

PE Gas Distribution Pipes Some Key Quality Issues

David Walton, PE100+ Association

Contents

- Background and scope of the PE100+ Association
- Key success factors for pipes made from PE
- PE Pipe model and material quality considerations
- New Developments
- Concluding remarks

PE100+ Association

- Founded on 24th February, 1999 by Borealis, Elenac and Solvay
- Consisting of eight member companies currently - **Borealis, Borouge, Ineos, LyondellBasell, Prime Polymer, SABIC, SCG Plastics and Total Petrochemicals**
- Supported by Advisory Committee and working closely with other associations

TOTAL PETROCHEMICALS



BOREALIS



PRIME POLYMER



lyondellbasell

INEOS

بورج
Borouge

سابك
sabic

Founding Scope of PE100+ Association

- **Establish** a quality label for PE100+ products
- **Assure** consistent quality at the highest level in the production and application of PE100 pipe materials
- **Promote** usage of PE piping systems in general
- **Focus** towards end-users with more information support
- **Welcome** any polyethylene manufacturer whose materials comply with the enhanced requirements of the PE100+ Association

What does the ‘+’ in PE100+ represent?

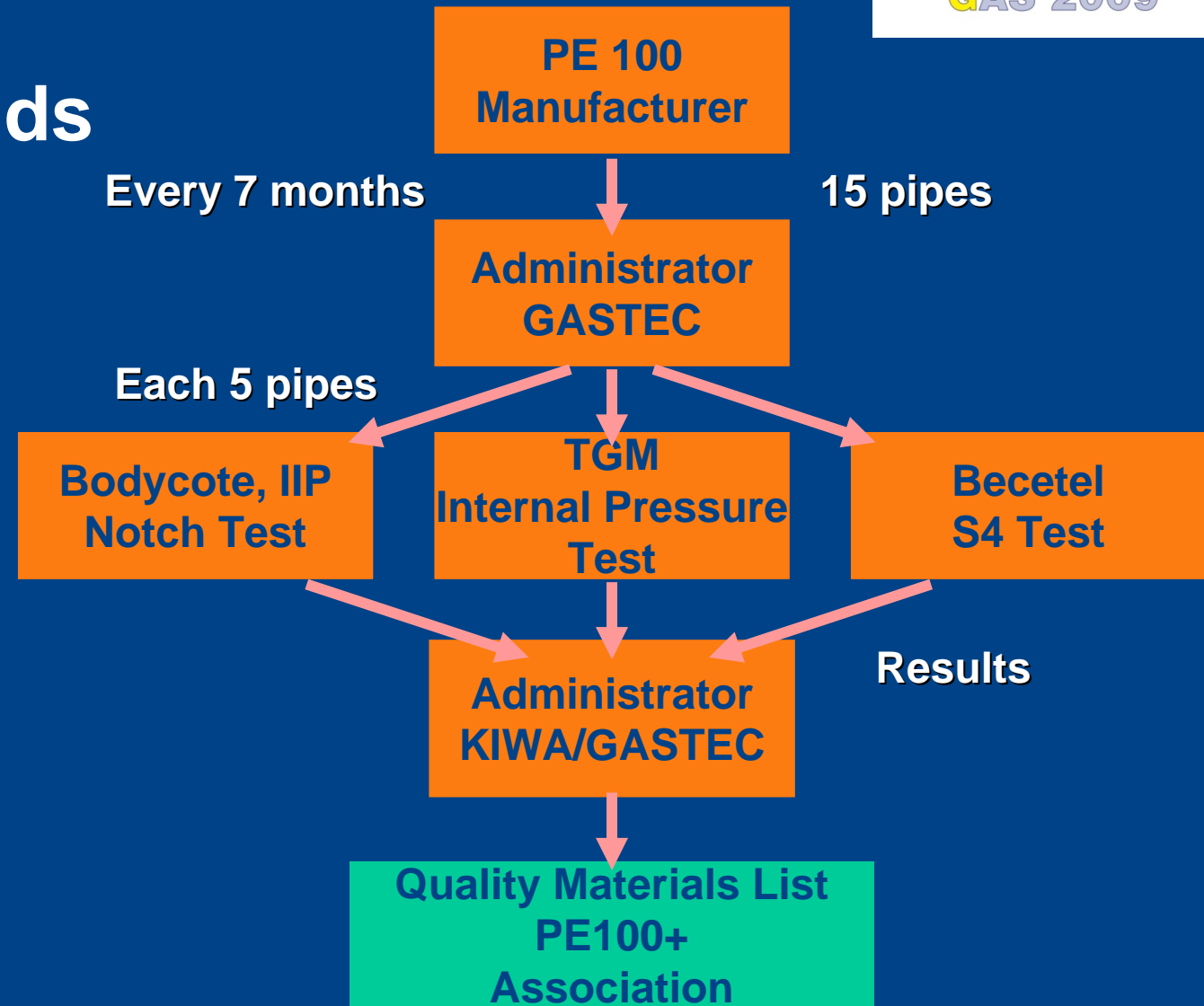
- Certified PE100 material consistency of 3 critical properties due to regular testing cycle
- Promotion of quality beyond the raw material to the entire chain of pipes & fittings, installation and maintenance
- Peace of mind due to use ready made compounds without the influence of MB compatibility/consistency, poor homogenisation during extrusion and incomplete testing/certification

