REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
OFFICE OF THE SECRETARY
MANILA

097.13 DPWH
02-16-2006

FEB 15 2006

DEPARTMENT ORDER)
NO. 12)
Series of 2006)

SUBJECT: Use of Terrazyme as Soil Stabilizer to Aggregates and Soil Materials

---

In line with the continuing efforts to upgrade the construction technology thru the adoption of successful research studies, this Department has approved the use of Terrazyme as Soil Stabilizer to Aggregates and Soil Materials to improve the stability of aggregates and soil materials in the roadways and other pavement structures subject to its specifications, hereto attached. A Certificate of Conditional Approval had been issued by this Department, accrediting the use of Terrazyme in DPWH projects from March 2005 until March 2010.

This order takes effect immediately.

HERMOGENES E. EBDANE, JR.
Acting Secretary

WIN6U00069

DPWH STANDARD SPECIFICATIONS FOR SOIL STABILIZED WITH TERRAZYME AS ROAD FOUNDATION MATERIALS

1.1 Description

This Item shall consist of furnishing, placing and compacting the soil stabilized with TERRAZYME on an embankment or on a prepared base/subbase in accordance with this Specification and in conformity with the lines, grades, thickness and typical cross-sections shown on the Plans, or as established by the Engineer.

1.2 Material Requirements

1.2.1 Soil Aggregates

It shall conform to the requirements of Subsection 203.2.1, Soil Aggregates, Item 203 – Lime-Stabilized Road Mix Base Course.

The Soil Aggregate shall conform to the grading requirements given in Table 1.

Table 1 – Grading Requirements

Sieve Designation	Mass Percent Passing	
Sieve Size, mm	Grading A	Grading B
50	100	100
4.75	45-100	55-100
2.00	37-80	45-100
0.425	15-20	25-80
0.075	0-25	11-35

The fraction passing the 0.425 mm (No. 40) sieve shall have a Liquid Limit not greater than 35 and a Plasticity Index of not less than 4 nor more than 10.

The material shall have a soaked CBR value of not less than 100% as determined by AASHTO T 193. The CBR value shall be obtained at the Maximum Dry Density (MDD) as determined by AASHTO T 180, Method D.

Grain sizes and plasticity of each soil type shall be classified in accordance with AASHTO Soil Classification System as A-1-a(0) and A-4(7). A-1-a materials shall consist of stone fragments or gravel, either with or without a well graded binder of fine materials. A-4 materials shall consist predominantly of non-plastic or moderately plastic silty soil passing the 0.075 mm (No. 200) sieve.

Grain size distribution for each soil type shall be determined in accordance with AASHTO T-88.

The Atterberg limits for each soil type shall be determined in accordance with AASHTO T-89 and T-90, Tests for Liquid Limit and Plastic Limit, respectively.

The maximum dry density and optimum moisture content for each soil type shall be determined in accordance with AASHTO T-180, Standard Method of Test for Moisture Density Relations of Soils using 4.54 kg rammer and a 457 mm drop.

Bearing strength of untreated and treated specimens shall be determined in accordance with AASHTO T-193, California Bearing Ratio. Each test specimen shall be compacted at the Maximum Dry Density (MDD) and at the Optimum Moisture Content (OMC). For each test specimen, the amount of water necessary to bring the soil to the optimum moisture content shall be added to the air-dried soil. For treated specimens, the Terrazyme solution shall be used to bring the soil to the optimum moisture content.

1.2.1.1 Untreated Soil/New Soil Aggregate

It shall conform to the applicable requirements of Subsection 203.2.1, Soil Aggregate, Item 203 – Lime-Stabilized Road Mix Base Course.

1.2.1.2 Raw Materials/Salvaged Soil Aggregate

Where the soil aggregate required is already in place, the Contractor shall not be responsible for its grading or quality, except for the removal of oversized materials as directed by the Engineer. In general, salvaged soil aggregate to be used with Terrazyme Road Mix Base Course shall consist of materials meeting the requirement given in Subsection 203.2.1, Soil Aggregate, Item 203 – Lime Stabilized Road Mix Base Course.

1.2.2 Terrazyme

Terrazyme is a bio-enzyme product, a chemical, organic, and liquid concentrated substance used with increasing frequency to improve the stability of aggregates and soil materials in the roadways and other pavement structures.

1.2.3 Water

It shall conform to the requirements of Item 714, Water.

Terrazyme requires the dilution in water before the application to allow the product to be dispersed and uniformly mixed with the particles of the soil materials being treated.

The amount of dilution water to be used depends on the soil dryness. In cases where the soil materials contain high amount of fines of high plasticity, the water to be added shall be from 1% to 2% below optimum moisture.

1.2.4 Proportioning of Mixture

The amount of TERRAZYME to be sprayed to the soil aggregate shall be in the range of 1 liter up to 2 liters per 35 cu.m. of soil depending on the soil type and characteristics.

1.3 Construction Requirements

1.3.1 Roadway Preparation

1.3.1.1 Embankment

It shall conform to the requirements of Item 104, Embankment.

1.3.1.2 Base/Subbase

The existing surface shall be graded and finished as provided under Item 105, Subgrade Preparation, before placing the soil stabilized with Terrazyme.

1.3.2 Placing

After the embankment has been made according to the conventional construction methods, the construction team shall place a layer of scarified soil on top of the subgrade soil.

The Engineer then shall start with the application by spraying Terrazyme solution on the road surface. Sufficient quantity of water shall be sprayed to bring the soil to optimum moisture content.

The soil shall be mixed thoroughly to make sure that the enzymes of the solution are mixed through the soil and initiate the process of cat-ion exchange.

