Environmental testing of fly ash for concrete in Germany – a really new approach?

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Kurzfassung

Umweltprüfung von Flugasche für Beton in Deutschland – Ein wirklich neuer Ansatz?

In seinem Urteil gegen die Bundesrepublik Deutschland vertrat der Europäische Gerichtshof die Auffassung, dass die Bauproduktenrichtlinie (Richtlinie 89/106/EWG) durch die Bauregellisten mit zusätzlichen Anforderungen an Bauprodukte, die durch harmonisierte Normen abgedeckt seien und eine CE-Kennzeichnung tragen, verletzt wurde.


Die neuen technischen Bauvorschriften beinhalten nur Anforderungen an eine Reihe von nicht umweltpolitisch relevanteren Parametern für Flugasche, wenn sie in Beton eingesetzt wird. Für die Umsetzung dieser Anforderungen wird eine technische Richtlinie vom Deutschen Ausschuss für Stahlbeton entwickelt.

Introduction

In Germany, fly ash is used for concrete production since more than 50 years. Over the years, the use was based on regional and later on national permissions. In 1996, the European standard EN 450 fly ash for concrete was implemented. With the revision in 2005 the standard was harmonised and the conformity evaluation described in a separate part. In addition, fly ash from coal combustion was introduced and technical approvals for environmental conformity for fly ash from co-combustion were granted on a national level.

The system of additional requirements to construction products were allowed under the Construction Products Directive but are seen as a barrier to trade under the Construction Products Regulation which entered fully force on 1st July 2013. The CJEU judgement of 16 October 2014 completed a discussion starting in 2005 about additional national requirements for CE marked construction products. The judgement against Germany cause changes in the German building regulations. Based on § 3 of the master building code (Musterbauordnung MBO) the “(master) Administrative Provision – Technical Building Rules” (Muster-Verwaltungsvorschrift Technische Baubestimmungen (VV-TB)) and the included “Requirements on constructions regarding impact on soil and water” (AbuG) specify requirements on constructions regarding environmental protection which by now were regulated for products in national technical approvals. But compared to the content in existing approvals the requirements were extended. The AbuG is of special importance for fly ash as concrete addition as it gives requirements only on content, release and release from concrete with fly ash. For the implementation a separate act is needed. A guidance of the German Committee for Structural Concrete (DAFStb) is under development and may be implemented into construction regulations once it is finally accepted.

Fly ash for concrete – history

In Germany, the use of fly ash in concrete is already reported in the 1930’s for cross border research for sulfate resisting concretes. In 1970, the Minister for house building and public work of the country NRW gave a first general building authority approval of hard coal fly ash as “non autonomous binder” for the use of concrete valid for all federal states in Germany. The approval covered also the application by the replacement of a part of the cement by fly ash. After the foundation of the German Institute for Construction (DIBt) in 1969, which took over a part of the responsibilities for buildings from the single countries, the approval was no longer accepted due to the application rule. It took time to 1983 before a new application rule was developed for the calculation of the fly ash amount to the binder amount. Compared to the application rules in the approval from 1970 the application rules were reduced. By 1995, in total 85 certificates for fly ash were granted based on the DIBt “Guidance for granting a certificate for hard coal fly ash [1] (later in 1990 “Guidance for granting of approvals for anorganic concrete additions [2]). The fly ashes produced in such a way have led to a constantly increasing fly ash utilization rate amounting to almost 100% since 1995 (see Figure 1).

In 1994, the European standard EN 450 [3] was published as the first product standard for a concrete source material. In 1995, it was included as DIN EN 450 in the list of building materials and thus, fly ash became a standardised building product. Only for fly ash not covered by the standard, e.g. fly ash for special applications, an approval was needed.

In 2005 the new EN 450 fly ash for concrete was harmonised in the list of building materials and thus fly ash became a standardised building product. Only for fly ash not covered by the standard, e.g. fly ash for special applications, an approval was needed. In 2014 the EU has decided to replace the old Directive 89/106/EEC with the new Construction Products Regulation (CPR) 2014/84. This new regulation has been in force since 1st July 2013.

