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Elements recycling — System of information exchange on rare earth elements in industrial waste and end of life cycled products

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Foreword

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The committee responsible for this document is Technical Committee *[or Project Committee]* ISO/TC *298*, *[Rare Earth]*.

Introduction

Rare earth elements (REEs) have become essential constituents for wide range of industrial applications including electric vehicles, batteries, smartphones, displays, transparent lenses, optical fibre and numerous other applications. Due to these various but important applications, REEs are called as “Vitamins of Industry”. In order to ensure the successful use of these vitamins of industry, supply to the industry should be smooth. But resource scarcity creates imbalance between supply and demand. Therefore, the importance of REEs is getting even more and more. In order to overcome this constraint of resource scarcity, recycling or urban mining of industrial waste and end of life cycle products is necessary.

For recyclers, it is of utmost importance to know what kind of REEs are present in the waste or scrap material, and how much can be extracted. Hence, in order to facilitate recycling it is important to define what information is required by recycler, and it is also necessary to establish a standard for methods of information exchange on REEs in industrial waste and end of life products.

Due to the lack of a standardized system and communication exchange mechanism between waste handlers and recyclers, the recycling ability still lags behind of what it should be. There are many producers of the same product but the compositions and concentrations are differernt, and that makes it difficult and complicated for the recyclers to obtain exact information about the elements being recycled. Furthermore, if producer and recycler is placed in different countries then information reliability and cross-border transaction of information exchange is problematic. Therefore, a system of information exchange between collector and recycler is needed.

This standard contains a system of information exchange between waste handlers and recyclers about REEs in industrial waste (Industrial waste generates from downstream processing operations of the manufacturing industries) and end of life products. System of information exchange refers to a data exchange mechanism such as and quick response (QR) code and radio frequency identification (RFID).

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1 Scope

This standard provides the methods of information exchange between waste handlers (of industrial wastes and end of life products) and recyclers of rare earth elements (REEs) about REEs contained in industrial wastes and end of life products. The purpose is to facilitate recyclers for efficient REE recycling for management of REE resources. The document also includes a generic life cycle of REE recycling process to highlight the area of application of this standard.

This standard includes the following point:

— A method of providing REE information to recyclers

— Generic life cycle of REE recycling.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/WD 22444-1 Rare earth — Terms and definitions — Part 1: Minerals, oxides and other compounds

ISO/WD 22444-2 Rare Earth — Terms and definitions — Part 2: Rare earth metals and their alloys

ISO/CD 22450, *Rare Earth — Elements recycling — Communication formats for providing recycling*

3 Terms and definitions

For the purpose of this document, the following terms and definitions apply.

3.1
REE
Rare earth elements

Note 1 to entry: A group of 17 chemical elements in the periodic table, specifically the 15 lanthanides and scandium and yttrium, which are difficult to extract from their ores.

3.2
industrial waste
industrial waste is the waste produced by industrial activity which includes any material that is rendered useless during a manufacturing process such as that of factories and industries. The industrial waste originates from downstream processing operations of the manufacturing industries. Here downstream operations refer to processes during the production stages such as machining, milling, chamfering etc

3.3
end of life products
end-of-life (EOL) is a term used with respect to a product supplied to customers, indicating that the product is in the end of its useful life (from the vendor's point of view), and a vendor stops marketing, selling or rework sustaining it

3.4
life cycle
consecutive and interlinked stages of a product system, from raw material acquisition or generation from natural resources to the final disposal

[SOURCE: ISO 14040:2006, definition 3.1]

3.5
life cycle stage
elements of a life cycle.

Note 1 to entry: Examples of life cycle stages are: raw material acquisition and production; manufacturing; collection; dismantling; pre-treatment; identification; sorting and recycling.

[SOURCE: IEC 62430:2009, definition 3.10, modified]

3.6
QR Code
Quick Response code

Note 1 to entry: It is a machine-readable code consisting of an array of black and white squares, used for storing information for reading by the camera on a smartphone.

3.7
RFID
Radio Frequency Identification.

Note 1 to entry: It is the use of radio waves to read and capture information stored on a tag attached to an object.

4 General Principles

There are a variety of processes to convert or use REEs from minerals to final products such as REE magnets, batteries, laser light source, and so on. This standard defines the methods of communication for exchange of information on REE-related substances that can be recycled at the product stage as industrial waste by the manufacturers, and end of life products by recyclers. The core purpose of this standard is to suggest ways to facilitate the recycling of REEs by recyclers on the basis of information provided to them by the waste handler. Information can be provided to the recyclers efficiently with the use of QR codes, bar codes and RFID depending on the precision of the data. The information containing code must be marked on the shipment box in which the REE Industrial waste and end of life product is packed.. The marking on the shipment will simplify the exchange of information. The recycler can scan the code and get the useful information provided by the producer

5 Life Cycle Example

The generic life cycle of recycling of Industrial Scrap and EoL is described in Figure 1. The life cycle given in Figure 1 is one of many potential scenarios, and tries to give a general picture of the steps involved in recycling. The purpose to add this value chain is to clarify at what life cycle stage of the recycling process this standard is applicable at. Actual recycling process may vary from Industry to Industry and may add additional processes, exclude or include portions of the steps shown here.

