

The role of slags and other by-products within circular economy in the steel industry

- Ferrous Slags in Germany: Regulatory Framework and Its Impact on Utilization
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*ESTEP Focus
Group Circular
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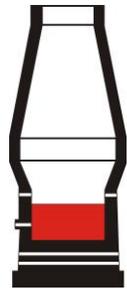
Ferrous Slags in Germany: Regulatory Framework and Its Impact on Utilization

Outline

- 1. Production and use of ferrous slag in Germany 2023**
- 2. The use of ferrous slags – regulatory requirements**
 - Use of ferrous slags as aggregates in road construction
 - Use of ferrous Slag in cement or concrete
 - Use of slag-based fertiliser lime
- 3. Key regulatory issues for ferrous slags in Germany: Enhancing the Circular Economy**



1. Production and use of ferrous slag in Germany 2023



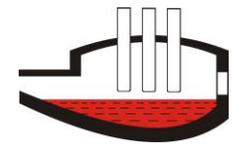
Blast Furnace Slag

7.77 Mt

Production: 11.4 Mt

Steel Slag

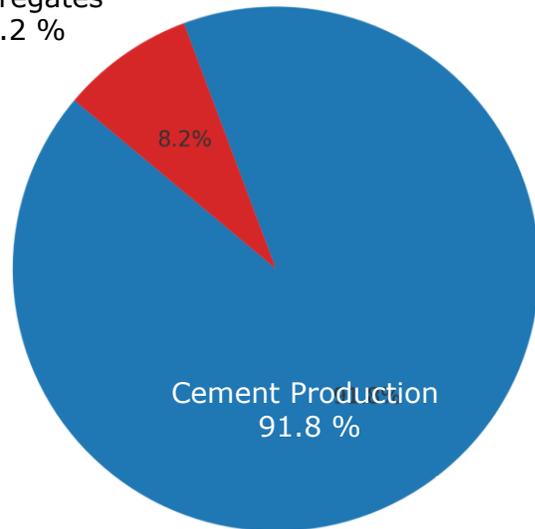
3.25 Mt



EAF: 1,2

BOS: 2,7

Aggregates
8.2 %

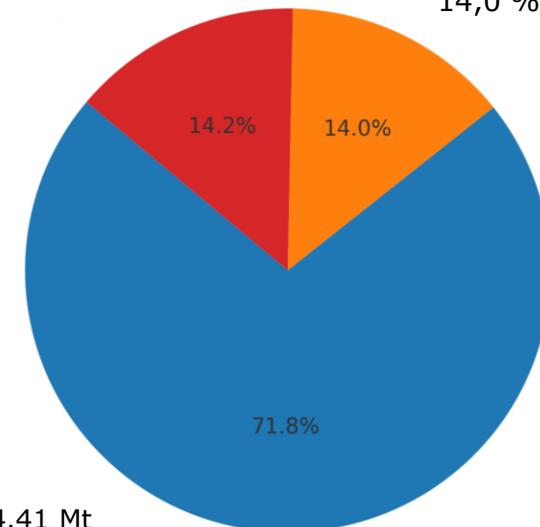


Production 7.00 Mt
From Storage 0.77 Mt

**Utilisation: 11.0 Mt
(= 96 %)**

Metallurgical Use
14.2 %

Fertiliser
14,0 %



Production 4.41 Mt
Itemim Storage - 0.71 Mt
Deposit -0.45 Mt

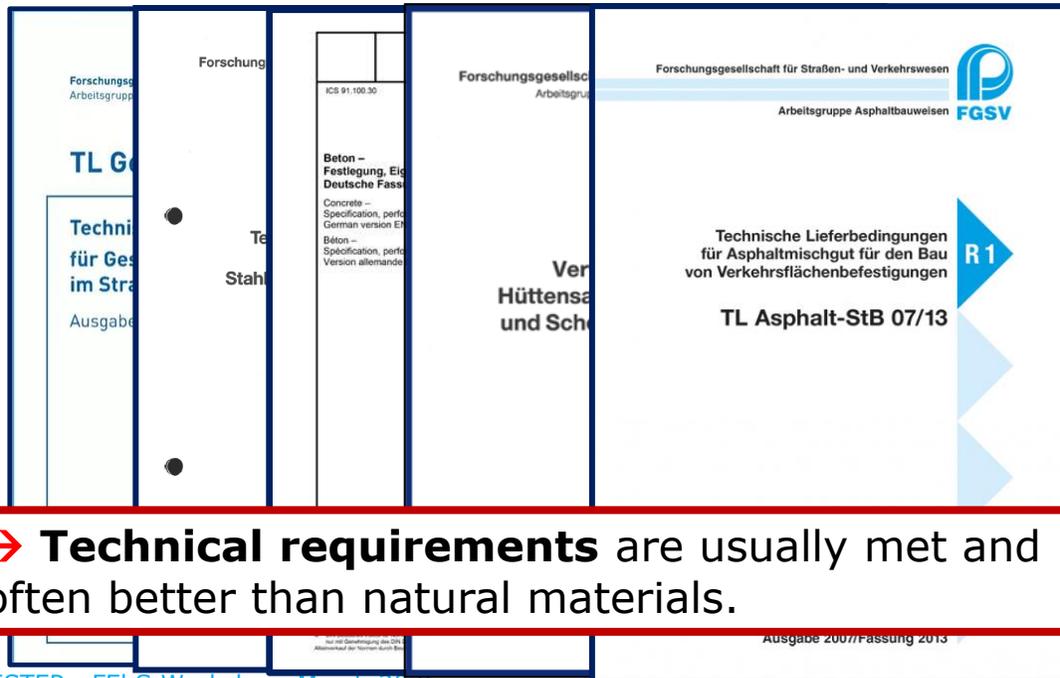
Construction Material
71.8 %

Urban Roads	26.1
Rural Roads	38.3
Earthworks	6.5
Track Building	0.9
Water Engineering	< 0.1

2. The use of ferrous slags – regulatory requirements

Technical Requirements

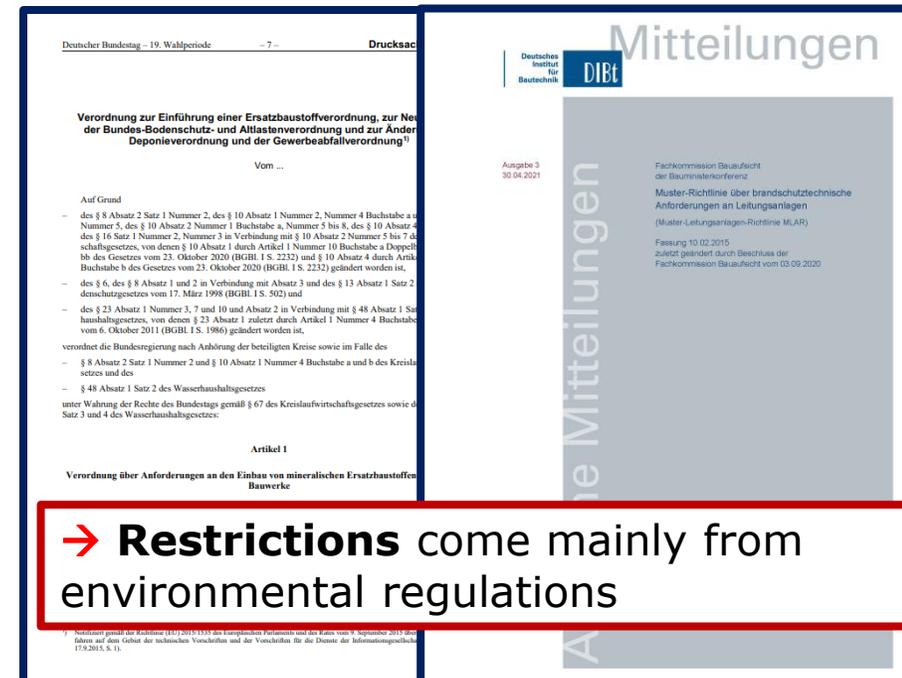
Depending on the application, different requirements are given in standards or guidelines, e.g. **volume stability, water and frost resistance, abrasion resistance, and compressive strength**



→ **Technical requirements** are usually met and often better than natural materials.

