HDPE For Drinking Water Pipes

The European Experience From The Beginning Until Today

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Outline

- PE100+ Association
- How Do PE100 materials compare to PE4170 materials
- Regulatory approach to pressure pipe design in accordance with ISO standards
- Actual failure statistics
- Composition of the European drinking water grid (selected countries)
- Conclusion

PE100 vs PE4710

- Same Material Listed:
  - For example, PPI TR-4 listing for Borealis BorSafe HE3490-LS
- Culmination of extensive advancements by the PE resin manufacturers

	BorSafe HD34990-LS	
Classification	PE100	PE4710
Temperature	68°F	73°F
HDB	--	1600 psi
MRS	1450 psi (10 Mpa)	--

PE100 vs PE4710

- Differences:
  - Calculating Long Term Pressure Strength
  - Maximum Operating Pressure Equations Different

- $MOP_{AWWA} = \frac{2 \times HDB \times \boldsymbol{DF}}{(SDR-1)}$

- $MOP_{ISO} = \frac{20 \times MRS}{\boldsymbol{C} \times [SDR-1]}$

PE100 vs PE4710

- Pressure Rating of Pipe
  - Systems and Equations Different

	PE 3408	PE 4710	PE 100
HDB, psi	1600	1600	
MRS, psi			1450
Design factor	0.5	0.63	
Design coefficient			1.25
Pressure (DR 11), psi	160	**200**	232

  - PE4710 Pressure Rating Still **16**% lower than PE100

Requirements of PE pipe resins for water supply according to ISO 4427

Table 3 — Material designation and corresponding maximum design stress values

Designation	Minimum required strength (MRS) MPa	σ_s MPa
PE 100	10,0	8,0
PE 80	8,0	6,3
PE 63	6,3	5,0
PE 40	4,0	3,2

Design stress, σ_s, is derived from the MRS by application of the overall service (design) coefficient, $C = 1,25$.

NOTE A higher value for C can be used; for example, if $C = 1,6$, this gives a design stress of 5,0 MPa for PE 80 materials. A higher value for C can also be obtained by choosing a higher PN class.

Overall Service (design) coefficient, C = 1.25.

Regulatory approach to the design of pressure pipes for water supply

- Specific codes of Industry Associations based on ISO and EN standards:
  - German DVGW Technical Code GW335-A2, Plastic piping systems in gas and water supply; requirements and testing – pipes made from PE80 and PE100
  - French NF114
  - UKWIR standards
  - Other European countries

German DVGW code W400-1

Approved pipe dimensions for drinking water

DVGW | Deutscher Verein des Gas- und Wasserfaches e.V.

	PE80	PE100	PE-Xa	PVC-U	Ductile Iron	Steel	GRP
Accepted diameters DN [inch]	≤25	≤25	≤10	≤16	3-79	3-79	6-95
Admissible DR and pressure [psig]	DR7.4 up to 290	DR11 up to 232	SDR7.4 up to 290	DR13.6 up to 232			Pressure less
	DR11 up to 182	DR17 up to 147	DR11 up to 182	DR21 up to 147			
				DR34.4 up to 87			

Design coefficient for pipes made from PE80 and PE100 is 1.25!

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Drinking water mains in **France** are standardized by NF144

NF 114
NF-Polyethylene pipes

Rev. 26
October 2010

PE 100 PIPES (cont.)

Nominal outer diameter Dn (1) (mm)	S.D.R (2)	Nominal pressure (bar)	Nominal thickness (e) (3) (mm)	Tolerances in relation to nominal values (mm)		Absolute maximum out-of-round values (4) on straight pipe	Mass per meter (kg/m)
				on mean outer diameter	On thickness		
180	7.4	25	24.6	1.1	+ 2.6 0	3.6	12.100
	9	20	20.1		+ 2.2 0		10.200
	11	16	16.4		+ 1.8 0		8.550
	13.6	12.5	13.3		+ 1.5 0		7.100
	17	10	10.7		+ 1.2 0		5.800

- Design coefficient is 1.25!

