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BSI Standards Publication

Source materials considered in the development of the Aggregate standards of TC 154

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National foreword

This Published Document is the UK implementation of CEN/TS 17438:2020.

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A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Source materials considered in the development of the Aggregate standards of TC 154

Bei der Erarbeitung der Normen für Gesteinskörnungen des CEN/TC 154 betrachtete Ausgangsstoffe

This Technical Specification (CEN/TS) was approved by CEN on 29 December 2019 for provisional application.

The period of validity of this CEN/TS is limited initially to three years. After two years the members of CEN will be requested to submit their comments, particularly on the question whether the CEN/TS can be converted into a European Standard.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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European foreword

This document (CEN/TS 17438:2020) has been prepared by Technical Committee CEN/TC 154 "Aggregates", the secretariat of which is held by BSI.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association.

CEN/TC 154 intends to keep this document under continual review. Any relevant information to assist in the updating, including any proposal for the incorporation of new source material types, can be submitted to the secretariat of CEN/TC 154. The procedure for inclusion of new source materials is described in Clause 6.

Source materials not described in this document can still be used as an aggregate, but the applicant will be aware that the relevant standard will not necessarily include all relevant aspects for use.

Due to the dynamic character of this document, no reference from the TC 154 Aggregate standards towards this document is made with regard to the scope of these standards.

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to announce this Technical Specification: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

1 Scope

This document informs users about the source materials that have been considered in the development of the aggregate standards:

— EN 12620, *Aggregates for concrete*;

— EN 13043, *Aggregates for bituminous mixtures and surface treatments for roads, airfields and other trafficked areas*;

— EN 13139, *Aggregates for mortar*;

— EN 13242, *Aggregates for unbound and hydraulically bound materials for use in civil engineering work and road construction*;

— EN 13383-1, *Armourstone — Part 1: Product standard*;

— EN 13450, *Aggregates for railway ballast*;

— EN 13055, *Lightweight aggregates*;

Only source materials with a history of use in one or more member states are included in this document. It also specifies source materials with a history of use for the scope of only one specific aggregate standard.

2 Normative references

There are no normative references in this document.

3 Terms, definitions, symbols and abbreviations

3.1 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at https://www.iso.org/obp

3.1.1
aggregate
granular material of natural, manufactured or recycled origin used in construction

3.1.2
lightweight aggregate
LWA
granular material of mineral origin having a particle density not exceeding 2 000 kg/m^3 (2,00 Mg/m^3) or a loose bulk density not exceeding 1 200 kg/m^3 (1,20 Mg/m^3)

3.1.3
manufactured aggregates
aggregate of mineral origin resulting from an industrial process involving thermal or other modification

3.1.4
natural aggregate
aggregate from mineral sources which has been subjected to nothing more than mechanical processing

3.1.5
recycled aggregates
aggregate resulting from the processing of inorganic mineral material previously used in construction

NOTE Recycled aggregates can also be obtained from production residues or nonconforming products, e.g. crushed unused concrete.

4 Source materials for aggregates

4.1 Source materials with a history of use

All source materials which have been considered in the preparation of aggregate standards EN 12620, EN 13043, EN 13139, EN 13242, EN 13383-1 and EN 13450 are listed in Table 1.

In some member states, there are additional requirements for the use of secondary aggregates. These additional requirements are summarized in Table 2. It is advised to control all relevant specific requirements in accordance with requirements at the place of use.

Table 1 — Inventory list with classification codes and status for source materials for aggregates standards by CEN/TC 154

