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ROADBOND EN 1 is a chemical soil stabilizer that may be used in lieu of lime to stabilize clay subgrade soils. The advantages over lime are a 60% savings in material cost and it is placed, mixed, compacted and finished in one operation without the need to remix, as with lime. Many projects are placed and paved in less than 5 days! In addition, this product is not adversely affected by high sulfates in the soil.

ROADBOND EN 1 has been used successfully for over 23 years on hundreds of projects to stabilize clay subgrade soil and road base material. Numerous lab reports and many field trials attest to the effectiveness of ROADBOND EN 1.

The Texas Transportation Institute in "Research Report 3929-1" determined it to be highly effective in strengthening clay soils, in providing a working table for construction during adverse weather and reducing the swell potential of the clay soil. Other independent tests conclude that ROADBOND EN 1:

- Increases the strength of treated soil and the strength continues to improve over time
- Reduces the permeability and lowers the swell potential of treated soil
- Increases the dry weight of treated soil

Moreover, ROADBOND EN 1 is a Green Product. Installation requires much less fuel and water than conventional stabilizers and a major component of ROADBOND EN 1 is a by-product of the citrus industry. Additionally, the production of ROADBOND EN 1:

- Does not involve mining, hauling, crushing or washing material
- Does not involve kilns or high energy burning
- Does not produce any greenhouse gases or heavy metals
- Does not produce any POP's (Persistent Organic Pollutants)
- Does not produce particulate emissions during manufacture or installation

For more information about ROADBOND EN 1 Patented Soil Stabilizer, including project videos and detailed technical reports, please visit www.RoadbondSoil.com.

P.O. Box 549
Tolar, TX 76476

Phone: (254) 835-4507
Fax: (254) 835-5297

Info@RoadbondSoil.com
RoadbondSoil.com

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INSTALLATION SPECIFICATION

ROADBOND EN 1 Soil Stabilizer

LIQUID STABILIZER TREATMENT FOR SUBGRADE SOILS

1. **DESCRIPTION:** This item shall govern for treatment of new and or existing subgrade material by pulverizing, adding the liquid stabilizer (ROADBOND EN 1 or approved equal), and mixing and compacting the mixed material to the required density as specified herein and in conformity with the typical sections, lines and grades as shown on the plans or as established by the Engineer.

2. **MATERIALS:**

   A. **The liquid stabilizer treatment:** ROADBOND EN 1 or approved equal is applied to subgrade soils for reduction of permeability, moisture susceptibility and swell and to improve strength and stiffness. When applied within the manufacturer's parameters for application, dilution, moisture control, processing, compaction and curing the stabilizer shall improve the shear and bearing strength as well as reduce the moisture susceptibility of soil and aggregate materials. Upon request, the supplier must be able to provide independent laboratory test reports from a certified analytical laboratory experienced in environmental acceptability testing documenting tests performed on product samples of the liquid stabilizer products.

   B. **Water.** Water shall meet the requirements of Item 2.2.4 Standard Specification for Public Works Construction (NCTCOG)

   C. **Water Truck:** Water truck may or may not be equipped with an agitator, but shall be capable of even water flow and uniform distribution over the area to be mixed.

   D. **Product Delivery:** ROADBOND EN 1 or approved equal shall be delivered, stored and handled in closed, weatherproof containers until immediate distribution on the road. Materials must be stored in covered storage that is well ventilated with adequate protection from theft, flooding or damage. If storage bins are used, they are to be completely enclosed. Insure that the manufacturer's safe handling and mixing instructions are followed without exception.

3. **CONSTRUCTION METHODS:**

   A. **Preparation of Subgrade.** Prior to treating existing material and/or placing any new material, the existing material shall be shaped to conform to the typical sections, as shown on the plans or as established by the Engineer. This work shall be done in accordance with the applicable bid items.

   Before pulverizing or scarifying an existing material, when shown on the plans or when directed by the Engineer, the Contractor shall proof roll the roadbed in accordance with special provisions Item 4.2 (A). Soft spots shall be corrected as directed by the Engineer.

P.O. Box 549
Tolar, TX 76476
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When the Contractor uses a reclaimer and/or pulverizing machine that will process the material to the plan depth, the contractor will not be required to excavate to the secondary grade or windrow the material. This method will only be permitted if equipment is provided that will insure the material is cut uniformly to the proper depth and which has cutters that will plane the secondary grade to a uniform surface over the entire width of the cut. The machine shall provide a visible indication of the depth of the cut at all times.

If the Contractor's equipment will not meet plan depth for cutting and pulverizing, then he/she shall be allowed to windrow in order to expose the secondary base or subgrade for proper cutting and pulverizing.

