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Uranium dioxide pellets — Determination of density and amount of open and closed porosity — Boiling water method and penetration immersion method

Pastilles de dioxyde d'uranium — Détermination de la masse volumique et de la quantité de pores ouverts et fermés — Méthode à eau bouillante et méthode de pénétration par immersion

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Foreword

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Uranium dioxide pellets — Determination of density and amount of open and closed porosity — Boiling water method and penetration immersion method

1 Scope

This International Standard describes two methods for determining the bulk density and the amount of open and closed porosity of sintered UO_2 pellets. The methods can be applied to other bodies, for example green pellets, and UO_2–PuO_2 or UO_2–Gd_2O_3 pellets.

2 Principle

The methods are based on the determination of the pellet volume and the volume of open and closed pores by measurement of the dry mass, the saturated mass and the immersed mass of the samples. Alternative penetration immersion liquids and saturation conditions can be used, provided that the samples can be completely impregnated during the procedure.

3 Apparatus

3.1 Balance, of adequate capacity, with an accuracy of 0,1 mg.

3.2 Oven, capable of maintaining a temperature of $100\ ^{+5}_{0}$ °C. A vacuum drying oven is recommended for samples with a large amount of open pores.

3.3 Weighing device, to allow the test piece to be weighed in air and in the penetration immersion liquid, in order to make saturated mass and immersed mass measurements (see table 1, step 1).

3.4 Container, a glass beaker or similar container of size and shape such that the sample, when suspended from the balance by the device, is completely immersed in the penetration immersion liquid, with the sample and the device for suspension being completely free from contact with any part of the container.

3.5 Pan, in which the specimens are boiled in distilled water, when the boiling water method (4.1) is used.

3.6 Vacuum impregnation apparatus, which may consist of glass components, when the *m*-xylene-type impregnation method (4.2) is used (see table 1, step 2).

3.7 Test ball, made of any hard alloy or metal, e.g. carbide metal. The radius (r) should be between 5 mm and 10 mm, known with an accuracy of $\pm$ 0,5 µm, for the determination of the density of the penetration immersion liquid (see 4.2.4).

4 Procedure

SAFETY PRECAUTIONS — Standard precautions shall be observed when handling uranium dioxide and plutonium dioxide samples.

4.1 Boiling water method

4.1.1 Determination of the dry mass (m_D)

Dry the pellets in the oven (3.2) at a temperature of 100 °C for at least 2 h. Cool to room temperature and weigh. The use of a dessicator, vacuum or a dry protective gas may be necessary during cooling, if the uptake of moisture from the environment does not allow a constant mass to be reached.

After the determination of the immersed mass and the saturated mass (4.1.3 and 4.1.4), dry the pellets again and weigh. Take the average (m_D) of the two measurements.

4.1.2 Saturation

Place the pellets in a pan of distilled water and boil for 5 h, taking care that the specimens are covered