Nr.	Source	Sub-nmbr	Specific material	EN 12620	EN 13043	EN 13139	EN 13242	EN 13383	EN 13450
P	Natural aggregates	P	All rock types included in EN 932-3	Yes	Yes	Yes	Yes	Yes	Yes
A	Construction and demolition recycling industries	A1	Reclaimed asphalt[a]	No	(Yes)[a]	No	Yes	No	No
		A2	Crushed concrete	Yes	No	No	Yes	Yes	No
		A3	Crushed bricks, masonry	Yes	No	No	Yes	No	No
		A4	Hydraulically bound and unbound materials	Yes	No	No	Yes	No	No
		A5	Mix of A1, A2, A3 and A4	Yes	No	No	Yes	Yes[b]	No
		A6	Recycled railway ballast	Yes	Yes	No	Yes	No	Yes
B	Municipal solid waste incineration industry	B1	Municipal incinerator bottom ash (excluding fly ash) (MIBA)[c]	Yes	Yes	No	Yes	No	No
		B2	Municipal incinerator fly ash (MIFA)	No	Yes (Only as a component of composite filler[d])	No	No	No	No
C	Coal power generation industry	C1	Coal fly ash	Yes	Yes	Yes	Yes	No	No
		C2	Fluidized bed combustion fly ash (FBCFA)	No	Yes	No	Yes	No	No
		C3	Boiler slag	Yes	Yes	No	Yes	No	No
		C4	Coal bottom ash	No	No	No	Yes	No	No
		C5	Fluidized bed combustion bottom ash (FBC bottom ash)	No	No	No	Yes	No	No

Nr.	Source	Sub-nmbr	Specific material	EN 12620	EN 13043	EN 13139	EN 13242	EN 13383	EN 13450
D	Iron and steel industry	D1	Granulated blast furnace slag (GBS) (vitrified)	Yes	No	No	Yes	No	No
		D2	Air-cooled blast furnace slag (ABS) (crystallized)	Yes	Yes	Yes	Yes	Yes	No
		D3	Basic oxygene furnace slag (converter slag, BOS)	Yes	Yes	No	Yes	Yes	No
		D4	Electric arc furnace slag (from carbon steel production, EAF C)	Yes	Yes	No	Yes	Yes	No
		D5	Electric arc furnace slag (from stainless/ high alloy steel production, EAF S)	Yes	Yes	No	Yes	No	No
E	Non-ferrous industry	E1	Copper slag	Yes	Yes	No	Yes	Yes	No
		E2	Molybdenum slag	Yes	Yes	No	Yes	No	No
		E3	Zinc slag	Yes	No	No	Yes	No	No
		E4	Phosphorus slag	No	Yes	No	Yes	Yes	No
		E5	Lead slag	Yes	No	No	No	Yes	No
		E6	Ferrochromium slag	Yes	Yes	No	Yes	No	No
F	Foundry industry	F1	Foundry sand	Yes	Yes	No	Yes	No	No
		F2	Foundry cupola furnace slag	No	Yes	No	Yes	No	No
G	Mining and quarry industry	G1	Red coal shale	No	No	No	Yes	No	No
		G2	Refuse from hard coal mining (black coal shale)	No	No	No	Yes	Yes	No
		G3	Pre-selected all-in from quarry/mining	No	No	No	Yes	No	No
		G4	Spent oil shale	No	No	No	Yes	No	No
H	Maintenance dredging works	H1	Dredge spoil sand	Yes	No	No	Yes	No	No
I	Miscellaneous	I1	Paper sludge ash	Yes	Yes (Only as a component of composite filler[d])	No	Yes	No	No
		I2	Sewage sludge incineration ash (municipal)	No	Yes (Only as a component of composite filler[d])	No	Yes	No	No
		I3	Biomass ash	No	Yes (Only as a component of composite filler[d])	No	Yes	No	No
		I4	Crushed glass	Yes	Yes	No	Yes	No	No

[a] Reclaimed Asphalt is an established component for bituminous mixtures but not an aggregate fitting to the scope of this specification.

[b] Only A2 and A3.

[c] Requirements on MIBA are based on experience with grated installations.

[d] Filler aggregate of mineral origin, which has been produced using two or more sources in Table 1.

4.2 Source materials with identified requirements on additional characteristics

In situations where the need for additional requirements has been identified by one or more Member States, this means that these additional requirements are not (yet) included in the relevant standard(s). This means that these sources are only suitable for its intended use when also the identified characteristics in that Member State are taken into account before placed on the market as aggregates. Additional characteristics may be specified on a case by case basis depending upon experience of use of the product, and defined in specific contractual documents.

