Beta-PPR™ - The New Performance Level in Polypropylene Plumbing & Heating Systems

Business Unit Pipe

January 2006

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BOREALIS

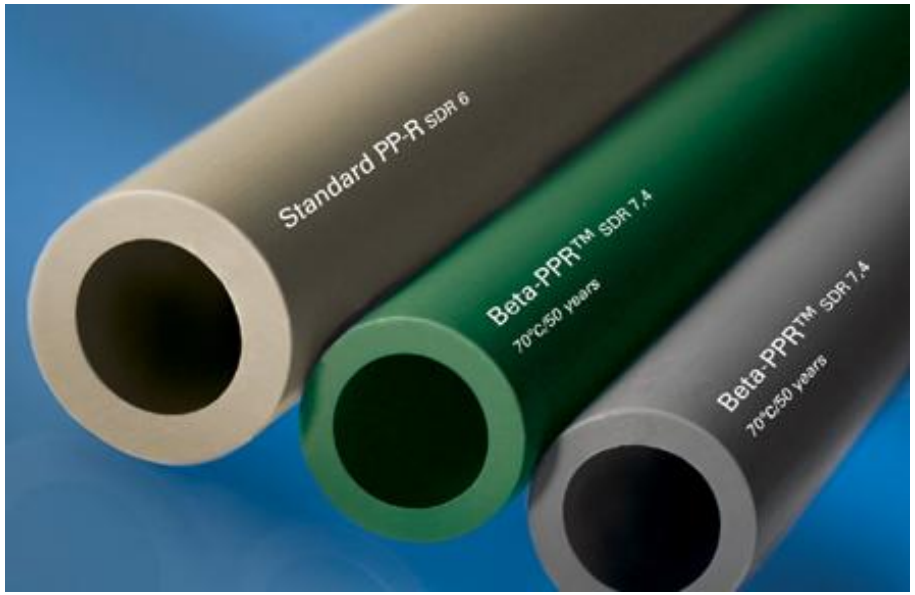
SHAPING *the* FUTURE *with* PLASTICS

Beta-PPR™ - Two Innovative Grades

Name & Colour

Beta-PPR™ RA7050
Grey (RAL 7042)

Beta-PPR™ RA7050-GN
Green (RAL 6024)



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Beta-PPR™ - Two Innovative Grades
What is behind the nomenclature?

Beta-PPR™ RA7050

- Brand name
- Primary dimensioning temperature
- Long-Term Extrapolated Strength (= 5,0 MPa @ 70 ºC, 50 years)

Beta-PPR™ RA7050-GN

- Green

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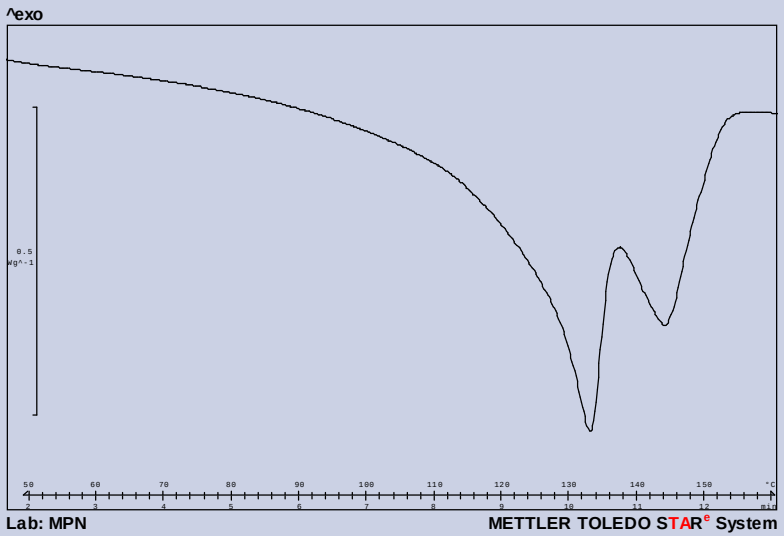
What is Beta-PPR™?

