PP-RCT: The innovative solution for higher competitiveness and performance

The industry is calling for innovation

Plastic pipes made from Polypropylene Random Copolymer (PP-R) were introduced more than 30 years ago. Since then, they have been used mainly for hot and cold water pipe systems and have significantly contributed to the growth and acceptance of plastic pipes for plumbing and heating systems. While system components have been gradually improved over time, no resin improvement of particular significance has happened in the last 20 years.

PP-RCT is a fully established pipe class on the market

PP-RCT (Polypropylene-Random Crystallinity Temperature) is a material classification used to describe the second generation class of PP-R materials. Introduced by Borealis in 2004 through its RA7050 range materials, it sets a milestone in the advancement of PP pressure piping systems. The material classification PP-RCT has been included in 2013 in EN ISO 15874, the global standard for polypropylene piping systems for hot and cold water pipe installations.
PP-RCT is a polypropylene random copolymer with a special crystallinity providing an improved pressure resistance, especially at elevated temperatures. Pressure tests according to ISO 9080 on pipes manufactured from PP-RCT materials demonstrate 50 years of service life at 70°C of $CRS_{70°C,\ 50\ years}$ = 5 MPa, compared to the $CRS_{70°C,\ 50\ years}$ = 3.15 MPa for standard PP-R materials. These very capabilities allow PP-RCT to increase performance and competitiveness for PP-R producers, and offer advantages for building designers and end-users alike.

Using PP-RCT in your pipe design will allow for increased performance vs. standard PP-R such as:

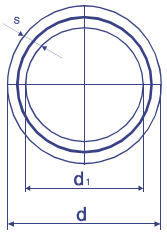
– Increased pressure class with the same dimensioning
– Higher hydraulic capacity with same outer diameter
– Weight reduction (from 14% up to 25%) in pipe production versus regular PP-R
– Higher percentage of smaller pipes in actual installations (percentage depends upon specific design)
– Cost efficient system due to beneficial dimensioning

– Easier installation
– Existing extrusion and injection moulding equipment can be utilized without major changes
– Optimized pipe dimensioning allow higher extrusion speed, resulting in lower production costs
– Greater possibilities to tailor your heating PP-R pipe design
– Enabling special applications such as larger diameter

mains for high-rise air conditioning systems
– Compatible with known PP welding procedures
– Fully established in domestic as well as global standards including ISO, ASTM and DIN

Comparison between PP-RCT pipe and PP-R pipe :

d	PP-RCT				PP-R			
	DN	d_1	s	kg/m	DN	d_1	s	kg/m
20	15	14.4	2.8	0.141	12	13.2	3.4	0.180
25	20	18	3.5	0.238	15	16.6	4.2	0.280
32	25	23.2	4.4	0.369	20	21.2	5.4	0.460
40	32	29	5.5	0.587	25	26.6	6.7	0.680
50	40	36.2	6.9	0,900	32	33.2	8.3	1.090
63	50	45.8	8.6	1.377	40	42	10.5	1.400
75	--	54.4	10.3	1.961	50	50	12.5	2.500
90	65	65.4	12.3	2.938	--	60	15	3.300
110	80	79.8	15.1	4.355	65	73.2	18.4	5.000
125	90	90.8	17.1	5.555	80	83.2	20.8	6.500



emperature °C	Use in years					
	1	5	10	25	80	100
	max. operating pressure (bar) according to DIN 8077					
20	25	24.2	23.9	23.5	23.1	22.8
40	18.6	18	17.7	17.3	17.1	16.8
60	13.5	13	12.7	12.4	12.2	--
70	11.3	10.9	10.7	10.4	10.2	--
80	9.5	9	8.9	8.6	--	--
95	7.1	6.7	6.6	--	--	--

Close to 10-year track record with PP-RCT and over 30 years of experience with beta-nucleation

Borealis RA7050-range is the well-established choice of PP-RCT solutions on the market:

– Close to 10-year track record on the market
– Fully PP-RCT classified materials with $CRS_{70°C,\ 50\ years}$ of above 5 MPa
– Produced using a special multiple-reactor technology
– Contain a high level of beta-nucleated crystals enabling excellent slow crack growth properties (no brittle failures within ISO9080 testing)
– The beta-nucleation technology is well-proven with over 30 years of success in demanding industrial and chemical applications
– State-of-the-art stabilization package for excellent thermal and chemical resistance
– Full chlorine evaluation in accordance with ASTM F2023
– Ready compounded for maximum quality control
– Available in distinctive green (RA7050-GN), steel grey (RA7050) and light grey (RA7050-LG) colors
– Established in a wide range of applications, including large diameters for high-rise air-conditioning systems and reinforced multi-layer heating pipes

