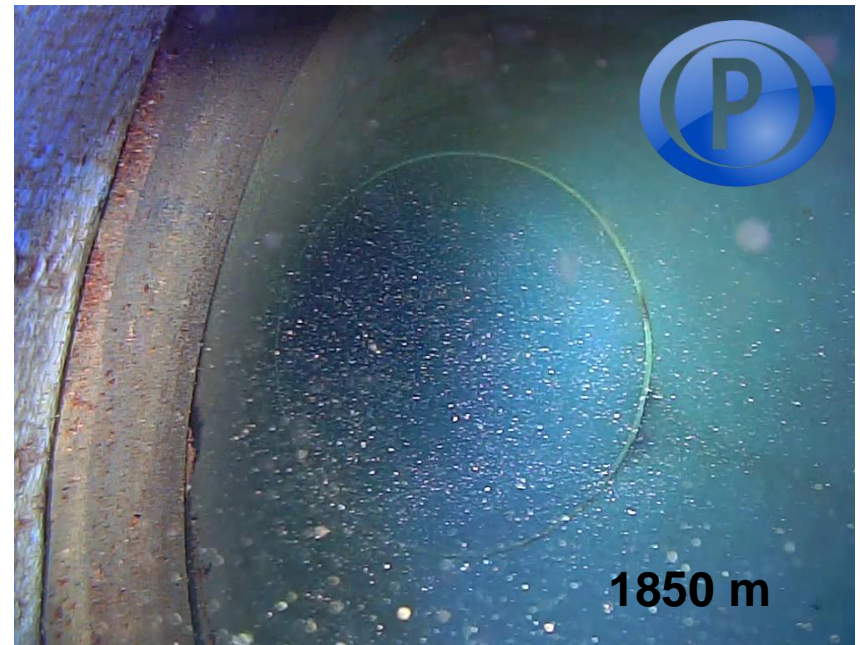
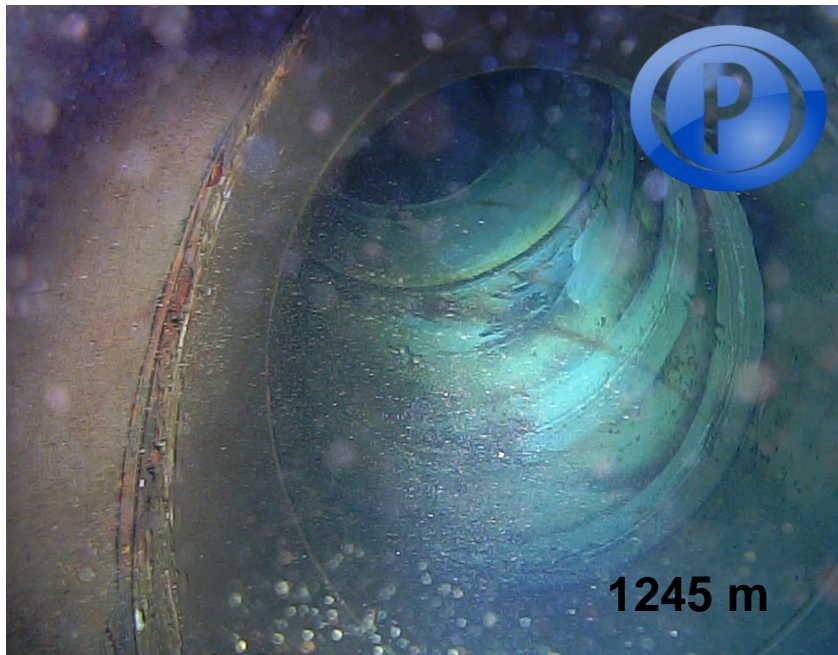


Ultra responsive hydrophone for accurate leak detection

Data capture includes:

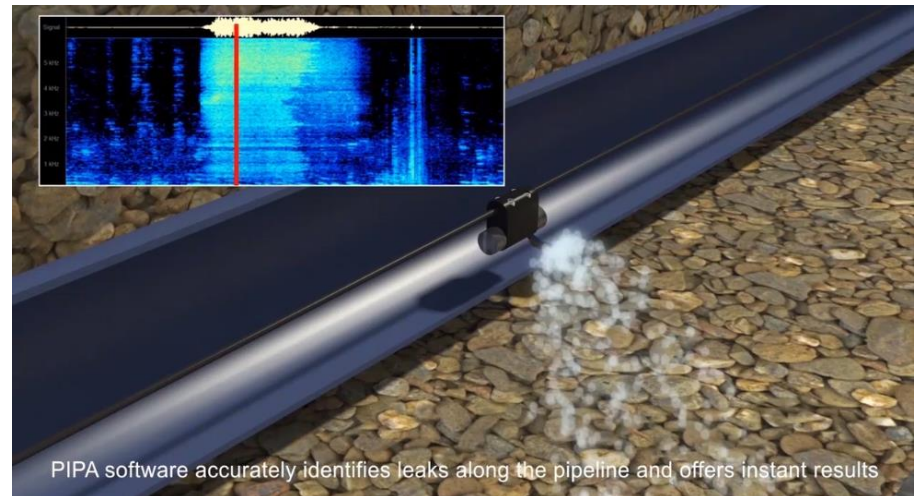
**HD CCTV – Hydrophone - Temperature sensors - Pressure sensors –
- Ultra bright COB lighting – 12 hour run time -**

The PIPA PLUTO™



**The unique system works by floating down a weightless cable and extracting downstream within a live water pipeline.
PLUTO is attached to a secondary cable and survey is completed.**

