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Rare earth — Analysis by wavelength dispersive x-ray fluorescence spectrometry (WD-XRFS) —

Part 1: Determination of composition of rare earth magnet scrap using standardless XRF commercial packages

Terres rares — Analyse par fluorescence X à dispersion de longueur d'onde (WD-XRF) —

Partie 1: Détermination de la composition des déchets magnétiques à base de terres rares à l'aide de kits XRF sans étalon vendus dans le commerce

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Foreword

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This document was prepared by Technical Committee ISO/TC 298, *Rare earth*.

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Introduction

Rare earth element (REE) magnets, especially neodymium-based magnets, can be found in numerous different applications.[4] According to some rough estimates, the annual demand of REE magnets was nearly 78 kilotonnes in 2015.[5] Based on those estimates, six major applications (namely wind turbines, hard disk drives, electric vehicles, e-bikes, audio speakers and air conditioners) account for nearly 60 % of the total demand. As components utilizing REE magnets continue to accumulate, the REE repository created by human activity will be crucial to address in the future by recycling.

The commercially used REE magnets can be divided into two main categories: samarium-cobalt (Sm-Co)-based magnets and neodymium-iron-boron (Nd-Fe-B)-based magnets:

— In Sm-Co-based REE magnets, $SmCo_5$ and Sm_2Co_{17} are the two technically important compositions. In the Sm_2Co_{17} magnet, the concentration of Co is sometimes partially replaced by other transition metal elements.

— In Nd-Fe-B magnets, the concentration of Nd is 32 % by mass. A small to considerable amount of other REEs are also sometimes added.

The mass of REE in magnet present in each product varies greatly. Additionally, the concentration of different REE elements within the magnet itself can vary greatly. For example, the incorporation of Dy into Nd-Fe-B magnets can be in the range of < (1 to 10) % mass fraction (10 g/kg). These factors contribute towards challenges in the recycling efficiency of REE magnets.

In the case of magnets derived from end-of-life (EOL) equipment, dismantling is carried out. Apart from REE magnets found inside wind turbines and electronic vehicles, the physical extraction of REE magnets from electronic application scrap is very challenging due to the complexity and small size of the components. This type of scrap is usually shredded. The shredded scrap is then sorted into ferrous and non-ferrous scrap. During the shredding process, the recovery rates of REEs can drop by 90 %.[5] Appropriate guidelines for dismantling the EOL scrap is important for improving the REE recovery. Overall, effective recycling of REE requires information regarding the amount and nature of the REEs present in the magnet scrap.

This document specifies the measurement protocol for assessing the composition of REE magnet scrap. Procedures for dismantling components containing scrap and for cleaning and demagnetizing the scrap are provided. Guidelines for determining the composition of REE magnet scrap using standardless wavelength dispersive X-ray fluorescence (WD-XRF) commercial packages are specified.

This document:

— outlines a procedure for safe handling of the EOL magnet scrap (see Clause 7);

— specifies measurement of the REE content in the EOL magnet scrap (see Clause 8).