Harmonization of test methods for the execution of the European Construction Products Directive

G. Spanka

WASCON 2012
Gothenburg, Sweden, 30 May - 1 June 2012
The European Construction Products Directive sets „Essential Requirements (ER)“

Requirements of the Construction Products Directive (CPD)

1. Structural stability
2. Fire safety
3. Hygiene, health and the environment
4. Safety in use
5. Protection against noise
6. Energy economy

„The construction work, must be designed and built in such a way that it will not be a threat to the hygiene or health of the occupants or neighbours“
Existing notified national regulations

Dutch “Soil Quality Decree”

German “Principles for assessment of effects on construction products on soil and groundwater, Part I” of the German Institute of Structural Engineering (DIBt) for construction products that need a technical approval

Only common references to existing national requirements
“Essential Requirement No. 3” of the Construction Products Directive should be implemented through the mandate M/366

Mandate M/366

HORIZONTAL COMPLEMENT TO THE MANDATES TO CEN/CENELEC CONCERNING THE EXECUTION OF STANDARDISATION WORK FOR THE DEVELOPMENT OF HORIZONTAL STANDARDISED ASSESSMENT METHODS FOR HARMONISED APPROACHES RELATING TO DANGEROUS SUBSTANCES UNDER THE CONSTRUCTION PRODUCTS DIRECTIVE (CPD)

- Sampling
- Determination of composition
- Determination of release
- Release scenarios

Brussels, 16th March 2005
M/366 EN
CEN installed 2006 a Technical Committee (TC) which will prepare the test standards

TC 351: Construction Products – Assessment of the Release of Dangerous Substances

Working group 1:
- Release from construction products into soil, ground water and surface water
CEN installed 2006 a Technical Committee (TC) which will prepare the test standards

TC 351: Construction Products – Assessment of the Release of Dangerous Substances

Working group 1:
- Release from construction products into soil, ground water and surface water

Working group 2:
- Emissions from construction products into indoor air
CEN installed 2006 a Technical Committee (TC) which will prepare the test standards

TC 351: Construction Products – Assessment of the Release of Dangerous Substances

Working group 3:
- Radiation

Working group 4:
- Terminology

Working group 5:
- Content
CEN installed 2006 a Technical Committee (TC) which will prepare the test standards.

- EGDS (Expert Group Dangerous Substances)
- Technical Committees (TCs) for environmental analysis
- CEN TC 351
- Mandate M/366
- National standardisation bodies e.g. DIN
- European Organisations e.g. CEN TC 351
- European Organisation for Technical Approvals
- > 40 Technical Committees (TCs) for construction products

(Ilvonen & Kirchner, 2010)
In the future the Construction Products Directive (CPD) will be replaced by the Construction Products Regulation (CPR) which was published on 4th April 2011 in the Official Journal of the European Union. However, the standardisation work in CEN/TC 351 is being continued under the conditions of the Construction Products Directive.
Current status of the work in TC 351/WG 1

Draft TS 351/WG 1 TS-1: “Guidance standard for CEN product TC’s for selection of leaching tests appropriate for their product(s) - General principles”

Draft TS 351/WG 1 TS-2: “Generic horizontal dynamic surface leaching test (DSLT) for the determination of surface dependent release of substances from monolithic or plate-like or sheet-like construction products”

Draft TS 351/WG 1 TS-3: “Generic horizontal up-flow percolation test for determination of release of substances from granular construction products”
Leaching tests

Tank leaching test

Column leaching test

(FEhS, Duisburg)
Validation of the test methods - Robustness Validation

Products to be tested with the TS-2 (tank test): Clay masonry, steel slag (including armour stone), autoclaved aerated concrete, roofing felt, external renders with organic binders, tiles or ceramic tiles, cement stabilised coal fly ash for road-base, treated wood, timber structures, plastic piping, plastic product, natural stone

Products to be tested with the TS-3 (column test): Phosphorous slag, masonry, steel slag, cement stabilised road-base material, natural aggregate, recycled concrete, coal fly ash, expanded clay, reclaimed asphalt, recycled aggregates, porous asphalt

