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## NATURAL SILT FENCE


### Abstract

A geotextile, and a silt fence made therefrom, comprised of a biodegradable nonwoven first sheet in combination with a woven biodegradable second sheet, stitched together by a natural, biodegradable thread. The silt fence includes stakes for installation at a work site. The stakes are typically biodegradable. Substantially the entire combination of elements is biodegradable at a typical work site.



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### Background/Summary

FIELD OF THE INVENTION

[0001] The invention relates to a sheet product comprised substantially of natural, biodegradable materials for use as a fence to retain soil on disturbed land, such as a construction site.

## BACKGROUND OF THE INVENTION

[0002] Water flow on and around a predominantly soil-containing surface will commonly result in movement of the soil caused by the flowing water. The effects of such water flow on the soil surface can range from very minor, if the soil is of an appropriate consistency and the water flow is low; to substantial erosion of the soil. In the latter scenario, the contour of the land may change, and substantial quantities of soil may be transported by the flow of water.

[0003] Various types of systems have been developed to control or counter sediment movement caused by the erosive effects of water flowing on soil. As used herein, the term “soil” is intended to include not only material suitable for the growth of plant life, but also other materials which can be found in a construction or commercial zone, such as but not limited to waste scraps of wood, small stones or concrete-containing particles, particles containing paper, and the like. One such sediment control system is a check dam, which is used to prevent erosion by reducing the velocity of channel flow in small drainage channels and swales. Sediment movement is controlled by a settling out process from the flowing water upstream from the check dam site. The water flows through a rock filter and the soil is maintained upstream from the check dam site. The check dam is essentially constructed of all natural materials. However, the rock structure which forms the actual check dam is a relatively permanent installation, is not easily removed, and must be taken into account when preparing the landscaping or other use of the surrounding area.

[0004] Another sediment control system can involve the utilization of hay bales arranged across the line of flow of the water. The system has the advantage of being largely biodegradable, but will fill eventually with sediment from the water flow, substantially reducing its effectiveness. Further, hay bales which have been effectively filled with sediment are unsightly. If removal of the bales is desired, the result is exposure of the underlying soil to water flow, with the risk of erosion in and around the area where the bales were located.

[0005] Another type of sediment control system is a sheet-like product constructed of a porous polymeric material such as polyethylene, polypropylene, nylon or PVC, among other polymeric materials, with and without additives contained therein. The system, when coupled to a series of wooden, plastic or metal stakes affixed to the sheet-like product, has the advantage of being portable and able to be installed in a range of water flow operating conditions. However, this system tends to clog easily with sediment from the water flow. Also, when the pores in the polymeric material through which the water will flow have become largely plugged by sediment, the sediment control system needs to be removed because the polymeric sheet material is not biodegradable and otherwise would simply remain in place. As a result, there would be a comparatively extensive remediation process needed once the sediment control system is removed and the process of removing the system will tend to damage or destroy any natural vegetation growing after the system installation, which would have been intended to return the soil to a more natural appearance.

[0006] Another challenge relating to the use of a sediment control system is the possible creation of standing pools of water upstream from the system location. The pools are more likely to form when a substantial percentage of the pores through which water will flow become clogged. Standing water will tend to kill any vegetation that is submerged in that area, as well as providing a breeding ground for insects. If a substantially ineffective sediment control system must be removed, the soil which has deposited around that system will be disturbed and will be susceptible to further erosion should waterflow recur in that area. Further, if the sediment control system contains nonbiodegradable materials, that system will then need to be discarded into a landfill.