Environmental Requirements

Depending on the application, national requirements are given in regulations or guidelines and must be met, different limit values apply.



→ **Restrictions** come mainly from environmental regulations

Use of Ferrous Slags as Aggregates in Road Construction

Substitute Construction Materials Ordinance

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Ersatzbaustoffverordnung (EBV)



Use of Ferrous Slags as Aggregates in Road Construction

Substitute Construction Materials Ordinance (EBV)

- Part of an Umbrella Ordinance
- Came into force on 1 August 2023 after 16 years of development
- First nationally binding regulation for the use of **mineral substitute construction materials / secondary raw materials**
- Replaced the previous patchwork of inconsistent state regulations
- Defines environmental requirements for the use of MEB in technical structures (road and earthworks, railway dams, noise protection walls, etc.)
- Applies to a wide range of materials (**MEB**): soils, RC-materials, ferrous slags, copper slag, bricks, track ballast, incinerator bottom ash, lignite fly ash, coal fly ash, foundry residual sand

Ordinance introducing a **Substitute Construction Materials Ordinance**, redrafting the **Federal Soil Protection and Contaminated Sites Ordinance** and amending the **Landfill Ordinance** and the **Commercial Waste Ordinance**

Article 1

Ordinance on Requirements for the Use of Mineral Substitute Construction Materials in Technical Structures

Article 2

Soil Protection and Contaminated Sites Ordinance

Article 3

Landfill Ordinance

Article 4

Commercial Waste Ordinance

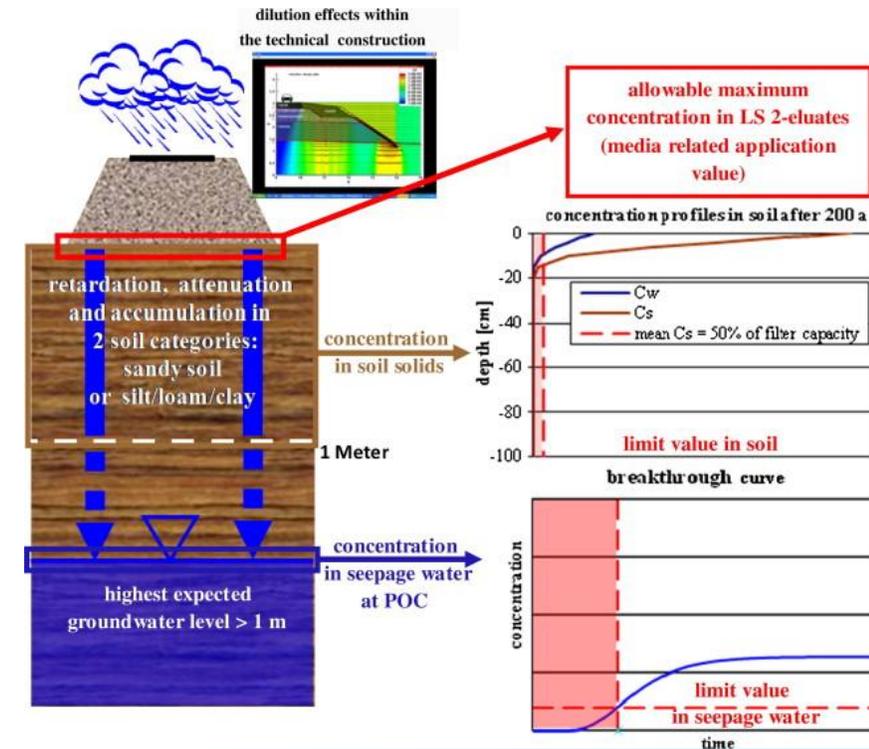
Article 5

Entry into force / Coming into effect

Use of Ferrous Slags as Aggregates in Road Construction

Substitute Construction Materials Ordinance (EBV)

- Developed under the leadership of the German Federal Ministry of Environment, based on 40+ research projects, including a large-scale joint research initiative on groundwater risk assessment.
- A media-related approach focusing on soil and groundwater protection.
- Two-step evaluation:
 - Leaching quantification – Measuring substance release from MEB (source term).
 - Transport modeling – Predicting migration through soil to groundwater (transport term), considering key influencing factors.
- Resulting **material values** (limit values) and **material classes** set standardized criteria for the safe and sustainable use of MEB in construction.
- Key decision criterion: Eluate concentrations at $L/S = 2$.