Technical Requirements

Property	Test Method	EN/ISO Standard Requirement	PE 100+ Requirement
Creep Rupture Strength	Internal pressure test at 20°C and 12.4 MPa ISO 1167	> 100 h	> 200 h
Stress Crack Resistance (SCG)	Pipe notch test at 80°C and 9.2 bar ISO 13479	> 500 h	> 500 h
Resistance to Rapid Crack Propagation (RCP)	S4 test at 0°C ISO 13477	$P_c > MOP/2,4 - 13/18$ P _c : critical pressure MOP: max. operat. pressure	> 10 bar

All tests are performed on 110 mm SDR 11 pipes

Test Rounds



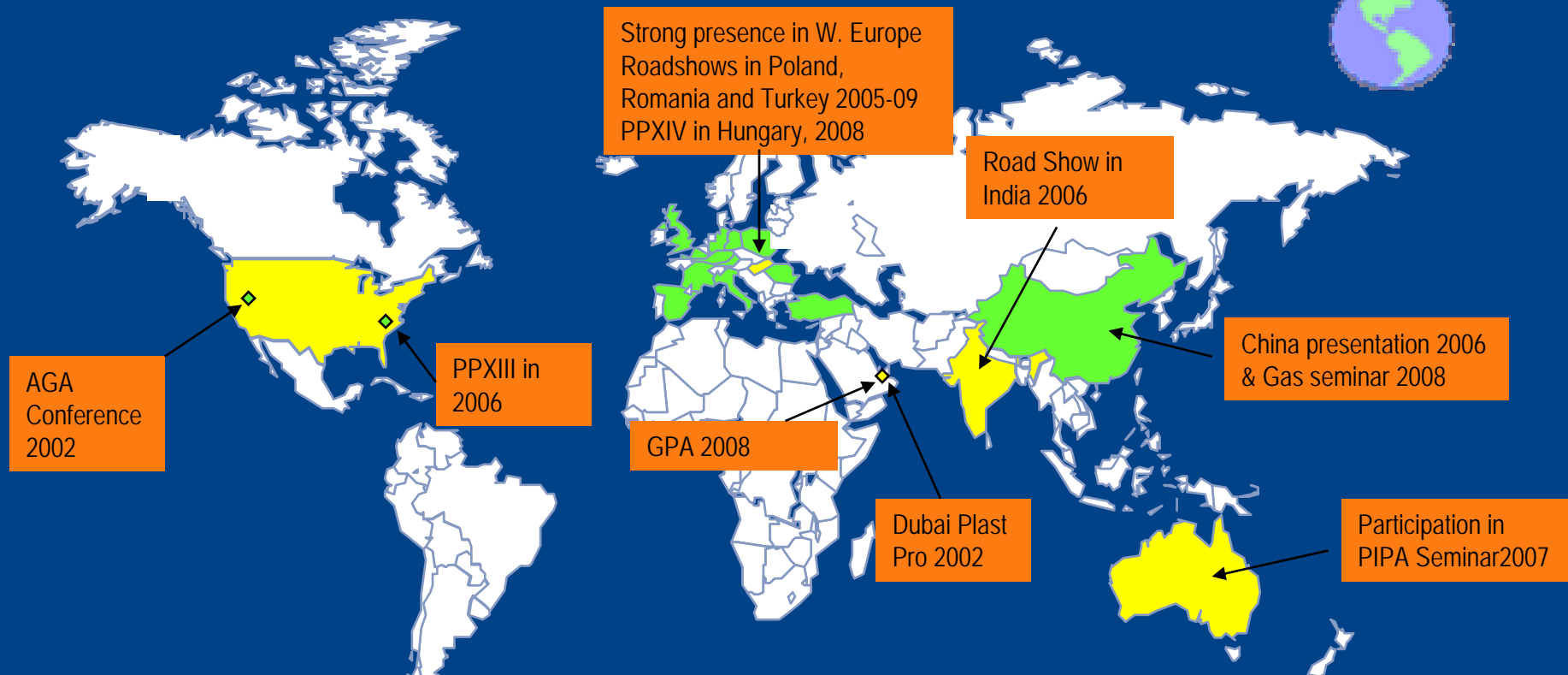
Product	Product Manufacturer
Borstar® HE3490-LS (black)	Borealis AB
Borstar® HE3492-LS(orange)	Borealis AB
Borstar® HE3494-LS (blue)	Borealis AB
Borstar® HE3490-LS (black)	Borouge Pte., Ltd.
ELTEX® TUB 121 (black)	Ineos Polyolefins
ELTEX® TUB 125 N2025 (orange)	Ineos Polyolefins
ELTEX® TUB 124 N2025 (blue)	Ineos Polyolefins
ELTEX® TUB 121 N3000 (black)	Ineos Polyolefins
Hostalen CRP 100 black	LyondellBasell
Hostalen CRP 100 blue	LyondellBasell
HI-ZEX® 7700 MBK (black)	Prime Polymer Co., Ltd.
EVL-H®SP5505BK (black)	Prime Polymer Co., Ltd.
SABIC VESTOLEN® A 6060 R (black)	SABIC Polyolefine GmbH
SABIC VESTOLEN® A 6060 R (blue)	SABIC Polyolefine GmbH
EL-LENE H1000PC (black)	SCG Chemicals & Thai Polyethylene, Ltd
HDPE XS10H (blue)	Total Petrochemicals
HDPE XS10B (black)	Total Petrochemicals
HDPE XS10 Orange YCF	Total Petrochemicals