## SUMMARY OF THE INVENTION

[0007] In its broader aspects, the invention is directed to a geotextile which is biodegradable, resistant to ultraviolet degradation, and contains essentially no petroleum-based component materials. The geotextile comprises a first sheet layer which is comprised of spun bond biodegradable nonwoven natural polymer fibers, such as those derived from polylactic acid; a second sheet layer comprised of a natural biodegradable fibrous material able to form a sheet product which can resist the degradative effects of a sediment-containing water flow and have sufficient strength to support the first sheet layer during use, such as woven coconut fibers, where the second sheet layer is brought into adjacent alignment with the first sheet layer to form a combination sheet; and a natural fiber thread inserted through aligned first and second sheet layers to maintain contact of the first sheet with the second sheet prior to biodegradation. The manner of construction of the second sheet layer preferably utilizes a weaving process. To the extent that other processes can be employed to create a contiguous sheet of sufficient strength, such as by a use of substantially aligned fibers, such an alternative is an option. Then, the natural fiber thread is sewn horizontally through both the aligned first and second sheet layers to maintain contact of the first sheet layer with the second sheet layer to form a combination sheet. In combination with a plurality of wood stakes secured to the geotextile for use at a work site or other location requiring such a sediment control system, this combination sheet geotextile product is essentially completely biodegradable, allows the passage of water through it, yet substantially resists the movement through the combination sheet of sediment carried by the water. In certain applications, it may be necessary to use metal posts in place of the wooden posts. In that embodiment, attachment of the metal posts to the geotextile is via zip ties or aluminum or other metal ties.

[0008] The geotextile, with affixed support stakes, is used as a silt fence, the purpose of which is to impede the flow of water at an outdoor site where water and soil will be in close contact, typically when the water contains sediment, wherein the silt fence comprised of the geotextile permits flow of water through the fence, but flow of sediment carried in that water is substantially inhibited. Typically, at least a lower portion of the geotextile used as the silt fence is laid directly into a trench cut into the soil, extending up to 12 inches below the surface of the soil, or the lower portion alternatively extends downwardly below the surface of the soil 11 inches, or 10 inches, or 9 inches, or 8 inches or 7 inches, or 6 inches, or 5 inches, or 4 inches, or 3 inches. In so doing, by laying the lower portion into the trench, a portion of the fence acts as a base which the flowing water will not undercut. Arranged in this fashion, the silt fence allows for minimal water flow underneath the fence which could otherwise frustrate the sediment control function of the silt fence. The smaller pore size component of the geotextile is the nonwoven polymer sheet, and that pore size will be the limiting factor defining the AOS of the geotextile. The typical AOS size range is between about No. 40 and about No. 70 U.S. Standard Sieve.

[0009] The geotextile used to produce the silt fence, comprised of a first sheet layer of spun bond nonwoven polymer fibers such as from polylactic acid (PLA), and a second sheet layer of natural fibers such as from coconut, preferably has an Apparent Opening Size (AOS) within a generally narrow range, which will be sufficient to inhibit flow of sediment while allowing flow of water. The AOS value is determined by applying ASTM D-4751 to a sample sheet. Spherical, solid glass beads are dry sieved through a geotextile for a specified time and at a specified frequency of vibration. The apparent opening size (AOS) is the pore size, measured in millimeters, at which 90% of the glass beads are retained on and within the fabric.

[0010] Preferably, the first sheet layer of nonwoven polylactic acid fibers has a degree of porosity to allow for a Water Flow Rate in the range of about 6 to about 14 gallons per minute (gpm) per square foot of sheet material. The coconut fiber sheet layer has openings therein, typically generated through a weaving process, to have larger openings than the openings in the first sheet layer, the limiting factor for sediment retention and water flow primarily being the openings in the sheet layer made of spun bonded nonwoven polylactic acid fibers.

[0011] The silt fence should be able to conduct water through the sheet combination at a rate which allows for the separation of sediment from the water, but will not create an unacceptably high water pressure upstream from the silt fence. Typically, the silt fences prepared from polymeric materials will test at approximately 8 or 9 gallons per minute of water flow per square foot of silt fence area. Some of these flow rates may be as low as 6 gallons per minute per square foot. Samples of silt fences prepared from PLA spun bond sheet and coconut fiber can have flow rates up to at least 11.5 gallons per minute per square foot, or up to about 14 gallons per minute per square foot.

[0012] In describing the particular silt fence product, one of the characteristics is the weight rating of the material per an area measurement. Thus a material with a rating of “80 g” means that the particular fence material prior to use weighs 80 g/m.sup.2. A rating of 10 oz means that the particular fence material prior to use weighs 10 oz/m.sup.2. If this rating term is used specifically as to either the spun bond component or the natural fiber component individually, that term is simply used to characterize the rating of one or the other of these components, and not the complete silt fence. As the rating number increases, the sheet has smaller openings between fibers. With smaller openings between fibers, the water flow rate decreases through the geotextile material.