UK – Choice of materials

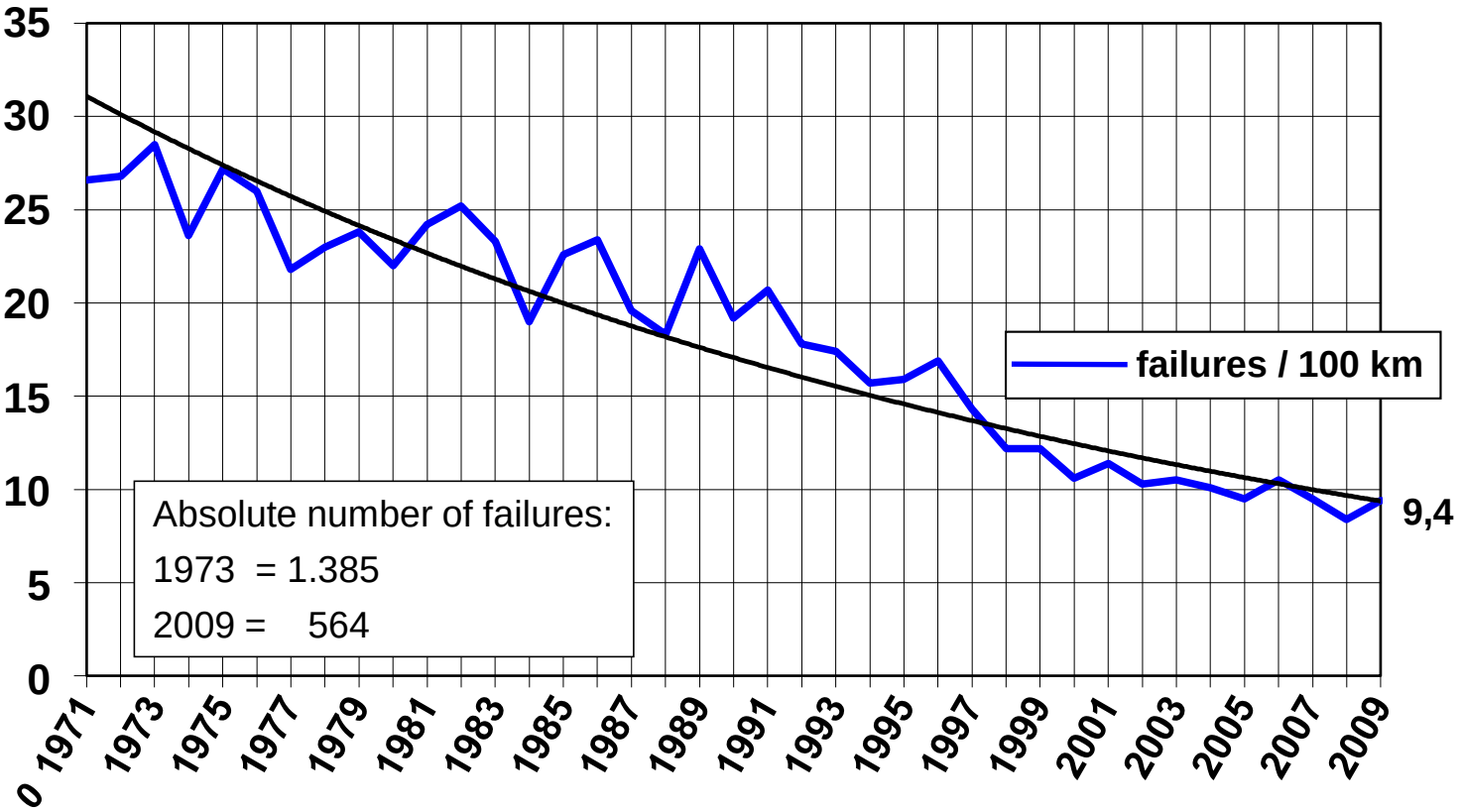
- „In common with the vast majority of UK water companies, Thames' standard material for new lay distribution mains and services is polyethylene (PE).
- Specifically, PE100 SDR 17 pipes for mains (147 psig rated)
- …and PE80 SDR 11 (182 psig rated) pipes for services."
- Hence a design coefficient of 1.25 is applied here as well

Quote from „Replacing London's Victorian Water Mains", Bill Becker, Mike Shepherd – Thames Water Utilities Ltd., Plastic Pipes XIII, Washington DC, 2-5th October 2006

Regulatory approach to the design of pressure pipes for water supply

- ISO Standards
  - **ISO 4427**: Plastic piping systems; Polyethylene pipes and fittings for water supply
- European System Standards deriving from ISO with national preambles
  - **EN 12201**: Plastic piping systems for water supply - Polyethylene

Total failure statistics of Gelsenwasser mains



- 19 failures in 2009 on a total PE100 network of 800 km result in an average failure rate of 2.4 failures /100 km and year
- A low failure rate of 9.4 for the total pipe grid is still significantly higher than the rate of 2.4 just for the PE part.

