भारतीय मानक

Indian Standard

IS 17946 : 2022

पुनश्चक्रित रबड़ — वल्केनाइज्ड क्रंब कण की विशिष्टि

Recycled Rubber — Vulcanized Crumb Particulate Specification

ICS 83.060

भारतीय मानक ब्यूरो
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November 2022 **Price Group 5**

Rubber and Rubber Products Sectional Committee, PCD 13

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Rubber and Rubber Products Sectional Committee had been approved by the Petroleum, Coal and Related Products Division Council.

Recycled vulcanized rubber particle commercially known as crumb rubber is generally manufactured from rubber products like tyre and non-tyre. The rubber products include the vulcanized rejects, End-of-Life products. Use of recycled vulcanized rubber has a positive environmental impact.

It is in the form of particulate matter produced principally by size reduction. Mechanical shredding/grinding, cryogenic grinding or alternate manufacturing methods are being used for the manufacturing of vulcanized crumb particulate. Mechanical shredding is conducted at ambient conditions whereas cryogenic process, the shredding/grinding is conducted at sub-zero temperatures, which makes it easier for breaking of rubber during the mechanical grinding process. As a good practice, CaCO3/chalk powder shall not be used during the manufacturing of vulcanized crumb powder and may be replaced with silica. The vulcanized rubber particulate is classified according to the particle size and particle size distribution.

There are several applications of vulcanized rubber particulate. Moulded and extruded products, asphalt modification (CRMB), sport surfacing, floor tiles (compressed), reclaim rubber, compounding for manufacturing rubber products, rubber and plastic blends, under layers for rubber and non rubber, recovered carbon black, construction, concrete gravel, decorative and drainage are some of the major uses of the product.

These applications all require different size categories of products ranging from 75 µm to 19 mm. Some of the specialized applications also require certain characteristics and specify a particular source and type of raw material to be used which helps in achieving certain properties in the recycled vulcanized particle.

Determination of polycyclic-aromatic hydrocarbons (PAH) in recycled rubber will help in containing their effect on human health and environment impact. PAHs like Benzo(a)pyrene (BaP) (CAS No 50-32-8), Benzo(e)pyren (BeP) (CAS No 192-97-2), Benzo(a)anthracene (BaA) (CAS No 56-55-3, Chrysen (CHR) (CAS No 218-01-9), Benzo(b)fluoranthene (BbFA) (CAS No 205-99-2), Benzo(j)fluoranthene (BjFA) (CAS No 205-82-3), Benzo(k)fluoranthene (BkFA) (CAS No 207-08-9) and Dibenzo(a,h)anthracene (DBAhA) (CAS No 53-70-3) are therefore included.

The composition of the Committee responsible for formulation of this standard is given in Annex B.For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 2022 'Rules for rounding off numerical values (*second revision*). The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

RECYCLED RUBBER — VULCANIZED CRUMB PARTICULATE SPECIFICATION

1 SCOPE

This Indian Standard prescribes classification based on particle size, requirements and methods of sampling and test for vulcanized crumb particulate, manufactured from rubber products like tyre and non-tyre. The rubber products include the vulcanized rejects, End-of-Life products.

2 REFERENCES

The following standards contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreement based on standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below.