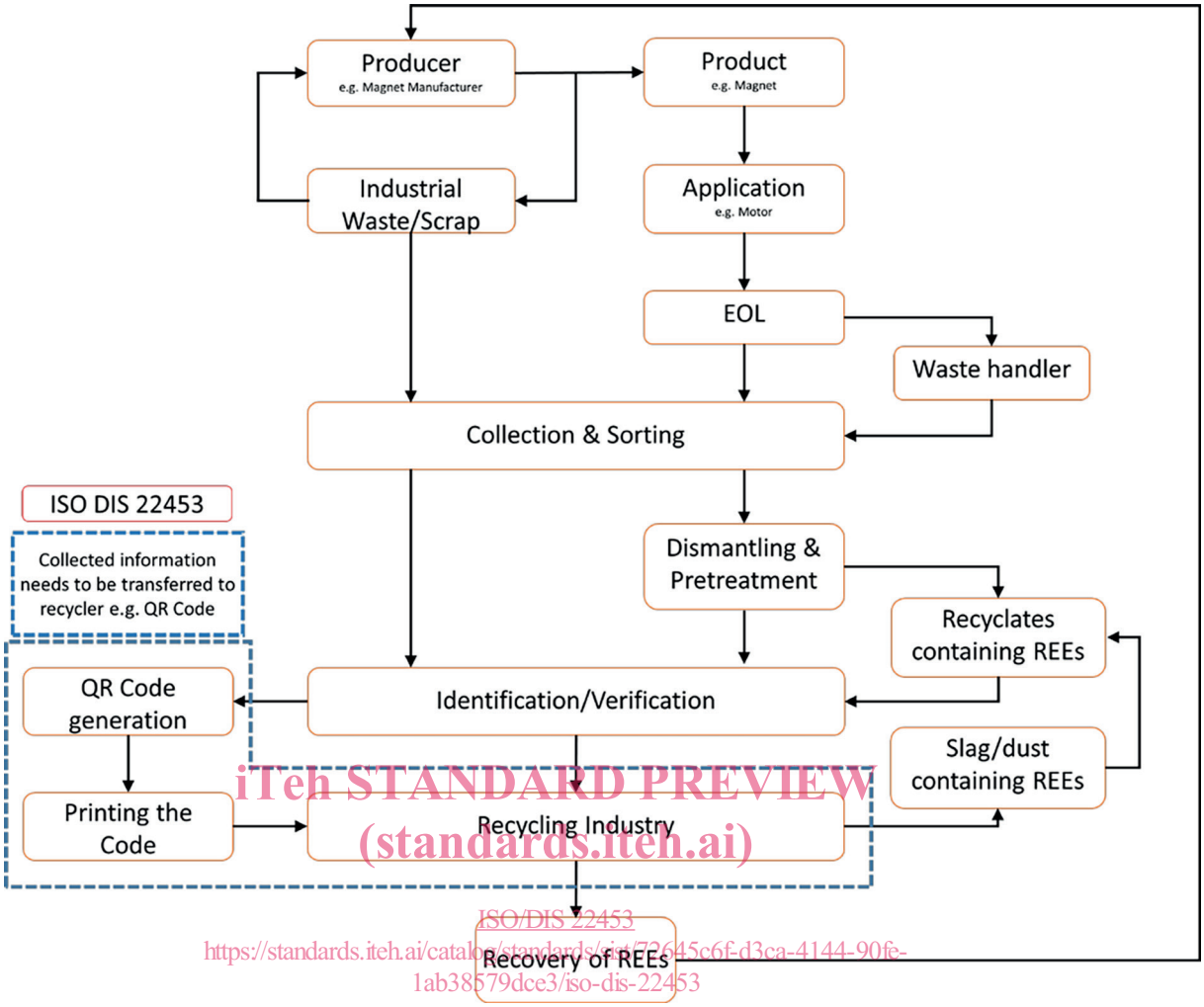

Figure 1 — Represents a generic downstream life cycle of REE recycling. It also shows the life cycle stage at which this standard is applicable at.

6 Labelling methods

There are many different types of labelling methods including barcode and RFID. 1-dimensional barcodes are simple and widely used for providing information for products; however, they can represent only small amount of data. In comparison with 1-dimensional barcodes, 2-dimensional barcodes and RFID can include lots of data. Therefore, a convention is provided in this standard by which REE information will be recorded using 2-dimensional barcodes and RFID.

6.1 2-dimensional barcodes

2-dimensional barcodes are types of printable labels with low cost and high storage capacity. There are several kinds of 2-dimensional barcodes including QR codes, PDF417, DataMatrix, and MaxiCode. The specifications state that up to 2900 bytes and 4200 ASCII characters may be encoded in single symbol.

QR codes are the most suitable and efficient method for storing REE information due to their larger capacity for recording data and error correction function. QR creation and reading tools are commonly available and the cost of creation is very low to negligible. They have readability in different orientations, good processing speed, high durability to damage and sufficient lifetime. Furthermore, their environmental impact is almost none and QR codes can lead to online content, Considering rare earth elements being 17 in number plus numerous variables including name of supplier, name of product, gross weight, physical form of the product, date of production, country and region, production