In addition to the Quality Materials List...

Focal Points:

1. Technical topics: To respond to industry technical issues (eg Butt Welding Project)
2. East Europe: To set industry standards together
3. Build strong quality image outside Europe: Turkey, India, China, N. America (through PPCA)
4. Continue promotion with industry co-operation: To Create Trust in high quality PE

PE100+ Selective Global Presence



In 2009 seminars are planned in Turkey, Romania, China & Dubai

Slide 10

s6 ppxiii in 2006 usa w.dc

south america. brazil, chile, argentina

china

australia

india

iran

south-east asia

south africa

global water..in moraco

stwangje, 16/02/2004

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Creating value in Pipe – basic human needs

- Water supply
- Energy supply (gas, oil, hot water)
- Sewage disposal
- Telecom



Roman times...



...and today

In Europe, PE & PP pipes have an impressive track record

- 1950's - first PE pressure pipe installed
- 1970's - second generation PE for water and gas
 - crosslinked PE (PEX) for hot water
- 1980's - PP pipe systems for new applications
- 1990's - bimodal PE100 introduced
 - higher pressures and larger pipes
 - PO pipe markets grow at 6 %
- 2000 - high momentum into the new millennium



Key success factor for PE pipes: Flexibility

- Long lengths in coils
- Curving trenches
- Modern installation techniques
 - Relining
 - Horizontal drilling
 - Plowing in



Key success factor for PE pipes: Weldability

- Cost effective butt welding
- Safe and practical electro fusion
- Leak tight pipeline
 - Earthquakes
 - Ground movements
 - Tree roots



Key success factor for PE pipes: Positive image

- Innovation / new generations
- High level of standards
- Safe for gas transportation
- Environmentally friendly
- 100 years reference design life