Failure statistics of UK water mains for reference

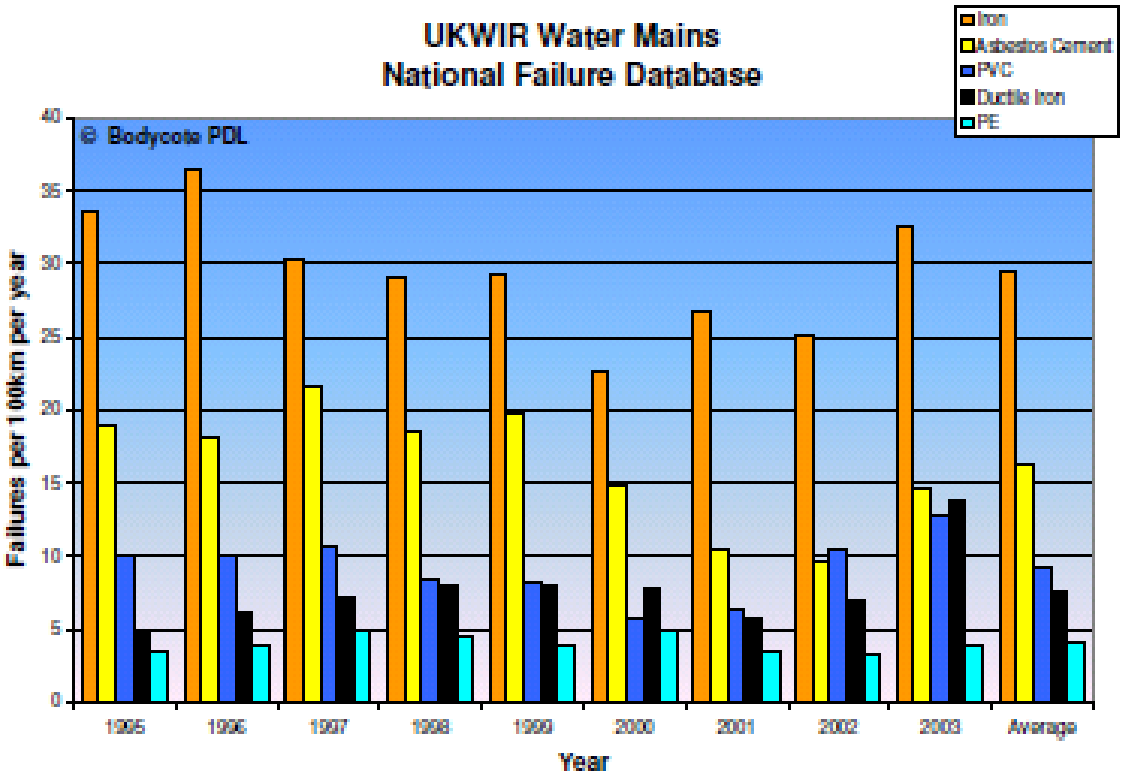
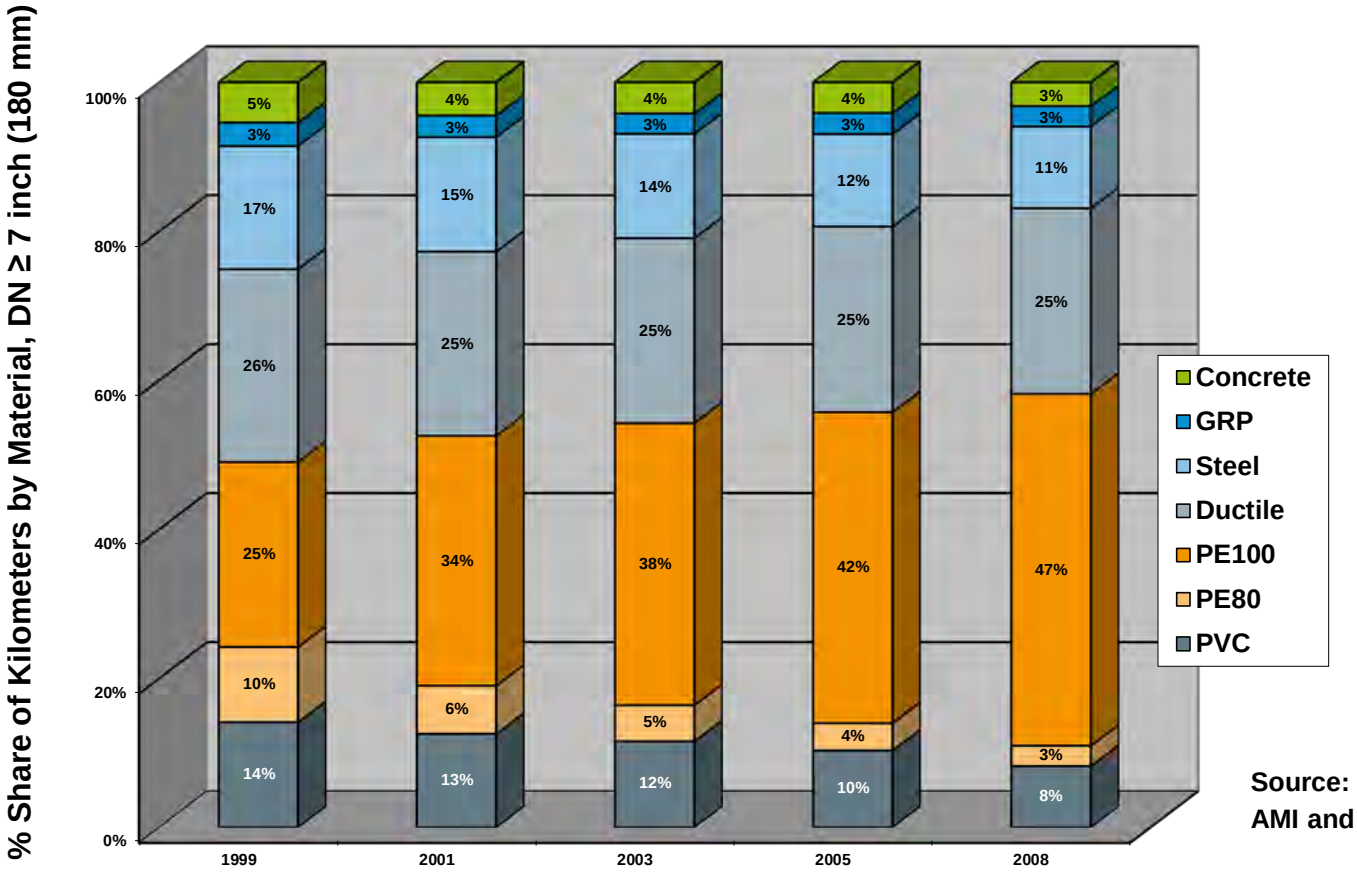