- Multiple reactor technology
- State-of-the-art stabilisation & additivation
- Special β-nucleation



Typical DSC plot of the second heating curve of Beta-PPR™ RA7050

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Beta-PPR™ - A New Material Class: PP-RCT (*)

- Polypropylene-Random-Copolymer
- Enhanced Crystalline Structure
- Improved Temperature Resistance

(*) For further information about the abbreviation see ISO 1043-1:2001

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Beta-PPR™ - Key Innovation Characteristics

- **Step change improvement in internal pressure performance & resistance to slow crack growth** compared to existing PP-R materials
- **Enhanced long-term durability** due to improved oxidation resistance and excellent resistance to slow crack growth
- **Good impact resistance**

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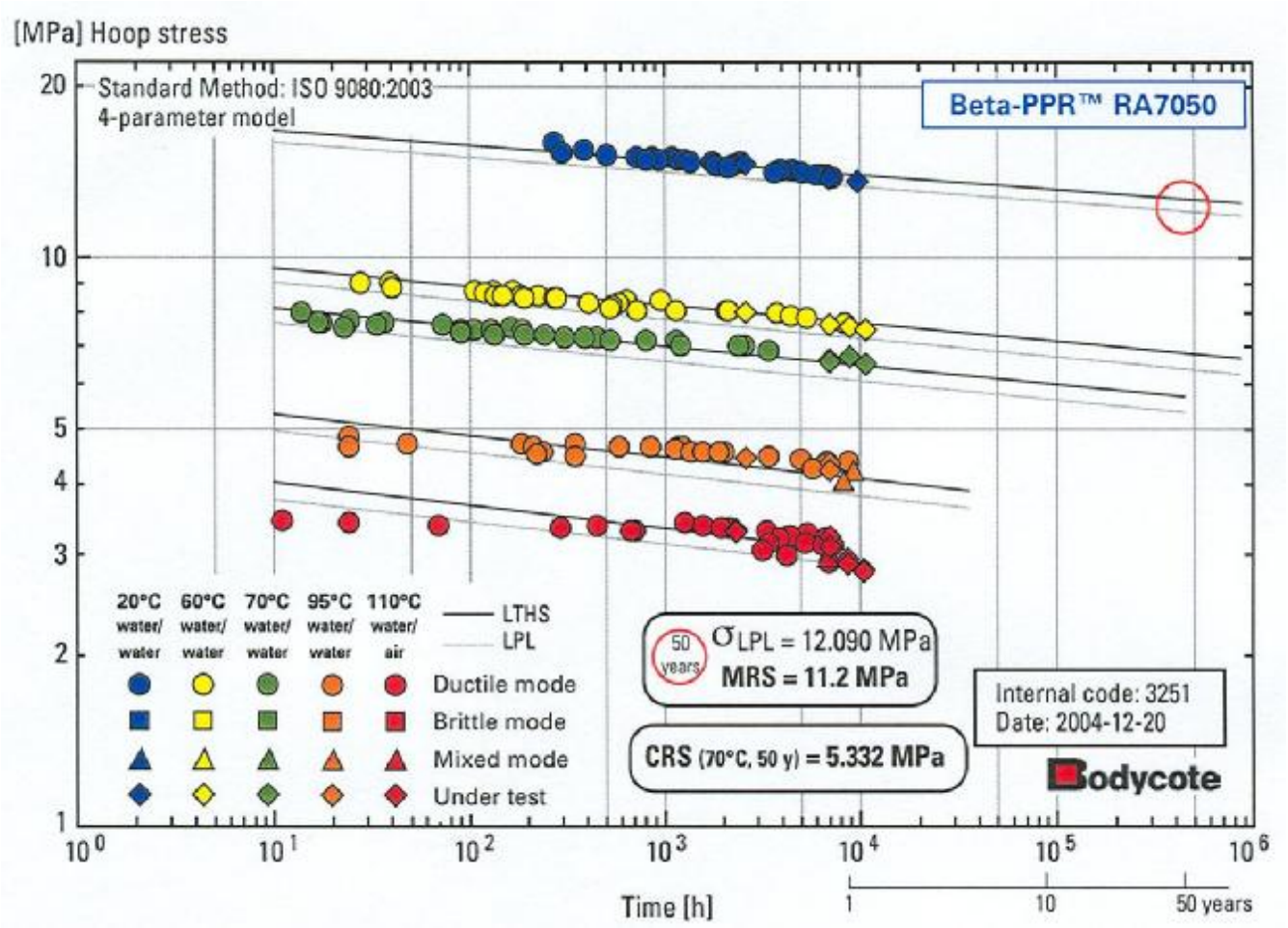
Beta-PPR™ - Hydrostatic Pressure Performance