New Main Leak Detection Pipepod Hydrostatic™



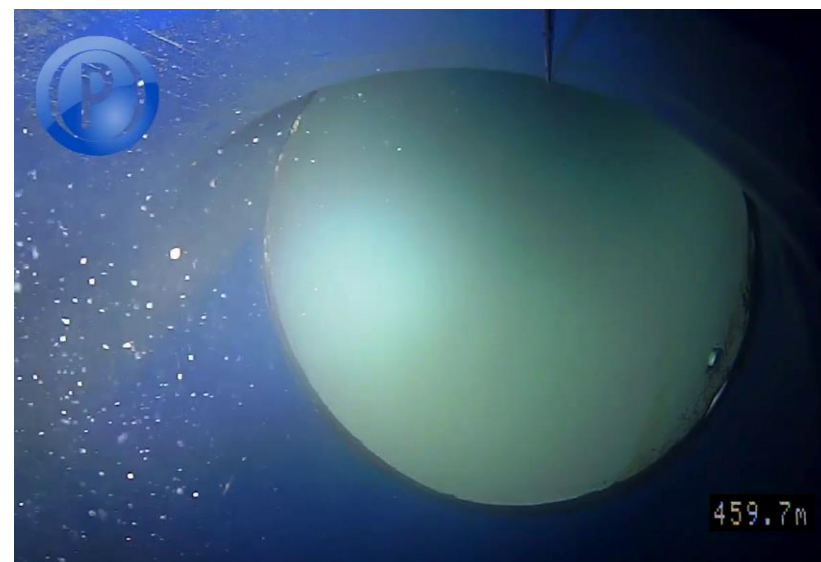
System offers a full leakage sweep in 1 pass up to 2km
irrelevant of bends or pipe diameter

New Main Commissioncam™



- PIPA introduces a revolutionary industry approach to pipe commissioning. PCI or pipe commissioning inspections, gives both contractors and the utility peace of mind on all new pipe installations. The new industry approach removes any guesswork, detects leaks, identifies air pockets and confirms the pipe is clean prior to putting into service.
- The unique HD CCTV system can cover a survey distance of 2000 metres through bends and fittings.

Commissioncam new pipe quality control tool



The cable can be installed as part of the pipe installation process, saving 1000's of gallons of wasted water required for pipe swabbing.

**HD CCTV & Leak Detection Valve location-Air pockets-Debris-Assessment
Video still of 650mm pressurised water main (new install)**

Pipepod Flowrider™



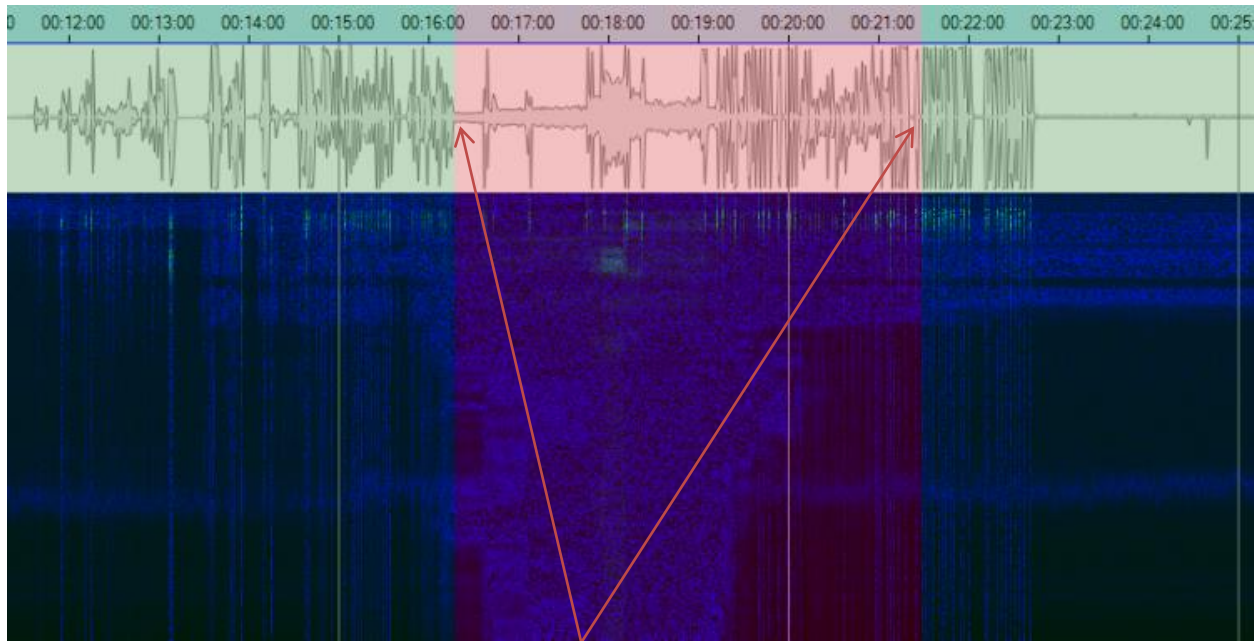
5 km Floating pipe leak detection tool (tethered acoustic sensor)

Pipeline™ Monitoring System



- The pipeline is a unique system manufactured specifically for in-line cabling of potable water pipelines
- The product can be installed (retro fitted) into existing high risk strategic water mains

PIPA Software



Acoustic band (leak pattern identified)

The Pipepod audio files are quickly assessed using PIPA software
The data is downloaded to a PC and can be overwritten onto a standard CCTV
inspection video