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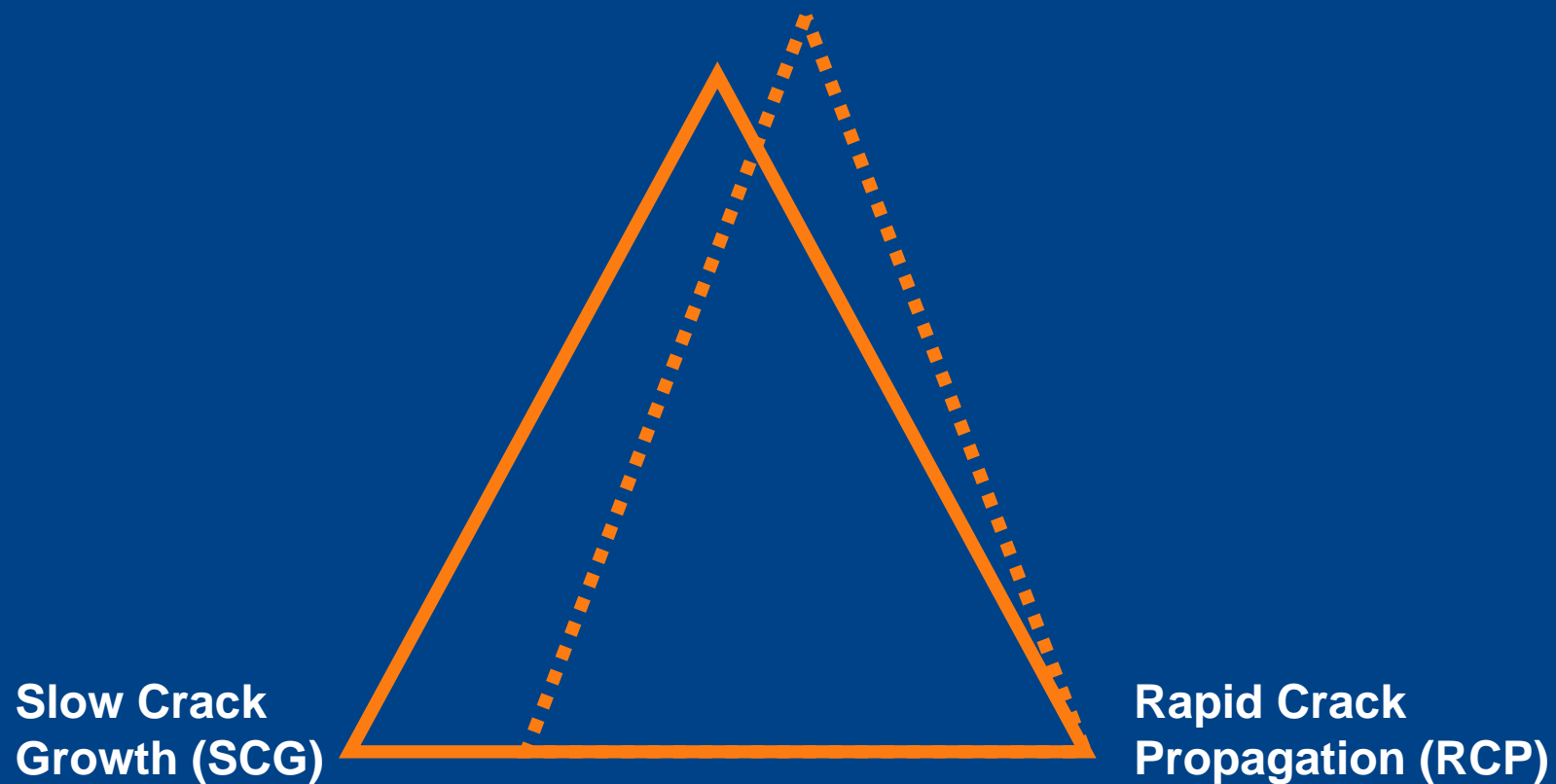
Pipe Material Performance Matches Today's Demands

- Product consistency has increased allowing lower safety factors to be safely implemented
- “Ready made” compounds are tested by the raw material supplier over a long period of time to demonstrate compliance with the MRS value
- This level of quality and consistency cannot be achieved by blending natural polymer and additive masterbatch on the extruder