[0013] As an alternative to using a PLA which has been spun bond, one can also utilize a nonwoven manufacturing process, or a needle punch nonwoven process, or a slit tape woven process, among other processes to produce the PLA sheet. In the process of producing the PLA spun bond sheet, the raw material source of the PLA is typically corn, specifically the sugar component of corn. A separate option for producing the PLA is to utilize sugarcane. PLA is classified as a 100% bio sourced plastic. Lactic acid obtained by the fermentation of sugar or starch is transformed into a monomer called a lactide. This material is then polymerized to produce PLA.

[0014] PLA is also identified as poly [oxy (1-methyl-2-oxo-1,2-ethanediyl], CAS number 26023-30-3. It is a biodegradable thermoplastic polymer which can be derived from entirely renewable resources. The material's properties depend on the enantiomeric content, polymer length, and method of preparation. The polymer can be in a “D” form, poly-D-lactic acid [CAS 26917-25-9], and an “L” form, poly-L-lactic acid [CAS 26161-42-2]. The acronym CAS herein refers to a Chemical Abstracts Registry number. Commercially, PLA is sold as either a predominantly D or L form which is semi-crystalline in structure, or a D/L mixture, which is amorphous. The L isomeric form can also include various additives to adjust the PLA properties known as PLA+. Various isomeric forms of PLA can be employed to produce the spun bond sheet. For example, PLA can be used which is comprised of primarily the L-isomer, but which contains about 1 to about 2% of the D-isomer.

[0015] Typically, the pore size becomes smaller as the gram weight of the material increases. The increased gram weight of the material is an indicator of less open space between fibers, and as a result the pore dimensions decrease. Thus, a 10 ounce burlap sheet has a smaller opening size aperture compared to that of an 8 ounce burlap. In a use application for a silt fence, a burlap material which is 8 ounce would typically allow too much sediment to pass through the opening. For a 10 ounce burlap material such as using coconut fiber, the aperture size is approximately 1/16 inch by 1/16 inch.

[0016] In the construction of the geotextile from the first sheet of spun bond nonwoven natural polymer fibers, and the second sheet of natural fibrous polymer fibers, which are then aligned and joined using a natural fiber thread, the first sheet height is approximately 2 feet, while the second sheet height is approximately 3 feet. Sheet length can vary as a function of manufacturing variables, but a typical length is about 100 feet.

[0017] Factoring in the area of material below the soil surface to minimize the effect of flowing water undercutting the silt fence, the height of the first sheet above the soil surface is about 18 inches, and the height of the second sheet above the soil surface is about 30 inches. The height of the lower portion of the geotextile which is buried vertically into the soil can be approximately 6 inches. The final height of each of the first and second sheets may vary from the uninstalled 2 feet and 3 feet values, respectively. Nonetheless, the layer height for the second sheet acts as a failsafe to allow more water to flow past the silt fence over the upper edge of the first sheet in the case of a significant water flow which could otherwise cause damage to the fence. Though the layer heights indicated above are typical, variations in these heights may exist due to specific use limitations, or to state or federal regulations affecting the use of a silt fence.

[0018] Generally, the silt fence has utility in any outdoor commercial activity where soil is capable of being disturbed. Thus, the silt fence can be used in projects involving home construction, or office or multi-family residence construction, or the construction of manufacturing facilities or retail or wholesale facilities, and the like. Further, the silt fence has utility in applications involving the movement of soil without a concurrent construction of a building, such as in farming or mining activities, in irrigation-related projects, road building projects, and the like.