Table 2 — Source materials with a positive history of use and additional requirements in one or more Member States

Nr.	Source	Sub-nmbr	Material	EN 12620	EN 13043	EN 13139	EN 13242	EN 13383	EN 13450
P	Natural aggregates	P	All rock types including 9.2.3						
A	Construction and demolition recycling industries	A1	Recycled asphalt[a]						
		A2	Crushed concrete						
		A3	Crushed bricks, masonry						
		A4	Hydraulically bound and unbound materials						
		A5	Mix of A1, A2, A3 and A4						
		A6	Recycled railway ballast						
B	Municipal solid waste incineration industry	B1	Municipal incinerator bottom ash[b] (excluding fly ash) (MIBA)	Loss on ignition or TOC Content of metals (Soundness)	Loss on ignition or TOC Content of metals (Soundness) Swelling		Loss on ignition or TOC Content of metals (Soundness)		
		B2	Municipal incinerator fly ash (MIFA)						
C	Coal power generation industry	C1	Coal fly ash	Loss on ignition or TOC	Loss on ignition or TOC				
		C2	Fluidized bed combustion fly ash (FBCFA)						
		C3	Boiler slag						
		C4	Coal bottom ash				Loss on ignition or TOC		
		C5	Fluidized bed combustion bottom ash (FBC bottom ash)						
D	Iron and steel industry	D1	Granulated blast furnace slag (GBS) (vitrified)						
		D2	Air-cooled blast furnace slag (ABS) (crystallized)	Thermal conductivity	Thermal conductivity		Thermal conductivity		
		D3	Basic oxygene furnace slag (converter slag, BOS)	Thermal conductivity	Thermal conductivity		Thermal conductivity		
		D4	Electric arc furnace slag (from carbon steel production, EAF C)						
		D5	Electric arc furnace slag (from stainless/high alloy steel production, EAF S)						

Nr.	Source	Sub-nmbr	Material	EN 12620	EN 13043	EN 13139	EN 13242	EN 13383	EN 13450
P	Natural aggregates	P	All rock types included in EN 932-3						
E	Non-ferrous industry	E1	Copper slag						
		E2	Molybdenum slag						
		E3	Zinc slag						
		E4	Phosphorus slag						
		E5	Lead slag						
		E6	Ferrochromium slag						
F	Foundry industry	F1	Foundry sand		Swelling				
		F2	Foundry cupola furnace slag		Dicalcium silicate and iron dis-integration		Dicalcium silicate and iron dis-integration		
G	Mining and quarry industry	G1	Red coal shale						
		G2	Refuse from hard coal mining (black coal shale)				Coal content		
		G3	Pre-selected all-in from quarry/ mining						
		G4	Spent oil shale						
H	Maintenance dredging works	H1	Dredge spoil sand						
		H2	Dredge spoil clay						
I	Miscellaneous	I1	Paper sludge ash				Loss on ignition or TOC		
		I2	Sewage sludge incineration ash (municipal)				Loss on ignition or TOC		
		I3	Biomass ash				Loss on ignition or TOC		
		I4	Crushed glass						

[a] Reclaimed Asphalt is an established component for bituminous mixtures but not an aggregate fitting to the scope of this specification.

[b] Requirements on MIBA are based on experience with grated installations.

5 Source materials for lightweight aggregates (LWA)

The source materials listed in Table 4 have been considered in the preparation of the lightweight aggregate standard EN 13055 for the relevant intended uses as defined in Table 3 of this document.

In situations where the need for additional requirements has been identified (see Table 4), such materials, when placed on the market as aggregates, should comply with this document but may also be obligated to comply with specific relevant additional requirements at the place of use. Additional requirements may be specified on a case-by-case basis depending upon experience of use of the product, and defined in specific contractual documents.

In all cases, there is an obligation to assess requirements at the place of use.

