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Nuclear energy — Soxhlet-mode chemical durability test — Application to vitrified matrixes for high-level radioactive waste

Énergie nucléaire — Test de durabilité chimique en mode Soxhlet — Application aux matrices vitrifiées des déchets radioactifs de haute activité

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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 16797 was prepared by Technical Committee ISO/TC 85, *Nuclear energy*, Subcommittee SC 5, *Nuclear fuel technology*.

Introduction

Any material submitted to the action of water is subject to alteration. Numerous leach tests have been developed to measure this alteration. One of these, the Soxhlet test, is routinely used to assess the chemical durability of nuclear glasses, and is now widely applied to other types of glass, to materials resulting from vitrification processes, or even to other nonporous solids intended for containment of non-radioactive toxic wastes. This is a short-term test designed to obtain a quick assessment of the chemical durability of a material in deionized water at about 100 °C.

In a static environment without water renewal, the concentration of dissolved material in solution increases, and the alteration rate subsequently diminishes. Conversely, the maximum alteration rate is observed in continuously renewed deionized water, or in a complexing medium that consumes elements from solution and prevents saturation from occurring.

This approach has several advantages: shorter test duration, higher element concentrations in solution in the boiler (well above the detection limits), assessment of the potential durability of the material under extreme conditions.

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1 Scope

This International Standard describes the Soxhlet-mode parameter test to assess the chemical durability of materials by measuring the initial dissolution rate in pure water. The measurement is performed at the boiling point of water, at which the dissolution rate is considerably higher than at room temperature. In most cases, the alteration phenomena are therefore significantly accelerated.

The test described in this International Standard is intended to measure the initial dissolution rate; it is thus applicable only to nonporous materials (or materials with small, closed porosity) for which the primary alteration phenomenon is a surface reaction mechanism (diffusion mechanisms are involved in the dissolution of porous media). The test results can therefore be compared only with findings obtained for nonporous materials if serious errors of interpretation are to be avoided.

The resulting “initial dissolution rate in pure boiling water at atmospheric pressure” can be used to compare materials of the same type (e.g. oxides), provided their initial dissolution is governed by the same mechanism (e.g. surface reactions).

This parameter test cannot be used to assess the long-term behaviour of a material, which generally requires several tests, modelling and validation, as described, for example, in Standard ENV 12920.

This test is applicable to any glass, vitrified material (i.e. material resulting from a vitrification process) or nonporous oxide material with a morphology that allows the preparation of monolithic test coupons of known surface area. It determines the initial dissolution rate of the material in deionized water at the boiling point (approximately 100 °C) by analysis of the leaching solution and by measurement of the specimen mass loss.

2 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

2.1
alteration
superficial chemical modification of a material due to surrounding agents

2.2
alterability
susceptibility to alteration

NOTE Alterability depends on the material itself and on its environment.

2.3
durability
ability of a material to exist for a long period of time while retaining its original qualities and properties

2.4
chemical durability
ability to withstand chemical attack

NOTE This characteristic may be an inherent material property if the environment is duly specified and established (e.g. chemical durability in pure water at 100 °C).