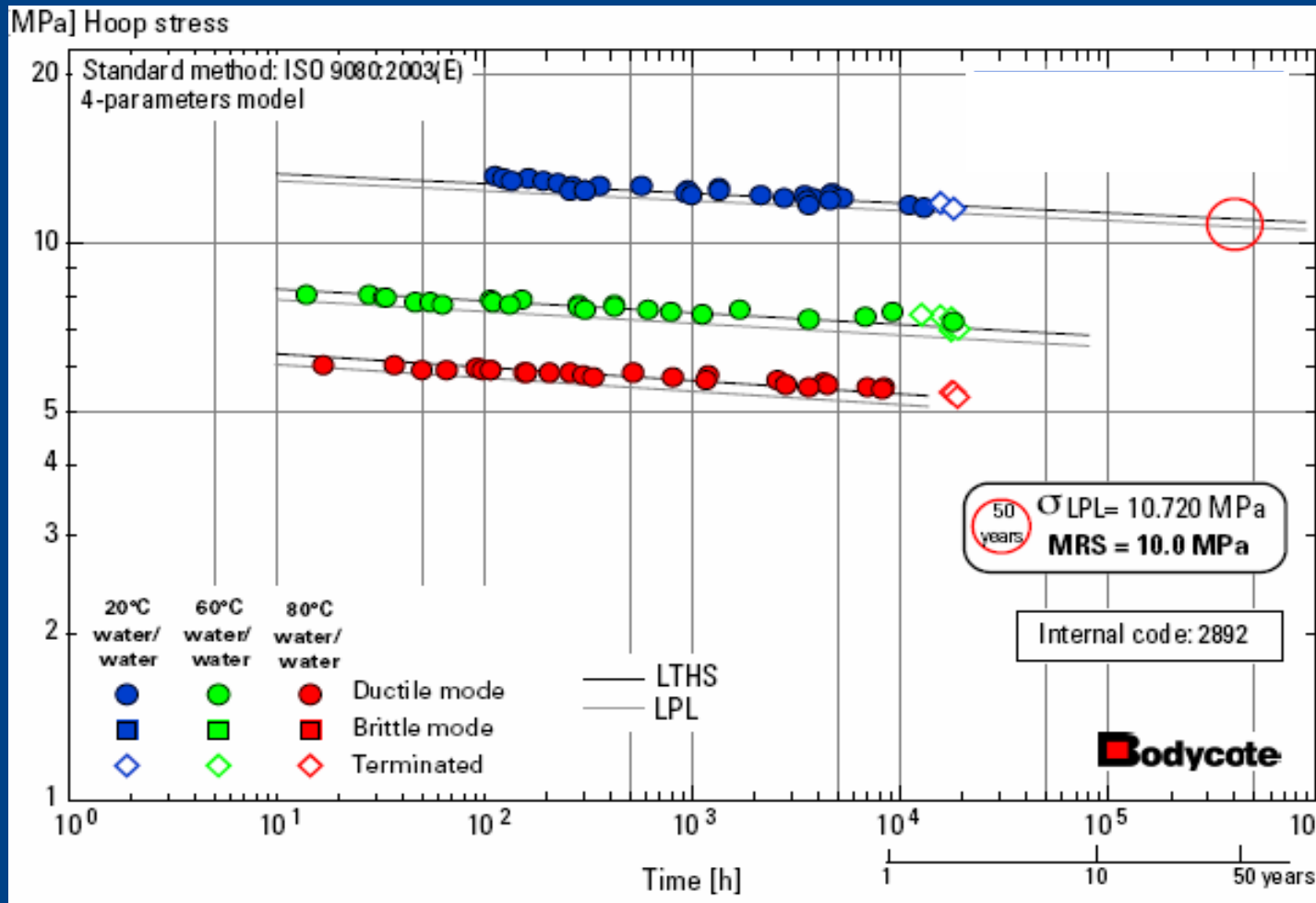


Balance of mechanical properties

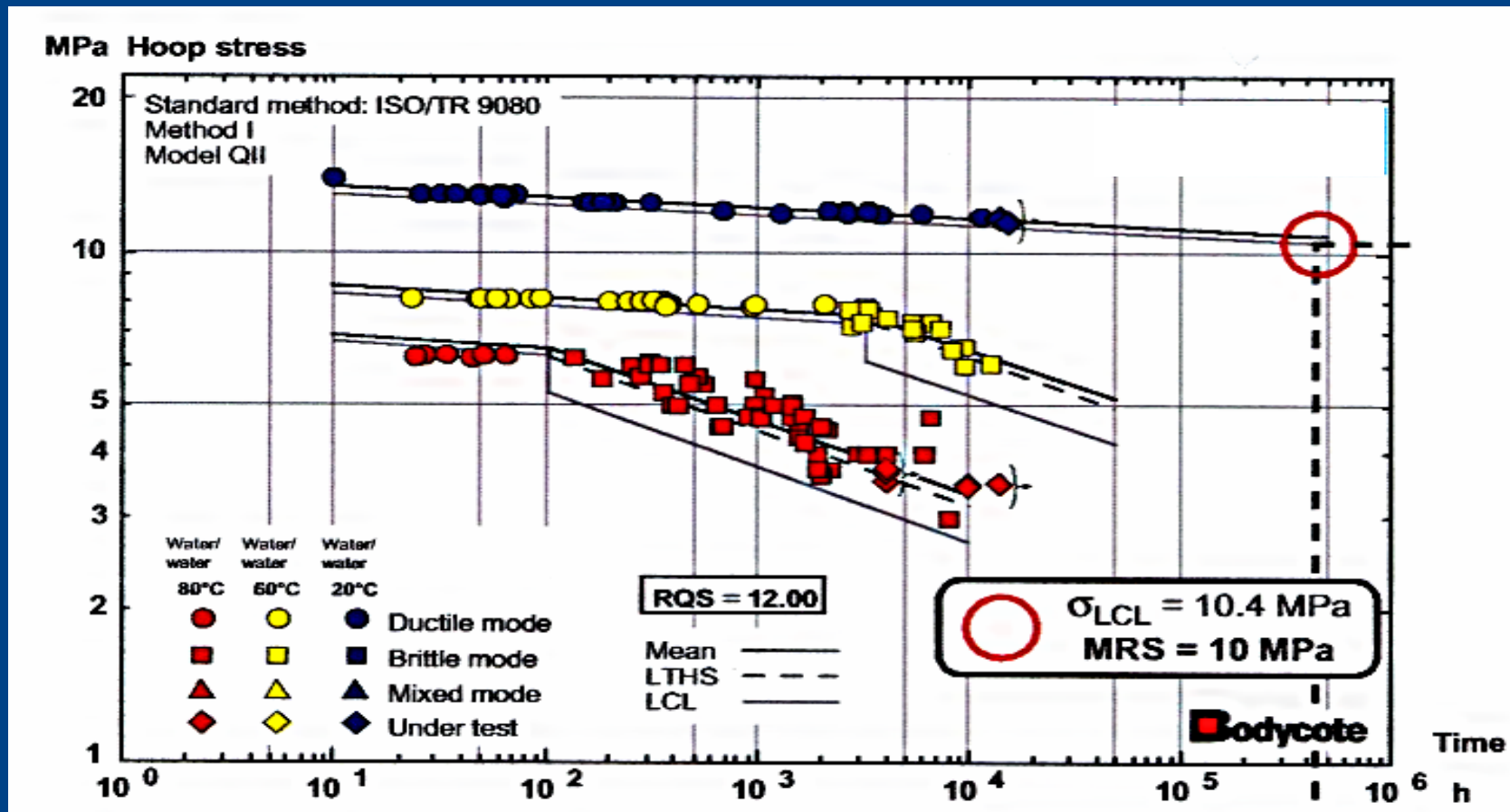
Long Term Hydrostatic Strength (MRS)



Long term hydrostatic strength