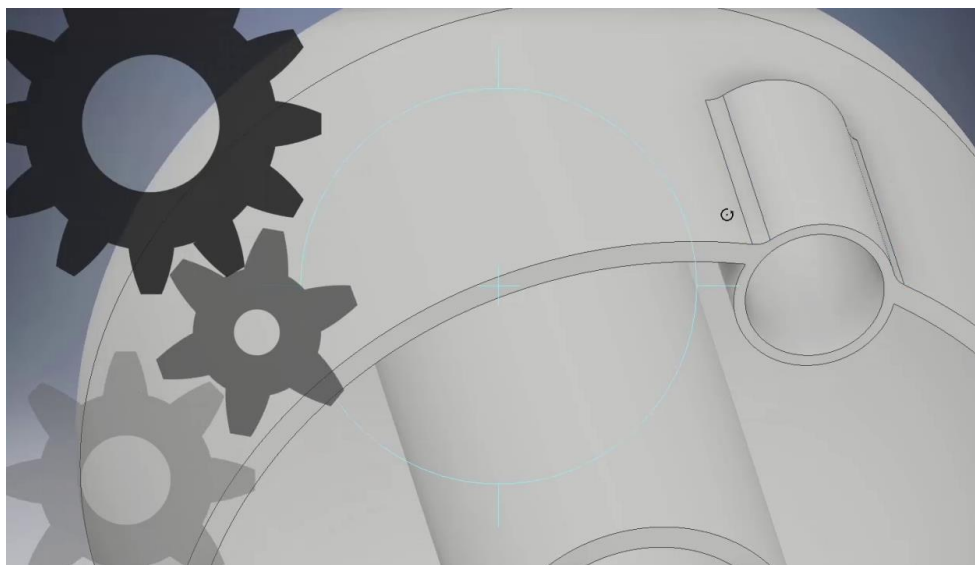
12 hours of audio can be scanned within only 30 seconds

Water Tooling Products



- Samples shown are a hydrant cleaning device and a water injection device for loose jumper hydrants

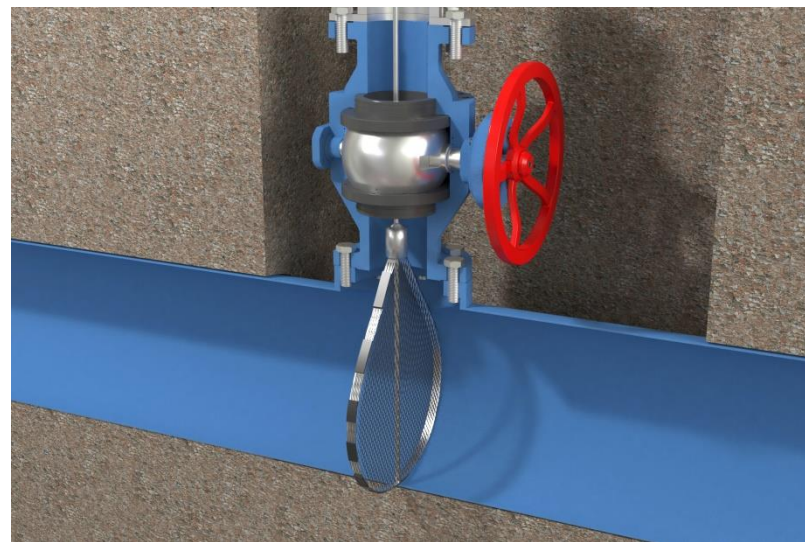
R&D New Water Industry Solutions



PIPA also offers collaboration opportunities with utilities to help design, develop and manufacture industry solutions from simple prototypes to full end user commercialisation

PIPA New solutions in development

- Live valve replacement on water boundary boxes
- Live installation insertion strainer for water discoloration complaints
- A new hand tool with 50% added torque for seized bolt release and tightening
- An 'in pipe' repair solution – we can see-we can hear-why not repair?



Difficult to Locate Leak Examples:



Utilising the Flowrider a 50 metre section of pipe was successfully identified as imploded and leaking resulting with a 25% loss of hydraulic output on a 600 mm PVC Scottish Hydro Scheme main (3.5 KM)

Loss of revenue per year £320,000



Difficult to Locate Leak Examples:



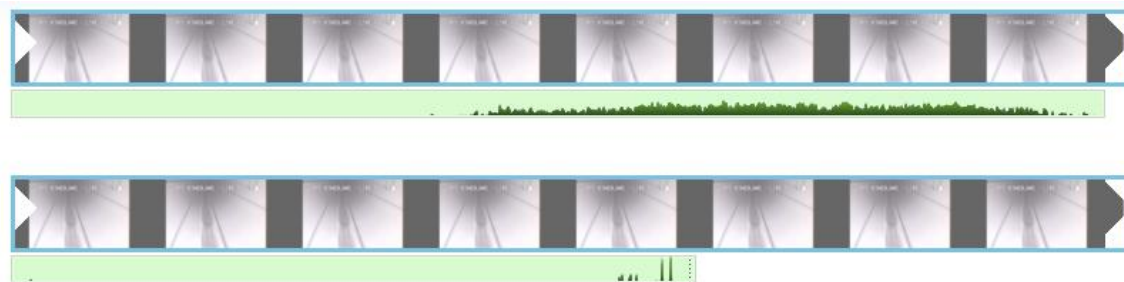
A new main failed a hydrostatic test and was out of service for **18 Months**
PIPA technology successfully located the leak in half a day
Client calculated costs of project downtime at **circa £250,000 GBP**

Hong Kong 2020 PLUTO Project



Longest tethered pressurised pipe inspection survey successfully completed using the PIPA PLUTO system. HD CCTV-Acoustic-Pressure-Temperature Survey distance 4.3 KM from a single launch, an industry first...