Use of Ferrous Slags as Aggregates in Road Construction

Substitute Construction Materials Ordinance (EBV)- material classes

		Blast Furnace Slag		GBS	Steel Slag	
		HOS-1	HOS-2	HS	SWS-1	SWS-2
pH-value¹⁾	-	9 - 12	9 - 12	8 - 12	9 - 13	9 - 13
elect. Conduct. ¹⁾	µS/cm	5.000	7.000	4.000	10.000	10.000
SO₄	mg/l	1.300	3.600	350		
F	mg/l				1,1	4,7
Cr	µg/l				110	190
Mo	µg/l				55	400
V	µg/l			55	180	450

¹⁾ Substance-Specific Reference Value – if exceeded, the cause must be investigated.

Use of Ferrous Slags as Aggregates in Road Construction

Substitute Construction Materials Ordinance (EBV) - Quality assurance

Initial material characterisation
Proof of suitability (EgN)

Percolation test
DIN 19528 (2009)



L/S: 4:1

➔ All four eluate fractions must be determined and documented.

Factory production controls (FPC), Compliance test
External Monitoring (FÜ)

Short percolation test
DIN 19528 (2009)



L/S: 2:1

OR

Batch test
DIN 19529 (2015)



L/S: 2:1

➔ For comparison with the material values, the results at L/S = 2 are decisive. These are either calculated from the extended column test or determined through the short column test or batch test.

Challenges and Limitations Under EBV

- Eighteen months after implementation, the EBV has not fully achieved its goals. Instead, regulations have led to a slight decline in MEB usage.
- **Use of MEB in Asphalt** – Regulations such as minimum installation quantities and strict delivery documentation have made it nearly impossible to use slags in asphalt since implementation.
- **Restrictions on gravel groundwater cover layers** – Due to wording issues in the EBV, MEB use is restricted on gravelly subsoil, even under dense asphalt roads.
- **Bureaucratic Challenges** – Complex administrative requirements, strict documentation and notification rules make MEB less attractive. Many authorities are unfamiliar with the EBV which further complicates the usage.
- **Testing and Certification Costs** - The quality assurance system requires extensive testing
- **Groundwater and Soil Regulations** – The mandatory assessment of soil type and groundwater level makes MEB use more difficult, especially for small-scale projects. The absence of a standardized national method for determining groundwater distance creates uncertainty.

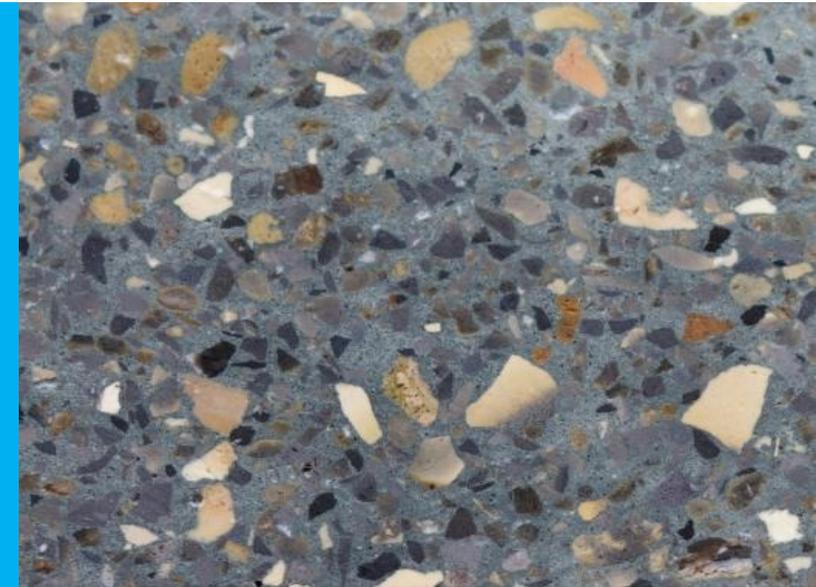
→ revisions of the ordinance is required

