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# NATIONAL STANDARD OF THE PEOPLE'S REPUBLIC OF CHINA

# GB/T 45203-2024

## Recycled black mass for lithium ion battery

锂离子电池用再生黑粉

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## 1 Scope

China's national standard for recycled black mass for lithium-ion batteries. Black mass is what remains after spent batteries are discharged, dismantled and shredded and the casings, foils and separators are removed: a dark powder of cathode and anode material carrying the lithium, nickel, cobalt and manganese that make recycling worth doing. It has become a globally traded commodity, shipped in thousands of tonnes to the hydrometallurgical plants that extract the metals, and China is the principal destination. What the trade lacked was a specification. Black mass varies enormously with the batteries it came from and the process that made it - the metal content differs by chemistry, and residual copper, aluminium, fluoride and graphite affect the leaching downstream - so buyers and sellers were negotiating over a material with no agreed description. The standard specifies classification and grading, technical requirements, test methods, inspection rules, marking, packaging, transport and storage.

This document specifies the classification and grading, technical requirements, test methods, inspection rules, marking, packaging, transportation, storage and accompanying documents of recycled black mass for lithium-ion batteries. This document applies to battery black mass obtained from the recycling of lithium-ion battery waste and used for subsequent recycling.



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## 2 Normative references

The contents of the following documents constitute the essential terms of this document through normative references in the text. Among them, for dated references, only the version corresponding to that date applies to this document; for undated references, the latest version (including all amendments) applies to this document.

GB/T 191 Packaging - Pictorial marking for handling of goods

GB/T 8170 Rules of rounding off for numerical values and expression and judgement of limiting values YS/T 1342 (all parts) Methods for chemical analysis of waste secondary battery

## 3 Terms and definitions

The following terms and definitions apply to this document.

3.1 Lithium ion battery scraps Waste lithium ion batteries and their waste raw materials.

Note. Including scrapped lithium ion batteries, scrapped semi-finished products, waste raw materials generated in industrial production processes, as well as the lithium ion batteries that have lost their use value in daily life or circulation.

3.2 Black mass out in accordance with the provisions of Appendix D.

6.1.3 The determination method of water-extractable total organic carbon (TOC) content in the product is shown in Appendix E.

6.1.4 The determination method of acid-insoluble matter content in the product is shown in Appendix F.

6.2 Loss on drying The determination method of drying loss in the product is shown in Appendix G.

### 6.3 Mixtures or inclusions

6.3.1 The calculation method of the molar ratio of the main elements of the product is shown in Appendix H. The determination method of zinc, lead, chromium, cadmium, arsenic content in the product is shown in Appendix A.

6.3.2 Inclusions are detected by visual method; the determination method of product particle size is shown in Appendix I.

### 7.1 Inspection and acceptance

7.1.1 Products are inspected by the supplier or a third-party inspection department. The supplier shall ensure that the product quality complies with the provisions of this document.

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7.1.2 The buyer may inspect the received products in accordance with the provisions of this document. If the inspection results do not comply with the provisions of this document, the buyer shall submit the matter to the supplier within 30 days from the date of receipt of the product; the supplier and buyer shall negotiate to resolve the issue. If arbitration is required, the supplier and buyer shall jointly sample or negotiate at the buyer's place.

7.2 Group-batching Each batch of products shall consist of products of the same class and grade; each batch of products shall not exceed 32 t. The group-batching method shall be carried out according to the supplier's incoming batch or determined by the supplier and buyer on- site.

7.3 Inspection items Each batch of products shall be inspected for chemical composition, drying loss, mixed materials or inclusions.

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## Appendix A

(Informative) Determination of nickel, cobalt, manganese, lithium, phosphorus, iron, zinc, lead, cadmium, chromium, arsenic content in recycled black mass for lithium-ion batteries - Inductively coupled plasma atomic emission spectrometry A.1 Principle The sample is dissolved in a hydrochloric acid-nitric acid mixture. In a nitric acid medium, the emission intensity of nickel, cobalt, manganese, lithium, phosphorus, iron, zinc, lead, cadmium, chromium, arsenic is measured on an inductively coupled plasma atomic emission spectrometer. The concentration of each element is found on the working curve and the mass fraction is calculated. A.2 Reagents Unless otherwise specified, the reagents used in this Appendix are reagents of analytical grade or above and distilled water or deionized water or water of equivalent purity. A.2.1 Nitric acid (1 + 1). A.2.2 Hydrochloric acid-nitric acid mixture. 3 volumes of hydrochloric acid (rho~

