Characteristics and Handling of Titanium Hydride

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Abstract

A possible method for the production of aluminum foams is the use of TiH_2 as a gas generating compound. This work provides a survey of the production methods and typical applications for different titanium hydride products. As current literature gives only very few hints on safety handling aspects, additional information concerning possible dangers is given. This should enable the ones processing these powders to prevent potential hazards through safe handling.

1. Production of Hydrides

All titanium hydride products are made by hydrogenating and grinding from titanium sponge. Zirconium hydrides are made eigther from zirconium sponge by an analogous process or by reducing and hydrogenating zirconium oxide. For a selection of some hydride products see Table 1 below.

2. Applications

Common established applications for titanium and zirconium hydride powders are:

- superalloys with high melting point
- magnetic alloys
- pyrotechnics

and, as a newly developing field

- as hydrogen source for the foaming of metals [1,2]

3. Properties

The maximum theoretical hydrogen content of titanium hydride is about 4 wt. %. Fig. 1 shows a thermogravimetric analysis of the product TiH – N. The measurement was performed under 1 atmosphere of argon gas. The heating rate was about 10K/minute. Thus 70% of the entire hydrogen content is lost at 700°C which is about the foaming temperature of aluminium [1,2].

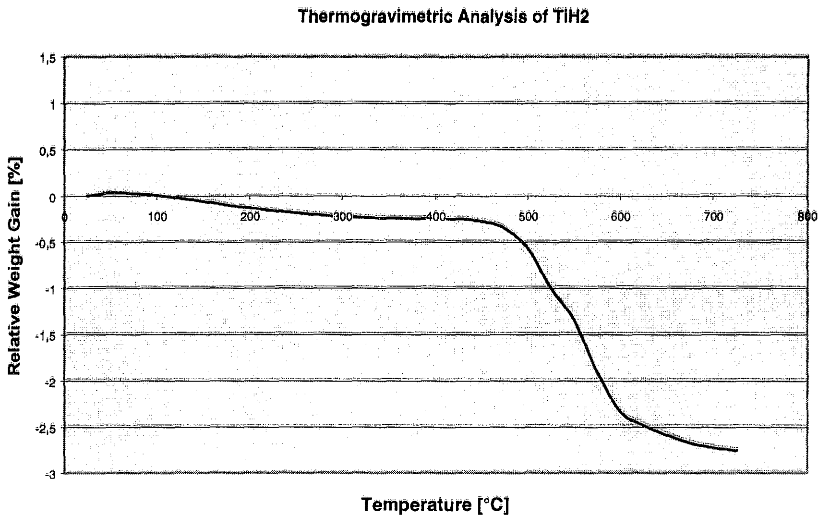

Fig 1: Thermogravimetric Analysis of Titanium Hydride (TGA)

4. Guidance for safe handling [3]

Titanium and zirconium metal hydrides in dry powder form with particle sizes below 10μm are flammable. They can be ignited by sparks, friction or low electric discharge energy.

The thin insulating oxide film on the particles passivates the powder but may cause electrostatic charging if the particles undergo friction from each other. Charging in operations like dry milling, sieving, pouring into other vessels can lead to self-ignition.

Dry metal powder presents a dust explosion hazard. If the powder dusts, electrostatic discharge and therefore self-ignition may occur.

Operations in which formation of dust clouds cannot be avoided, e.g. mixing or sieving must be carried out under an atmosphere of argon or helium gas. Do not use nitrogen or carbon dioxide for inertization because of vigorous reaction with the powder when heated.

5. Safety Equipment

Personnel handling the powders should be equipped for fire prevention. Fire resistant or non-flammable clothing and gloves together with a face-shield are recommended. Non sparking, ground-connected apparatus should be used preferably made of stainless steel, brass or copper. Working area, machinery and clothes must be kept perfectly clean.

In case of fire cover with dry sand or dry chemical/dolomite (powdered limestone). Never extinguish with water, carbon dioxide or halocarbon.

6. Storage and Transportation

Dry powder, packed into thightly closed thin cans, has almost unlimited shelf life. It can be stored for at last for 5 years without considerable oxidation. The degree of oxidation depends upon the average particle size of the material, storage temperature and the kind and quality of the package. The powders should kept in a dry cool place.

6.1 Transport Classification:

TiH_2-T, N, P :	GGVE, GGVS, RID, ADR:	class 4.1, fig. 14 b)
	IMDG-Code:	class 4.1 UN-No. 1871 PG.II
	ICAO:	class 4.1 UN-No. 1871 PG.II/Drill-Code 3W
ZrH_2-S :	GGVE, GGVS, RID, ADR:	class 4.1, fig. 14 b)
	IMDG-Code:	class 4.1 UN-No. 1437 PG.II
	ICAO:	class 4.1 UN-No. 1437 PG.II/Drill-Code 3L

7. Quality Control

Chemetall's production of titanium and zirconium hydrides is certified to ISO 9001.

References

[1] T. Miyoshi,M. Itoh, S. Akiyama, A. Kitahara, this proceedings, p. 127
[2] F. Baumgärtner, H. Gers, this proceedings, p. 73
[3] Chemetall GmbH, Sales Program Special Metal Products, 1999

Typical Analysis Data for Titanium and Zirconium Hydride Products					
(% units: wt.%)	**TiH_2, Type T**	**TiH_2, Type N**	**TiH_2, Type P**		**ZrH_2, Type S**
Gain on Ignition	min. 58 %	min. 58.4 %	min. 58.4 %		31,5 +/- 0,5 %
Total Metal Content Ti	min. 95 %	min. 95 %	min. 95 %	Zr + Hf	97,4 +/-0,5 %
				Hf	min. 0,2%
Hydrogen	**min. 3,8 %**	**min. 3,8 %**	**min. 3,8 %**		**2 +/- 0,1 %**
theoretical maximum Hydrogen content	**4,04%**	**4,04%**	**4,04%**		**2,16%**
Nitrogen	max. 0,3 %	max. 0,3 %	max. 0,3 %		n/a
Fe	n/a	max. 0,09 %	n/a		max. 0,08 %
Cl	n/a	max. 0,06 %	n/a		max. 0,015 %
Ni	n/a	max. 0,05 %	n/a	Ni, Al, Ti	max. 0,01 %
Si	n/a	max. 0,15 %	n/a		max. 0,03 %
Mg	max. 0,04 %	max. 0,04 %	max. 0,04 %	Mg,Cr,Ca	max. 0,02 %
C	max. 0,03 %	max. 0,03 %	max. 0,03 %		max. 0,015 %
Spec. Surface BET	n/a	n/a	n/a		0,4 m^2/g
Particle Size (Sieve Test)	99,9% < 63μm	99,9% < 63μm	99,9% < 63μm		100% < 45μm
Average Particle Size * (* according to Blaine)	**3,5+/-0,5 μm**	**5,0 +/-1 μm**	**8,0 +/-2 μm**		**3 +/- 0,5 μm**
Auto Ignition Temperature	n/a	> 400 °C	> 400 °C		290+/-20°C

Table 1: Typical Analysis Data for Titanium and Zirconium Hydrides produced by Chemetall GmbH