Table 3 — Intended use for lightweight aggregates (LWA)

Intended uses	Concrete	Mortar and grout	Bituminous mixtures and surface treatments	Unbound and hydraulically bound mixtures (other than concrete, mortar and grout)
Codes in Table 4	U1	U2	U3	U4

Table 4 — Inventory list of source materials for lightweight aggregates (LWA)

Nr.	Source material	Sub-Nmbr	Specific LWA material	Positive history of intended uses [d]	Specific requirements in this standard	Additional requirements identified for inclusion
LA	Natural LWA	LA1	Pumice	U1,U2, U4	Yes	No
		LA2	Scoria	U1, U2, U3, U4	Yes	No
		LA3	Tuff	U1, U4	Yes	No
LB	Manufactured LWA from natural source materials	LB1	Expanded clay	U1, U2, U3, U4	No	No
		LB2	Expanded shale	U1, U2, U3, U4	No	No
		LB3	Expanded slate	U1, U2, U3, U4	No	No
		LB4	Expanded perlite	U1, U2, U3, U4	No	No
		LB5	Exfoliated vermiculite	U1, U2, U3, U4	No	No
LC	Manufactured LWA from by-products of industrial processes or recycled source materials	LC1	Sintered fly ash	U1, U2, U3, U4	No	No
		LC2	Cold bonded fly ash	U1, U2, U4	No	No
		LC3	Foamed blast furnace slag [a]	U1, U2, U4	No	No
		LC4	Expanded pelletized blast furnace slag [a]	U1, U2, U4	No	No
		LC5	Expanded glass	U1, U2, U3, U4	No	Yes
		LC6	Foamed glass	U1, U4	No	Yes
LD	LWA as by-products of industrial processes	LD1	Furnace clinker [b,c]	U1, U2, U4	Yes	No
		LD2	(Furnace) Bottom ash (BA, FBA) [c]	U1, U2, U3, U4	Yes	No
		LD3	Fly ash (FA, PFA) [c]	U1, U2, U3, U4	Yes	No

[a] From iron- and steel production.

[b] Ash from boilers fired with coal, which has not been pulverized, typically known as chain-grate or spreader-stoker boilers.

[c] From coal fired power generation.

[d] Intended uses/applications as defined in Table 3.

6 Procedure for the incorporation of new source materials

A request for the incorporation of new source materials into this document will be taken into account when this request is made by at least one of the CEN members and the request is based on the actual routine application of an aggregate from this new source on the market.

The request is formally taken into consideration by CEN/TC 154.

Basic information on the following items has to be provided as an input for the request. Use the format in Table 5.

Table 5 — Information requested for new source materials

Subject	General information to be given by applicant
CEN Member	*From one or more CEN Members*
Definition	*Clear description of the source material*
Field of application(s)	*Applicable CEN/TC 154 standard (s)*
Technical information	*Material characteristics and end use information*
Experience/quantity/demonstration	*Existing applications, not only laboratory experience*
Criteria used to control the quality of material	*Factory production control, national regulation(s) or private assessment*
Additional requirements necessary to consider	

CEN/TC 154 can request for additional information from the CEN Member.

7 Descriptions

For convenience, Table 6 gives a global description of the source materials in this document.

Table 6 — Description of source materials

Nr.	Source	Sub nmbr	Material	Definition
A	Construction and demolition recycling industries	A1	Reclaimed asphalt	Aggregate obtained by processing bituminous layers
		A2	Crushed concrete	Aggregate obtained by processing concrete
		A3	Crushed bricks, masonry	Aggregate obtained by processing demolition brick work and masonry
		A4	Hydraulically bound and unbound materials	Aggregate obtained by processing hydraulically bound and unbound materials
		A5	Mixed A1, A2, A3 and A4	Aggregate obtained by processing a mix of bituminous layers and/or concrete and/or demolition brick work and masonry
B	Municipal solid waste incineration industry	B1	Municipal incinerator bottom ash [a] (excluding fly ash) (MIBA)	Aggregate obtained by processing 'bottom ash' [b] following the incineration of Municipal Solid Waste (domestic and commercial) by a 'moving grate' or 'fluidised bed' or 'gasification' process
		B2	Municipal incinerator fly ash (MIFA)	Aggregate obtained from flue gas following the incineration of municipal solid waste (domestic and commercial) by a 'moving grate' or 'fluidised bed' or 'gasification' process, captured by flue gas treatment (FGT) systems and in some cases 'electrostatic precipitators'
C	Coal Power generation industry	C1	Coal fly ash (FA or PFA)	Aggregate obtained from flue gas following the burning of pulverised coal, with or without co-combustion materials, captured by electrostatic precipitators
		C2	Fluidized bed combustion fly ash (FBCFA)	Aggregate obtained from flue gas following coal burning with or without co-combustion in fluidized bed combustion boilers at temperatures of 750 °C to 900 °C
		C3	Boiler slag (BS)	Aggregate obtained from coal combustion in boilers at temperatures of 1 500 °C to 1 700 °C, followed by wet ash removal of wet bottom furnaces
		C4	Coal bottom ash (BA or FBA)	Aggregate obtained from the bottom of dry boilers, derived from the combustion of coal with or without co-combustion
		C5	Fluidized bed combustion bottom ash (FBC bottom ash)	Aggregate obtained from the bottom of fluidized bed combustion boilers at temperatures of 800 °C to 900 °C, derived from the burning of coal with or without co-combustion