## Description

BRIEF DESCRIPTION OF THE DRAWINGS
[0019] The objects and advantages of the present invention will become more apparent when viewed in conjunction with the following drawings, in which:
[0020] FIG. **1** is a schematic perspective view depicting the geotextile arranged in the soil, the face of the geotextile facing the flow of water.
[0021] FIG. **2** is a perspective view depicting the geotextile including mounting spikes in a partially rolled condition.
[0022] FIG. **3**A is a schematic cross-sectional view of the geotextile mounted into the soil with a portion of the geotextile below grade.
[0023] FIG. **3**B is a schematic cross-sectional view of the geotextile mounted into the soil with a portion of the geotextile below grade, further depicting a water flow into the face of the geotextile.
[0024] FIG. **4** is a perspective view of the woven fiber layer above the nonwoven polymeric layer.
[0025] FIG. **5** is a schematic cross-sectional side depiction of the geotextile shown in FIG. **4**, depicting the woven fiber layer aligned with the nonwoven polymeric layer, the two layers affixed together via a stitched thread.
DETAILED DESCRIPTION
[0026] With further reference to the figures, the silt fence **1** mainly comprises the geotextile **2** which is depicted in FIG. **1**, with the face **6** of the geotextile **2** facing the direction from where water **8** would flow and entrained silt would be expected to flow.
[0027] The geotextile **2** is secured into position in the soil using stakes **12**, the stakes in turn being secured to the geotextile **2** using staples **18**. Face **6** of the geotextile **2** is oriented to receive the flow of water **8** and sediment, and is comprised of a first, spun bond nonwoven sheet **22**, typically comprising PLA, backed by a second sheet **24** comprised of natural fibers, typically coconut fibers, typically woven.
[0028] The second sheet alternately can be constructed using aligned fibers instead of woven fibers. Other biodegradable natural polymers may be utilized in place of PLA in making the first sheet. Polysaccharides as starch and cellulose may be alternative biodegradable natural polymers for use in making fibers. The spun bond nonwoven sheet **22** and fiber sheet **24** are affixed, one to the other, by the use of a natural fiber thread **28**, which is sewn into each of the sheets **22** and **24** and sewn horizontally across the geotextile **2**.
[0029] In one embodiment of the invention, the geotextile **2** comprises only a spun bond nonwoven sheet **22** produced from PLA, and a fiber sheet **24** produced from coconut fibers, in the absence of any additional sheet layers and in the absence of any chemical surface treatment of either of the sheets **22** and **24**. The PLA nonwoven sheet **22** and the coconut fiber sheet **24** are affixed by a natural fiber thread **28** produced from cotton.
[0030] In an embodiment of the invention, the spunbond nonwoven sheet **22** and the fiber sheet **24** contain no chemical or mechanical surface treatments which delay the biodegradation of the sheets **22** and **24** due to environmental elements. These elements can include the presence of moisture, temperature sufficient to facilitate biodegradation, and microbes which can facilitate the natural material degradation. Typically, about a one to about three year period of time to substantially

complete the degradation of the silt fence is considered acceptable, though portions of the silt fence not in contact with soil may degrade over a longer time period.
[0031] In an embodiment of the invention, the PLA for producing a spun bond nonwoven sheet **22** contains a predominant, or even exclusive quantity of the D or L isomer of the molecule. The polymeric material can exist commercially as a D-version, an L-version, a racemic version, and an L "plus" version, this latter comprising the L isomer with certain additives. Typically, the spun bond nonwoven sheet **22** is produced from predominantly L-version polymeric material, with about 1% to about 2% D isomer.
[0032] The geotextile **2** is combined with a plurality of stakes **12** and then formed into a roll **34** for easier transport. For ease in transportation and installation, the stakes **12** are fixed via staples **18** to the geotextile **2**, with the securing tips of the stakes extending downwardly outside of the roll. It is to be noted that a portion of the geotextile **2** is typically buried into the soil so that water flow cannot work downward to a point underneath the geotextile and erode the soil base. That portion of the geotextile **2** which is installed below grade is the subsurface portion **40**.
[0033] During the installation process of the silt fence **1**, the stakes **12** containing geotextile **2** are driven into the soil to a point typically just above the lowest staple **18** on each of the stakes. The subsurface portion **40** of the geotextile **2** is laid in an approximately vertical orientation into a trench **42** (shown in phantom in FIG. **3**A) which is dug adjacent to the line of installation of the geotextile **2**. The resulting construction has the geotextile **2** arranged generally vertically at the work site, supported by the stakes **12**. A subsurface portion **40** of the geotextile **2** is lower than the level of water flow expected at the site, and the geotextile **2** is secured from movement that would otherwise be attributed to the flow of water in the vicinity of the installed geotextile **2**.
[0034] This installation arrangement is further shown in FIG. **3**A, wherein a trench **42** which would receive the subsurface portion **40** has been backfilled adjacent to the stake **12**. As shown in FIG. **3**A, the water flow directed toward the face **6** of the geotextile **2** does not undercut the geotextile due to the placement of the subsurface portion **40** a distance into the ground.
[0035] As seen in further detail in FIG. **3**B, the flow of water containing sediment toward the face **6** of the geotextile **2** will tend to build up a debris residue **46** along the face **6** of the geotextile, thus stopping sediment movement caused by water erosion. On the reverse **50** of the geotextile **2** is the water **8** passing through each of the sheets **22** and **24**. On the reverse **50** is also some portion of sediment residue of a particle size sufficiently small to pass through both of these sheets **22** and **24**. Certain fines are expected to pass through the pores of both the spun bond nonwoven sheet **22** and sheet of natural fibers **24**.
[0036] The relationship between the nonwoven sheet **22** and the fiber sheet **24** is shown further in FIG. **4**. The adjacent coconut fiber sheet **24** and spun bond nonwoven sheet **22** depict in part the relative pore sizes of the two sheets. Typically, the AOS range for the spun bond nonwoven sheet, typically prepared from polylactic acid is about 20 to about 100 US Standard Sieve, as determined by ASTM D4751. Preferably the range is between about 40 and about 70. In an embodiment, the spun bond nonwoven sheet has an AOS of about 70. The aperture size range of the sheet of woven coconut fibers, which alternatively can be fibers from other natural products such as but not limited to hemp or jute, spans roughly square openings from about 1/32″× 1/32″ to about ⅛″×⅛″. Preferably, the aperture is about 1/16″× 1/16″. FIG. **5** identifies the relationship between the spun bond nonwoven sheet **22** underneath, and the sheet of natural fibers **24** on top. There is a difference in height of the sheet of natural fibers **24** relative to the spun bond nonwoven sheet **22**, generally in a ratio range of about 2:1 to about 4:3 natural fiber height to nonwoven sheet height. Also, FIG. **5** shows the natural fiber thread **28** binding the two sheets together. One source for the PLA sheet **22** is Thai Unitika Spunbond Co., Ltd. in Thailand. The coconut fiber sheet material has as one source the company Fiber Wonders in India.
[0037] The natural fiber thread **28** is stitched at intervals horizontally into the aligned spun bond nonwoven sheet **22** and sheet of coconut fibers **24**. The binding process using natural fiber thread