The report was presented at the EURACOALASH 2017 on 6 to 8 February 2017 in Brno, Czech Republic and gives the status of discussion in 01/2017.

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Fig. 1. Utilisation rate of fly ash in Germany from 1975 to 2014.
ash from lignite and those from co-combustion of pet coke, sewage and paper sludge, technical approvals were further granted. Based on technological developments in the power industry and experiences from application the revised EN 450-1 and EN 450-2 [4, 5], published in 2006, also covered fly ash from co-combustion and from processing. The application was described in the guidance of the German Committee for Reinforced Concrete (DASStb) [6]. The content of the guidance was implemented into the national application standard to EN 206-1, namely DIN EN 1045-2.

Regarding environmental compatibility EN 450-1 (clause 4.3; clause 5.4.2 in revised versions) refers to additional national regulations which have to be considered prior the final use in concrete. Therefore, the national approvals were further used for demonstration of compliance for environmental compatibility. For the fly ash from co-combustion regular test on the content of selected parameters have to be performed (1/month). The conformity was subject of third party control (two per year) and confirmed with the "U-mark". To avoid a divided market for fly ash with fly ash from coal only with CE-mark and fly ash from co-combustion with CE- and U-mark also for fly ash from coal an U-mark was granted which proofs the use of coal only without testing.

At present, there are 74 certificates for environmental compatibility fly ashes as concrete addition according EN 450-1 obtained from German and foreign power plants. Besides, one certificate exist for fly ash from lignite and six certificates are granted to the application of fly ash from specific power plants according clause 5.2.53 of DIN EN 206/DIN 1045-2 based on a performance concept.

The use of fly ash in cement and concrete accounts 2.5 to 3 million tonnes respectively to about 75% of the total amount utilised over the last years. An overview of the uses of fly ash in Germany is given in Figure 2.

The CJEU judgement

Already in 2005 the Commission sent a letter of demand to Germany due to several claims regarding additional test and certificates with the U-mark for specific construction products which are covered by European product standards and bearing the CE-mark. This praxis was seen in contradiction with the requirements of art. 4 clause 2 und art. 6 clause 1 of the Directive 89/106 (CPD) [7].

In its answers sent December 2005 and August 2006 Germany argued that the tests are necessary as the product standards are not complete and would not satisfy the requirements in annex I of the CPD. The letters were answered with a statement by the Commission. As the answers of Germany to this statement were considered non sufficient the Commission decided a court action.

In its judgement on 16 October 2014 the European Court of Justice considered that the Federal Republic of Germany infringed the Construction Products Directive (Directive 89/106/EEC) through its Construction Products Lists which imposed additional requirements for the effective market access and the use of construction products in Germany even though the construction products in question were covered by harmonised standards and bore a CE marking. The CJEU judgement relates to additional requirements for three products specifically mentioned. These requirements relate to the long-term seal effect of pipe seals made of thermoplastic elastomer, the glowing combustion behaviour of insulation materials made of mineral wool and the reaction to fire of gates without fire and smoke protection properties. The CJEU judgement is a declaratory judgment which requires the Member State to end the violation and take the necessary measures to comply with the judgment on its own initiative and at its own discretion.

As a consequences of the CJEU judgement C-100/13 in 2014 the competent committees of the Conference of Construction Ministers have carefully considered the consequences of the judgment and initiated a revision to the Building Codes of the federal states and a change in the regulatory system following the withdrawal of the provisions specified in the judgment from Construction Products List Part 1 for products acc. harmonised product standards. The European Commission, the Federation and the federal states basically agreed on a transition period of two years for the implementation of the CJUE judgement. The deadline for implementation was 15 October 2016.

As direct reaction to the CJEU judgement, – the Construction Products List B Part 1 listing additional requirements for construction products according harmonised European product standards was abrogated with the revision on 10th October 2016.