B. **Pulverization:** Prior to treatment of new or existing subgrade, materials shall be pulverized to prevent run-off and to facilitate even distribution of the diluted ROADBOND EN 1 or approve equal. The liquid stabilizer shall be applied to the subgrade material at a plan depth per lift and rate of application as recommended by the manufacturer, provided the equipment used in preparation, mixing and compaction adequately completes each phase of construction.

C. **Moisture Tolerances:** Unless otherwise approved by the Engineer, the ROADBOND EN 1 or approve equal shall not be installed when soil moisture content measures in excess of optimum moisture content (+3%) (ASTM D698) as measured by Test Method ASTM D2216 or ASTM D3017. If the soil moisture content is above the maximum accepted limit, the soil shall be re-mixed and air-dried (aerate) to reduce the moisture content to within tolerances.

D. **Application Method:** The ROADBOND EN 1 or approve equal shall be applied to the subgrade materials as shown on the plans. Should the plans require a depth greater than a maximum lift of ten (10") inches, the contractor shall be required to work the subgrade material in multiple lifts.

E. **Application Preparation:** Clean existing base material and pavement surface of all foreign (i.e. loose dirt, organic material), unstable and objectionable material by means of blading, sweeping and/or other approved methods prior to scarifying and/or initial pulverization. The diluted ROADBOND EN 1 or approve equal may be applied directly on the existing material after pulverization is complete and accepted by the Engineer.

F. **Dilution Ratio and Distribution:** The ROADBOND EN 1 concentrate shall be diluted with water in the water truck at a ratio of not less than 100 to 1 or more than 300 to 1. The ROADBOND EN 1 solution shall then be evenly distributed over the intended area to be mixed in such a manner as to assure even, uniform coverage. (The dilution ratio shall be adjusted to control the moisture content in the mixed material and is not to be confused with the application rate. The application rate is the correct amount of concentrated ROADBOND EN 1, properly diluted, added to the base and/or subgrade material. The dilution ratio is the amount of water used to evenly distribute the correct amount of ROADBOND EN 1 over the area to be mixed. Once diluted, the stabilizer solution shall be applied to project materials the same day. Overnight storage will not be permitted, unless approved by the Engineer.

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Multiple passes by the water truck laden with the ROADBOND EN 1 solution may be required to insure the proper amount of stabilizer is applied to the area to be mixed. (Refer to manufacturer's application rate). The ROADBOND EN 1 shall be applied only on the area where installation operations can be completed during the same working day.

The Contractor shall take precautions when application occurs on uneven or sloping terrain to avoid excess runoff of the ROADBOND EN 1 down slopes and/or through the channels in the soil created by the equipment.

G. **Mixing:** The subgrade material and the liquid stabilizer shall be thoroughly mixed by equipment approved by the Engineer. Mixing shall begin when no more than one-half (1/2) of the required diluted ROADBOND EN 1 has been evenly placed on the section to be treated. When one pass with the approved mixer over the section is completed, the remaining diluted ROADBOND EN 1 shall be placed and the mixing shall continue until the treated material reaches a homogenous mixture and the proper moisture content is achieved.

To reduce evaporation, mixing shall not be delayed longer than two (2) hours from the time of initial distribution of the diluted ROADBOND EN 1 solution. If the temperature exceeds eighty (80) degrees F., then this window is reduced to sixty (60) minutes.

H. **Compaction:** At all times the shape of course shall be maintained by blading and the surface upon completion shall be smooth and in conformity with the typical sections, lines and grades as shown on the plans or as established by the Engineer. Compaction of the mixture shall begin immediately after mixing; pulverization and compaction moisture content requirements are met.

Initial compaction must be achieved with a vibratory pad-foot roller. A steel-wheel, flat-wheel or pneumatic roller shall not be used to achieve initial density, but the same may be used for **Finishing, Curing.**

The material shall be sprinkled as necessary to provide the required optimum moisture content. Compaction shall begin at the bottom and shall continue until the entire depth of mixture is uniformly compacted to the density required by the plans or the methods provided to the governing specifications.

All other subsequent courses treated under this item shall be compacted to a minimum of 95 percent of compaction ratio density at a moisture content between –1 and + 2% of OMC. The testing will be outlined in Test Method ASTM D698 or other approved methods. In addition to the requirements specific for density, the full depth of the material shown on the plans shall be compacted to the extent necessary to remain firm and stable under construction equipment. After each section is completed, tests as necessary will be requested by the Contractor. If the material fails to meet the density requirements, it shall be reworked as necessary to meet these requirements. Throughout this entire operation the shape of the course shall be maintained by blading, and the surface upon completion shall be smooth and in conformity with the typical section shown on the plans and to the established lines and grades.

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Should the material, due to any reason or cause, lose the required stability, density and finish before the next course is placed or the work is accepted, it shall be reprocessed and refinished at the expense of the Contractor to include retesting of all failures.