Full chlorine evaluation in accordance with ASTM F2023

The ASTM F2023 test method describes the general requirements for evaluating the long-term, chlorinated water, oxidative resistance of plumbing materials. The test is a circulation loop set up, with controlled pH and chlorine level. The chosen test conditions are pH = 6.8 and 4.3ppm chlorine with a so called ORP (Oxidation reduction potential) of above 825mV, one of the harshest test conditions in the piping industry. The aim was to evaluate the chlorine resistance of the PP-RCT pipe material RA7050-GN in accordance to ASTM F2389 (Pressure-rated Polypropylene (PP) Piping Systems) with reference to ASTM 2023. The results and end use classification was taken out of F876 (Crosslinked Polyethylene (PEX) Tubing). Samples were tested at 95°C, 105°C and 115°C using double samples, resulting in 12 samples in total. The material meets the class 3 rating as given in F876. A so called DLT has been applied for

RA7050 based on the data set of RA7050-GN and therefore, all estimations are valid for Borealis PP-RCT RA7050-GN and RA7050.

How to calculated ΔI (length deformation of PP-RCT)

$\Delta t = 0{,}35 \cdot 10^{-4}\ (K^{-1})$

$\Delta l = \varepsilon t \cdot L \cdot \Delta t\ (mm)$

Key:

ΔI = Linear expansion (in mm)

εt =Coefficient of thermal expansion (in mm / m °C)

L =Pipe length (in m)

Δt = Temperature difference (in °K)

Length deformation in difference temperature

Temperature difference ΔT in K										
Pipe length	10	20	30	40	50	60	70	80	90	100
0,1 m	0,04	0,07	0,11	0,14	0,18	0,21	0,25	0,28	0,32	0,35
0,2 m	0,07	0,14	0,21	0,28	0,35	0,42	0,49	0,56	0,63	0,70
0,3 m	0,11	0,21	0,32	0,42	0,53	0,63	0,74	0,84	0,95	1,05
0,4 m	0,14	0,28	0,42	0,56	0,70	0,84	0,98	1,12	1,26	1,40
0,5 m	0,18	0,35	0,53	0,70	0,88	1,05	1,23	1,40	1,58	1,75
0,6 m	0,21	0,42	0,63	0,84	1,05	1,26	1,47	1,68	1,80	2,10
0,7 m	0,25	0,49	0,74	0,98	1,23	1,47	1,72	1,96	2,21	2,45
0,8 m	0,28	0,56	0,84	1,12	1,40	1,68	1,96	2,24	2,52	2,80
0,9 m	0,32	0,63	0,95	1,26	1,58	1,89	2,21	2,52	2,84	3,15
1,0 m	0,35	0,70	1,05	1,40	1,75	2,10	2,45	2,80	3,15	3,50
2,0 m	0,70	1,40	2,10	2,80	3,50	4,20	4,90	5,60	6,30	7,00
3,0 m	1,05	2,10	3,15	4,20	5,25	6,30	7,35	8,40	9,45	10,50
4,0 m	1,40	2,80	4,20	5,60	7,00	8,40	9,80	11,20	12,60	14,00
5,0 m	1,75	3,50	5,25	7,00	8,75	10,50	12,25	14,00	15,75	17,50
6,0 m	2,10	4,20	6,30	8,40	10,50	12,60	14,70	16,80	18,90	21,00
7,0 m	2,45	4,90	7,35	9,80	12,25	14,70	17,15	19,60	22,05	24,50
8,0 m	2,80	5,60	8,40	11,20	14,00	16,80	19,60	22,40	25,20	28,00
9,0 m	3,15	6,30	9,45	12,60	15,75	18,90	22,05	25,20	28,35	31,50
10,0 m	3,50	7,00	10,50	14,00	17,50	21,00	24,50	28,00	31,50	35,00
Length deformation ΔL in mm										

Support distances L in CM at T° C

Support distances L in cm at T°C							
d mm	20°C	30°C	40°C	50°C	60°C	70°C	80°C
20	100	90	85	85	80	70	65
25	105	100	95	90	85	80	75
32	120	115	110	105	100	95	90
40	130	125	120	115	110	105	100
50	150	145	140	135	130	125	120
63	160	155	150	145	140	135	130
75	180	175	170	165	160	155	145
90	190	185	180	175	170	165	150
110	200	195	190	180	175	170	160
125	220	210	205	195	185	175	165
160	220	210	205	195	185	175	165
180	235	225	220	210	200	190	180
200	245	235	230	220	210	200	190
225	260	250	240	230	220	210	200
250	275	265	255	245	235	225	210