IS No./Other Publication(s)	*Title*
460 (Part 1) : 2020	Test Sieves — Specification Part 1 Wire Cloth Test Sieves *(fourth revision)*
1070 : 1992	Reagent grade water-Specification **(***third revision)*
2500 (Part 1) : 2000/ISO 2859-1 : 1999	Sampling procedure for inspection by attributes: Part 1 **S**ampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection *(third revision)*
3400 (Part 22) : 1984	Methods of test for vulcanized rubber Part 22 Chemical analysis
3660 (Part 9) : 2016/ISO 1407 : 2011	Methods of test for natural rubber: Part 9 Determination of solvent extract [NR : 10] (*second revision*)
ISO 1408:1995	Rubber — Determination of carbon black content — Pyrolytic and chemical degradation methods
ISO 9924-1 : 2016	Rubber and rubber products — Determination of the composition of vulcanizates and uncured compounds by thermogravimetry — Part 1: Butadiene, ethylene-propylene copolymer and terpolymer, isobutene-isoprene, isoprene and styrene-butadiene rubbers
ISO 9924-2 : 2016	Rubber and rubber products — Determination of the composition of vulcanizates and uncured compounds by thermogravimetry — Part 2: Acrylonitrile-butadiene and halobutyl rubbers
ISO 9924-3 : 2009	Rubber and rubber products — Determination of the composition of vulcanizates and uncured compounds by thermogravimetry — Part 3: Hydrocarbon rubbers, halogenated rubbers and polysiloxane rubbers after extraction
ISO 19050 : 2015	Rubber, raw, vulcanised — Determination of metal content by ICP-OES

EN 16143 : 2013	Petroleum products — Determination of content of Benzo(a)pyrene (BaP) and selected polycyclic aromatic hydrocarbons (PAH) in extender oils — Procedure using double LC cleaning and GC/MS analysis

3 TERMINOLOGY

3.1 Vulcanized Particulate Rubber

Vulcanized Rubber that has been processed to give particulates different shapes, sizes, and size distributions.

3.2 Micronized Rubber

n-particulate rubber composed of mainly non-spherical particles that span a broad range of particle dimension between 75 µm to 250 µm (60 mesh to 200 mesh) as defined in detail in the Table below

3.3 Granulated Rubber

n-particulate rubber composed of mainly non-spherical particles that have the majority of particle size in between 19 mm to 251 µm as defined in detail in the Table below.

3.4 Designation Screen size

The designation screen size is the screen size which use for defining the product class of vulcanized crumb particulate rubber. Each designation screen size has a specified maximum retention percent value as given in Table 1.

Table 1 Vulcanized Crumb Particulate Classification (Granulated and Micronized)
(*Clause* 4)

Sl No.	**Product Classification**	**Equivalent Mesh Size**	**Designated Screen Size as Per IS 460 (Part 1)**	**Designated Screen Retention Percent, *Max***	**Zero Screen Size as Per IS 460 (Part 1)**	**Zero Screen Retention Percent, *Max***
(1)	(2)	(3)	(4)	(5)	(6)	(7)
i)	VCP 12.5	12.5 mm	12.5 mm	5	19 mm	0
ii)	VCP 8	8 mm	8 mm	5	12.5 mm	0
iii)	VCP 4	5 mesh	4 mm	5	6.3 mm	0
iv)	VCP 2.5	8 mesh	2.5 mm	5	4 mm	0
v)	VCP 2	10 mesh	2 mm	5	3.35 mm	0
vi)	VCP 850	20 mesh	850 µm	10	1.18 mm	1
vii)	VCP 600	30 mesh	600 µm	10	850 µm	1
viii)	VCP 425	40 mesh	425 µm	10	600 µm	1
ix)	VCP 300	50 mesh	300 µm	10	425 µm	1
x)	VCP 250	60 mesh	250 µm	10	355 µm	1
xi)	VCP 212	70 mesh	212 µm	10	300 µm	1
xii)	VCP 180	80 mesh	180 µm	10	250 µm	1
xiii)	VCP 150	100 mesh	150 µm	10	212 µm	1
ix)	VCP 125	120 mesh	125 µm	15	180 µm	2
x)	VCP 106	140 mesh	106 µm	15	150 µm	2
xi)	VCP 90	170 mesh	90 µm	15	125 µm	2
xii)	VCP 75	200 mesh	75 µm	15	106 µm	2

NOTE — The equivalent mesh size for the designated screen size as per column 4 of Table

Table 2 Vulcanized Crumb Particulate Manufactured from Tyre
(*Clause* 5.2)