1.19 g/mL) + 1 volume of nitric acid (rho~

1.42 g/mL); mix well. A.2.3 Nickel standard stock solution. National certified standard solution, wherein 1 mL of this solution contains 1 mg of nickel. A.2.4 Cobalt standard stock solution. National certified standard solution, wherein 1 mL of this solution contains 1 mg of cobalt. A.2.5 Manganese standard stock solution. National certified standard solution, wherein 1 mL of this solution contains 1 mg of manganese. A.2.6 Lithium standard stock solution. National certified standard solution, wherein 1 mL of this solution contains 1 mg of lithium. A.2.7 Phosphorus standard stock solution. National certified standard solution, wherein 1 mL of this solution contains 1 mg of phosphorus. A.2.8 Iron standard stock solution. National certified standard solution, wherein 1 mL of this solution contains 1 mg of iron. A.2.9 Zinc standard stock solution. National certified standard solution, wherein 1 mL of this solution contains 1 mg of zinc. A.2.10 Lead standard stock solution. National certified standard solution, wherein 1 mL of this solution contains 1 mg of lead. A.2.11 Cadmium standard stock solution. National certified standard solution, wherein 1 mL of this solution contains 1 mg of cadmium. A.2.12 Chromium standard stock solution. National certified



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standard solution, wherein 1 mL of this solution contains 1 mg of chromium. A.2.13 Arsenic standard stock solution. National certified standard solution, wherein 1 mL of this solution contains 1 mg of arsenic. A.2.14 Nickel, cobalt, manganese mixed standard solution. Pipette

10.00 mL of nickel standard stock solution (A.2.3), cobalt standard stock solution (A.2.4), manganese standard stock solution (A.2.5) to a 100 mL volumetric flask; dilute to the mark with water; mix well. 1 mL of this solution contains 100 μg of nickel, cobalt, manganese, respectively. A.2.15 Iron and lithium mixed standard solution. Take

10.00 mL of iron standard stock solution (A.2.8) and lithium standard stock solution (A.2.6); place them in a 100 mL volumetric flask; dilute to the mark with water and mix well. 1 mL of this solution contains 100 μg of iron and lithium each. A.2.16 Phosphorus, zinc, lead, cadmium, chromium, arsenic mixed standard solution. Take

10.00 mL of phosphorus standard stock solution (A.2.7), zinc standard stock solution (A.2.9), lead standard stock solution (A.2.10), cadmium standard stock solution (A.2.11), chromium standard stock solution (A.2.12), arsenic standard stock solution (A.2.13); place them in a 100 mL volumetric flask; dilute to the mark with water; mix well. 1 mL of this solution contains 100 μg of phosphorus, zinc, lead, cadmium, chromium, arsenic each. A.2.17 Lithium standard solution. Pipette

10.00 mL of lithium standard stock solution (A.2.6) into a 100 mL volumetric flask; dilute to scale with water; mix well. 1 mL of this solution contains 100 μg of lithium. A.2.18 Phosphorus and iron mixed standard solution. Pipette

10.00 mL of phosphorus standard stock solution (A.2.7) and iron standard stock solution (A.2.8) into a 100 mL volumetric flask; dilute to scale with water; mix well. 1 mL of this solution contains 100 μg of phosphorus and iron, respectively. A.2.19 Mixed standard solution of zinc, lead, cadmium, chromium, arsenic, nickel, cobalt, manganese. Take

10.00 mL of zinc standard stock solution (A.2.9), lead standard stock solution (A.2.10), cadmium standard stock solution (A.2.11), chromium standard stock solution (A.2.12), arsenic standard stock solution (A.2.13), nickel standard stock solution (A.2.3), cobalt standard stock solution (A.2.4), manganese standard stock solution (A.2.5); place them in a 100 mL volumetric flask; dilute to the mark with water; mix well. 1 mL of this solution contains 100 μg of each element of zinc, lead, cadmium, Perform two tests in parallel and take the average value. A.5.3 Blank test Perform a blank test with the test material. A.5.4 Determination A.5.4.1 Conventional digestion A.5.4.1.1 Place the sample (A.5.1.1) in a 1000 mL beaker; moisten with a small amount of water; add 60 mL of hydrochloric acid-nitric acid mixture (A.2.2); cover with a watch glass; heat until completely dissolved; cool to room temperature; transfer to a 500 mL volumetric flask; dilute to scale with water; mix well, to obtain the test solution 1. A.5.4.1.2 Filter test solution 1 (A.5.4.1.1) with filter paper to obtain a filtrate. Take



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