Nr.	Source	Sub nmbr	Material	Definition
D	Iron and steel industry	D1	Granulated blast furnace slag (GBS) (vitrified)	Aggregate generated during the manufacture of iron by thermochemical reduction in a blast furnace. It is formed in a continuous process by the fusion of limestone (and/or dolomite) and other fluxes with the residues from the carbon source and the non-metallic components of the iron bearing materials (e.g. iron ore, iron sinter). Blast furnace slag is generated at temperatures above 1 500 °C. Dependent on the way of cooling of the liquid slag it can be distinguished between crystalline air-cooled blast furnace slag (ABS) and glassy granulated blast furnace slag (GBS)
		D2	Air-cooled blast furnace slag (ABS) (crystallized)	
		D3	Basic oxygene furnace slag (converter slag, BOS)	Aggregate formed during the conversion of liquid iron (hot metal) into steel during a batch process in a basic oxygen furnace. The slag is generated by the addition of fluxes, such as limestone and/or dolomite, during blowing oxygen into the melt. Due to the oxidising conditions some elements (like Fe and Mn) are partly oxidized and contribute to the formation of the slag. Furthermore, some components are either oxidized to gas (like carbon) or are chemically bound in the slag (like silicon or phosphorus). The liquid slag which has tapping temperatures of around 1 600 °C is air-cooled under controlled conditions in pits forming crystalline slag
		D4	Electric arc furnace slag (from carbon steel production, EAF C)	Aggregate formed during melting steel scrap in an electric arc furnace, converter and ladles. The slag is generated by the addition of fluxes, such as limestone and/or dolomite. Furthermore, some elements of the melt are oxidized and contribute to the formation of the slag. The liquid slag which has tapping temperatures of around 1 600 °C is air cooled (possibly applying small amounts of water) under controlled conditions in pots or pits forming crystalline slag.
		D5	Electric arc furnace slag (from stainless/high alloy steel production, EAF S)	Aggregate formed during the manufacture of stainless or high alloy steel in different metallurgical vessels, e.g. electric arc furnace, converter and ladles. In this process, scrap (in some cases direct reduced iron) together with alloys is melted to stainless or special steel by means of electrical and chemical energy. The slag is generated by the addition of fluxes and reducing agents, e.g. lime and/or dolomite, silicon compounds or aluminium. The liquid slag which has tapping temperatures of around 1 600 °C is treated if necessary to improve the properties of the slag. Then, the slag is cooled under controlled conditions in pots or pits forming crystalline slag.