After the mixing process, the Engineer shall start with the formation of the camber or crossfall.

After the camber formation is completed, the compaction of the soil shall take place. This can be done with smooth drum rollers, vibrating compactors or sheet-foot rollers, depending upon the composition of the soil.

After compaction, the soil shall be sprayed further with a light concentration of the Terrazyme solution to enhance the curing, especially under extreme weather conditions.

The constructed road shall be opened to traffic within two to three days after construction under dry conditions and shall be ready for the construction of pavement layers.

1.3.3 Construction Equipment

The equipment to be used by the Contractor shall include among others, the following:

- Grader with ripping teeth for breaking the load surface
- Farm tractor with roto-filler for pulverizing and mixing the soil
- Water truck with spray bars for Terrazyme spraying (7,000 – 12,000 liters capacity)
- Flat steel drum vibrator-roller for compacting (12 – 15 tons)

The use of other types of Terrazyme sprayer equipment shall have been approved by the Engineer before the start of construction.

1.3.4 Preparation of Soil-Aggregate

It shall conform to the requirements of Subsection 203.3.3, Preparation of Soil-Aggregate, Item 203-Lime Stabilized Road Mix Base Course.

1.3.5 Spreading and Compacting

After the soil aggregates have been thoroughly mixed with the Terrazyme solutions, the mixture shall be spread and compacted to the specified thickness as per plans and specifications.

Where the required thickness is 150 mm or less, the material shall be spread and compacted in one layer. Where the required thickness is more than 150 mm, the soil aggregate with Terrazyme shall be spread and compacted in two or more layers of approximately equal thickness, and the maximum compacted thickness of any layer shall not exceed 150 mm. All subsequent layers shall be spread and compacted in a similar manner.

The moisture content of the soil treated with Terrazyme shall, if necessary, be adjusted prior to its compaction either by watering with sprayers mounted on a truck or by drying out, as may be approved by the Engineer, in order to obtain the required compaction.

Immediately following final spreading and smothering, each layer shall be compacted to the full width by means of approved compacting equipment. Rolling shall progress gradually from the sides to the center, parallel with the centerline of the road and shall continue until the whole surface has been rolled. Any irregularities or depressions that develop under such rolling shall be corrected by loosening the material at these places and adding or removing material until the surface is smooth and uniform. Along curbs, headers, and walls, and at all places not accessible to the roller, the treated soil with Terrazyme shall be compacted with tampers or compactors as directed by the Engineer, provided that the equipment can produce the required density.

If the layer of the treated soil with Terrazyme, or part thereof, does not conform to the required finish, the Contractor shall, at his own expense, make the necessary corrections.

Compaction of each layer shall continue until a field density of at least 100 percent of the maximum dry density determined in accordance with

AASHTO T 180, Method D, has been achieved. In-place density determination shall be made in accordance with AASHTO T 191.

The compacted treated soil with Terrazyme shall be continuously cured prior to surfacing of either asphalt or concrete pavement.

1.3.6 Testing

The treated soil specimens which are compacted into the CBR mold shall be left at room temperature at the different amounts of time and different curing procedure. CBR tests shall be performed on soaked and unsoaked specimens to determine the effect of soaking on the treated specimens and to monitor the improvement in the strength of the soil. CBR tests shall be performed initially on the untreated specimens to provide base line value. Some specimens shall be covered with plastic during the entire curing period while the other uncovered specimen shall be cured by means of slight spraying with water. Generally, the CBR values for the Terrazyme treated specimens increase with time if cured continuously up to four (4) weeks.

1.3.7 Trial Sections

Trial sections of soil stabilized with Terrazyme shall be constructed at least two weeks before actual construction. These shall conform to the applicable requirements of subsection 200.3.4, Trial Sections.

1.3.8 Tolerances

Soil stabilized with Terrazyme shall be laid to the designed level and transverse slopes as shown on the Plans. The allowable tolerances shall be in accordance with the following:

Permitted variation from design THICKNESS OF LAYER	± 10 mm
Permitted variation from design LEVEL OF SURFACE	+ 5 mm -10 mm
Permitted SURFACE IRREGULARITY Measured by 3-m straight-edge	5 mm

Permitted variation from design CROSSFALL OR CAMBER	± 0.2%
Permitted variation from design LONGITUDINAL GRADE over 25 m in length	± 0.1%

1.3.9 Method of Measurement

Soil and TERRAZYME will be measured in cubic meters (m^3) and liters, respectively. The quantity to be paid for shall be the design volume (compacted in-place) as shown on the Plans, and reflected in the completed course. Materials placed outside the design limits shall not be considered. Trial sections shall not be measured separately; instead it shall be included in the quantity of soil and TERRAZYME herein measured.

1.3.10 Basis of Payment

The accepted quantities, measured as prescribed in Section 1.3.9, shall be paid for at the contract unit price per liter (for Terrazyme) and per cubic meter (for soil), which price and payment shall be full compensation for furnishing and placing of all materials, including all labor, equipment, tools and incidentals necessary to complete the work prescribed in this Item.

Payment will be made under:

Payment Item Number	Description	Unit of Measurement
1	Soil Aggregate	Cubic meter
2	Terrazyme	Kilogram/Liter

References:

1. Pilot Road Research Projects on the Use of Terrazyme in Cabanatuan City and Abucay, Bataan.

2. DPWH Standard Specification for Highway, Bridges and Airport, Volume II, 1995.

3. Internet, General Use of BIO-ENZYME stabilizers in Road Construction (Terrazyme Soil Stabilizer)