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Subject

Summary of preliminary examination of Monokote Z-146 T insulation mortar sprayed on concrete slabs under Rijkswaterstaat (RWS) fire conditions
TNO report **2006-Efectis-R0606**
Projectno: 2006124

Date

October 4, 2006

Our reference

2006-Efectis-R0606/LKA/DNA

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Efectis Nederland BV:
a TNO Company

Dear Mr Pernot,

On behalf of your firm, Efectis Netherlands (previously TNO Centre for Fire Research) has performed a preliminary examination on Monokote Z-146 T insulation spray mortar.

Monokote Z-146 T Industrial Cementious Fireproofing is a petrochemical grade fire protection coating manufactured by GRACE Produits de Construction (under the Follow-up Service Program of the Unterwriter's Laboratories Inc. (UL) USA) specifically formulated for applications to steel and concrete constructions under Hydro Carbon and Jet Fire conditions.

The spray mortar was sprayed onto concrete slabs to protect the concrete against a Rijkswaterstaat time-temperature curve.

The results of this test are written in Efectis Nederland report 2006-CVB-R0584.

Protection materials for tunnels are tested in The Netherlands according to a test method specially developed by Rijkswaterstaat and TNO for tunnel safety aspects. During this test the required protection thickness of the spray mortar is determined at approximately 200 C for bored tunnels and 380 C for immersed tunnels. For this kind of tests concrete slabs are used with dimensions of 1500 x 1500 x 150 mm and a concrete grade of B35.

The tested concrete slabs were provided with a reinforcing mesh, which was mounted with Hilti anchors, type X-CR-39 P8. The Monokote Z-146 T spray mortar was sprayed with a thickness of 25 mm and 50 mm.

The specimens were dried for a period of 10 weeks and were at equilibrium moisture content at the beginning of the test with moisture content of approximately 6%.

For the fire test the specimens were provided with eight thermocouples at the interface (toplayer of the concrete directly behind the spray insulation) and with five thermocouples at the top of the concrete slab to measure the temperatures.

The Standard Conditions for Research Instructions given to Efectis, as filed at the Registry of the District Court and the Chamber of Commerce in The Hague shall apply to all instructions given to TNO; the Standard Conditions will be sent on request.

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The test specimens were heated for a period of 4 hours.

The test results are used to calculate the optimal thickness of the Monokote Z-146 T spray mortar.

The calculation indicates that the optimal thickness of the Monokote Z-146 T spray mortar after two hours for an interface temperature of 200 C is 33.5 mm and for an interface temperature of 380 C is 25 mm.

The optimal thickness of the Monokote Z-146 T spray mortar after four hours for an interface temperature of 200 C is 47 mm.

In the table and graph at the next page the results of the fire test and the calculation are shown.

I hope I have informed you completely with this summarized letter.

This TNO-report is a summary of the official test report for details of the tested construction refer to TNO-report 2006-CVB-R0584.

Yours sincerely,



A.J. Lock



Dr. Ir. G. van den Berg

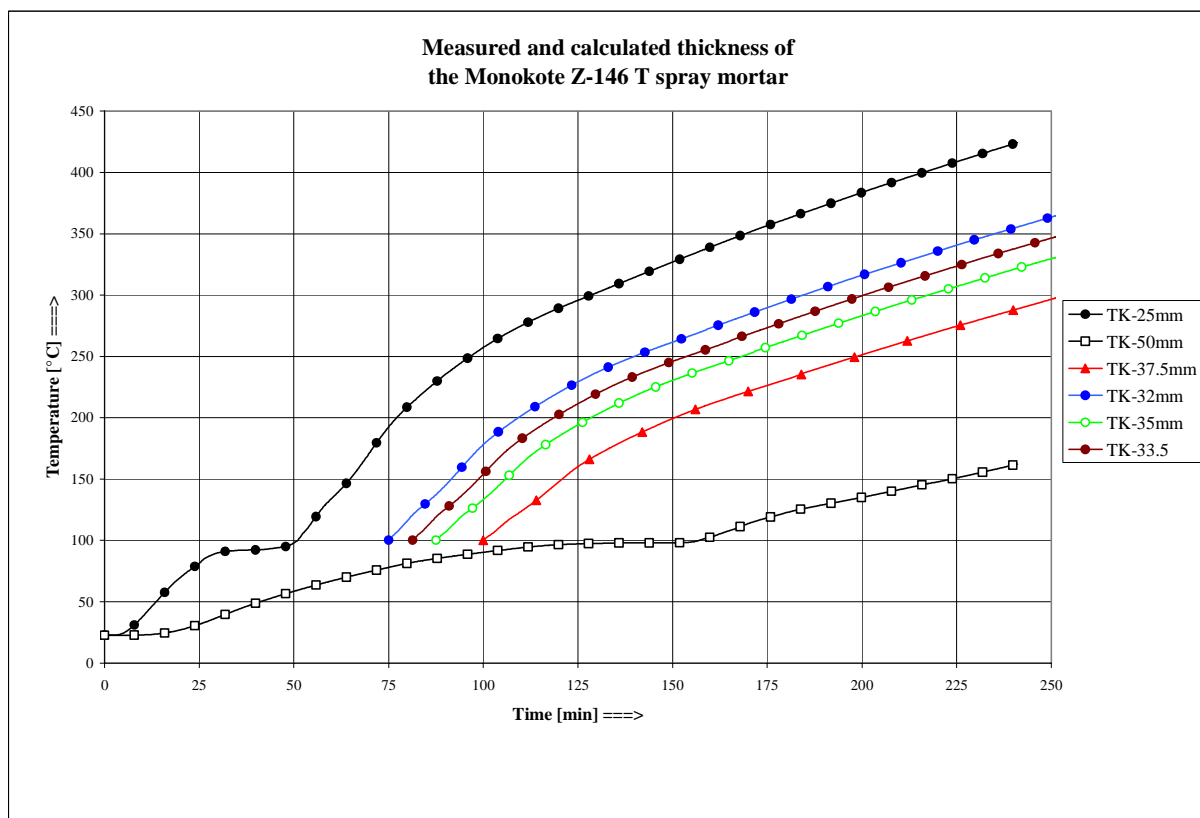
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| Measured and calculated average temperatures at the interface in °C | | | | | | | |
|---|-------------------------------|------|------|------|------|------|-----|
| Time [h] | Thickness of the mortar in mm | | | | | | |
| | 25 | 29 | 32 | 33.5 | 35 | 37.5 | 50 |
| 1 | 134 | <100 | <100 | <100 | <100 | <100 | 67 |
| 2 | 289 | 255 | 220 | 200 | 186 | 150 | 97 |
| 3 | 362 | 328 | 295 | 278 | 263 | 230 | 123 |
| 4 | 386 | 388 | 355 | 338 | 320 | 288 | 162 |