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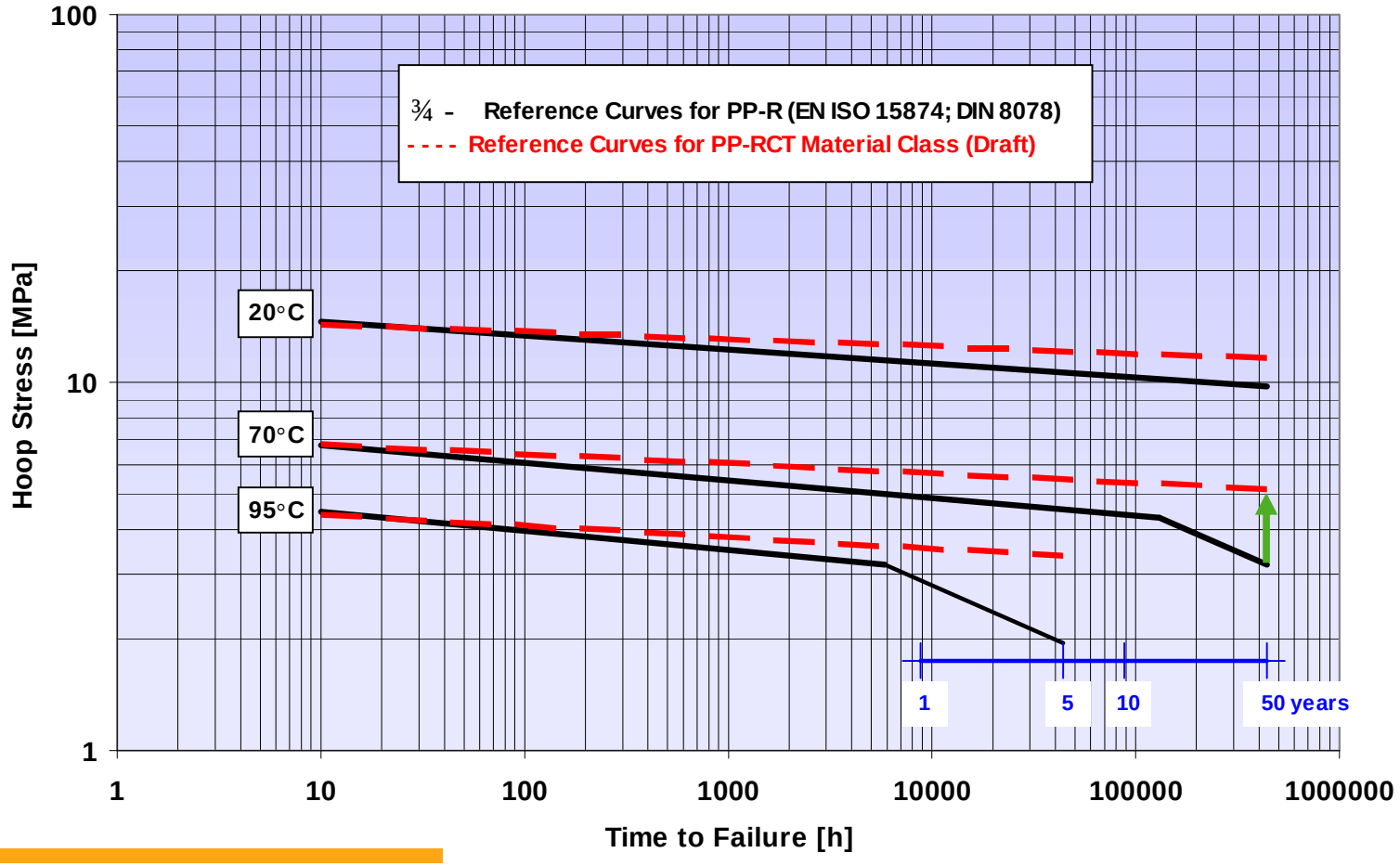
Reference Curves of PP-RCT and PP-R

