Appendix I:

**Table 1** Technical Data Sheet of Geo Mesh (GN 900)

|  |  |  |
| --- | --- | --- |
| Technical Data sheet | Standard | GN 900 |
| Constituent materials |  | HDPE |
| Density | ASTM D 792 | 0,94 g/cm3 |
| Minimun Thickness | IRAM 78004-1 | 5 mm |
| Minimum mass per unit area | IRAM 78002 | 725 g/cm2 |
| Minimum tensile strength (Longitudinal) | IRAM 78012 | 7 kN/m |
| Transmissivity | ASTM D 4716 | 2,5 x 10-3 |
| Compressive strenght | ASTM D 1621 | 350 kPa |
| Minimun width | - | 2 m |
| Minimun Lenght | - | 50 m |

**Table 2** Technical Data Sheet of **w**oven Geotextile 150 of Polyester

|  |  |  |  |
| --- | --- | --- | --- |
| Technical Data sheet | | | |
| Constituent materials | 100 % Polyester | | |
| Mechanical Properties | | | |
| Tensile properties Wide width strip method | IRAM 78012 / ASTM D-4595 |  | 8 kN/m |
| Deformation | IRAM 78012 / ASTM D-4595 |  | 70% |
| Index Puncture Resistance CBR | IRAM 78011 / ASTM D-6241 |  | 1,3 kN/m |
| Trapezoid Tearing Strength | IRAM 78017 / ASTM D-4533 |  | 250 N |
| Hydraulic Properties |  | | |
| Apparent Opening Size of a Geotextile | IRAM 78006 / ASTM D-4751 |  | 0,21 mm |
| Water Permeability of Geotextiles by Permittivity | IRAM 78007 / ASTM D-4491 |  | 2,4 s-1 |
| Water Flux | IRAM 78007 / ASTM D-4491 |  | 115 l/s/m2 |

**Table 3** Sand description\* based on the percentage of sand, silt, and clay in each sample.

|  |  |
| --- | --- |
| SAMPLE DESCRIPTION | Silicic Sand |
| Sand | 92.3% |
| Silt | 2.6% |
| Clay | 5.1% |

\*based on the Wentworth scale of grain size.

**Table 4:** Particle size distribution \*.

|  |  |
| --- | --- |
| SAMPLE DESCRIPTION | Silicic Sand |
| NO. 10 | 0.2% |
| NO. 14 | 0.0% |
| NO. 18 | 0.1% |
| NO. 35 | 1.0% |
| NO. 40 | 0.6% |
| NO. 60 | 13.6% |
| NO. 100 | 70.7% |
| NO. 140 | 5.5% |
| NO. 200 | 0.7% |
| NO. 270 | 0.4% |
| PAN (SILT & CLAY) | 7.4% |
| **OTHER:** |  |
| MOISTURE | 3.7% |
| ORGANIC CARBON | 0.7% |

**\***FEI approved method.

**Table 5** Classification\* of sand by comparison of the gravel, sand, silt, and clay distribution of the sample.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| SAMPLE DESCRIPTION | Gravel | |  | Sand |  | Silt | Clay | Ratio Med to V.  Fine divided by Gravel + Cs.  Sand |
| Coarse | Fine | Very Coarse | Coarse | Med. To Very Fine |  |  |
| 5 - 12  mm | 2 - 5  mm | 1 - 2  mm | 0.5 - 1  mm | 0.05 - 0.5  mm | 0.002 - 0.05  mm | 0 - 0.002  mm |
| Silicic Sand | 0.2% | | 0.1% | 1.0% | 91.3% | 2.3% | 5.1% | 70.3 |
| 0.2% | | 1.1 % |  | 91.3% | 7.4% | |

\*based on the USDA soil texture classification.

**Table 6** XRD Analysis which shows mineral composition of sand.

|  |  |
| --- | --- |
| Whole Rock Mineralogy (Weight Percent) | |
| Quartz | 90,6 |
| K-Feldspar | 2,7 |
| Plagioclase | 2,5 |
| Calcite | 0,2 |
| Dolomite | 0 |
| Total Phyllosilicates | 4 |
| TOTAL | 100 |
|  |  |
|  |  |
| Phyllosilicate Mineralogy (Relative Abundance) | |
| R0 M-L I/S (90%S)\* | 72,5 |
| Illite & Mica | 20 |
| Kaolinite | 5 |
| Chlorite | 2,5 |
| TOTAL | 100 |
|  |  |
|  |  |
| Quartz | 90,6 |
| K-Feldspar | 2,7 |
| Plagioclase | 2,5 |
| Calcite | 0,2 |
| Dolomite | 0 |
| R0 M-L I/S (90 % S)\* | 2,9 |
| Illite & Mica | 0,8 |
| Kaolinite | 0,2 |
| Chlorite | 0,1 |
| TOTAL | 100 |
|  |  |
| \*R0 M-L I/S (90 % S) - R0 Ordered Mixed-Layer Illite/Smectite  with 90% Smectite Layers | |
| NOTE: For the two RDE\_19002 samples, a minor amount of  paraffin wax was present in the samples. | |
| The paraffin was not included in the above analytical results. | |

Gráfico, Gráfico de líneas

Descripción generada automáticamente

**Figure 1** Bulk density of silicic sand and silicic sand and geotextile addition with gravimetric moisture content (kg/m33).

**Gráfico, Gráfico de líneas

Descripción generada automáticamente**

**Figure 2**. Bulk density of silicic sand and silicic sand and geotextile addition (2 kg/m2) with volumetric moisture content (kg/m3).

