

Weatherability of Thermoplastic Piping Systems TR-18/2005



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Foreword

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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 in various outdoor applications and have given many years of service. For those piping systems that are intended for continuous outdoor exposure, a material composition must be selected that has 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 ingredients. The combination of the basic thermoplastic polymer with these select ingredients results in the 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 compounding ingredients. Thermoplastic materials that are to be exposed to ultraviolet radiation for long periods of time should be made from plastic compounds that are properly stabilized for such conditions.

2.2 Temperature

The daily range of temperature varies considerably both with season and location and can be quite large. Heat from solar radiation can raise the temperature of directly exposed materials as much as 60°F higher than ambient, depending on the pipe color. Such extremes of temperature over an extended period can cause physical damage to the polymer. Therefore, it is important that heat stabilizers be incorporated into the compounding ingredients in order to offset the deleterious effects of high temperature. In addition, 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.

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.

2.5 Gases

The nature and quantity of gases vary widely but, in industrial areas especially, gases are present which can result in chemical action on some materials.

2.6 Location

The geographical location is also a factor. Less effects are produced where there are less sunlight hours per year and where the radiation is less intense. For example, a specific period of exposure in Arizona is more detrimental than in New Hampshire due to the obvious extra hours of UV (ultraviolet) exposure and, less obviously, to the higher ambient temperatures encountered.