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Standard Test Method for RADIOACTIVE ZIRCONIUM IN WATER¹

This standard is issued under the fixed designation D 3315; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method covers the determination of radioactive zirconium in water in concentrations greater than 100 pCi/L. Concentration of the sample can increase the sensitivity of the method. It is applicable to the analysis of mixtures of zirconium isotopes of atomic mass 95 and 97, if a high resolution semiconductor detector is available. Otherwise it is limited to the analysis of zirconium-95.

1.2 This test method may be used for absolute determinations by calibrating the nuclear detector with a standard zirconium-95 source, or for relative determinations by comparing measurements with each other.

1.3 This test method does not meet the requirements of the current edition of Practice D 2777.

1.4 *This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. A specific precautionary statement is given in Note 1.*

2. Referenced Documents

2.1 ASTM Standards:

D 1066 Practice for Sampling Steam²

D 1129 Definitions of Terms Relating to Water²

D 1192 Specification for Equipment for Sampling Water and Steam²

D 1193 Specification for Reagent Water²

D 2777 Practice for Determination of Precision and Bias of Applicable Methods of Committee D-19 on Water²

D 3370 Practices for Sampling Water²

D 3648 Practices for the Measurement of Radioactivity³

D 3649 Practice for High-Resolution Gamma-Ray Spectrometry of Water³

3. Definitions

3.1 For definition of terms used in this test method, refer to Definitions D 1129. For terms not defined in Definitions D 1129, reference may be made to other published glossaries.⁴

4. Summary of Test Method

4.1 This test method is based on the extraction of zirconium from the sample with 2-thenoyltrifluoroacetone (TTA) in xylene (1).⁵ A fluoride pretreatment converts hydrolytic and colloidal species of zirconium to an extractable form. Radio-iodine, the only fission product significantly extracted with zirconium, is separated by stripping the zirconium from the organic phase with a dilute nitric-hydrofluoric acid mixture. The aqueous phase containing the zirconium is gamma counted. No yield determination is required, since the recovery is greater than 97 %.

5. Significance and Use

5.1 Zirconium-95 is formed by neutron irradiation of nuclear reactor structural materials or fuel element cladding materials (Zircaloy). It is also a fission product. Zirconium-95 is of impor-

¹ This test method is under the jurisdiction of ASTM Committee D-19 on Water and is the direct responsibility of D19.04 on Methods of Radiochemical Analysis.

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² Annual Book of ASTM Standards, Vol 11.01.

³ Annual Book of ASTM Standards, Vol 11.02.

⁴ ANSI Standard "Glossary of Terms in Nuclear Science and Technology," N.1-1967.

⁵ The boldface numbers in parentheses refer to the list of references at the end of this test method.