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The Effects of Sunlight Exposure on PVC Pipe and Conduit

Introduction

The sun emits visible and non-visible radiation. One component of non-visible radiation is ultraviolet (UV) light. Like many other substances, PVC plastics are affected by exposure to UV radiation. This bulletin will provide information on the effects sunlight exposure has on PVC, what the resulting consequences are for PVC pipe and conduit, and what can be done to prevent the effects of UV radiation.

The Effects of Sunlight Exposure

The exposure of PVC to the UV component of sunlight results in PVC molecules in the first .001" to .002" of exposed surface becoming permanently converted to a complex structure typified by polyene formations. The result is a brownish discoloration, often termed "UV Discoloration," "UV Degradation," or simply "Sunburn." UV discoloration does not occur where PVC is not exposed to sunlight, and ceases when exposure ends.

The discoloration process is time dependent, and can be slowed with the addition of UV absorbers in the PVC compound. The most common additive used for this purpose is titanium dioxide, which also functions as a pigment. Titanium dioxide imparts a beige to bright white color to PVC compounds, depending upon the type used.

The Consequences of Sunlight Exposure for PVC Pipe and Conduit

Research has been done to determine the effects of long-term (two year) sunlight exposure on PVC pipe (See "UNI-TR-5: The Effects of Ultraviolet Aging on PVC Pipe," by the Uni-Bell PVC Pipe Association). Other than the visible discoloration, the following summarizes the results on pipe physical properties:

| Physical Property | Performance Characteristic | Effect of Sunlight Exposure |
|-------------------|----------------------------|-----------------------------|
| Impact Strength | Impact Resistance | Decrease |
| Tensile Strength | Pressure Capacity | No Effect |
| Modulus | Pipe Stiffness | No Effect |

The research indicates that the sole performance characteristic adversely affected by sunlight exposure is impact resistance. Depending upon the type of pipe, additional care may be required during pipe handling and installation to avoid potential breakage. Once installed, however, there will be no effect on the pipe's pressure capacity and external load capacity.

The degree to which impact strength is affected by sunlight depends upon a number of variables, including: time of exposure, climatic conditions, diameter of pipe, wall thickness of pipe, and type of PVC compound used. Because of these variables, it is impossible to state how long it will take before the effects of sunlight exposure become noticeable. In general, pipes of smaller diameter and thinner wall will exhibit more effect from sunlight exposure than larger, thicker-walled pipe. The effect of sunlight exposure on thick-walled pressure pipes such as those made to AWWA C900 and C905 is almost unnoticeable, other than the surface discoloration.

The tapping of UV-discolored pressure pipes has been a topic of concern. However, the PVC pipe industry has found no evidence of tapping failures due to UV discoloration.

PWPipe's Schedule 40 and Schedule 80 UL listed electrical conduit has been tested for sunlight resistance according to UL requirements and is listed for continuous outdoor exposed use.

Prevention of UV Discoloration

For permanent above-ground PVC pipe installations, it is recommended that the pipe be protected from sunlight exposure. This can be accomplished by wrapping the pipe with an opaque material, or more commonly, by painting it. If the pipe is to be painted, a water-based latex paint formulated for exterior use is recommended. Oil or solvent-based paints may damage the pipe and/or not adhere well. In order to minimize heat build-up, white or light-colored paints are best.

Pipe that is going to be stored for a long period of time (one to two years or more) may be protected from the sun with light colored tarps. The tarps should be placed so as to allow for adequate ventilation to prevent heat build-up.