Technical Specification (TS) **September 2013**
Validation of the test methods - Robustness Validation

Concrete and mortar are not included in the before mentioned list, because the German Federal Environment Agency (UBA) funded a research project concerning the robustness of the tank leaching test for monolithic test specimen produced from these materials in the year 2009 to promote the European validation process. CEN/TC 351/WG 1 decided on its meeting on 13 November 2009 in Berlin to take the results of the German research programme on robustness validation for concrete and mortar as a substantial contribution to the work of CEN/TC 351.
Validation of the test methods - Robustness Validation

The research project was performed in Cooperation between the Institute of Building Materials Research (ibac) of the RWTH Aachen University and the German Cement Works Association (VDZ)

Construction products:

- common concrete
- mortar with high content of organic substances
Concrete composition

The robustness testing was done in one laboratory, for three concretes produced using two different cements (CEM I 42,5 R and CEM III/A 42,5 N)

Cement content: 280 kg/m³

Water/cement ratio: 0.60

Test specimen: Concrete cubes 100 X 100 X 100 mm³

Curing: 56 days
Concrete production and testing

Production of 28 concrete cubes with the CEM I 42,5 R cement

Leaching test on 8 concrete cubes according to the draft standard “Generic horizontal dynamic surface leaching test (DSDLT) for determination of surface dependent release of substances from construction products”

Variation of the test conditions (20 concrete cubes), double test for each variation
## Variation of the test conditions

<table>
<thead>
<tr>
<th>Variation No.</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Decrease of the curing time to 28 days</td>
</tr>
<tr>
<td>2</td>
<td>Increase of the curing time to 91 days</td>
</tr>
<tr>
<td>3</td>
<td>Decrease of the testing temperature to 15 °C</td>
</tr>
<tr>
<td>4</td>
<td>Increase of the testing temperature to 25 °C</td>
</tr>
<tr>
<td>5</td>
<td>Duration of the specific leaching step according to the DAfStb-long term leaching test</td>
</tr>
<tr>
<td>6</td>
<td>Duration of the specific leaching step according to the Dutch standard NEN 7375</td>
</tr>
<tr>
<td>7</td>
<td>Decrease of the surface to volume ratio to 40 L/m²</td>
</tr>
<tr>
<td>8</td>
<td>Increase of the surface to volume ratio to 120 L/m²</td>
</tr>
<tr>
<td>9</td>
<td>Decrease of the pH-value of the starting leachant to 4</td>
</tr>
<tr>
<td>10</td>
<td>Increase of the pH-value of the starting leachant to 10</td>
</tr>
</tbody>
</table>
Results of the eightfold test

Chloride-release in mg/m²

Time in d
## Results of the eightfold test

<table>
<thead>
<tr>
<th>Variation</th>
<th>Unit</th>
<th>Time in days</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>0.083</td>
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</tr>
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<td>2</td>
<td>2</td>
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<td>3</td>
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<td>&lt;0.1</td>
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<td>6</td>
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<td>7</td>
<td></td>
<td>&lt;0.1</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>&lt;0.1</td>
</tr>
</tbody>
</table>
Results of the eightfold test

Chloride-release in g/m²

Time in d
Results of the eightfold test

Chromium-release in mg/m²

Time in d
# Results of the eightfold test

<table>
<thead>
<tr>
<th>Variation</th>
<th>Unit</th>
<th>Time in days</th>
<th>0.083</th>
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<th>15</th>
<th>28</th>
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<td>8</td>
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<td>1</td>
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<td>µg/L</td>
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<td>µg/L</td>
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<td>12.5</td>
<td>5.30</td>
<td>5.49</td>
<td>2.95</td>
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<td>0.72</td>
<td>1.98</td>
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</table>
Results of the eightfold test