maintains these two sheets in a generally fixed relationship, thereby taking advantage of the supporting function of the sheet of coconut fibers **24** behind the spun bond nonwoven sheet **22** so the filtration can still occur with the proper retention of sediments found in the water.

[0038] The geotextile **2** with stakes **12** for installing at a worksite has the advantage of being produced from virtually all biodegradable material components. The only components which are not readily biodegradable are the staples **18**. Typically though, they will be an iron-based staple and as such will eventually degrade via rust oxidation. In one embodiment, the spun bond nonwoven sheet **22** is generally about 12 inches shorter than the sheet **24** of coconut or other natural product fibers. This differential in height is intended to permit any inordinately high flow of water **8** to be able to overreach the spun bond nonwoven sheet **22** of the installed geotextile **2** without destroying the installed product. Thus, a high level of water would simply flow through the larger pores of the sheet of natural fibers **24**, minimizing the risk of breaching the spun bond nonwoven sheet **22**. Further, as previously noted, a portion of the geotextile **2** is buried in a generally vertical orientation below grade at the worksite to thereby minimize the risk of water flow cutting beneath the exposed portion of the geotextile **2** that would normally make contact with the face **6**, and thus maintain the integrity of the silt fence **1** comprised of the geotextile **2** secured by stakes **12**.

[0039] In a typical geotextile material, the spun bond nonwoven sheet **22** was 80g biodegradable PLA. The height of this fabric **22** was 24 inches. The second sheet of natural fibers **24**, typically from coconut, was produced from 10-ounce biodegradable burlap. The second sheet **24** height was 36 inches. The two sheets **22** and **24** were stitched together using natural fiber thread **28**, such as cotton thread, at horizontal intervals typically ranging between about 5 and about 20 inches. Spacing between the stakes **12**, which individually had dimensions of 1.5 inch by 1.5 inch by 48 inches nominally, was about 10 feet. A roll **34** of this geotextile **2** was about 100 feet in length.

[0040] The physical properties of this geotextile **2** comprised of nonwoven sheet and a natural fibers sheet are set out in Table 1 below. For comparison, textiles produced from woven polypropylene are identified in the Table as samples A, B, C & D, and included with the inventive sample, identified as “E”.