Schematic Illustration



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SHAPING the FUTURE with PLASTICS

Mechanical Properties of Beta-PPR™ RA7050

Property	Unit	RA130E	Beta-PPR™ RA7050
$MFR_{230/2,16}$	[g/10 min]	0,3	0,3
Density	[kg/m^3]	905	905
Tensile Modulus	[MPa]	900	900
Tensile Stress at Yield	[MPa]	25	25
Charpy Impact Strength			
23°C	[kJ/m^2]	20	40
0°C	[kJ/m^2]	3,5	4
–20°C	[kJ/m^2]	2	2
MRS	[MPa]	10,0	11,2
CRS (70°C, 50 years)	[MPa]	3,15	5,0

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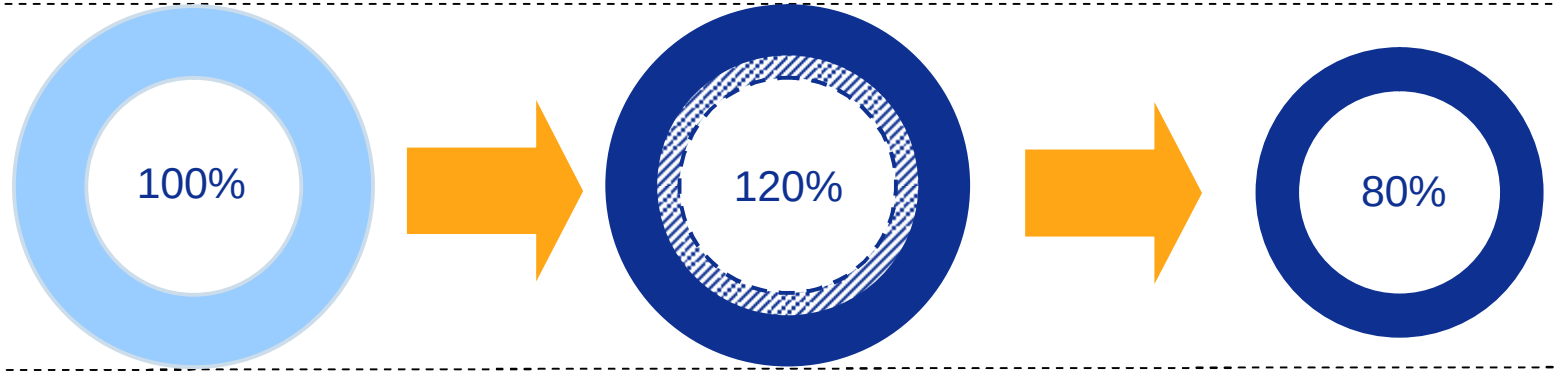
“Reduced Systems Cost”: maintain water flow using a higher percentage of smaller sized pipes



Standard PP-R Pipe

SDR 6

Same diameter pipe made with Beta-PPR™ SDR 7,4

Stronger material allows for a 18% reduction in wall thickness, which increases the inside area of the pipe

Smaller Beta-PPR™ pipe SDR 7,4

Plumbers can install a certain percentage of smaller pipes while securing sufficient hydraulic capacity ⇒ savings in:

- Pipe system costs
- Pipe insulation costs
- Labour costs

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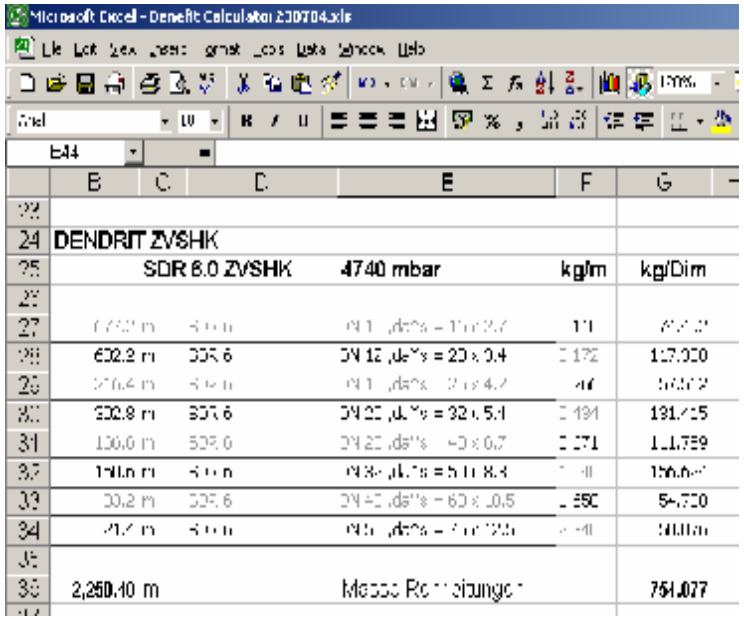
Beta-PPR™ Pipes: engineering calculations demonstrate that a higher number of pipes with smaller sizes can be used



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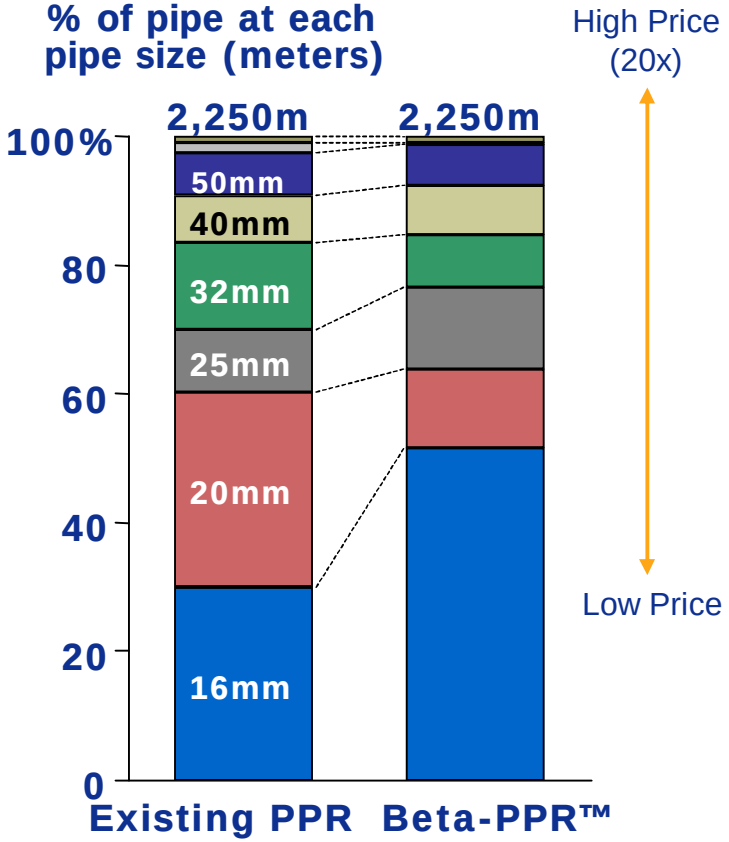

