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Hydrogen decrepitation neodymium iron boron permanent magnetic powder

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*(English Translation)*

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Foreword

This standard is drafted in accordance with the rules given in the GB/T1.1-2009 Directives for standardization-Part1：Structure and drafting of standards”

This standard was proposed and prepared by SAC/TC 229(China Rare Earth Standardization Technical Committee).SAC/TC 229 is in charge of this English translation. In case of any doubt about the contents of English translation, the Chinese original shall be considered authoritative.Hydrogen decrepitation neodymium iron boron permanent magnetic powder

1. Scope

This standard specifies the requirements, test methods, inspection rules, marks, package, transportation, storage and quality certificates of hydrogen decrepitation neodymium iron boron permanent magnet powder.

This standard is applicable to hydrogen decrepitation neodymium iron boron permanent magnet powder produced by powder metallurgy process for the production of sintered neodymium iron boron magnet.

2. Normative references

The following referenced documents are indispensable for the application of this document. For dated referenced documents, only the edition citied applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

*GB/T* 223*.82 Steel and iron-Determination of hydrogen content-Inert gas impulse fusion heat conductivity method.*

*GB/T* 8170 *Rules of rounding off for numerical values & expression and judgement of limiting values.*

*GB/T* 20170*.1 Test methods for physical characters of rare earth metals and their compounds-Determination of particle size distribution of rare earth compounds.*

*GB/T 29655 Neodymium iron boron strip-casting alloy.*

*XB/T 617.1 Chemical analysis methods for neodymium iron boron alloy-Part 1: Determination of total rare earth content-Oxalate gravimetry method.*

*XB/T 617.7 Chemical analysis methods for neodymium iron boron alloy-Part 7: Determination of oxygen and nitrogen contents-Impulse-infrared absorption and impulse-thermal conductance methods.*

3. Terms and definitions

For the purpose of this document, the following terms and definitions apply.3.1 hydrogen decrepitation neodymium iron boron permanent magnetic powder

The powder is manufactured by crushing the neodymium iron boron strip-casting alloys through the reaction of hydrogen absorption and dehydrogenation under a certain pressure.

4 Classification and designation

4.1 Classification

Hydrogen decrepitation neodymium iron boron permanent magnetic powder is classified into three grades based on the total amount of rare earth and hydrogen content, i.e., H-NdFeB 30/9, H-NdFeB 33/13 and H-NdFeB 39/15, respectively.

(Hydrogen decrepitation neodymium iron boron permanent magnetic powder are designed as H-NdFeB 30/9, H-NdFeB 33/13 and H-NdFeB 39/15 three designations according to rare earth content and hydrogen content)

4.2 Designation

The designation of hydrogen decrepitation neodymium iron boron permanent magnetic powder consists of three parts: process category, element symbol and technical parameters. The first part is H, indicating the process category of the product, which is an acronym for of "Hydrogen decrepitation ".The second part is NdFeB, indicating the element symbol of the product, which is composed of the chemical symbol of neodymium element, the chemical symbol of iron element and the chemical symbol of boron element; The number before the slash in the third part represents the maximum value of the total rare earth content contained in the hydrogen decrepitation neodymium iron boron permanent magnet powder [mass fraction (%)]; And the number after the slash in the third part represents the figure that is 100 times of the maximum hydrogen content in the hydrogen decrepitation neodymium iron boron permanent magnet powder [mass fraction (%)]. The three parts are connected by short horizontal lines.

H － NdFeB － XXX / XX

Representing the maximum value of hydrogen content multiplied by 100

Representing the maximum value of the total rare earth content

Representing neodymium iron boron

Represents process category, i.e., hydrogen decrepitation

Example: H-NdFeB-30/9 represents hydrogen decrepitation neodymium iron boron permanent magnet powder, with the maximum total rare earth content of 30% and the maximum hydrogen content of 0.09%.

5. Requirement

5.1 Raw materials

The composition and phase structure of neodymium iron boron strip-casting alloys before hydrogen decrepitation should meet the regulations of GB/T 29655.

5.2 Chemical composition

The main chemical composition of hydrogen decrepitation neodymium iron boron permanent magnet powder shall comply with the requirements as listed in Table 1. The content of Fe, B, Cu, Co, Al, Zr, Ga, C and other elements are usually not regarded as the routine acceptance indexes. The content of the elements and manufacturing process are referred to Appendix A. If the buyer has any special requirement, it shall be negotiated by the supplier and the buyer

Table 1 Main chemical composition of product

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| designation | Composition（Mass fraction/ %） | | | |
| Total rare earth content  （Pr, Nd, Tb, Dy） | H | O | N |
| H-NdFeB-30/9 | 27～30 | ≤0.09 | ≤0.2 | ≤0.03 |
| H-NdFeB-33/13 | 29～33 | 0.05～0.13 | ≤0.2 | ≤0.03 |
| H-NdFeB-39/15 | 33～39 | 0.08～0.15 | ≤0.2 | ≤0.03 |

5.3 Particle size

The particle size of hydrogen decrepitation neodymium iron boron permanent magnet powder shall be less than 2000μm, and the ratio of particle size less than 25μm should not exceed 10% of the total weight of the product. The supplier and the customer can negotiate the details if there are special requirements by the customer.

5.4 Appearance quality

Hydrogen decrepitation neodymium iron boron permanent magnetic powder is gray, and the product should be clean without visible rust spots and inclusions.

6 Test methods

6.1 Chemical composition

6.1.1 The determination of the total rare earth content shall be carried out in accordance with the rules given in XB/T 617.1.

