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High Performance PE Materials for Water Piping Applications

Municipal and Industrial Division



PLASTICS·PIPE·INSTITUTE™

105 Decker Court, Suite 825, Irving, TX 75062 P: 469-499-1044 F: 469-499-1063 www.plasticpipe.org



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Foreword

This technical note was developed and published with the technical help and financial support of the members of the Plastics Pipe Institute. The members have shown their interest in quality products by assisting independent standard-making and user organizations in the development of standards, and also by developing reports on an industry-wide basis to help engineers, code officials, specifying groups, and users.

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The Plastics Pipe Institute, Inc.
469-499-1044
www.plasticpipe.org

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I. Abstract

This white paper describes the key advantages available to water companies who choose to use pipe produced from the higher performance polyethylene (PE) materials now available. This paper also reviews the changes to several PPI documents and ASTM standards to recognize the improved performance properties of these new generation PE materials.

Upon the introduction of higher performance PE piping materials into North America, it was determined that the current PE 3408 pipe material designation code did not sufficiently recognize the improved properties of these materials. For that reason, several PPI documents, AWWA standards and ASTM standards have been revised. The result of these revisions is the introduction of several new PE pipe material designation codes, such as PE 4710. The new PE pipe material designation codes identify high performance PE 4710 that is PPI rated for 73°F (23°C) water service at 1000 psi (6.9 MPa) hydrostatic design stress compared to the PE 3408 at 800 psi (5.5 MPa) HDS for the same service. The higher HDS for PE 4710 allows water companies to use higher pressures for the same DR pipes or to obtain greater flow capacity for the same pressure rating with higher DR (thinner wall) pipes. Compared to conventional PE materials, higher performance PE 4710 piping materials provide a more cost effective PE piping systems based on the significantly improved properties of the higher performance PE materials.

II. Background

Polyethylene (PE) has been used for water piping applications both domestically and internationally since the 1960's. In 1988 high performance PE materials were introduced in Europe. Recognizing the advantages afforded by higher performing PE materials, PPI and ASTM worked to characterize higher performing PE materials that culminated in PE 4710 designations that are now manufactured in the U.S. by a number of resin companies. Pipe made from these PE 4710 materials have a unique combination of having the highest PE pressure rating (PR), outstanding resistance to slow crack growth (SCG) along with increased resistance to rapid crack propagation (RCP). These are the three key engineering properties for evaluating a plastic piping material, and these high performance PE materials exhibit outstanding performance in all three areas. The increased working stress rating of these high performance PE materials allows use of a larger inside diameter (thinner wall) for a given operating pressure, which makes PE very attractive compared to steel or ductile iron pipe, especially for the large diameter pipe sizes. A larger inside diameter not only improves system capacity or flow, but also lowers the pipe cost and improves upon the already demonstrated lower on-site handling and installation costs of PE versus steel and ductile iron piping materials. Although these high performance PE materials may be relatively new in North America, they have over 20 years of very successful history worldwide for water piping applications.

The Plastics Pipe Institute (PPI) identified that the best way to take advantage of these high performance PE materials in North America was to incorporate them into the ASTM and AWWA standards by applying higher material specifications