



Adinotec AG

Road Construction Technology  
Hohenzollernstraße 89  
D-80796 München

Anerkannt nach RAP Stra 15  
für die Fachgebiete  
A1, A3, A4, BB3, BB4, BE3, BE4,  
D3, D4, F2, F3, F4, G3, G4,  
I1, I2, I3, I4  
Anerkennung als Prüfstelle gemäß  
ZTV M 13  
NB 1742  
VMPA anerkannte Betonprüfstelle

**Reportnumber: 16/0288**

**Hamburg, 10.10.2016**

## 1. Client:

Adinotec AG  
Road Construction Technology  
Hohenzollernstraße 89  
D-80796 München

Investigation order:

Production of a solidification of sand, F1 material,  
with cement and Perenium DX compared to a  
Sand consolidation only with cement. Investigation of  
the consolidation to compressibility with and without  
Perenium DX and reusability based on the LAGA  
characteristics

Pattern input:

15.09.2016

## 2. General information on the investigation order:

Adinotec AG, Road Construction Technology, commissioned Baustofflabor Hamburg GmbH to study the Perenium DX additive. The research should focus on the following questions:

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- Is it possible to reduce the amount of cement from cement by a partial substitution?
- Is there a measurable influence on the compressive strength caused by the addition of Perenium DX?
- Is the reusability of solidification with the addition of Perenium DX changed?

The following ingredients were used for carrying out the tests:

Naturalsand F1, taken directly from the pit

Perenium DX, sent by the client

Cement Ferro 3R, CEM II / 8-S 32.5 R, cement produced for road construction applications

The formulation of the consolidation was chosen according to the specifications of the client as follows:

- Replacement of 2.5 M .-% cement by Perenium DX in the same height, 1st variant
- 92.5% by weight of sand F1 with 7.5% by mass cement CEM II for comparison, 2nd variant

### 3. Investigation results

The substitute formulation was subjected to a Proctor test according to DIN 18127. The result gave a necessary water content of 14.2% by weight to achieve the maximum dry density of  $1.74 \text{ g/cm}^3$ . With this recipe, Proctor samples were also produced for the 2nd variant.

### 3.1 Compressive strength of test specimens after 28 days of storage

After 28 days of storage, the compressive strengths of the specimens were determined. In both variants, comparable densities, which were around  $2.02 \text{ g/cm}^3$ , were determined before the determination of the compressive strengths.

Table 1: Compressive strength after 28 days of storage

Description	Density test specimen	Unit	Compressive strength	Unit
1te variant	2,01	$\text{g/cm}^3$	1,85	$\text{N/mm}^2$
2te variant	2,03	$\text{g/cm}^3$	0,48	$\text{N/mm}^2$

The compressive strengths of solidification with Perenium DX have significantly increased in comparison with the conventional variant.

### 3.2 LAGA values after 28 days of storage of the solidified test specimens

Of the solidified sands, a sufficient amount of test was stored for the determination of the LAGA values in the laboratory for a period of 28 days. These two test quantities were subsequently subjected to an investigation according to the LAGA-TR soil consortium.

The following results were determined. The results are attached as an annex.

Table 2: LAGA-TR soil, significant deviations from the classification

Description	pH-value	Unit	Conductivity at 25°C	Unit	Chrom, total	Unit
1te Variante	12,2	-	2010	$\mu\text{S/cm}$	60	$\mu\text{g/l}$
2te Variante	12,2	-	2250	$\mu\text{S/cm}$	94	$\mu\text{g/l}$

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Due to the fact that the total chromium limit of 60 µg/l is exceeded and the assumption that this chromium load is from the cement, both products were subjected to a chromatic analysis according to LAGA-TR soil. Excesses in pH and conductivity are caused by the addition of cement. These two values do not constitute an exclusion criterion for an orderly reuse.

Tabelle 3: LAGA-TR soil, Chromium research

Description	Chrom, total	Unit
1te Variante, Perenium DX	<1	µg/l
2te Variante, CEM II	81	µg/l

#### 4. Assessment of the results of the investigation

The specific data show the following results with regard to the above-mentioned questions:

- Ca the cement become reduced by a partial substitution?

**Yes, it is possible without problems.**

- Is there any measurable effect on the compressive strength caused by the addition of Perenium DX?

**Yes, the compressive strength increases measurably. In the present case it is more than doubled by the addition of Perenium DX.**

- Is the reusability of solidification with the addition of Perenium DX changed?

**According to LAGA-TR soil, there is no indication of a negative influence by Perenium DX. The specific chromium loading of the reinforcements comes from the cement and is typical for cement. In the Perenium DX there was no determinable chromium content.**

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The product Perenium DX shows no load according to LAGA-TR soil and can therefore be classed as harmless.

Head of Inspection



Dr.-Ing. Burghard Herr

Attachments

Attachment 1: 16-43517-001/1; Sand/Cement

Attachment 2: 16-43517-002/1; Sand/Cement/Perenium DX

Attachment 3: 16-46990/1; Validation of Chrom in Cement and Perenium DX