Sl No	Characteristic	Requirement	Method of Test, Refer to
(1)	(2)	(3)	(4)
i)	Acetone extractable, percent	4-25	IS 3400 (Part 22)/IS 3660 (Part 9)[1)]
ii)	Carbon black, percent	20-38	IS 3400(Part 22)/ISO 1408[2)]
iii)	Loss on heating, *Max*, percent	1	Annex A
iv)	Rubber hydrocarbon content (RHC), *Min*, percent	40	IS 3400 (Part 22)
v)	Ash[4)], *Max*, percent	To report	IS 3400 (Part 22)[3)]/ISO 9924-1/ISO 9924-2 2/ISO 9924-3
vi)	Natural rubber[5)], percent	To report	IS 3400 (Part 22)
vii)	Metal content[5)], max, percent	To report	ISO 19050
viii)	Fiber content[5)], max, percent	To report	See note below the Table[6)]
ix)	Sum of Polycyclic-aromatic hydrocarbons (PAHs):	≤ 10 pphm	See note below the Table[7)]
	Benzo(a)pyrene (BaP), Benzo(e)pyren (BeP), Benzo(a)anthracene (BaA), Chrysen (CHR), Benzo(b)fluoranthene (BbFA), Benzo(j)fluoranthene (BjFA), Benzo(k)fluoranthene (BkFA) and Dibenzo(a,h)anthracene (DBAhA)		

[1)]In case of dispute, IS 3660 (Part 9) shall be the referee method for the determination of acetone extractable.
[2)]In case of dispute, ISO 1408 shall be the referee method for the determination of carbon black.
[3)]In case of dispute, IS 3400 (Part 22) shall be the referee method for the determination of ash.
[4)]Values as agreement between to the purchaser and the supplier as this is variable depending on the inorganic content of the input material (silica, clay, etc.).
[5)]Values as agreement between to the purchaser and the supplier as this is variable between tyres due to variations in the input material.
[6)] Any validated test method to be used till corresponding Indian Standard is developed.
[7)]EN 16143 or any validated test method to be used till corresponding Indian Standard is developed.

Table 3 Vulcanized Crumb Particulate Manufactured from Non-Tyre
(*Clause* 5.3)

Sl No	Characteristic	Requirement	Method of Test, Refer to
(1)	(2)	(3)	(4)
i)	Acetone extract, percent	4-25	IS 3400 (Part 22)/IS 3660 (Part 9)[1)]
ii)	Carbon black, *Max*, percent	40	IS 3400(Part 22)/ISO 1408[2)]
iii)	Loss on heating, *Max*, percent	1	Annex A
iv)	Rubber hydrocarbon content (RHC), *Min*, percent	20	IS 3400 (Part 22)
v)	Ash[4)], *Max*, percent	To report	IS 3400 (Part 22)[3)]/ISO 9924-1/ISO 9924-2 2/ISO 9924-3

[1)]In case of dispute, IS 3660 (Part 9) shall be the referee method for the determination of acetone extractable.
[2)]In case of dispute, ISO 1408 shall be the referee method for the determination of carbon black.
[3)]In case of dispute, IS 3400 (Part 22) shall be the referee method for the determination of ash.
[4)]Values as agreement between to the purchaser and the supplier as this is variable depending on the inorganic content of the input material (silica, clay, etc.).

6 PACKING AND MARKING

6.1 Packing

The material shall be packed in HDPE/PP woven sacks conforming to IS 11652 or in containers or as agreed to between the purchaser and the supplier.

6.2 Marking

Each bag/packing document shall be marked with the following:

a) Name and class of the product;
b) Net weight of the material, in kg;
c) Name of the manufacturer;
d) Batch number;
e) Month and year of the manufacture;
f) In case of vulcanized crumb particulate (VCP) are manufactured from Tyre, the word 'Tyre VCP';
g) In case of vulcanized crumb particulate (VCP) are manufactured from non-Tyre, the word 'Non-tyre VCP';
h) Additional marking requirements, if required, as agreed between the manufacturer and user; and
j) Any other statutory requirement.

6.2.1 For supplies of crumb rubber in container(s), a test report containing the following additional information shall be provided for each consignment:

a) Supply date; and

b) container(s) number.