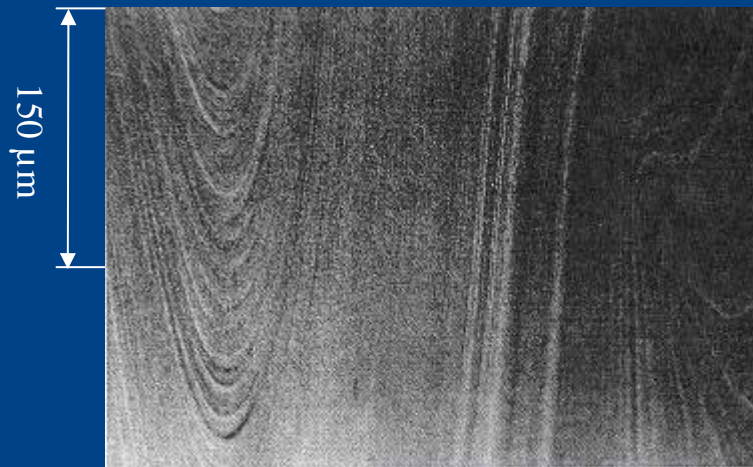
Long term hydrostatic strength



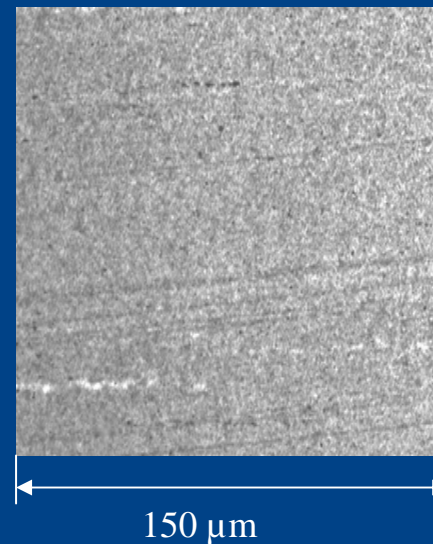
Now excluded from the ISO specifications ISO4437 & ISO4427