Use of ferrous slag in cement or concrete

Model Administrative Provisions – Technical Building Rules

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Muster-Verwaltungsvorschrift Technische Baubestimmungen
(MVV-TB)*

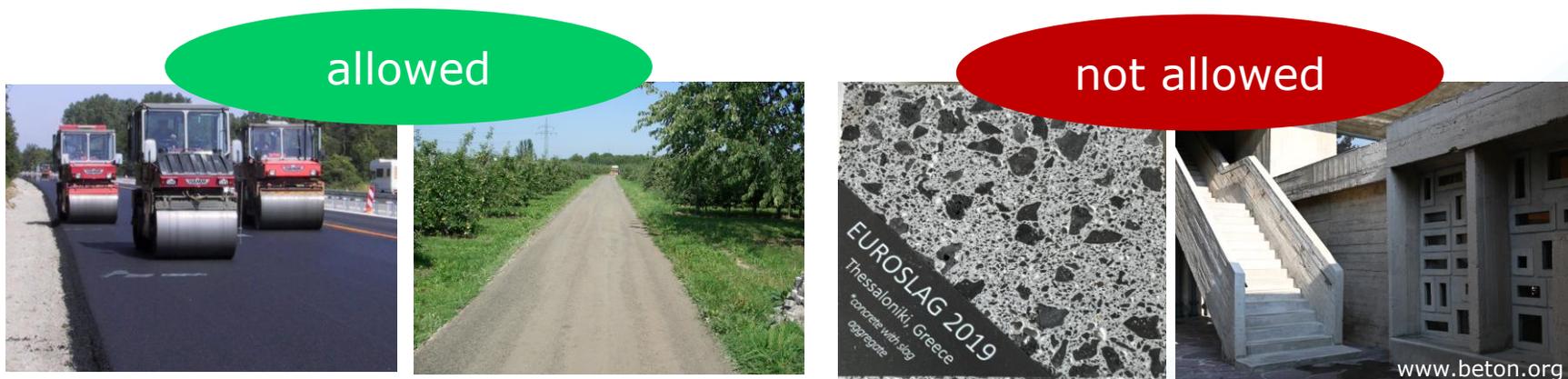


* published by the DIBt (Deutsches Institut für Bautechnik), The German Institute for Building Technology

Use of ferrous slag in cement or concrete

Current situation

- The MVV TB officially regulates only water-exposed concrete, but in practice, it is applied to all concrete produced according to DIN 1045-2 and is also adapted for cement components.
- While blast furnace slag (BFS) can be used in concrete or granulated as a clinker substitute with **NO** need to proof the environmental compatibility, the use of steel slag is **restricted** in Germany due to regulatory barriers.
- Paradoxical situation in Germany: Steel slag is allowed in road construction (bound and unbound) but not bound in a dense matrix in cement or concrete.



Use of ferrous slag in cement or concrete

Evaluation principles of the MVV TB

Requirement for „pure“ constituents

- Solid contents
(*aqua regia digestion*)
- Eluate concentration
(*batch test according to DIN EN 12457-4*)



Upper limits for solid contents (steel slags)		
As	mg/kg	150 ✓
Cd	mg/kg	10 ✓
Cr _{total}	mg/kg	600 ✗
Cu	mg/kg	400 ✓
Hg	mg/kg	5 ✓
Ni	mg/kg	500 ✓
Pb	mg/kg	700 ✓
Tl	mg/kg	7 ✓
Zn	mg/kg	1500 ✓



Limits are mostly met

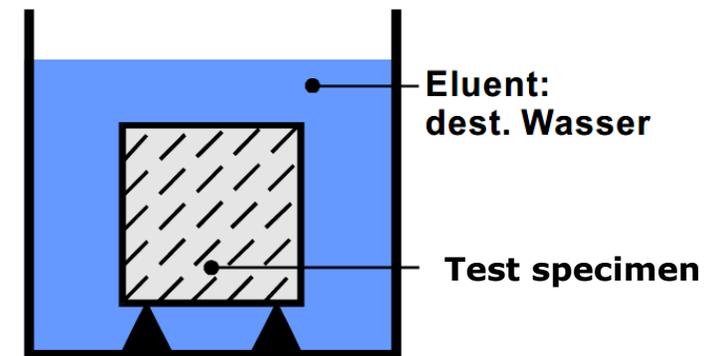
Cr_{ges} = 600 ppm → Exclusion criterion for steel slags