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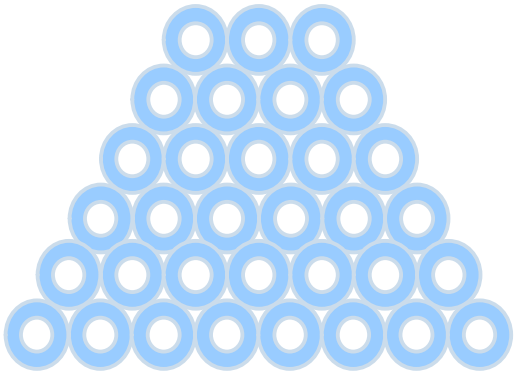
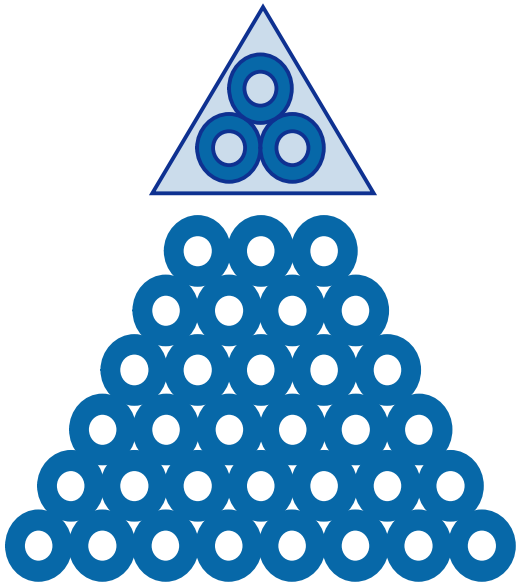
Speed-up your lines with Beta-PPR™ stronger material, thinner walls, faster lines



Old PP-R

- Higher profits for capacity constrained customers
- More production flexibility for all customers



Beta-PPR™

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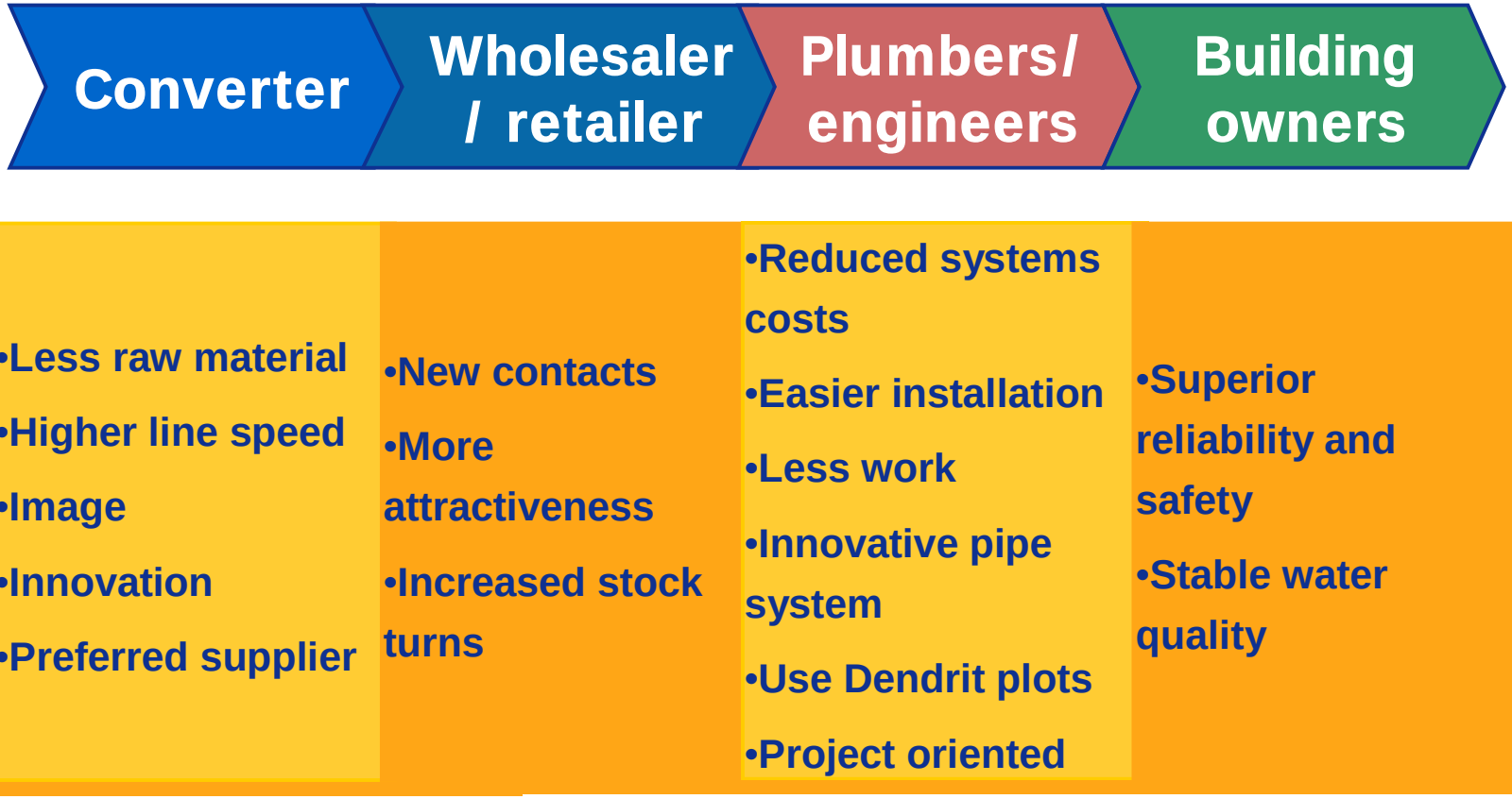
Beta-PPR™ will provide benefits throughout the value chain