Dispersion of additives

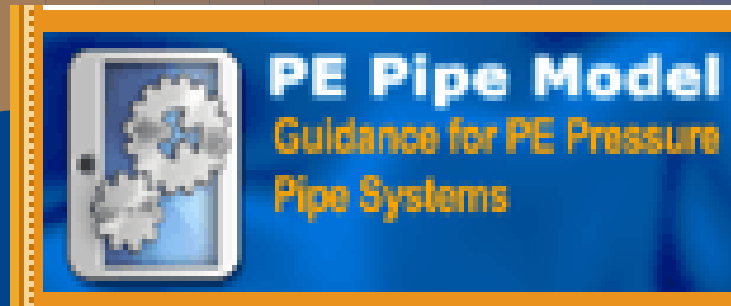
The demand on proper homogenisation can only be met by high quality “ready made” raw material compounds. The requirements are described in ISO 18553.



Unacceptable homogenisation
by a single screw pipe extruder
(natural resin & master batch)
Image taken from ISO 18553



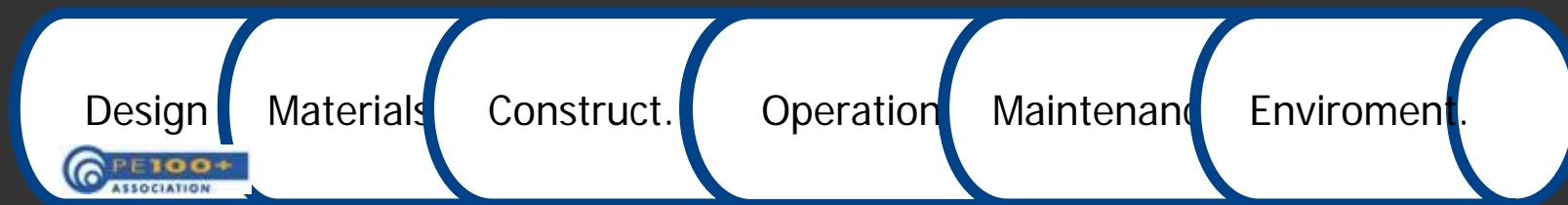
Perfect homogenisation of 2,25%
carbon black by professional
compounding equipment



PE pipe model

- Purpose to educate and inform decision makers about PE
- Updated by Jason Consults and Webmaster with expert inputs
- view it on www.pe100plus.net (soon in Chinese!)

- Introduction
- Disclaimer



- ISO Standards

Test on real pipe systems to confirm quality



Full scale...



...and internal pressure test

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New Developments based on PE100

- Changing the parameters in the bimodal process enables materials to be “tailor – made” for specific applications.
- Recent developments include
 - PE100 materials for injection moulding
 - High stress crack PE100 materials
 - Others to follow.....

