

TECHNICAL NOTE

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WEATHERING AND AGING OF PVC PIPES

This technical note addresses only technical matters related to the application of our products. It does not address issues of health and safety practices, nor any regulatory limitations that may apply, and does not constitute a recommendation of suitability for any purpose

Introduction

The effect of "weathering" or surface degradation by radiant energy, in conjunction with the elements, on plastics has been well researched and documented.

In general, there is no problem related to weathering for pipe in normal usage, but the subject is a complex one and there are many misconceptions commonly held. The purpose of this note is to explain what effects occur and the significance of these in terms of performance of the product.

Effects of Solar Radiation

Solar radiation causes changes in the molecular structure of polymeric materials, including PVC. Under the influence of incident energetic radiation (primarily UV), certain photo-chemical processes occur, such as chain scission, cross-linking and hydrodechlorination. High temperatures, water and chemical pollutants may accelerate these processes or bring about secondary changes.

The result is a change to the surface of the product, firstly loss of gloss, progressing to chalking and discolouration (usually yellow to brown).

It is important to note that the effects are limited to the first few microns of the outside surface by the inhibitors and reflectants that are normally incorporated into the material. The bulk material is unaffected and from the point of view of the main functional requirements of the pipe, its strength is unimpaired. Performance under primary tests will show no change, i.e. tensile strength and modulus.

However, microscopic disruptions on a weathered surface can initiate fracture under

conditions of extreme local stress, e.g. impact on the outside surface. Impact strength will therefore show a decrease under test.

To the extent that impact properties are relevant to the application, loss of impact resistance may or may not be of consequence. For most normal pipework, it is of no significance. For example, clay, concrete and asbestos cement pipe have an impact resistance far lower than even heavily weathered PVC pipe, but this fact does not necessarily make them unfit for the purpose in service.

Protection against Solar Degradation

All PVC pipes manufactured by Vinidex contain protective systems that will ensure against detrimental effects for normal periods of storage and installation. Some products, such as DWV pipes and fittings contain additional protection to aid performance under permanently exposed service conditions.

For periods of storage longer than one year, and to the extent that impact resistance is important to the particular installation, additional protection may be considered advisable.

This may be provided by under-cover storage, or by covering pipe stacks with an appropriate material such as hessian. Heat entrapment should be avoided and ventilation provided. Black plastic sheeting should not be used.

Buried pipes require no additional protection. These processes require input of energy and cannot proceed if the material is shielded.

Above-ground systems exposed to UV radiation may be protected by a coat of white or pastel-shade PVA paint. Good adhesion will be achieved with simply a wash with strong

detergent or a wipe with acetone to remove any grease and dirt.

Material Aging

Plastics undergo a change in morphology with time, independent of any exposure, such that the "free volume" in the matrix reduces, with an increasing number of cross-links between molecules. This results in some changes in mechanical properties:

- A marginal increase in ultimate tensile strength.
- A significant increase in yield stress.
- An increase in modulus at high strain levels.

In general, these changes would appear to be beneficial. However, the response of the material at high stress levels is altered in that local yielding at stress concentrators is inhibited, and strain capability of the article is decreased. Brittle-type fracture is more likely to occur, and a general reduction in impact resistance may be observed.

These changes occur exponentially with time, proceeding rapidly immediately following forming, and more and more slowly as time proceeds. By the time the article is put into service, they are barely measurable, except in the very long term.

Artificial aging can be achieved by heat treatment at 60 °C for 18 hours. PVC-O (Oriented PVC) undergoes such aging in the orientation process and its characteristics are similar to a fully aged material, but with greatly enhanced ultimate strength and impact strength.

It is important to appreciate that the stress regression line on which pressure pipe stress ratings are established does not represent a weakening of the material with time. A pipe held under continuous pressure for many years will still show the same short-term ultimate burst pressure as a new pipe, possibly even increased slightly through the aging process.

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