

Resistance of Thermoplastic Piping Materials to Micro- and Macro- Biological Attack

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Foreword

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The purpose of this technical report is to provide important information available to PPI on resistance of thermoplastic piping materials to micro- and macro-biological attack.

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1.0 Introduction

The micro- and macro-biological degradation of organic materials has been of great concern the world over. Fungus was found to be a severe problem during World War II, particularly in tropical and subtropical climates where fabrics deteriorated rapidly and electrical equipment malfunctioned. Similarly, malfunction of marine communication cables due to attack of living organisms on outer cable materials has been a continuing problem. Rodents have caused damage to underground power and communication cable. Termites have been responsible for damage to structural organic materials in most climates and soils.

This report provides available information regarding the resistance of thermoplastic piping materials to micro- and macro- degradation. Summary information follows on resistance of thermoplastic pipe to fungi, bacteria, termites, and rodents. A considerable number of papers directly and indirectly related to plastic pipe have been screened. References that have pertinent data are presented in a list at the end of this report and are grouped according to their relative significance.

2.0 Possible Degradation Factors

Fungi

The term fungi refers to a family of heterotrophic plant life including molds, mildews, mushrooms, etc. They are completely lacking in chlorophyll, so are unable to derive energy from sunlight. Rather, they derive their energy from utilizable organic materials, such as carbohydrates, which are a particularly good nutrient for fungi. Fungi thrive in a warm humid environment and are most abundant in, but by no means limited to, tropical areas. Temperatures of 25-30°C and relative humidity of 85% to 100% are most favorable, although certain fungi have been found to exist at much lower temperatures. At relative humidity below 70%, fungi will show very little active growth but can survive extended periods of exposure.

As a result of extensive loss of military equipment due to fungi in tropical areas during World War II, considerable studies were made on the relations between plastics compounds and the effects of fungi (1, 2, 3, 4, 5). From the literature surveyed, it is apparent that the growth of fungi on plastics is not due to the nutrient value of the polymer or resin component but rather to lower molecular weight additives such as lubricants, stabilizers, and plasticizers. Even in the case of highly plasticized (flexible) vinyl chloride plastics, however, attack by fungi is avoided if proper attention is paid to the selection of plasticizer and other additives (1, 2, 5).