6.1.2 The determination of the hydrogen content shall be carried out in accordance with the rules given in GB/T 223.82.

6.1.3 The determination of the oxygen and nitrogen content shall be carried out in accordance with the rules given in XB/T 617.7.

6.2 Particle size

The test of particle size is carried out according to the provisions of GB/T 20170.1.

(The determination of the particle size shall be carried out in accordance with the rules given in GB/T 20170.1.)

6.3 Appearance

The appearance quality of the product shall be tested by magnifying glass with 10 times of magnification rate.

6.4 Numerical rounding

The numerical rounding rule shall be carried out according to the provisions of GB/T 8170.

7 Inspection rules

7.1 Inspection and acceptance

7.1.1 The supplier shall inspect the products to guarantee the quality to comply with the requirements of this standard and provide the quality certificate.

7.1.2 The consumer shall inspect the received product according to the provisions of this standard. If the inspection results do not accord with this standard, notification of the discrepancies shall be proposed to the supplier within 15 days from the date of receipt. Both parties should resolve it through negotiation. If no quality objection is raised after 15 days, it shall be deemed as qualified for acceptance. If arbitration is required, sampling procedure shall be carried out in the plant of the customer under the witness of both parties, and inspection procedure shall be conducted by a third party inspection organization agreed by both parties.

7.2 Batch inspection

Products should be submitted in batches for inspection, and each batch of products shall be of the same designation.

7.3 Inspection items

Inspection items for each batch of products include composition, particle size and appearance quality.

7.4 Sampling and sample preparation

7.4.1 The sampling quantity for chemical composition analysis and appearance quality inspection, which is used for arbitration, should follow the provisions in Table 2.

Table 2 Sampling quantity

|  |  |  |
| --- | --- | --- |
| Weight of each batch /kg | ≤600 | >600 |
| Sampling weight /kg | 0.05 | 0.1 |

7.4.2 The sampling method for chemical composition inspection for arbitration should be carried out as follows. When sampling, the sample bag shall be directly connected to the discharge port after removing the air from the bag. Then open the discharge valve discharge the sample into the sample bag, and split the sample into the required amount immediately. The sample bags shall be filled with the inert gas for protection with the bag mouth fastened and then sealed.

7.5 Judgment of inspection results

7.5.1 If the results of the chemical composition analysis and particle size are not in conformity with the rules of this standard, double samples shall be taken from the detected batch of products to repeat the test for the unqualified items. If any result remains unqualified, this batch of products shall be judged as unqualified.

7.5.2 If the results of appearance inspections are not in conformity with the rules of this standard the batch of the product shall be directly judged as unqualified

8 Marking, package, transportation, storage and quality certificate

8.1 Marking and package

8.1.1 Package

Two options are available for the product packaging methods:

a) The products are packed in double-layer plastic bags by vacuum packaging, with a net weight of 5kg ~ 50kg per bag. Then the bags are placed in an iron drum with a net weight of 10kg ~ 600kg per drum.

b) The products are sealed in steel tanks filled with inert gas, with a net weight of 300 kg per steel tank. Then the steel tanks are placed in an iron drum with a net weight of 300 kg ~ 600 kg per drum. The supplier and the consumer should negotiate on details if the consumer has special requirements for package.

8.1.2 Marking

There should be a distinct sign on the outside of each packaging barrel, indicating:

a) Name of supplier;

b) Product name

c) Designation, batch number, net weight and gross weight;

d) Date of manufacture

e) Marking or notation of “fire protection”, “moisture-proof”, “anticollision”, etc.

8.2 Transportation and storage

8.2.1 The product should be stored in a dry place with good ventilation and should not be placed in the open air. In transportation, it should be carefully handled, fireproof, anticollision, moisture-proof, and attached with relevant marks.

8.3 Quality certificate

Quality certificate shall be attached to each batch of products, indicating:

a) Name of supplier;

b) Product name

c) Product designation, batch number, net weight and number of packages;

d) Test results with the stamp of the quality control department of the supplier;

e) Serial number of this standard;

f) Date of inspection;

g) Date of manufacture.

Appendix A

(Informative)

Composition and manufacturing process of hydrogen decrepitation neodymium iron boron permanent magnetic powder

A. 1 Composition of hydrogen decrepitation neodymium iron boron permanent magnetic powder

The content of boron, copper, cobalt, aluminum, zirconium, gallium and carbon elements in hydrogen decrepitation neodymium iron boron permanent magnetic powder are shown in Table A.1. The amount of iron element is the residual amount apart from the main elements (total rare earth content, hydrogen, oxygen and nitrogen) and the elements in Table A.1.

Table A.1 Content of other elements in hydrogen decrepitation neodymium iron boron permanent magnetic powder

|  |  |  |  |
| --- | --- | --- | --- |
| composition | B | Other elements such as Cu/Co/Al/Zr/Ga, etc. | C |
| Content | 0.8%～1.3% | ＜10% | ＜0.03% |

A. 2 Manufacturing process of hydrogen decrepitation neodymium iron boron permanent magnetic powder

The neodymium iron boron strip-casting alloys are filled into stainless steel container, which is vacuumized and filled with high purity hydrogen (generally 99.999%). In this process, hydrogen is absorbed into the Nd-rich intergranular phase and forms into the hydride in the alloys, which expands and causes the alloys to fracture and decrepitate into the powders. Then evacuating hydrogen and filling argon, the alloy powders are dehydrogenated by heating-up under vacuum atmosphere. After dehydrogenation, argon is filled into the container to cool down the alloy powders. The manufacturing process of hydrogen decrepitation neodymium iron boron permanent magnetic powders is shown in Figure A.1.



Fig. A.1 Manufacturing process of hydrogen decrepitation neodymium iron boron permanent magnetic powder