

Weatherability of Thermoplastic Piping Systems TR-18 2019



Foreword

WEATHERABILITY OF THERMOPLASTIC PIPING SYSTEMS

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The purpose of this technical report is to provide information on the weather resistance of the basic plastic materials used in commercial plastic piping systems.

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1.0 INTRODUCTION

Thermoplastic polymers, like many other materials, are affected by weathering, which is a general term used to cover the entire range of outdoor environmental conditions. However, plastic piping made of thermoplastics that incorporate appropriate weathering protection have been used successfully in various outdoor applications and have provided many years of service. For piping systems that are intended for prolonged outdoor exposure, a material composition must be selected with the necessary weather resistance for the specific conditions involved. Most thermoplastic piping has sufficient weather resistance to withstand normal exposure that occurs before installation. In some instances, this time period can be as long as several years.

Thermoplastic polymers have definitive characteristics regarding weather deterioration: Some are inherently resistant while others are less resistant. The weatherability of all thermoplastics can be improved by the incorporation of select additives. The combination of the basic thermoplastic polymer with these select additives results in a finished material that is generally termed a thermoplastic compound.

This report covers the structure and inherent weather resistance of the basic thermoplastic polymers used in commercial thermoplastic piping and discusses the weather resistance of those thermoplastic compounds that are in established use. Much of the discussion focuses on the effects of ultraviolet radiation exposure, as this is generally the weathering factor with the greatest impact on the performance of thermoplastic piping.

2.0 FACTORS INFLUENCING WEATHERING

When making a determination for the suitability of a particular plastic material for either outside storage or long term above ground service, the environment surrounding the piping material must be considered. A brief description of the more important environmental parameters follows:

2.1 Sunlight

Sunlight contains a significant amount of ultraviolet radiation. The ultraviolet radiation that is absorbed by a thermoplastic material may result in actinic degradation (i.e., a radiation promoted chemical reaction) and the formation of heat. The energy may be sufficient to cause the breakdown of the unstabilized polymer and, after a period of time, changes in compounded materials.

Thermoplastic compounds that will be exposed to ultraviolet radiation should be made with additives that are properly suited to stabilize the compound for such conditions.

2.2 Temperature

First, thermoplastic compounds are exposed to manufacturing heat histories where high temperature is present during the production of the final products. Thermal stabilizers are incorporated to protect the thermoplastic compound against these heat histories in order to maintain appropriate and applicable thermoplastic compound cell classifications.

In addition to manufacturing temperature exposures, there are daily ranges of temperature that vary considerably with season, prevailing climate, and location or orientation of pipe. Heat from solar radiation can significantly raise the temperature of directly exposed products, depending on the pipe location and color. Such extremes of temperature over an extended period can potentially cause physical damage to the thermoplastic compounds, if not properly protected. Therefore, it is important that heat stabilizers be incorporated into the thermoplastic compound to offset the deleterious effects of outdoor high temperature exposures and manufacturing processes. Note, it should be remembered that chemical reaction rates increase exponentially as the temperature increases.

2.3 Moisture

Rain and humidity are the two main contributors of moisture, with humidity having the greater overall effect. In general, humidity contributes a moist continuum in constant contact with the material to produce hydrolysis, leaching, etc. Rain produces a washing and impacting action.

Note: Exposure to moisture is not typically a concern for “most” thermoplastics compounds. Some thermoplastic compounds may be more hygroscopic in nature (i.e. polyamides). These compounds may become a concern when installed in extremely humid conditions or direct water contact. For more information, the reader is referred to the manufacturer’s literature.

2.4 Wind

Wind acts as a carrier of impurities such as dust, gases and moisture that can contribute to weathering effects. Similarly, the absence of wind can allow the accumulation of air contaminants, as in smog areas, which could contribute significantly to the weathering of a material.