I. **Finishing, Curing:** All placing, compacting, and finishing operations shall be completed within the guidelines set forth in **Section 3** Construction Method of this specification. After compaction and within twenty-four (24) hours of placement, the surface shall be finished to grade and section by blading and shall be sealed with approved pneumatic or other suitable roller as approved by the Engineer. The complete section may then accept a surfacing as detailed elsewhere.

After finishing the section and prior to placement of the base course and/or surfacing as detailed elsewhere, the finished section shall be sprinkled with plain water as needed to maintain Optimum Moisture Content and to prevent cracking of the finished surface.

J. **Reworking a Section:** When a section is reworked within forty-eight (48) hours after completion, the Contractor shall at its own expense purchase more ROADBOND EN 1 and reapply at the rate of one-half (1/2) of the original application rate to the effected area. However, the dilution ratio shall not exceed 200 to 1 and the Contractor shall mix and compact the material according to the specifications of the original application.

If the plans provide for the treated material to be sealed or covered by other courses of material, such seal or course shall be applied within 3 days after compaction and testing, unless otherwise directed by the Engineer.

4. JOB CONTROL AND TOLERANCES:

A. **Density Control:** The ROADBOND EN 1 applied to the base and/or subgrade material shall follow the standard density test methods ASTM D698 or as directed by the Engineer.

If the material fails to meet the density requirements or should the material loose the required stability, density or finish before the next course is placed or the project is accepted, it shall be reworked as set forth in Section 3.J of this specification.

B. **Density Tolerances:** The Engineer may accept the work providing that not more than one (1) of the most recent five (5) consecutive density test performed is below the specified density and provided that the failing test is no more than 80.74 lbs/CY below the specified density.

C. **Thickness Tolerance of Treated Subgrade:** At no time during the mixing process shall the Contractor increase or decrease the depth of the subgrade section as detailed on the plans without the approval of the Engineer. If any deviation should occur, that section shall be reworked according to construction operations and testing described in **Section** 3 J

5. MEASUREMENT: This item will be measured as follows:

P.O. Box 549
Tolar, TX 76476
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Info@RoadbondSoil.com
RoadbondSoil.com

Liquid Stabilizer Products will be measured by the gallon

Liquid Stabilizer Treatment will be measured by the square yard of the depth specified to the lines and grades shown on the typical sections.

6. PAYMENT The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for as follows:

"Liquid Stabilizer" will be paid for at the unit price bid per gallon. This pricing shall be full compensation for furnishing all the liquid stabilizer products.

"Liquid Stabilizer Treatment" of the depth specified will be paid for at the unit price bid per square yard. This pricing shall be full compensation for shaping existing material, loosening, mixing, pulverizing, spreading, drying, testing, applying stabilizer treatment, dilution water for the stabilizer treatment, compacting, curing including curing materials, shaping and maintaining, processing, hauling, reworking if required, preparing secondary subgrade, and for all mixing water, tools, equipment, labor, and incidentals necessary to complete the work.

Payment for the preparation of the subgrade will be measured and paid for in accordance with the pertinent stabilized base and base course bid items.

Measurement and payment for all items involved in constructing base or subgrade courses, including sprinkling and rolling, compaction will be as provided in the governing base or subgrade item as indicated above in payment.

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ROADBOND EN 1 APPLICATION RATES

REQUIREMENTS: ROADBOND EN 1 shall be stored and handled in closed, weatherproof containers until immediate distribution on the road. ROADBOND EN 1 materials must be stored in covered storage and well ventilated with adequate protection from flooding or damage. For mixing ease and safety round up to the nearest 5 gallon increments (i.e. 72 gallons up to 75 gallons). Follow strict application instructions.

Road Width in Feet	6" in Depth *.00056 GA/SY	8" in Depth *.00075 GA/SY	10" in Depth *.0089 GA/SY
20" wide road	66 gallons per mile	88 gallons per mile	104 gallons per mile
22" wide road	73 gallons per mile	97 gallons per mile	120 gallons per mile
24" wide road	80 gallons per mile	106 gallons per mile	132 gallons per mile
26" wide road	86 gallons per mile	115 gallons per mile	143 gallons per mile
28" wide road	93 gallons per mile	124 gallons per mile	154 gallons per mile
30" wide road	99 gallons per mile	132 gallons per mile	165 gallons per mile
Square yards treated/ gallon	180 square yards	135 square yards	108 square yards
Square yards treated/gallon (when using CTB)	171 square yards	128 square yards	103 square yards

**Use 5% more ROADBOND EN 1 than the chart calls for when treating Cement Treated Base. (Calculate 28.5 cubic yards per gallon)

***Application rate per square yard = $\frac{\text{Length (feet) C Width (feet)}}{9\ \text{SF}} \times \text{Appl. Rate}$

For more information contact:
Roadbond Service Company
Steve Merritt
817.223.0354 cell
254.835.4507 office
Info@RoadbondSoil.com