Figure 5 UK water main failure rates

Source: UKWIR National Mains Failure Database, Steve MacKellar, Bodycote PDL, PP XIII, Washington DC, 2006

>7 inch Piping: Drinking water supply in Europe
Intermaterial competition – Long term demand 1999 - 2008



Source:
AMI and LYB Market Intelligence

Germany: PE 100 is gaining ground vs. steel, PVC and PE80

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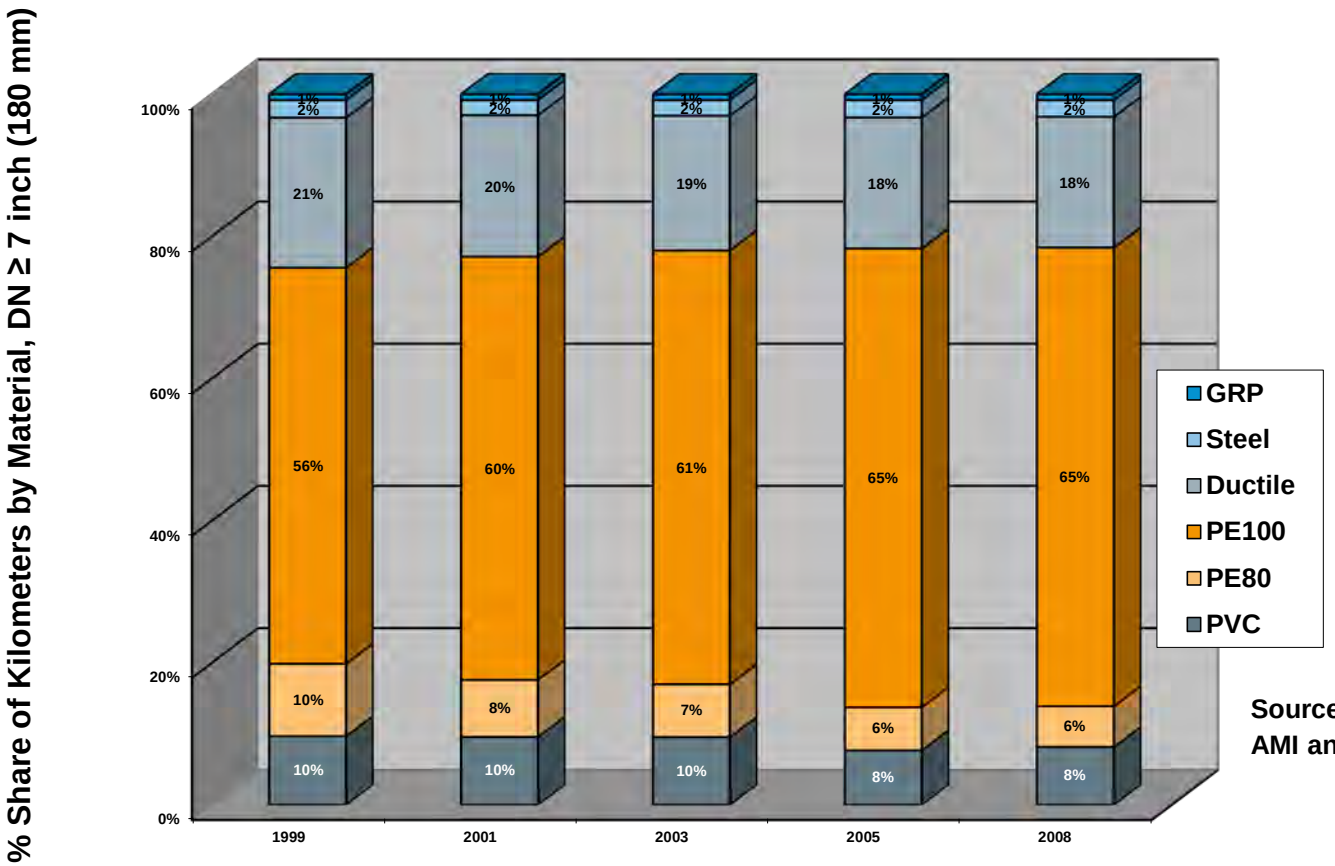
Intermaterial competition – Long term demand 1999 - 2008



Source:
AMI and LYB Market Intelligence

UK: PE100 pipes are well established, above Ø300 dominates ductile iron

Drinking water supply in Europe in a nut shell!

TEPPFA: Today about 90% (in length) of all newly installed pipes are made from certified HDPE grades

The vision of the 1950s has today become a reality

- Following the discovery of the low-pressure process, the production of HDPE began at a pace that would be inconceivable today.
- From the very beginning, pipes manufactured from HDPE were able to meet high service life expectations.
- Today‘s HDPE pipe extrusion compounds of the 4th generation are high-performance materials distinguished by their strength, stability and durability.
- The development of HDPE as a pipe extrusion compound has not yet reached its peak – the next generation is only just around the corner

Pipes made from HDPE have proven highest reliability over the recent half century. This covers the total diameter range from less than 1“ up to 65 inches

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Thank you

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