**SINTEF Civil and Environmental Engineering**
Roads and Transport

Address: NO-7465 Trondheim
NORWAY
Location: Klæbuveien 153
Telephone: +47 73 59 46 60
Fax: +47 73 59 46 56

Enterprise No.: NO 948 007 029 MVA

# SINTEF REPORT

TITLE

**Gravel base material stabilised by DUSTEX**

**Test of development of moisture content during curing/drying of the material**

AUTHOR(S)

Leif Bakløkk and Inge Hoff

CLIENT(S)

Borregård Ligno Tech

| REPORT NO. | CLASSIFICATION | CLIENTS REF. | |
|---|---|---|---|
| STF22 A03321 | Open | Jan Hörke | |
| CLASS. THIS PAGE | ISBN | PROJECT NO. | NO. OF PAGES/APPENDICES |
| Open | 82-14-03154-0 | 22G194.01 | 7 |
| ELECTRONIC FILE CODE | | PROJECT MANAGER (NAME, SIGN.) | CHECKED BY (NAME, SIGN.) |
| I:\pro\22G172\Report drying test | | Leif Bakløkk | Joralf Aurstad |
| FILE CODE | DATE | APPROVED BY (NAME, POSITION, SIGN.) | |
| | 2003-08-26 | Tore Knudsen, Research Director | |

ABSTRACT

One sample stabilised with DUSTEX and one reference sample have been tested to determine how long time it takes for the samples to dry at 40 $^{o}$C. After the drying the samples were soaked in water and tested following the CBR – loading procedure.

The following was found from the testing:

- The sample with DUSTEX needed longer time to dry than the reference sample.

- The sample stabilised with DUSTEX was significantly stronger than the reference sample.

| KEYWORDS | ENGLISH | NORWEGIAN |
|---|---|---|
| GROUP 1 | Highway Engineering | Vegteknikk |
| GROUP 2 | Laboratory testing | Laboratorieforsøk |
| SELECTED BY AUTHOR | DUSTEX | DUSTEX |
| | Lignin | Lignin |
| | | |

# 1 Background

DUSTEX is a product from cellulose production. It is made from Lignin which is a natural binder in threes and plants. The product has been used in Norway since 1990 to minimise problems from dust from unpaved roads.

DUSTEX is easily soluble in water before mixing with the gravel material, but after a drying/curing period the material will bind to the aggregates and will become stabile also in new contact with water.

The drying tests were performed to determine how long period of drying/curing was necessary to secure a stabile material.

# 2 Sample preparation

The gravel material for these tests where taken from the road (Fv631-01 km 15.000)
The material was oven dried and particles larger than 19 mm were removed.

The reference sample without DUSTEX was compacted with optimum moisture content determined by Modified Proctor test = 6.5 %.

The sample with DUSTEX was compacted with 2 % (dry weight) of DUSTEX and 4.3 % water.

Both samples were compacted using the Modified Proctor protocol i.e. 5 layers with 25 blows per layer.

Figure 1 shows a sample with DUSTEX after compaction and levelling of the surface.

**Figure 1 Sample with DUSTEX after compaction**

## 3 Results from drying/curing investigation

The samples was placed in a heating cabinet with 40 $^{o}$C and the weight loss was controlled after 3, 7, 14, 21 and 54 days. After this the samples were heated to 110 $^{o}$C to remove the final amount of water. The results are shown in Table 1 and illustrated in Figure 2.

**Table 1 Results from drying test**

| Time (days) | Reference | | DUSTEX | |
|---|---|---|---|---|
| | Weight of sample and mould (g) | Moisture content (%) | Weight of sample and mould (g) | Moisture content (%) |
| 0 | 9754 | 7.06 | 9804 | 4.46 |
| 3 | 9507 | 1.32 | 9756 | 3.39 |
| 7 | 9471 | 0.49 | 9721 | 2.60 |
| 14 | 9461 | 0.26 | 9696 | 2.04 |
| 21 | 9460 | 0.23 | 9680 | 1.68 |
| 54 | 9459 | 0.21 | 9633 | 0.63 |
| After heating to 110 $^{o}$C | | | | |
| 56 | 9450 | 0.00 | 9605 | 0.00 |

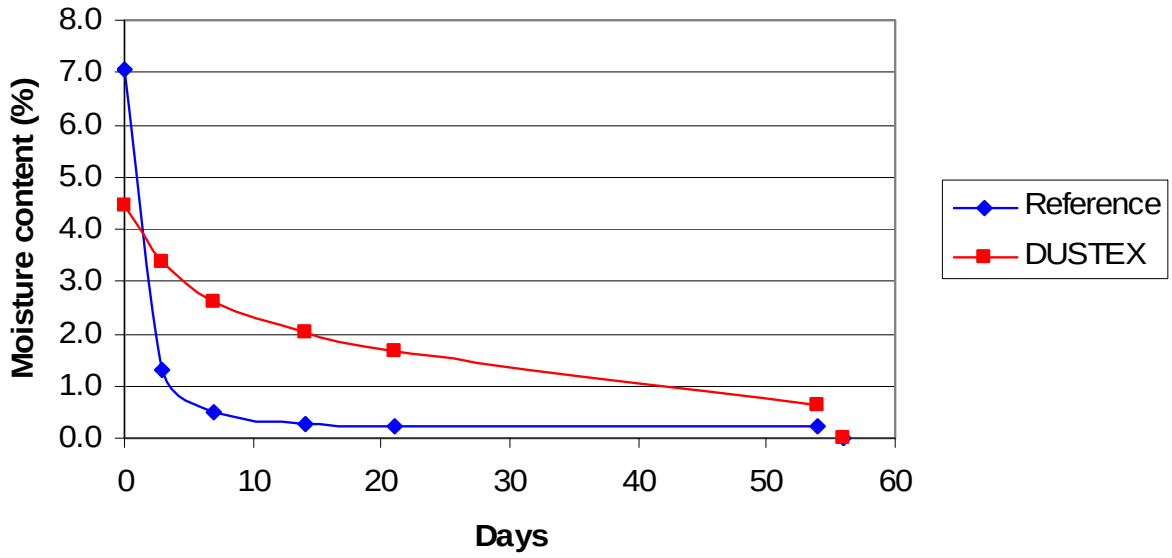


**Figure 2 Development of moisture content**

## 4 Results from modified CBR test

After the tests were dried at 110 $^{o}$C they were placed in water for one day. Then a "CBR test" was performed on the samples. The standardised test protocol for the CBR test specifies both the sample preparation and loading procedure. Obviously this procedure was not followed for these tests. Hence, the values found are not the real CBR – value. However some information about the relative strength between the two samples could be obtained using this method.

The loading is shown in Figure 3. The lead rings around the piston are used to simulate weight of overlaying materials.

**Figure 3 CBR bearing capacity test**

The difference in “CBR value” between the two samples was quite dramatic. The reference sample needed 2.8 kN for a 6.35 (2.5 in) deformation giving “CBR” = 20 %. The sample modified with DUSTEX needed 31.5 kN for the same deformation giving “CBR” = 233 %. These results are only based on single tests and before the results could be used for design the tests should be repeated with parallel tests.

## 5 Conclusions and recommendations

The curing/drying tests performed show that it the samples with DUSTEX will hold on to the water much longer than gravel without any stabilisation. For the reference sample most of the water was disappeared after only three days. For the samples with DUSTEX about 76 % of the original water was still in the sample.

The simplified “CBR-tests” indicates that the potential for improvement of the material strength using DUSTEX is large after a curing/drying period.