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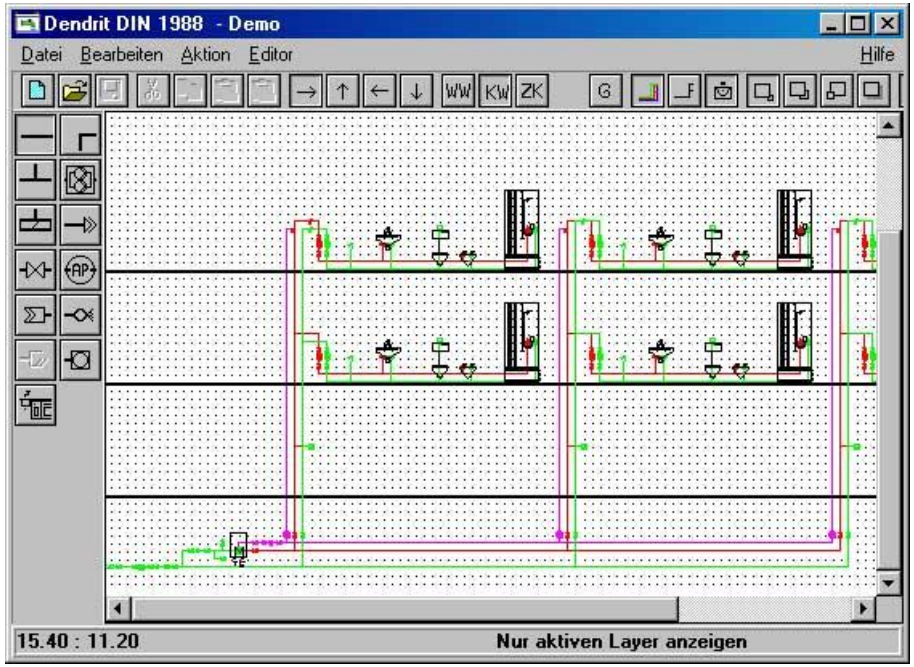
Beta-PPR™ plus Dendrit Design Program

- Substantial material savings due to calculated and **not estimated** pipe dimension
- Smaller sizes of insulation material needed
- Easier installation
  - easier pipe cutting
  - less space required to prepare for installation
  - less time consumed to chisel the slot



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Beta-PPR™ plus Dendrit Design Program

- Optimum functionality of the system with respect to pressure and water volume flow at any tap
- Less material consumed means as well a positive environmental impact
- Optimized water volume in the installation reduces stagnation time
  - water stays fresher
  - no impact on taste & odour of the water
  - no changes on the microbiology of the water