TABLE-US-00001 TABLE 1

| TEST PROPERTY | METHOD | A | B | C | D | E |
|---|---|---|---|---|---|---|
| Tensile Strength (Grab) | ASTM D4632 | 60 × 60 lbs. | 100 × 100 lbs. | 124 × 124 lbs. | 140 × 140 lbs. | 116 × 98 lbs. |
| Elongation | ASTM D4632 | 15% | 15% | 15% | 15% | 8% |
| CBR Puncture | ASTM D6241 | 200 lbs. | 300 lbs. | 350 lbs. | 400 lbs. | 455 lbs. |
| Trapezoidal Tear | ASTM D4533 | 30 × 30 lbs. | 45 × 45 lbs. | 50 × 50 1bs. | 65 × 65 lbs. | 30 × 23 lbs. |
| UV Resistance (500 hrs) | ASTM D4355 | 70% | 70% | 70% | 70% | 90% |
| Apparent Opening Size | ASTM D4751 | 30 US Std. Sieve | 30 US Std. Sieve | 30 US Std. Sieve | 30 US Std. Sieve | 70 US Std. Sieve |
| Permittivity | ASTM D4491 | 0.05 $Sec^{-1}$ | 0.05 $Sec^{-1}$ | 0.05 $Sec^{-1}$ | 0.05 $Sec^{-1}$ | 0.15 $Sec^{-1}$ |
| Water Flow Rate | ASTM D4491 | 9 gpm/sf | 6 gpm/sf | 8 gpm/sf | 8 gpm/sf | 11.5 gpm/sf |

As the data show, inventive sample E compared to the woven polypropyline textiles A through D demonstrated a lower Elongation, a higher CBR Puncture value, greater UV resistance, a smaller Apparent Opening Size, higher Permittivity, and a higher Water Flow Rate.

[0041] The ability of the natural silt fence **1** to effectively retain soil was evaluated using the ASTM D 7351 test, in a simulated 16 foot wide toe-of-slope installation with wooden posts set at an 8 foot spacing. The sample E material described in Table 1 above was used for this test.

[0042] The sediment retention device (SRD) was installed and exposed to simulated runoff. The runoff was created by combining water and soil in the mixing tank and agitating during the test. 3560 lb of water and 230 lb (dry weight) of test soil were combined to create the runoff of about 6% (60,000 mg/L). This was a default condition provided in the standard, which is defined as a hypothetical 30-minute peak flow from a 24 hour, 4 inch rainfall in a 100-ft long×20 ft wide bare soil slope. The water/soil quantities were adjusted to reflect a 16-ft wide installation. Sediment-laden water was mixed and discharged onto a 3:1 slope and allowed to run to and seep through the installed SRD. The weight of sediment-laden flow was measured in both mixing and collection tanks during the test. Grab samples of the seepage were taken over 5 minute intervals. The measurement of sediment passing through the installed SRD was compared to the measured amount in the upstream flow and used to quantify the effectiveness of the SRD in retaining sediment while allowing continued seepage.

[0043] The installation zone for the soil to be tested had a subgrade soil layer in place and compacted. Compaction was verified to be 90% (+3%) of Standard Proctor density and moisture content was verified to be within +3% of an optimum moisture content using ASTM D 2937.

[0044] The test soil used in the test plots had the properties set out in Table 2 below.

TABLE-US-00002 TABLE 2 Soil Characteristic Test Method Value % Gravel ASTM D 422 0 % Sand 65 % Silt 20 % Clay 15 Liquid Limit, % ASTM D 4318 26 Plasticity Index, % 5 Soil Classification USDA Sandy Loam Soil Classification ASTM Silty Clayey Sand (SC-SM)

The results of the soil retention test, per ASTM 7351, are set out below in Table 3.