Pipe Testing Philosophy



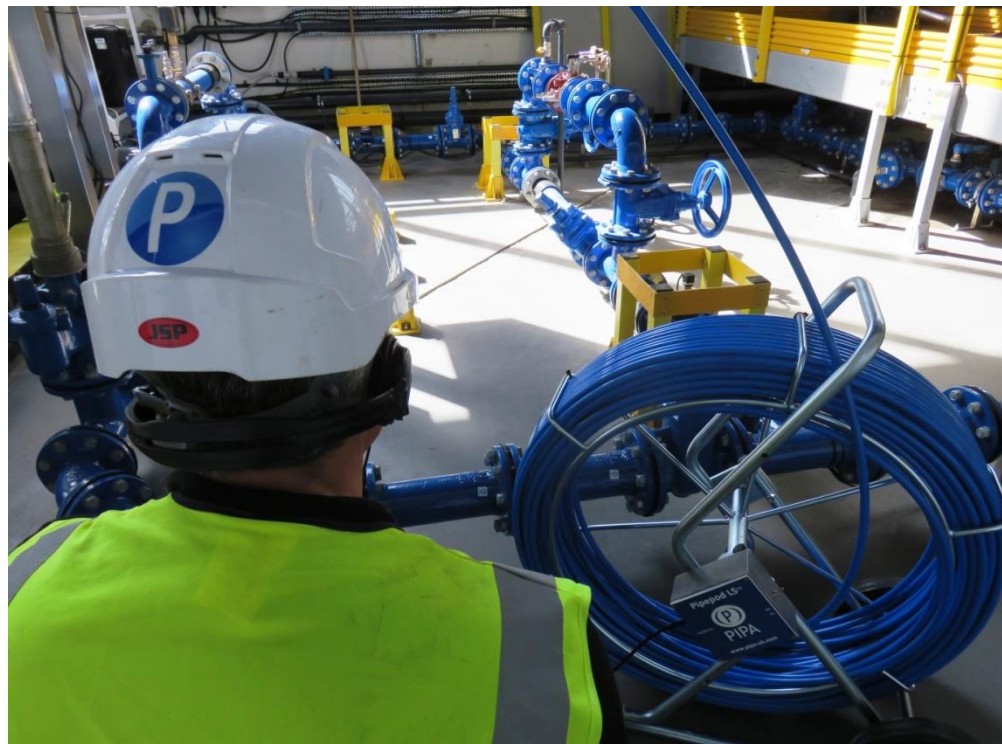
Look – Undertake Live CCTV surveys to confirm pipe condition and material, update GIS records and solve unknown pipe issues

Listen – Undertake Live ‘in pipe’ acoustic inspections to determine areas of leakage interest and identify pinhole leaks prior to catastrophic failure

PIPA offers the complete pipe inspection solution



PIPA Technology



Innovation-Knowledge-Training



PIPA Technology



**Specialist water tooling and pressurised pipe
inspection solutions, for all sized water mains.**

www.pipa-uk.com

Thank You Q and A

Pipebots – Micro-robots revolutionising the management of buried pipes

Professor Nicole Metje & Professor Kirill Horoshenkov

The University of Birmingham & Sheffield

21st Annual Leakage Conference

8-9th February 2021

www.pipebots.ac.uk

In partnership with:

Supported by:



UNIVERSITY OF
BIRMINGHAM



What is Pipebots?

Development of micro-robots designed to work in underground pipe networks

➔ revolutionise buried pipe infrastructure management

- 5 year, EPSRC Programme grant
- March 2019 – February 2024
- 4 Academic institutions
- Over 40 researchers
- Over 30 industry partners
- Links to other groups overseas



In partnership with:

www.pipebots.ac.uk

Supported by:



UNIVERSITY OF
BIRMINGHAM



UNIVERSITY OF LEEDS

EPSRC
Engineering and Physical Sciences
Research Council

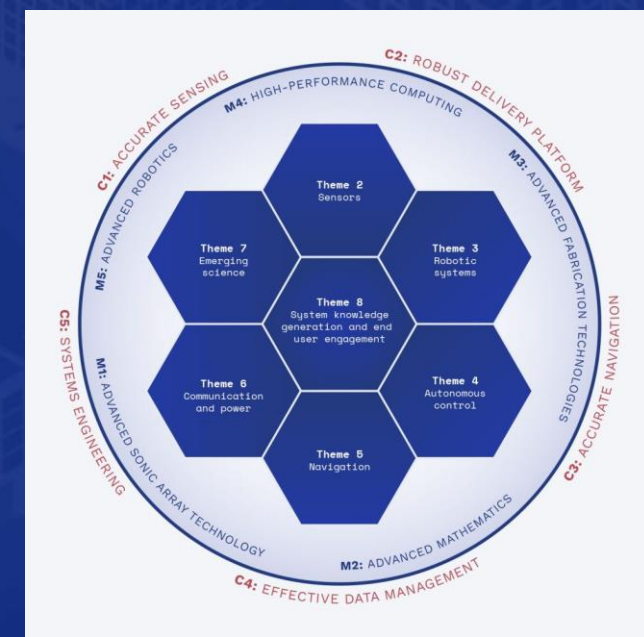
TWENTY65

UKCRIC

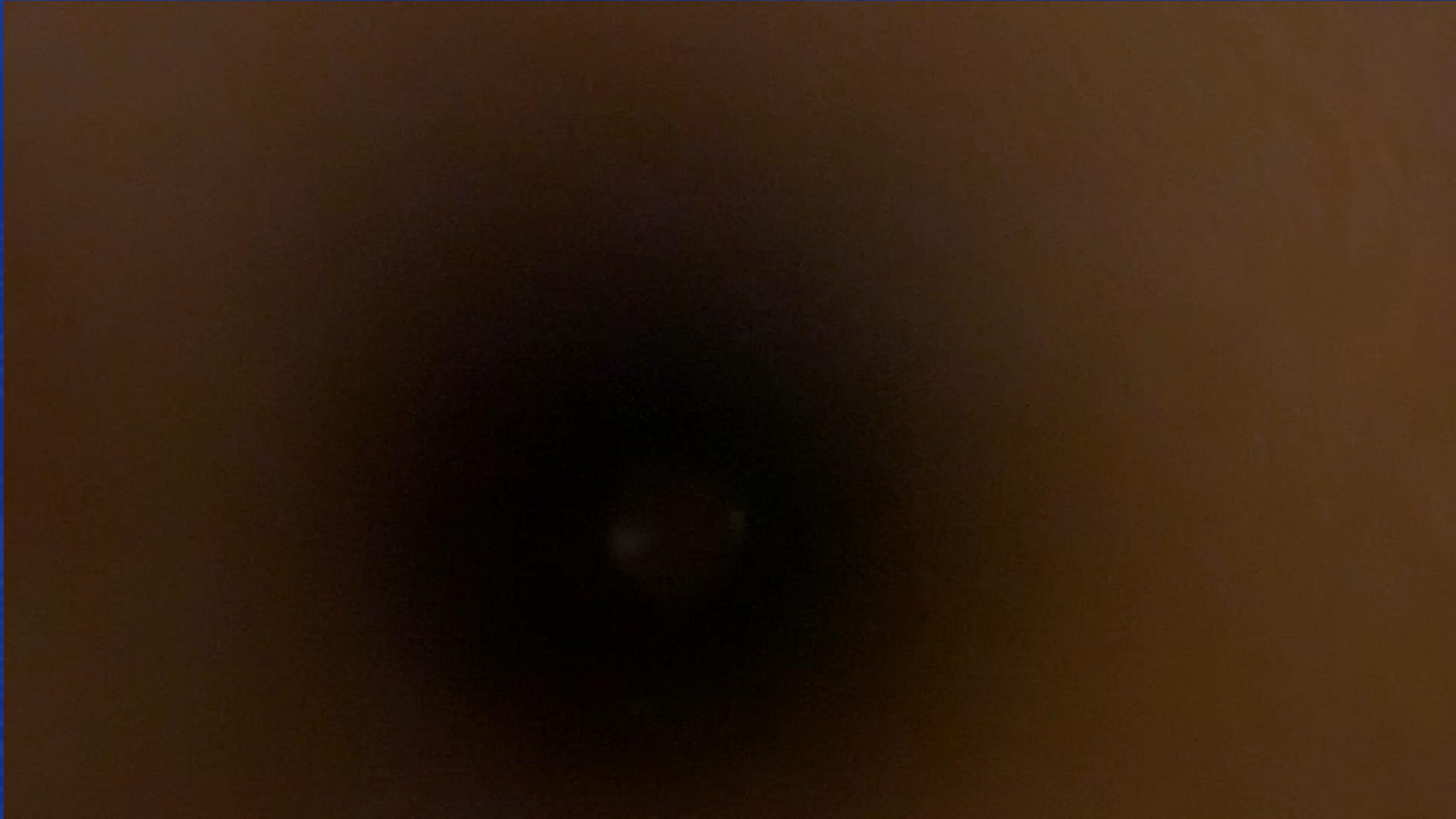
SELF REPAIRING CITIES

What we will do?

- Develop a new science of sensing for high fidelity in-pipe inspection
- Integrate this new science with robotic, navigation and communication solutions
- Advance this science from a laboratory prototype to field scales
- Actively engage with the end user community throughout the project
- Co-create the research with key UK stakeholders
- Establish a world leading research Centre of Autonomous Sensing for Buried Infrastructure.