Dendrit

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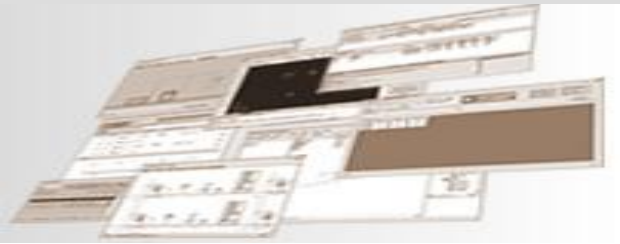

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Beta-PPR™
Standards, Guidelines, Approvals

- Beta-PPR exceeds pressure requirements of EN ISO 15874, DIN 8078 → Pipe approvals with Standard PP-R requirements possible (but no down-gauging then).
- The *SKZ-Testing and Supervisory Guideline HR 3.34 – Pressure Pipe System made of PP-RCT* covers the application classes of EN ISO 15874. It specifies raw material requirements as well as the type-, audit-, batch release- and process verification testing
- Borealis will work on international and national standards (ISO, EN, DIN etc) that cover the improved properties (long-term project).

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Beta-PPR™ - The next Generation PP-R for Plumbing & Heating Systems - Conclusions

- Biggest innovation since PP-R was introduced more than 20 years ago
- Beta-PPR™ is stronger than standard PP-R, which offers several possibilities:
  - thinner pipe walls with same outer diameter (hydraulic capacity)
  - higher operating pressures with dimensions of standard PP-R
  - allows installation of a higher percentage of smaller pipes while maintaining sufficient water supply
- In addition, Beta-PPR™ pipes will offer enhanced long-term durability, due to better resistance to oxidation and to slow crack growth

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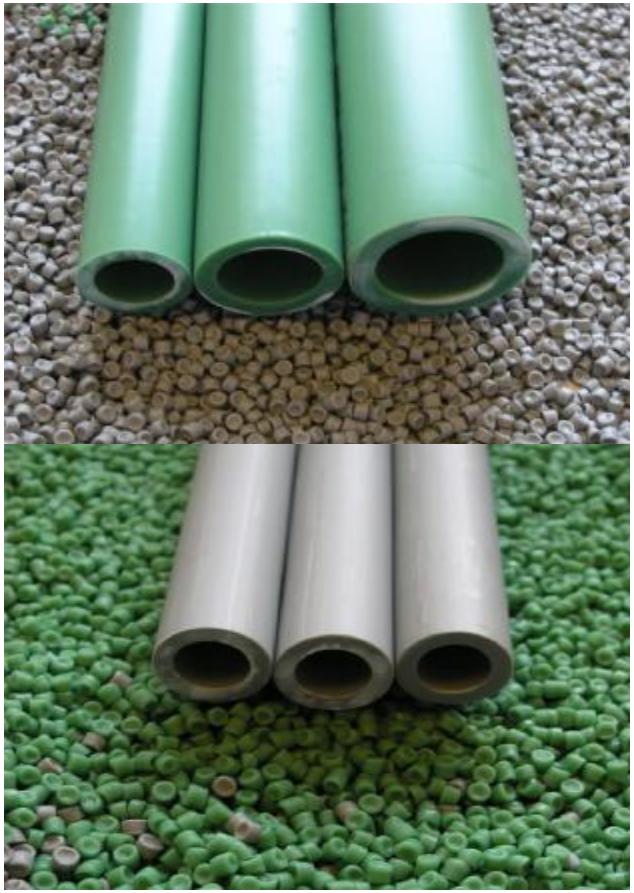
What does it mean for the future?

- The companies who quickly decide for Beta-PPR™ will make the race
- Normal PP-R will be replaced over the years (similar to what happened with PE80/PE100)
- Distributors/Wholesalers will seek for partners for the supply of the new system
- Beta-PPR™ offers the possibility to demonstrate INNOVATION
- Beta-PPR™ can/will be printed on the pipe to show QUALITY



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Beta-PPR™ - The next Generation PP-R for Plumbing & Heating Systems

Beta-PPR™ provides benefits to all members of the value chain: pipe producers, wholesalers, installers and house owners.

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