– additional requirements in the Construction Products List A (list which are no longer needed) were deleted

– from 16 October 2016, national technical approvals or other national proofs of fitness for use, attestations of conformity and additional national conformity marks will no longer be permitted for harmonised construction products with CE marking under the Construction Products Regulation.

Especially affected are construction products according harmonised European standards for which additional requirements in national technical approvals or national standards with remaining requirements exist. These are for example the national approvals regarding environmental compatibility for fly ash for concrete according to DIN EN 450-1 or for bottom ash as lightweight aggregate according to DIN EN 13055-1 [8].

The national approvals regarding environmental compatibility for these products are valid by April 2020 maximum. They remain valid as a technical proof of product performance and provide attestation of conformity.

Since 1st July 2013 the Construction Products Regulation [9] is fully in force. It requires i.a. information on Basic Work Requirement Nr 3 on “Hygiene, Health and Environment” (BWR3) and on “Sustainability” (BWR7). Especially information about BWR3 has to be considered in the revision work of harmonised European product standards. As long as this is not the case the proofs can also be based on a European Technical Assessment (Art. 39, para 1 Construction Products Regulation).

Administrative provisions – Technical Building Rules (VV-TB and ABuG)

To maintain the safety level in Germany the competent committees of the Conference
of Construction Ministers see a legally acceptable solution in addressing the necessary national requirements to constructions (and no longer to construction products).

On May 2, 2016 the Conference of Construction Ministers have released the draft of an “Administrative Provision – Technical Building Rules” (VV-TB) with deadline for comments by 27 May 2016. The provision consists i.a. “Requirements on constructions regarding impact on soil and water” (ABuG).

However, the additional requirements for constructions are in the final end addressed to construction products used in these constructions, e.g. fly ash and bottom ash.

The German Committee for Reinforced Concrete (DAfStb), the International Technical Association for Generation and Storage of Power and Heat (VGB PowerTech) and the (trade) Association for Mineral By-Products (WIN) have objected to the provision.

On July 21, 2016 the notification procedure of the (master) “Administrative Provision – Technical Building Rules” (VV-TB) was started (No of the EC: 2016/0376/D) [10]. The first deadline for statements or comments was October 24, 2016 but was extended to January 23, 2017.

The ABuG defines requirements for constructions (or building components) only. The requirements for fly ash on content, leaching and concrete leaching are given in Table 1.

Compared to the existing requirements in the national technical approvals the future requirements are extended in the number of parameters and address now leaching parameters for fly ash beside the requirements for content. The requirements for concrete leaching are taken from the DIBt guidelines [11].

The DAFStb guidance for fly ash and bottom ash

In principle, the ABuG defines requirements for constructions only. But for fly ash specific requirements for content, fly ash leaching and concrete leaching and for bottom ash for content and leaching are addressed. However, the ABuG only contains the requirements and no information is given on how the requirements have to be fulfilled. Without a specification the requirements would lead to confusion as in principle each batch of fly ash has to meet the requirements. Therefore, all parties agreed that a guideline prepared by the German Committee for Reinforced Concrete (DAfStb) is needed to allow the industry to demonstrate the environmental compatibility.

Two meetings were held on a first draft containing the existing requirements for content of fly ash from co-combustion and the evaluation of the leachate from concrete including information on conformity control. Also requirements for bottom ash as lightweight aggregate are addressed based on the existing requirements in the technical approvals. As they are based on content and leaching tests on bottom ash it is expected that the evaluation will be harmonised for leaching from concrete.

The guideline will define autocontrol and third party control and the procedures how to handle single value exceedances. The discussion about the evaluation criteria are not completed by now. Especially regarding the criteria of fly ash leaching a consensus could not be reached by now.

**Summary**

In Germany, fly ash is used as concrete addition since more than 50 years. Over the last years about 2.5 to 3 million tonnes have been used each year. The use is based on DIN EN 450-1 for the technical requirements. For the proof of environmental compatibility national technical approvals are granted requiring tests on content of specific parameters for fly ash from co-combustion and a proof of coal use for those from coal only.