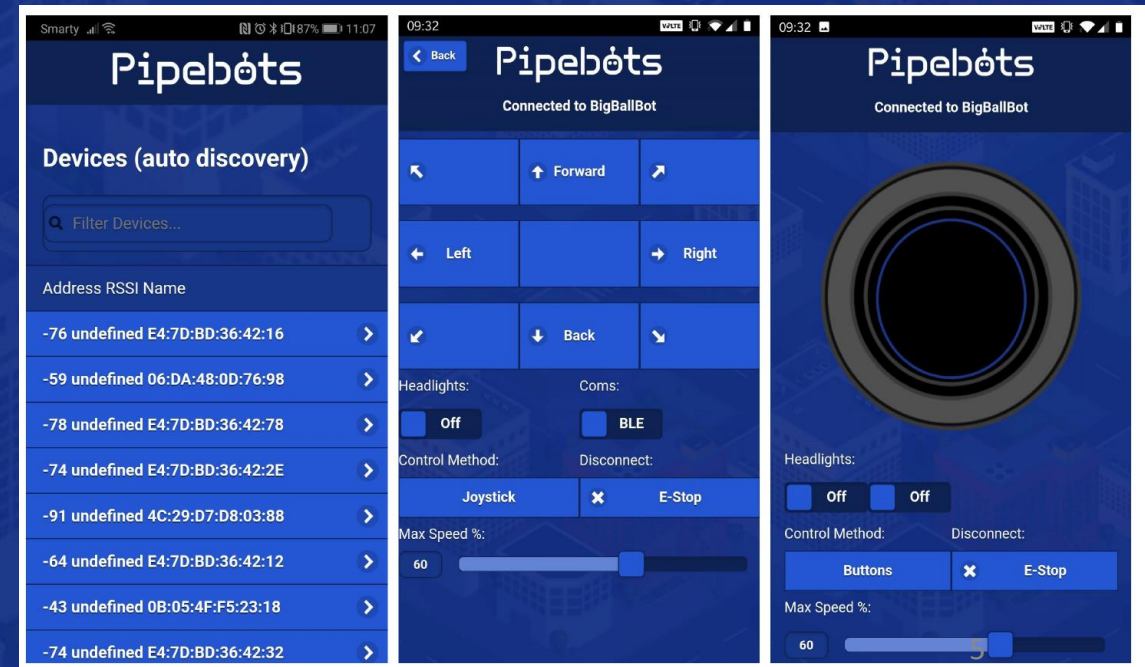
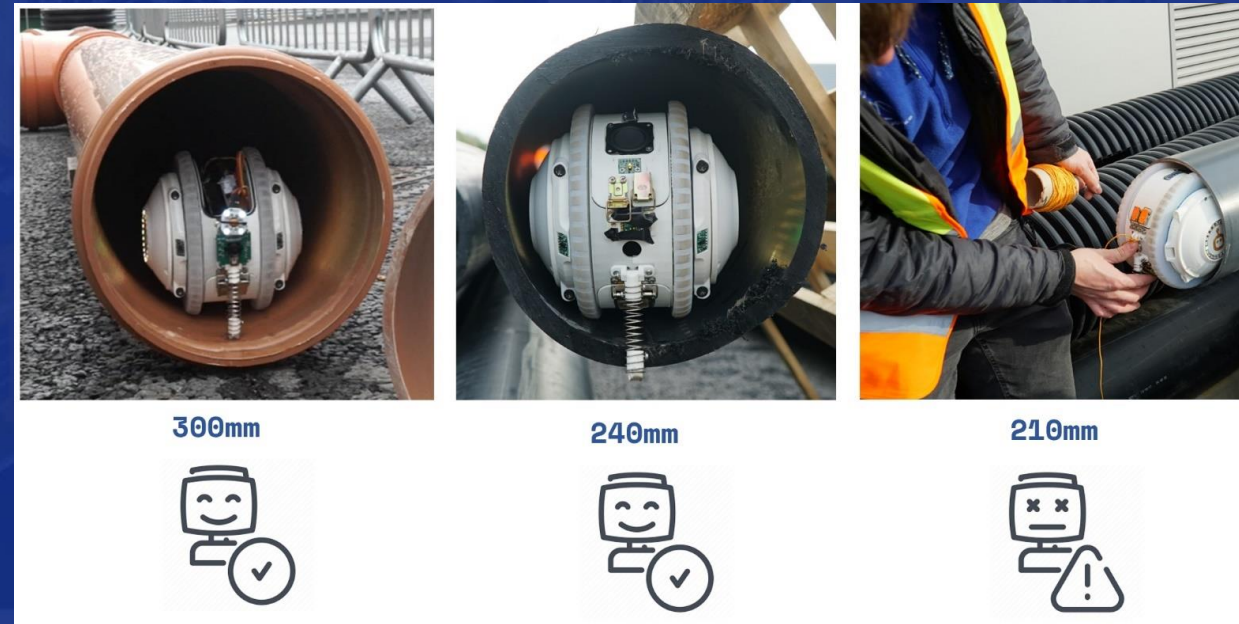
Sprint Robotic systems



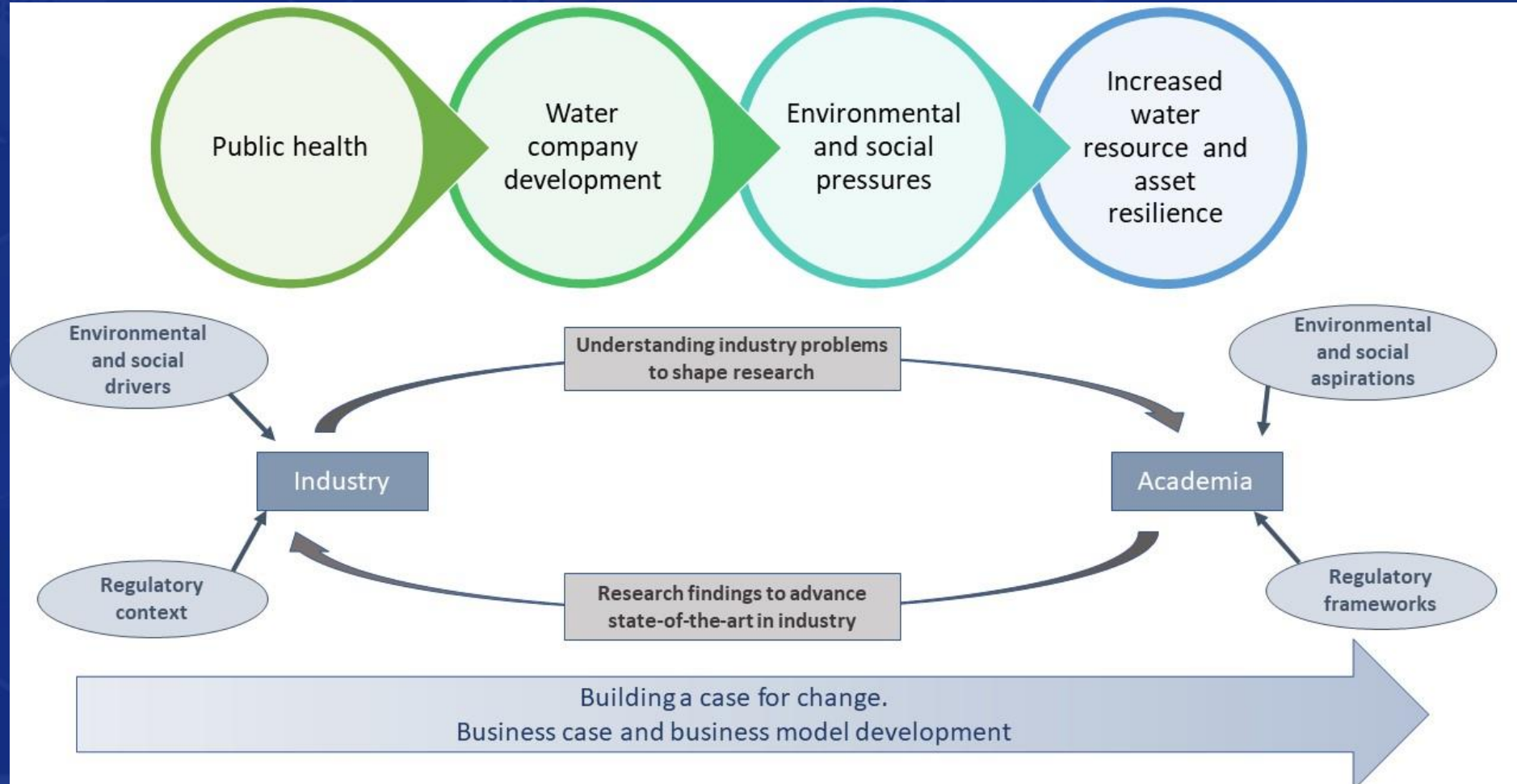
Developed a number of small robotic platforms including Sprintbot (above) and new robot concepts
Studied interconnecting robots which can work together to cope with pipe artefacts