The test report shall be certified by authorized person of the manufacturer's organization.

6.3 BIS Certification Marking

The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act*, 2016 and the Rules and Regulations framed thereunder, and the products may be marked with the standard mark.

7 SAMPLING AND CRITERIA FOR CONFORMITY

7.1 Lot

Vulcanized crumb particulate in a single consignment of a single class, belonging to same batch of manufacture, shall constitute a lot.

7.2 Unless otherwise agreed to between the purchaser and the supplier, the sampling procedure given in IS 2500 (Part 1) shall be followed.

7.3 Lot shall be declared as conforming to the requirements of the specification, if all the test results on the test samples satisfy the corresponding requirements as given in Table 2 and Table 3.

8 TEST METHOD

8.1 Tests shall be conducted according to the methods prescribed in relevant standards which are given in Table 2 and 3.

8.2 Quality of Reagent

Unless otherwise specified 'pure chemicals' and distilled water (*see* IS 1070) shall be employed in tests.

NOTE — 'Pure chemicals' shall mean chemicals that do not contain impurities which affect the results of analysis.

ANNEX A
(*Clause* 5.3)

DETERMINATION ON LOSS ON HEATING (OVEN METHOD)

A-1 PRINCIPLE

Test portion is taken from the sample and is dried in an oven to constant mass at a specified temperature. The measured weight loss is estimated as loss on heating.

NOTE — The number of test portions shall be as agreed between the interested parties.

A-2 APPARATUS

A-2.1 Oven

ventilated, preferably air-circulating type, capable of being maintained at 105 °C ± 5 °C.

A-2.2 Balance, capable of weighing to the nearest 0.1 mg.

A-3 PROCEDURE

A-3.1 Take a test portion of about 10 g ± 0.1g from the test sample in suitable aluminium tray or silica crucible or glass petri dish which was previously dried at 105 °C and cooled in desiccator (mass m1).

A-3.2 Dry the test portion in the oven, maintained at 105 °C ± 5 °C at least for 2h, with the ventilators open and with the air-circulating fan, switched on. Arrange the test piece so as to present the largest possible surface area to the hot air. After heating for specified time, allow to cool to room temperature in a desiccator and weigh. Repeat the heating for further 30 min periods until the mass does not decrease by more than 1 mg between successive weighing (final mass m2).

A-4 EXPRESSION OF RESULTS

A-4.1 The heat loss content w_1 is given, as a percent mass fraction, by the following formula:

$$w_1 = \frac{m_1 - m_2}{m_1} \times 100$$

where

m_1 = mass of the test portion and the aluminium tray or silica crucible or glass petri dish before drying, in g; and

m_2 = mass of the test portion and the aluminium tray or silica crucible or glass petri dish after drying, in g.

ANNEX B
(*Foreword*)

COMMITTEE COMPOSITION

Rubber and Rubber Products Sectional Committee, PCD 13

Organization	*Representative(s)*
Rubber Research Institute of India, Rubber Board, Kottayam	DR SIBY VARGHESE **(*Chairaperson*)**
All India Rubber Industries Association, Mumbai	SHRI SRIKANTH KRISHNAMURTHY SHRI CHINMOY RAY (*Alternate*)
Association of Latex Producers of India, Kerala	SHRI SATISH ABRAHAM
Association of Planters of Kerala, Thiruvananthapuram	SHRI SANTOSH KUMAR SHRI PHILIP C. JACOB (*Alternate*)
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Research, Designs and Standards Organization (RDSO), Lucknow	SHRI MNJESH KUMAR
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Voluntary Organization in Interest of Consumer Education (VOICE), New Delhi	SHRI M. A. U. KHAN SHRI H. WADHWA (*Alternate*)
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Member Secretary
VIJAY KUMAR GUPTA
SCIENTIST 'D' (PCD), BIS

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Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the website-www.bis.gov.in or www.standardsbis.in.

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Amend No.	Date of Issue	Text Affected

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