Nr.	Source	Sub nmbr	Material	Definition
E	Non ferrous industry	E1	Copper slag	Aggregate obtained from the manufacture of copper in a furnace process. Aggregate is generated from primary or secondary copper raw material during the copper production by thermochemical processes at high temperature, or during processes to clean copper rich slag in an electric furnace, fuming plant or flotation plant. Dependent on the way of cooling the liquid slag which has tapping temperatures of more than 1 100 °C it can be distinguished between air-cooled crystalline slag and water-cooled glassy granulated slag. Main constituents are iron silicate and calcium-aluminium silicates, present as amorphous glass and/or crystalline structures. Residual trace metals (e.g. Fe, Cu, Zn) are chemically bound in the glass/crystalline structures.
		E2	Ferromolybdenum slag	Aggregate generated during a metallo-thermic reduction process to produce ferromolybdenum from roasted molybdenite concentrate and other raw materials. After the exothermic smelting operation, the reaction products are cooled down. The slag is a glass-like fraction that forms above and separates from the ferromolybdenum. The slag is primarily composed of fused silicates and aluminates of calcium, magnesium and iron oxides, with minimal residual molybdenum content.
		E3	Zinc slag	Aggregate obtained from the pyrometallurgical step when treating zinc-bearing materials. The slag is generated from primary and/or secondary sources by thermochemical reduction at high temperatures of around 1 100 °C. The faster the cooling of the tapped slag is, the more glassy and less crystalline its structure is. Main constituents are calcium ferrites and iron-calcium-aluminium silicates. Residual trace metals (e.g. Pb, Cu, Zn, Mn) are chemically bound in the glass/crystalline structures.
		E4	Phosphorous slag	Aggregate produced from the manufacture of phosphorus in an electric arc furnace process. The slag is generated from primary and secondary source materials during the phosphorus production by electrothermal reduction at high temperature. The liquid slag, which has a tapping temperature > 1 200 °C, is air-cooled under controlled conditions in pits, forming crystalline slag.
		E5	Lead slag	Aggregate formed during lead production.
		E6	Ferrochromium slag	Aggregate formed during of ferrochromium production. Slag product processing starts from melt phase. Ferrochromium and ferrochromium slag are manufactured in high temperatures by reducing chromite, which is chrome and iron oxides containing mineral. Materials which do not dissolve into metallic ferrochromium phases form primarily silicate phases, which form the ferrochromium slag.
F	Foundry industry	F1	Foundry sand	Aggregate obtained in iron, steel and malleable iron foundries as well as in non-ferrous foundries during core making, preparation of moulding material and after casting and shake out of the moulds.
		F2	Foundry cupola furnace slag	Aggregate formed during operation of a cupola furnace in iron foundries. Cupola furnace slag is mainly generated through oxidic substances that are not dissolved in liquid iron. It is formed by adhesion to charge materials such as adhesions to sand. Fluxes such as limestone also contribute to the formation of slag. The liquid slag is cooled and forms crystalline or glassy slag. Residual trace metals are bound in the glass/crystalline structures.

Nr.	Source	Sub nmbr	Material	Definition
G	Mining and quarry industry	G1	Red coal shale	Aggregate produced from the burning of black coal shale
		G2	Refuse from hard coal mining (black coal shale)	Aggregate produced from black coal shale (black mine stone)
		G3	Pre-selected all-in from quarry/mining	Aggregates from quarrying/mining activities not being intended to produce aggregates(by-products).
		G4	Spent oil shale	Aggregate from the shale oil extraction process
H	Maintenance dredging works	H1	Dredge spoil	Aggregate produced from dredging
I	Miscellaneous	I1	Paper sludge ash	Aggregate produced from the incineration of paper sludge
		I2	Sewage sludge incineration ash (municipal)	Aggregate produced from the incineration of sewage sludge (mostly communal sludge)
		I3	Biomass ash	Aggregate produced from the incineration of biomass
		I4	Crushed glass	Aggregate obtained by processing glass

a Requirements on MIBA are based on experience with grated installations.

b Bottom ash can include a small amount of 'boiler ash'.

Bibliography

[1] EN 12620, *Aggregates for concrete*

[2] EN 13043, *Aggregates for bituminous mixtures and surface treatments for roads, airfields and other trafficked areas*

[3] EN 13055, *Lightweight aggregates*

[4] EN 13139, *Aggregates for mortar*

[5] EN 13242, *Aggregates for unbound and hydraulically bound materials for use in civil engineering work and road construction*

[6] EN 13383-1, *Armourstone – Part 1: Specification*

[7] EN 13450, *Aggregates for railway ballast*

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