Sprint Robot - Evaluation

- Robot fits comfortably in 300mm test network (and in 240mm) and can move effectively.
- Handles T and Y sections and gets into and out of the “manholes”.
- Robot was simple and intuitive to control by an inexperienced user with custom smartphone app.
- The integrated electronic system was reliable and effective.
- The modularity of the design combined with the incorporation of access panels made it easy to perform modifications and maintenance in the field



Themes 7 & 8: Emerging Science & System Knowledge Generation and End-user Engagement



Working on business case and business model development

Working on cost benefit analysis scenarios with a focus on robotic sensing

The Challenges

- Miniaturising the robots
- Communication / Data Retrieval
- Autonomy
- Navigation
- Robot insertion in pressurised systems
- Impact of flow
- Operation in wet & dry environments/interfaces
- Control
- Data interpretation – making sense of the data
- Agility/mobility within the pipe network
- ...

Case Studies

- Blockage
- Asset Mapping
- Condition Assessment
 - Leakage

Collaboration

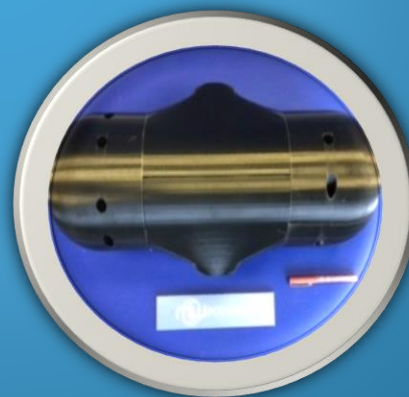
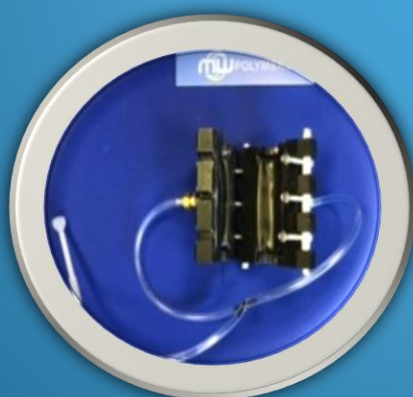
- Joint, safe testing
- Data sharing – help us make the case for Pipebots
- Water regulations
- Alternative business models

Thank you

www.pipebots.ac.uk & a.m.cooling@sheffield.ac.uk

1. MW Polymer Products Ltd Water Repairs 2021

'Aqua-tite' – an easy fit repair clamp





Composites 
Trade Association

Member Company



2. About MW Polymers

- Supply of Sealants, Adhesives & Coatings
- Operating for > 40 Years:
 - Factory Manufacturing – bespoke solutions
 - Research & Development
 - Contractor Services
- Repair solutions to a global customer base
- Patents: PE pipe repair & Multi Occupancy Buildings
Anti-Corrosive sleeves
- A range of approved products for the global Gas industry

3. Water leaks

Our research found:



- Research of **48,000 km** of mains pipes found **78,000** water leaks
- Most bursts are on **pipes of 250mm diameter or less**
- **60,000** were circumferential breaks
- **18,000** were other leaks including **pinhole corrosion**

4. Circumferential breaks due to stress loading



Caused by corrosion and pipe movement

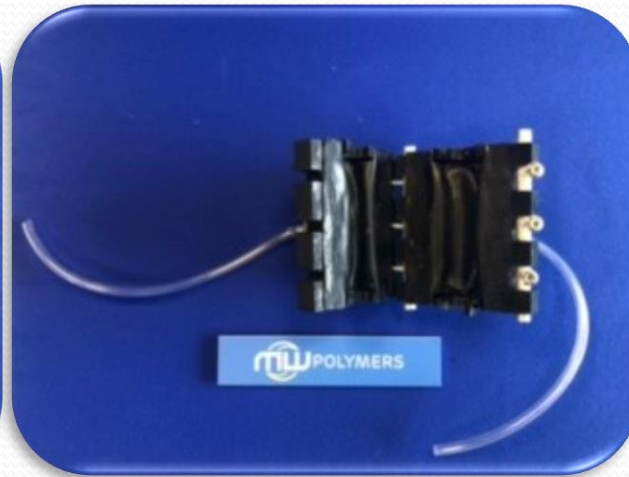


**Conventional clamps
move stress down the
pipes**

5. Sealing Circumferential breaks without stress loading the pipe



3D Resin clamp



Fitted clamp on a cracked pipe

6. 'Aquatite' – an easy-fit repair clamp

- A loose fit, resin clamp that covers the damaged section of pipe
- The inner sleeve is filled with a settable resin that under pressure deforms to create an exact profile around the pipe before curing
- The hydraulic pressure stops the leak.
- The resin cures to an exact fit around the pipe.
- The result is a robust sealing system that remains under pressure without building stress into the pipe system.