**Gráfico, Histograma

Descripción generada automáticamente**

**Figure 3.** FTIR Analysis shows that the fibers are 100 % polyester. Peaks left of 2000 wave numbers are from dust.

**Appendix II:**

**Calibration of Going Stick**

To obtain penetration data in engineering units the Going Stick was placed into a calibration fixture with a 4.5 kN. (1000 lbf) load cell (Omega Engineering, Omegadyne LC101-1K) in line with the measuring tip. Applied loads are shown in Table 1 with the equivalent calibration values from the GSP shown in Table 2 for an average of two Going Stick used. Moments also applied to the probe tip of the clamped Going Stick as shown in Table 3 for the shear calibration to determine the equivalent GSS value. Going Stick values were plotted and a polynomial curve fit are shown in Figure 1. The resulting equation to convert GSP to peak penetration force in Newtons (N)

With

The GSS value can be converted to peak shear force in Newton-meters (Nm) where :

With

In the same line, and using theoretical loads, Going Stick values of penetration and shear were plotted, and curve fitted using a linear fit (Figure 1).

**Table 1** The table shows the results from verifying force applied to the Going Stick´s probe tip using the calibration rig for penetration force.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Applied Load IU (lbf) | Applied Load SI (N) | Force Out Theoretical (N) | Force out measured (N) | Percent Error |
| 4,41 | 19,62 | 69,13 | <59,291 | 14,23 |
| 11,02 | 49,02 | 172,59 | 98,42 | 42,97 |
| 22,05 | 98,08 | 345,63 | 319,51 | 7,56 |
| 33,07 | 147,10 | 518,22 | 527,69 | 1,83 |
| 44,09 | 196,12 | 691,25 | 711,49 | 2,93 |
| 52,51 | 233,59 | 823,12 | 850,83 | 3,37 |
| 55,12 | 245,19 | 863,84 | >889,365 | 2,95 |
| 66,14 | 294,21 | 1036,88 | >889,365 | 14,23 |
| 70,5479 | 313,81 | 1105,82 | >889,365 | 19,57 |

**Table 2.** The table shows the results from varying force applied to the Going Stick´s probe tip using the calibration rig, for engineering mode.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Calibration Load (IU units) | 4,41 | 11,02 | 22,05 | 33,07 | 44,09 | 52,51 | 55,12 | 66,14 | 70,5479 | lbf |
| Calibration Load (SI units) | 19,62 | 49,02 | 98,08 | 147,10 | 196,12 | 233,59 | 245,19 | 294,21 | 313,81 | N |
| Load at tip (Theoretical) | 69,1 | 172,6 | 345,6 | 518,2 | 691,3 | 823,1 | 863,8 | 1036,9 | 1105,816 | N |
| GS 001 | 16 | 39 | 72 | 106 | 135 | 158 | 167 | 199 | 209 | GS EV\* |
| GS 005 | 14 | 34 | 67 | 102 | 135 | 159 | 169 | 202 | 215 | GS EV |
| Average | 15 | 36,5 | 69,5 | 104 | 135 | 158,5 | 168 | 200,5 | 212 | GS EV |
| Flat Penetration | <1 | 1,66 | 5,4 | 8,9 | 12 | 14,35 | >15 | >15 | >15 | GS Value |
| Conversion factor | 4,6 | 4,7 | 5,0 | 5,0 | 5,1 | 5,2 | 5,1 | 5,2 | 5,2 | to N |

\*Going Stick Engineering value

**Table 3.** The table shows the results from verifying torque applied to the Going Stick´s probe tip using the calibration rig for shear force.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Applied Load (Lbf) | Applied Load (N) | Torque Theoretical (N-m) | Torque measured (N-m) | Percent Error |
| 0,00 | 0,00 | 2,68 | 4,07 | 51,90% |
| 0,90 | 4,02 | 5,63 | 7,29 | 29,49% |
| 3,82 | 16,97 | 15,14 | 18,55 | 22,56% |
| 6,16 | 27,42 | 22,81 | 24,57 | 7,74% |
| 8,22 | 36,59 | 29,54 | 30,09 | 1,89% |
| 11,30 | 50,25 | 39,57 | 39,76 | 0,48% |
| 14,84 | 66,01 | 51,14 | 48,04 | 6,06% |

**Table 4.** The table shows the results from varying torque applied along the Going Stick´s probe tip using the calibration rig.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Calibration Load (IU) | 0,00 | 0,90 | 3,82 | 6,16 | 8,22 | 11,30 | 14,84 | lbf |
| Calibration Load (SI) | 0,00 | 4,02 | 16,97 | 27,42 | 36,59 | 50,25 | 66,01 | N |
| App. Torque (Theoretical) | 2,68 | 5,63 | 15,14 | 22,81 | 29,54 | 39,57 | 51,14 | N-m |
| GS 001 | 11 | 20 | 44 | 66 | 85 | 121 | 151 | GS EV |
| GS 005 | 10 | 20 | 46 | 66 | 87 | 121 | 151 | GS EV\* |
| Average | 10,5 | 20 | 45 | 66 | 86 | 121 | 151 | GS EV |
| Flat Shear | 1,23 | 2,20 | 5,60 | 7,42 | 9,08 | 12,00 | 14,50 | GS V\*\* |
| Conversion factor | 0,3 | 0.3 | 0,3 | 0,3 | 0,3 | 0,3 | 2,8 | to N-m |

\*Going Stick Engineering Value \*\*Going Stick Value

**Gráfico, Gráfico de líneas, Gráfico de dispersión

Descripción generada automáticamente**

**Figure 1.** Curve fits assuming linearity to determine conversion factor of GS values of penetration and shear.