Table: 1



Graph: 1

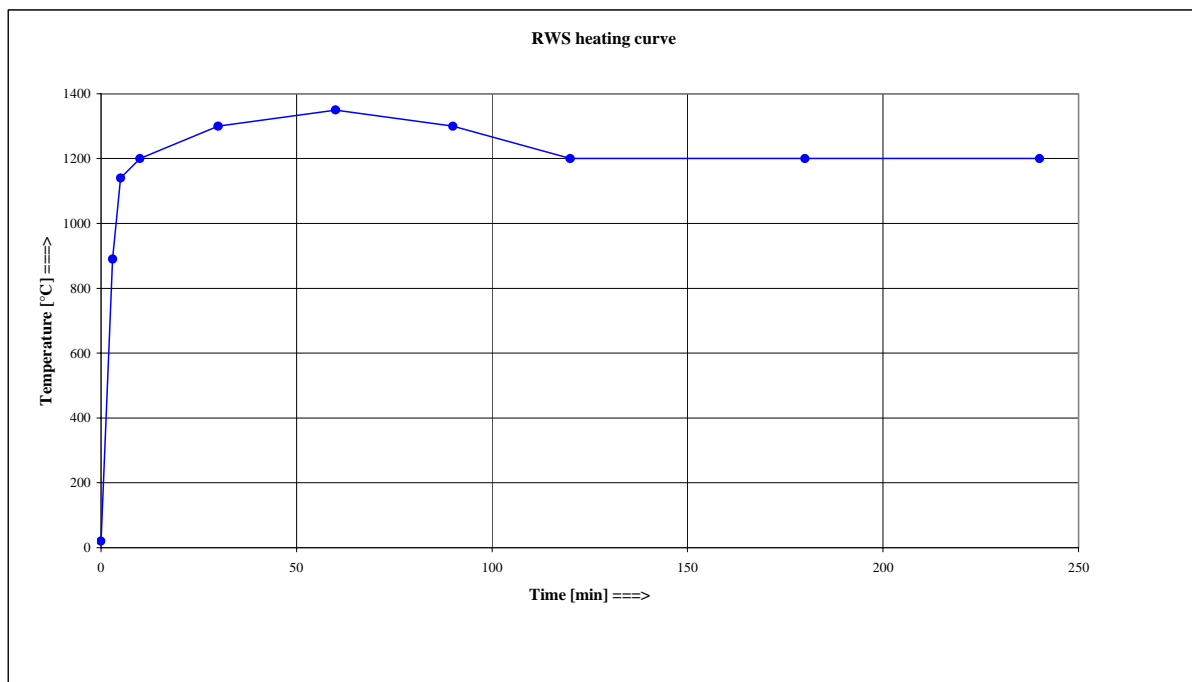
| RWS curve table | |
|-----------------|------------------|
| Time [min.] | Temperature [°C] |
| 0 | 20 |
| 3 | 890 |
| 5 | 1140 |
| 10 | 1200 |
| 30 | 1300 |
| 60 | 1350 |
| 90 | 1300 |
| 120 | 1200 |
| 180 | 1200 |
| 240 | 1200 |

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Table 2:



Graph: 2

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