As the additional national requirements result in additional testing and also quality marks the European Commission started a court action against Germany. In its judgement on 16 October 2014 the European Court of Justice considered that Germany infringed the Construction Products Directive (Directive 89/106/EEC) through its Construction Products Lists which imposed additional requirements for the effective market access and the use of construction products. As a consequence of the CJEU judgement C-100/13 in 2014 the competent committees of the Conference of Construction Ministers have initiated a revision to the Building Codes. In addition, they have released the draft of an “Administrative Provision – Technical Building Rules” (VV-TB) including “Requirements on constructions regarding impact on soil and water” (ABuG). The provision is in the notification procedure. The deadline for statements and comments was extended to 23 January 2017.

The requirements on constructions regarding impact on soil and water are addressing requirements for fly ash on content, leaching and concrete leaching and for bottom ash on content and leaching.

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**Table 1. Requirements of the administrative provision (VV-TB) and on constructions regarding impact on soil and water (ABuG) for fly ash. Status 15.06.2016.**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Content</th>
<th>Leaching</th>
<th>Concrete leaching</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antimony (Sb)</td>
<td>150</td>
<td>100</td>
<td>5.5</td>
</tr>
<tr>
<td>Arsenic (As)</td>
<td>700</td>
<td>200</td>
<td>11</td>
</tr>
<tr>
<td>Barium (Ba)</td>
<td>10</td>
<td>10</td>
<td>375</td>
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<tr>
<td>Lead (Pb)</td>
<td>600</td>
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<td>7.7</td>
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<tr>
<td>Cadmium (Cd)</td>
<td>400</td>
<td>100</td>
<td>0.56</td>
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<tr>
<td>Chromium VI (Cr)</td>
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<td>1,500</td>
<td>6.6</td>
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<tr>
<td>Chromium, total (Cr)</td>
<td>500</td>
<td>70</td>
<td>8.8</td>
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<tr>
<td>Cobalt (Co)</td>
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<td>7</td>
<td>1.54</td>
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<tr>
<td>Copper (Cu)</td>
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</tr>
<tr>
<td>Nickel (Ni)</td>
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<tr>
<td>Mercury (Hg)</td>
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<td>Thallium (Tl)</td>
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<td>Vanadium (V)</td>
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<td>4.4**</td>
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<td>PCDD/PCDF (ng/kgTE)</td>
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<td>100</td>
<td>100</td>
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<tr>
<td>TOC (M.-%)</td>
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<td>5</td>
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<td>Chloride (Cl)</td>
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<td>Fluoride (F-)</td>
<td>1,000</td>
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<td>Sulphates (SO4²⁻)</td>
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<td>Phenolindex (µg/l)</td>
<td>9 to 13</td>
<td>9 to 13</td>
<td>9 to 13</td>
</tr>
<tr>
<td>Conductivity (µS/cm)</td>
<td>5,000</td>
<td>5,000</td>
<td>5,000</td>
</tr>
</tbody>
</table>

Tab. 1. Environmental testing of fly ash for concrete

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**Not in force**
For the implementation of the requirements the work on a DAfStb guideline for fly ash for concrete according DIN EN 450-1 and bottom ash as lightweight aggregate according DIN EN 13055 was started. The guideline will define autocontrol and third party control and the procedures how to handle single value exceedances. The work on the guideline is not completed by now. Environmental testing of fly ash in concrete or of concrete is not really new. However, the fly ash producers see new requirements in notification as an additional burden for the products and a hurdle to market and free trade and they are therefore in conflict with the CPR. As the requirements are only for fly ash and bottom ash for concrete and not for all concrete constituents they are seen as discriminating and disturbing competition. Whether the regulation will be accepted by the Commission is subject of the notification process. Once in force, they will serve as a basis for implementing BWR3 in product standards.

References

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