Co-Polymer (PPR) vs. Homopolymer Polypropylene (PPH)

The comparison of Homopolymer to Co-Polymer Polypropylene is best performed by looking at critical mechanical properties one at a time. By going through this procedure it will clearly be demonstrated that the material of choice is Co-Polymer Polypropylene.

<table>
<thead>
<tr>
<th>Property</th>
<th>Co-Polymer</th>
<th>Homopolymer</th>
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<tbody>
<tr>
<td>Composition:</td>
<td>4-6% Polyethylene 94-96% Polypropylene</td>
<td>100% Polypropylene</td>
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The additive of the Polyethylene is what gives the copolymer superior mechanical properties. The Ethylene additive increases the flexibility of the pipe and reduces residual stresses.

Modulus of Elasticity: 800 N/mm², Homopolymer: 1200 N/mm²

By definition the modulus of elasticity is the ratio of unit stress to the unit deformation within the elastic range. The modulus is the key element in comparing the Co-Polymer pipe to the Homopolymer as all other factors are constant when you are evaluating the thermal stress in a system. The formula for calculation of thermal stress is as follows:

\[ S = \frac{ETX}{E} \]

Where:  
\( E \) = Modulus of elasticity  
\( T \) = Temperature change  
\( X \) = Coefficient of thermal expansion

The coefficient of thermal expansion for both materials is the same, 8.33 x 10⁻⁵. As the \( T \) is also constant the modulus of elasticity is the key element that determines the actual stress due to temperature changes in a system. The bottom line is that the higher the modulus the greater the stresses.

Percent Elongation: 400%, Homopolymer: 200%

Another key benefit of a lower modulus is the effect on thermal end loads. The formula for end loads is as follows:

\[ F = SA \]

Where:  
\( S \) = Thermal Stress  
\( A \) = Cross sectional area pipe

As the cross sectional area of the pipe is identical for both systems the resulting end load is based on the thermal stress. For this comparison the lower the modulus the lower the thermal stress and the lower the ends loads.

Percent Elongation: 400%, Homopolymer: 200%

The percent elongation is a term used to demonstrate the flexibility of the system. The benefit achieved from this is the ability to handle surge temperatures and pressures that may cause thermal growth. The fact that the material will deform at a greater percent prior to failure guards the system against unforeseen conditions such as those brought on by an exothermic reaction.
Impact Strength: 20 Kj/m² 10 Kj/m²

The impact strength is the resistance or mechanical energy absorbed by a plastic component to thermal and mechanical shocks. The benefit of having a greater impact strength is the ability to withstand improper material handling upon burial, water hammer and thermal shock created by a large volume of high temperature water being introduced to the pipe which is at ground temperature.

Operating Pressures:

As documented the Co-Polymer can operate at higher temperatures/pressures.

During the molding process of fittings many localized stress points develop. These locations are the first to fail when a fitting is subjected thermal stress, chemical attack and/or mechanical abuse. For this reason most manufacturers use Co-Polymer for the fittings to minimize residual stresses. The competition typically uses homopolymer resin on the pipe to minimize costs. Asahi/America feels that is inappropriate to mix and match resins on systems that are by design meant to handle corrosive fluids safely and over long periods of time (50 years).

I hope that this information proves helpful to you. Please call if you have any questions or need more specific data.