Chromium content in steel slags up to ~ 8000 mg/kg

Note: Hexagonal Chromium (Cr-VI) ist **always** below the analytical detection limit of 1 mg/kg.

Release of potetial harmful substances from the concrete

- Worst-case consideration: Concrete installation in groundwater (→ Installation above groundwater is also covered)
- Tank test according to DIN EN 16637-2



Limits are mostly met

Use of ferrous slag in cement or concrete

Need for regulatory adaption

- The transformation of the steel industry will eliminate blast furnace slag and increase "new" slags (DRI/SAF, DRI/EAF), with need for utilization pathways.
- The scrap-based EAF (and limited BOS) will remain; but their use in road construction is declining due to regulatory and market changes. The use in concrete represents a higher-value application and helps to ensure high utilization rates.
- Using steel slag (EAF, DRI/EAF) as a cement constituent can help to close the supply gap for cement.
- The Chromium (Cr-III) content in steel slag does not pose any environmental risk. Steel slags are neither hazardous nor toxic due to their intrinsic heavy metal content (proofed by tests within the REACH registration).
- Solid content is not a reliable indicator for environmental behavior → **solid limit values should be disregarded**
- The environmental assessments should focus on substance release through elution tests.
- Political pressure emphasizes resource conservation, circular economy, and CO₂ reduction.

→ **urgent revisions of the regulations required**

Use of slag-based fertiliser lime

Düngemittelverordnung (DüMV, 2012)
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Fertiliser Ordinance



* Verordnung über das Inverkehrbringen von Düngemitteln, Bodenhilfsstoffen, Kultursubstraten und Pflanzenhilfsmitteln

Use of slag-based fertiliser lime

- **DüMV (2012)** applies to all fertilizers, including slag-based ones.
- **Cross-border sales:** Marketing per DüMV & mutual recognition (EU Reg. 2019/515).
- **Contaminants & Trace Elements:** DüMV sets limits for As, Cr-VI, Cd, Hg, Ni, Pb, Tl; no rules for V.
- **New limit values:**
 - EU Reg. 2022/973 introduced **Cr (400 mg/kg) & V (600 mg/kg) limits** via delegated act, excluding most ferrous slags from the market.
 - Scientific basis is questionable because the EU Commission used incorrect assumptions to justify them.
- **Industry Challenge & Court Ruling:**
 - “Fachverband Eisenhüttenschlacken e.V.” filed a claim against the limits.
 - Court dismissed the case, granting the EU Commission broad discretion.
 - Appeal filed — process ongoing.
- **Impact:**
 - Cross-border trade has come to a halt due to mutual recognition issues.
 - Some have adopted the limits into national law (e.g., Finland).
 - Germany has not implemented the limits yet, but there is a risk of future adoption
 - Risk of expansion to other legal areas.



Key regulatory issues for ferrous slags in Germany: Enhancing the Circular Economy

Revision of the EBV

Use of slag in asphalt, Application over gravel groundwater cover layers, Reducing administrative burdens

Regulatory Barriers in Cement and Concrete Applications

Permission for the use of steel slag is required.

Exclusion of Secondary Raw Materials in Public Procurement

- Public tenders still often exclude secondary raw materials, despite legal preference (§ 45 KrWG, Circular Economy Act) for eco-friendly, circular economy-promoting products.
- Legally binding formulations in the Circular Economy Act (KrWG) are needed to ensure compliance in practice.

End-of-Waste and By-Product Regulation

- Whether MEB is classified as waste or a product is crucial for market acceptance.
- Recognizing ferrous slags as a by-product would reduce user skepticism and regulatory burdens (e.g., transport and storage).

Thank you for your attention

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