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Long-term radiation ageing in polymers -- Part 1: Techniques for monitoring diffusion-limited oxidation

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Foreword

GB /Z 28820 "polymer long-term radiation aging" consists of three parts.

--- Part 1. Monitoring of diffusion-limited oxidation technology;

--- Part 2. Prediction of aging programs at low dose rates;

--- Part 3. Low voltage cable materials in service monitoring procedures.

This section GB /Z 28820 Part 1.

This section drafted in accordance with GB/T 1.1-2009 given rules.

This section uses the translation method is equivalent to using IEC /T S61244-1.1993 "polymer long-term radiation aging Part 1. Monitoring diffusion limit

Oxidation technology. "

This part is proposed by China Electrical Equipment Industry Association.

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This part of the drafting unit. Shenzhen Asahi Health Sanyi Science and Technology Co., Ltd., Beijing Institute of Electrical Technology Machinery Industry, Shanghai Cable Research

Institute, Shanghai Nuclear Industry Research and Design Institute, Shanghai Special Cable Electrical Technology Co., Ltd., Jiangsu Shangshang Cable Group Co., Ltd., Shanghai Cable Factory

Co., Ltd., Linhai Yadong Special Cable Material Factory, Shanghai Kaibo Special Cable Material Factory Co., Ltd., Wuxi Jiangnan Cable Co., Ltd., Changzhou Ba Yi

Cable Co., Ltd., Shanghai Zhidaohua Polymer Materials Co., Ltd., Shanghai Innovation High Temperature Cable Factory, Zhejiang Wanma Cable Co., Ltd.

Company, Shenzhen Walnut Nuclear Materials Co., Ltd., Beijing North Heavy Turbine Electric Co., Ltd., Beijing Xin Rui Runda Insulation Limited

Responsible company.

Introduction

It is often necessary to assess the expected lifetime of a polymeric material in a variety of different applications. In order to extend the service life,

Commonly used accelerated aging technology to predict the service life, this technology is to use higher than the ambient conditions to get the result. In a variety of realities

Applications, there are direct exposure to air conditions, which shows that oxidation is an important reason for material degradation. Unfortunately, aggregation

Exposure to air during aging often leads to non-uniform oxidation example results. Therefore, it is necessary to try a method that is both understandable

Oxidation process in turn can infer the impact of long-term exposure to accelerated aging.

The complexity of heterogeneous oxidation is paramount, with diffusion limited oxidation included. In a variety of environments, this complex and meaningful

Methods include many years of recognized heat [1] [2-4] and ultraviolet radiation [5]. When a material oxygen consumption rate greater than the ambient by the proliferation of make up

When oxygen is supplied to the interior of the material, diffusion-limited oxidation can occur. This example results in the concentration of oxygen equilibrating the adsorption value from the sample surface

Smoothly drops to the lower or non-existent value inside the sample. This will cause heterogeneous oxidation of the material, and oxygen generation on the surface of the material

(Eg, equivalent to an air-saturated environment) so as to reduce or not cause internal oxidation.

The geometry of the material is important, plus the rate of oxygen consumption, the oxygen permeability coefficient, and the partial pressure of oxygen in the surrounding sample [5-8]

ring. Because the rate of oxygen consumption generally depends on the ambient pressure level (eg, temperature, radiation dose rate), and when the material degrades [9-10], oxygen

The rate of consumption and the oxygen permeability coefficient will also vary, and the importance of diffusion-limited oxidation will vary with pressure levels and degradation. This

It is shown that the percentage of samples oxidized under high pressure is substantially lower than the percentage oxidized under low pressure conditions [5-7,10-16].

Therefore, in order to determine conclusively whether short-term acceleration can simulate long-term air aging conditions, the key is to monitor and quantitatively understand the diffusion limit

The impact of oxidation.

Recently, a large number of improvement studies in this field have demonstrated that diffusion-limited oxidation can be achieved. This section reviews

this field. Chapter 2 describes an experimental profiling method that can be used to monitor diffusion-limited oxidation. Chapter 3 will briefly introduce this

As the theoretical description. The shape of the theoretical graph depends on the oxygen permeability coefficient and oxygen consumption rate, and these quantities must be measured or estimated to

From the data to verify the validity of the theory. Many experimental methods have been developed to measure the permeability coefficient, and a large amount of data can be found in the literature

To Chapter 4 will introduce some important documents. The experimental method of estimating oxygen consumption rate is briefly reviewed in Chapter 5. Experimental data support

Theory of treatment is introduced in Chapter 6. Once the trusted theoretical treatment exists, this theory can be used to select experimental aging bars

Or predict the importance of such effects, the impact of proliferation is not significant. If it is impossible to eliminate the proliferation of shadow in the air aging conditions

Ringing increases the oxygen pressure on the surrounding sample at the time of aging, which in some instances is used to obtain the desired result, as outlined in Chapter 7 for oxygen

Overvoltage technology.

Part 2 of GB /Z 28820 will be published separately and describe the procedure for predicting radiation aging at low dose rates.

Long-term polymer radiation aging

Part 1. Techniques for monitoring diffusion limiting oxidation

1 Scope

When oxygen is present, the polymer ages in a variety of environments, including temperature, radiation, or ultraviolet light, and is affected by diffusion-limited oxidation.

Non-homogeneous aging caused by. These effects make it difficult to understand the aging process and to infer accelerated long-term exposure conditions. This section reviews quantitative

The experimental techniques for monitoring these effects provide theoretical equations for assessing the importance.

2 to monitor diffusion-limited oxidation profiling techniques

Diffusion Limits The presence of oxidative effects indicates that various properties are associated with certain oxidations depending on the material

In the space location. Therefore, any technique that can be mapped into a spatial map can be used to monitor diffusion-limited oxidation. Because of the few polymers

The structure is expressed in cross-sections down to a few millimeters or less, and diffusion-limiting oxidation effects work on small dimensions. Therefore, cut

Analysis techniques should have a resolution of 100 μm. Another sensitivity-related issue is measured data, which degrades the polymer in general

It is true that less than 1% of the polymer is oxidized. Therefore, a useful analytical techniques should have the condition is that with reasonable results,

Sensitive to minute chemical changes, research can be applied extensively, and operation and analysis are relatively straightforward. This chapter briefly describes some special ones

Technology used.

2.1 infrared analysis technology

The impact of infrared spectroscopy to monitor diffusion-limited oxidation has been exceeded due to the ability of sheet samples to provide detailed chemical information

25 years [17]. Whether it is the effect of sample thickness or the effect of ultrathin sections, any oxidation-sensitive infrared peak can be monitored, allowing

To get heterogeneous oxidation information. Many research data show that the absorption peak of carbonyl group in polyolefin material is about 1720cm-1,

Such as polyethylene and polypropylene, characterize the infrared absorption peaks of this region with higher sensitivity, and these materials do not have absorption peaks when not aged.

Since the carbonyl region represents the superposition of the absorption peaks of various oxidation products (such as ketones, aldehydes, esters and acids) and has different elimination at different wavelengths

The light coefficient, therefore, simplifies assumptions to extract semi-quantitative