Potassium-release in mg/m²

Time in d

1 2 3 4 5 6 7 8
# Results of the eightfold test

<table>
<thead>
<tr>
<th>Variation</th>
<th>Unit</th>
<th>0.083</th>
<th>1</th>
<th>2.25</th>
<th>8</th>
<th>14</th>
<th>15</th>
<th>28</th>
<th>36</th>
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<td>19.7</td>
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<td>19.1</td>
<td>4.80</td>
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<td>4</td>
<td>mg/L</td>
<td>13.0</td>
<td>31.7</td>
<td>16.3</td>
<td>30.8</td>
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<td>5.50</td>
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<td>5.00</td>
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<td>11.4</td>
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<td>32.9</td>
<td>17.0</td>
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<td>4.70</td>
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<td>17.3</td>
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<td>4.40</td>
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<td>18.6</td>
<td>4.30</td>
<td>18.8</td>
<td>10.6</td>
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</tbody>
</table>
## Results of the eightfold test

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Relative standard deviation (coefficient of variation V) in %</th>
<th>Parameter</th>
<th>Relative standard deviation (coefficient of variation V) in %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barium (Ba)</td>
<td>36.3</td>
<td>Sodium (Na)</td>
<td>14.4</td>
</tr>
<tr>
<td>Lead (Pb)</td>
<td>19.8</td>
<td>Selenium (Se)</td>
<td>7.16</td>
</tr>
<tr>
<td>Chloride (Cl⁻)</td>
<td>89.6</td>
<td>Sulphate (SO₄²⁻)</td>
<td>33.8</td>
</tr>
<tr>
<td>Chromium (Cr)</td>
<td>17.2</td>
<td>Vanadium (V)</td>
<td>6.55</td>
</tr>
<tr>
<td>Potassium (K)</td>
<td>6.86</td>
<td>Zinc (Zn)</td>
<td>34.9</td>
</tr>
<tr>
<td>Copper (Cu)</td>
<td>56.6</td>
<td></td>
<td></td>
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</tbody>
</table>
Variation of the test conditions

Chromium-release in mg/m²

Time in d

1-8 Average
28 d
91 d
15 °C
25 °C
DAfStb
NEN7375
40 L/m²
120 L/m²
pH = 4
pH = 10
Variation of the test conditions

Sodium-release in mg/m²

Time in d

- 1-8 Aver.
- 28 d
- 91 d
- 15 °C
- 25 °C
- DAfStb
- NEN 7375
- 40 L/m²
- 120 L/m²
- pH = 4
- pH = 10
Mortar production and testing

The robustness testing was done in one laboratory, for one mortar produced using a pre-packaged reinforcing render according to the manufacturers instructions.

Water/solid: 1/5.3

Test specimen: mortar cubes 100 X 100 X 100 mm³

Curing: 56 days
Variation of the test conditions (mortar)

Sodium-release in mg/m²

- 1-2 Average
- 28 d
- 15 °C
- 25 °C
- DAfStb
- NEN7375
- 40 L/m²
- 120 L/m²
Variation of the test conditions (mortar)

Total organic carbon (TOC)-release in mg/m²

Time in d

- 1-2 Average
- 28 d
- 15 °C
- 25 °C
- DAfStb
- NEN7375
- 40 L/m²
- 120 L/m²
Conclusions (1)

The results of the eightfold test show a relative great variation, especially if the values are near or below the quantification limit.

The results for sodium and potassium show a relative standard deviation below 15 % in the eightfold test. Also, the variation of the test conditions has only little influence on the leached amounts of these elements. This result shows, that the leaching test as such is robust.
Conclusions (2)

The results for the Dutch test NEN 7375 and the German DAfStb test for sodium and potassium are well located within the range of dispersion of the other variations of the test conditions. From this it can be concluded that it should be possible to transfer the results of the different tests relative easily.

The results for the reinforcing render verify the results for the concretes. From the results for the TOC-release it can be concluded that the tank leaching test is also appropriate for the investigation of the release of organic substances from cementitious construction products.
Acknowledgement

The research project was set up on behalf of the German Federal Environment Agency (UBA) as part of the environmental research plan - funding code 3709 95 303 - and financed with federal funds. The comprehensive final report with investigative results has been published in electronic form by the Federal Environment Agency, and can be downloaded from:

http://www.uba.de/uba-info-medien-e/4152.html
Thank you for your kind attention