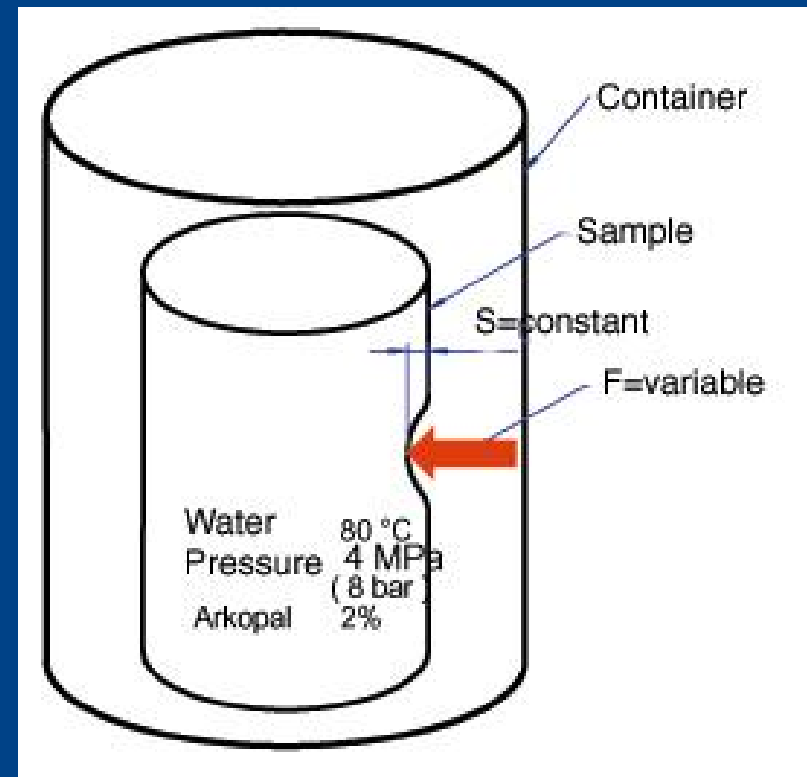
High Stress Crack Resistant Materials

- Why do we need these materials?
 - Installation conditions are getting tougher
 - Pipes can get damaged during installation
 - Pipes can experience damage during operation from stones in the backfill material
- How can we evaluate these materials?
 - Need to meet all PE100 requirements
 - Plus increased stress crack resistance for which new tests are required

High Stress Crack Resistant Materials

- New Point Load Test
 - DVGW have adopted a new test - Point Load Test for directional drilling & pipe bursting
 - Simulates stone loading
 - Crack growth accelerated by use of a stress cracking agent and high temperature
 - Sample must pass 8760 hours without failure

- Shorter term FNCT Test Used for Quality Testing



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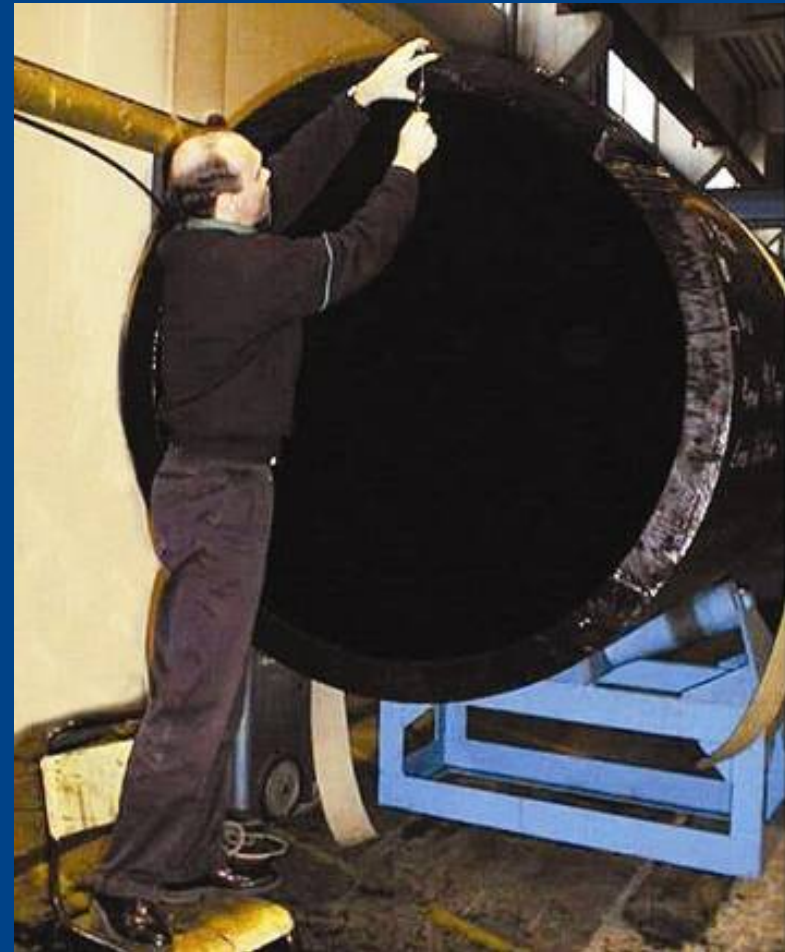
The High Demands on PE Pipe Materials

- The full cost benefits from PE pipes comes for installation savings due to the flexibility and fusion capabilities of PE.
- High on the benefit list is the ability to use a range of No-Dig methods to renovate old gas and water mains.
- These techniques impart external damage to the pipe which must not develop into cracks.



The High Demands on PE Pipe

- PE pipes are also getting larger in diameter and thicker walled - demanding higher toughness from the PE raw materials
- Today, PE pipes are also used at higher pressures and with a lower design factor demanding greater consistency of performance.



The Need for High Quality

- PE pipes are replacing products that have performed well and must achieve similar targets
- These demands can only be met by high quality “ready made” raw material compounds
- International specifications have been updated to bring in additional safeguards.
- The PE100+ Association has set the additional requirement of consistency by regular testing





Thank you for your attention