International Standard 6962

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Standard method for testing the long term alpha irradiation stability of solidified high-level radioactive waste forms

Méthode normalisée d'essai de la stabilité à long terme à l'irradiation alpha des formes de déchets solidifiés de haute activité

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Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

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It has been approved by the member bodies of the following countries :

Austria	Hungary	South Africa, Rep. of
Belgium	Italy	Sweden
Brazil	Japan	Switzerland
Canada	Mexico	Turkey
Czechoslovakia	Netherlands	United Kingdom
Egypt, Arab Rep. of	New Zealand	USA
Finland	Philippines	USSR
France	Poland	
Germany, F. R.	Romania	

No member body expressed disapproval of the document.

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0 Introduction

It is generally agreed that a solid is the best form in which to store or dispose of the highly radio-active waste (High Level Waste : HLW) from the first stage of a nuclear fuel reprocessing plant. This solid will usually be in the form of blocks weighing several hundred kilograms, cast or formed in a steel container. The material favoured hitherto is a borosilicate glass, but possible alternatives include

a) ceramics or glass-ceramics;

b) a two-phase mixture of glass beads dispersed in a metal matrix.

The solid will receive a large dose of radiation of every kind and it is important that this radiation should not significantly alter the properties of the solid for very long periods of time. Thus, proposed compositions must be tested to ensure their radiation stability.

Although the β-decays of the fission products will far outnumber the α-decays of the incorporated actinides, most of the energy of the β particles (electrons) is dissipated by ionisation of the atoms in their path and this will only have a transient effect. Almost all the atom displacements in the solid will be caused by the α-decays, with the recoiling actinide nuclei being responsible for the great majority of these. Thus, it is the stability of the solid to α-decays that must be tested.

1 Scope and field of application

This International Standard specifies a method designed to check the long-term stability of a solid to alpha disintegration by detection of all modifications in the properties of an irradiated sample.

2 References

ISO 6961, *Long-term leach testing of solidified radioactive waste forms.* [1)]

ISO 6963, *Soxhlet leach test procedure for testing of solidified radio-active waste products.* [1)]

3 Principle

Because most of the atom displacements are caused by the recoiling actinide nuclei, external radiation with α-particles is not considered a satisfactory simulation. A satisfactory simulation however is as follows : a sample of the candidate solid is made up in a realistic manner using the proper concentrations of the fission product elements, although these can (and, for convenience, usually will be) the non-active isotopes. This sample is "spiked" or "doped" with a short half-life α-emitter so that it will receive the same number of α-decays per gram in, say, one year as the actual storage medium will receive over a much longer time. The important properties of the sample can then be examined for changes.

It should be noted that it is the detection of any changes in sample properties with radiation that is important. The two ISO leach tests prescribed in 9.1 will adequately detect any significant changes and so are satisfactory in this context although they have only limited environmental significance.

4 Methods of test

4.1 Calculation of the necessary dose

The concentration of the actinides in the particular discharged fuel can be calculated using a computer code. The amount of these actinides that is or will be incorporated in the high level waste stream of the reprocessing plant must then be ascertained. If this information is not available, it should be assumed that all the americium and curium and 0,5 to 1,0 % of the plutonium will be incorporated in the glass. The amount of plutonium left in the waste stream only makes a significant contribution to the integrated radiation dose to the solid after thousands of years; at shorter times ^{241}Am is the most important isotope.

As an example, the number of disintegrations per gram of solid has been calculated for a particular set of conditions for Pressurized Water Reactor waste and this is presented in annex A and figure 1.

The age of the solid that is to be simulated must then be decided. It is recommended that this should be at least several thousand years.

1) At present at the stage of draft.