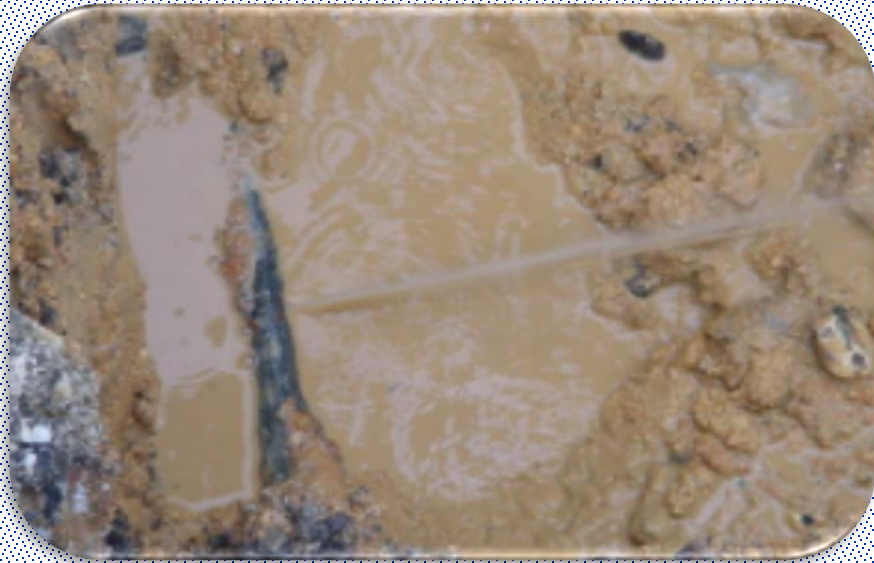


Image shows a cut-away of the fitted clamp



Image shows a cut-away through the rubber sleeve with cured resin

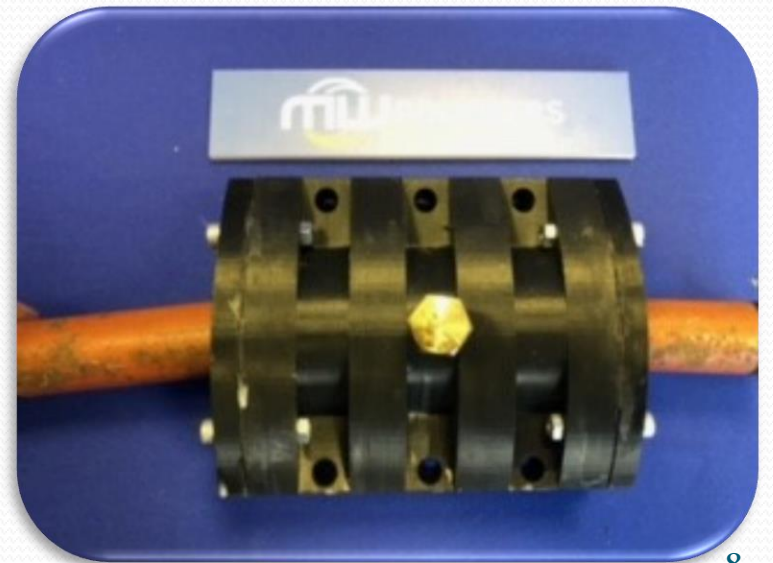
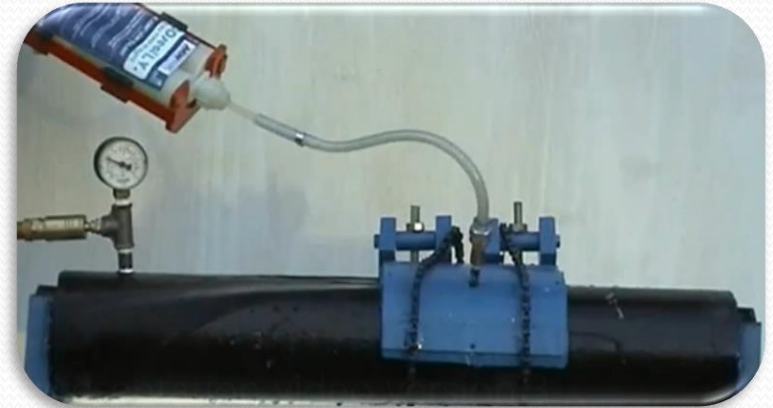
7. Examples of pinhole corrosions



9. Aqua-tite Unique Product Features

In summary...

- *Aqua-tite* tolerates compound angular mis-alignment, corrosion pitting and pipe ovality by injecting a settable resin between the clamp and the rubber sleeve
- Our method does not put the stress back into the pipe system
- The resin clamp will not corrode
- The injected liquid resin does not come into contact with the leaking water



10. Aqua-tite Elbow clamp

- *Using the Aqua-tite technology we can produce variations for different leak requirements on demand*



PARTNERSHIP REQUEST

M W Polymers are looking to partner with a Water utility to apply for funding from the Innovation in Water (IWC) Challenge competition.

Closing date 26 February

We would welcome enquiries and can be contacted on these numbers:

M W Polymers 01332 835 001

Mike Wild 07786 067 436

Jez Parker 07813 288 641

...thank you for your time

