Aquatherm Technical Bulletin

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Oxygen Permeation and Aquatherm Pipe

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There have been several articles published on the issue of oxygen permeation through plastic piping and the history regarding the testing and requirements established in Europe.

First, it should be noted that the intent of the permeation testing and barrier on plastic pipe was to reduce the permeation level by a factor of 50 for radiant flooring systems (0.1 vs. 5.0 g/m3•d). This was for tubing that is being used as the radiant "panel", where typical installations use thousands of feet of tubing.

The diffusion of oxygen through plastic piping is a function not only of the type of polymer/pipe construction, but also the ratio of surface area exposed to the air/oxygen to the volume of water (surface area to volume ratio). This ratio for ½-in. PEX is 0.42, whereas for ½-in. Aquatherm Blue Pipe® it is 0.30. This would result in a 29% reduction in oxygen concentration just based solely on the difference in pipe geometry, all else being equal. The ratio also decreases significantly as the pipe size increases. For example, 1-in. Aquatherm Blue Pipe® is 0.19, 2-in. Aquatherm Blue Pipe® is 0.095, and 4-in. is 0.048.

Laboratory testing of the fiberglass-reinforced "faser" pipe showed a permeation level of 0.8 g/m3•d without an oxygen barrier layer. This is only 16% of the starting value of 5 assumed in DIN 4726. Combining this with a minimum 29% reduction based on surface-area-to-volume ratio results in a maximum 11% of the original 5.0 value. To decrease this to 2% (reduction by factor of 50), would require simply using approximately 1/6 of the lineal feet of tubing that would be used in PEX radiant panel system.

For example, a 1500-ft radiant panel system using barrier pipe would have the equivalent permeation of 250 ft. of non-barrier ½-in. Aquatherm Blue Pipe. The length of Blue Pipe allowed would then increase as the size increased, due to the decrease in area-to-volume ratio:

½" Blue Pipe® = 263 ft.	¾" Blue Pipe® = 329 ft.
1" Blue Pipe® = 329 ft.	1-¼" Blue Pipe® = 527 ft.
1-½" Blue Pipe® = 659 ft.	2" Blue Pipe® = 830 ft.
3" Blue Pipe® = 1186 ft.	4" Blue Pipe® = 1647 ft.

So while the permeation through faser pipe is higher than barrier pipe, the differences in pipe geometry and system length will normally offset this and help avoid oxygen-induced corrosion of iron/steel components. For most systems which are not using extensive lengths of pipe loops for the radiant “panels”, the oxygen introduced into the water is through mechanical seals, make-up water, and other sources aside from the piping.

The Aquatherm Blue Pipe® is not used to construct “panels” as is the case with some flexible tubing such as PEX, PE and PE-RT, and because of this, there is rarely any need for an oxygen barrier on the Blue Pipe®.

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