



Calculation of Zr metal content and total Zr content by combustion

Basic principle

A weighed sample of zirconium metal is subjected to combustion in air, with subsequent calcining at 1000 °C until the weight is constant. The oxygen intake per g of the substance is referred to as the ignition gain or oxidation value, and it is an indicator of metal content; it is quoted as percentage of the original weight.

For the calculation of the metal content, one must decide whether to take into account potentially present impurities (other metals, H₂) or not.

Calculation of the ignition gain Ignition gain IG of Zr metal:

$$\% \text{ IG} = \frac{(\text{g weight increase}) \cdot 100}{\text{g initial weight of sample}}$$

Zr content of Zr metal disregarding other elements

This calculation is based on the assumption that the sample exclusively consists of Zr metal and ZrO₂. It is not applicable for Zr/Ni alloys and ZrH₂.

$$\% \text{ Zr met.: } \% \text{ IG} \cdot 2.851$$

$$\% \text{ total Zr: } \left(\frac{\% \text{ IG}}{100} + 1 \right) \cdot 74.03$$

Explanation of factors:

$$2.851 = \frac{91.22}{32.00}$$

$$74.03 = \frac{91.22}{91.22 + 32.00} \cdot 100$$

Presence of other elements will distort the calculation. This can be taken into consideration if the content of these elements is known.

Calculation of Zr metal content and total Zr content by combustion

Zr content of Zr metal considering other elements

In the following, calculation examples are given for the most common accompanying elements (Hf and H₂). If further elements (such as Si) are to be taken into account, it is recommended to determine Zr by using a different Zr-specific method. The precision of the indirect determination of the Zr-content from the ignition gain decreases with increasing number of additionally regarded elements.

The calculations are not applicable to Zr/Ni alloys and zirconium hydride.

Zr + Hf:

Naturally occurring Zr-ores are always associated with Hf. Zr metal powders produced from such sources generally contain approximately 2 weight-% Hf, which is taken into account according to the equations below:

$$\%Zr_{\text{met}} + \text{Hf}_{\text{met}} : \% \text{IG} \cdot 2.905$$

$$\% \text{ total Zr} + \text{total Hf} : \left(\frac{\% \text{IG}}{100} + 1 \right) \cdot 74.39$$

Explanation of factors:

The general procedure is the same as above, with the exception that the molecular weight is adjusted to a Hf-content of 2 weight-%.

$$98 \% \text{ Zr} \cdot 91.22 + 2 \% \text{ Hf} \cdot 178.49 = 100 \% \cdot 92.96$$

$$2.905 = \frac{92.96}{32.00}$$

$$74.39 = \frac{92.96}{92.96 + 32.00} \cdot 100$$

In case of a different Hf-content, the factors have to be recalculated accordingly.

Calculation of Zr metal content and total Zr content by combustion

Zr + H₂:

H₂ is driven out during the determination of the oxidation value and lowers the IG by exactly its content.

$$\% \text{Zr (as metal and hydride)}: (\% \text{IG} + \% \text{H}_2) \cdot 2.851$$

$$\% \text{ total Zr}: \left(\frac{\% \text{IG}}{100} + 1 \right) \cdot 74.03$$

Zr + H₂ + Hf:

based on a Hf-content of 2 %, the equations are as follows:

$$\% \text{Zr + Hf (as metal and hydride)}: (\% \text{IG} + \% \text{H}_2) \cdot 2.905$$

$$\% \text{ total Zr + total Hf}: \left(\frac{\% \text{IG}}{100} + 1 \right) \cdot 74.39$$

Edition: May 2001

Chemetall GmbH

Special Metals Division

Trakehner Straße 3
D-60487 Frankfurt am Main
P.O. Box 90 01 70
D-60441 Frankfurt a.M.
Phone +49 69 7165-3911
Fax +49 69 7165-2523
Mail specialmetals@chemetall.com

The above details have been compiled to the best of our knowledge on the basis of thorough tests and with regard to the current state of our long practical experience.

No liabilities or guaranties deriving form or in connection with this leaflet can be imputed to us. Reproduction in whole or in part, only for personal use.