TABLE-US-00003 TABLE 3 Testing Procedure: ASTM 7351 Test Setup: Toe-of-Slope Installation: Wooden Posts @ 8′ Spacing Soil: Loam-6% Sediment Concentration Dry Total Total Sedi- Test Oil & Total Dry Bottle Sediment Collected Collected ment Sample Time, Grease, Weight, weight, Weight, Weight, Water Volume, Conc., Number minutes mg/L Turbidity g g g mg Wt., g 1 mg/l Upstream B0 0 n/a 9999 391.99 172.84 156.27 16570 62.88 0.25 66280 B5 5 n/a 8626 386.19 171.75 156.75 15000 57.69 0.25 60000 B10 10 n/a 9999 384.41 171.62 157.15 14470 55.84 0.25 57880 B15 15 n/a 9999 384.80 170.78 156.82 13960 67.00 0.25 55840 B20 20 n/a 9999 386.85 169.55 156.60 12950 60.70 0.26 51800 825 25 n/a 9999 384.66 169.31 157.59 11720 67.76 0.25 46880 B30 30 — 9999 382.92 166.87 155.11 11760 60.94 0.25 47040 Water in Mixer (lbs): 3560 Soil Added (lbs): 228 Oil Added (g): 0 AVGS: 56103 Downstream AD 0 — 0 367.35 157.89 157.26 630 52.20 0.25 2520 A5 5 n/a 4810 367.35 157.89 157.25 630 52.20 0.25 2520 A10 10 n/a 3451 358.74 157.69 157.24 450 43.81 0.25 1800 A15 15 n/a 4177 360.86 156.77 156.20 570 47.89 0.25 2280 A20 20 n/a 4321 343.99 157.47 156.94 530 29.58 0.25 2120 A25 25 n/a 3725 360.37 157.71 157.23 480 45.43 0.25 1920 A30 30 n/a 3673 372.56 157.44 156.98 460 58.14 0.25 1840 A35 35 n/a 1367 368.76 157.59 157.40 190 53.77 0.25 760 A45 45 n/a 993 372.08 157.48 157.34 140 57.26 0.25 560 A60 60 n/a 868 375.75 157.65 157.52 130 60.58 0.25 520 A75 75 n/a 767 381.61 158.81 158.69 120 64.11 0.25 480 A90 90 n/a 643 363.14 155.31 155.20 110 52.63 0.25 440 Soil Collected (lbs): n/a 1480 (avg) Testing Procedure: ASTM 7351 Test Setup: Toe-of-Slope Installation: Wooden Posts @ 8′ Spacing Soil: Loam-6% Sediment Concentration Cumu- Soil Water Assoc. lative Cumu- Reten- Reten- Reser- Water Water Coll. SRD lative Assoc. tion tion voir Dis- Dis- Tank Ponding Soil Solids Effec- Effec- Sample % Weight, charge, charge, Depth, plot Height, Loss, Loss, tive- tive- Number Solids lb gal gal in time in lbs lbs ness, % ness, % Upstream 0 0 0 B0 7.03% 3788 66.2 66.2 5.0 40.2 40.2 B5 6.54% 3196 71.3 137.5 10.0 81.2 41.0 B10 6.37% 2560 71.5 209.0 15.0 120.9 39.7 B15 6.13% 1924 72.4 281.4 20.0 158.7 37.7 B20 5.62% 1282 73.0 354.4 25.0 193.4 34.7 825 5.16% 638 72.5 427.0 30.0 226.3 32.9 B30 5.18% 0 — — — — — 6.00% TOTALS: 426.9 226.3 Downstream 0 0 AD 0.30% 0 0.0 0.0 0.0 5 0.0 0.0 0.0 97.44% 21.83% A5 0.30% 0 29.4 29.4 0.0 10 48.0 0.6 0.6 A10 0.22% 248 47.4 76.8 30.0 15 89.0 1.6 1.0 A15 0.28% 642 48.1 124.8 48.0 20 78.0 2.8 1.1 A20 0.28% 1044 52.6 177.4 70.0 25 91.0 3.9 1.1 A25 0.24% 1484 59.8 237.2 90.0 30 104.0 5.0 1.1 A30 0.21% 1984 37.3 274.6 115.0 35 113.0 5.6 0.5 A35 0.09% 2296 29.0 303.6 130.0 45 95.0 5.7 0.2 A45 0.07% 2538 17.3 320.8 145.0 60 76.0 5.8 0.1 A60 0.06% 2682 7.7 328.5 150.0 75 56.0 5.8 0.0 A75 0.05% 2746 5.3 333.8 155.0 90 60.0 5.8 0.0 A90 0.05% 2790 — — — — — — — 0.18% 2790 333.7 5.8 Soil Collected (lbs): n/a (avg) (total) (total) (approx.)

[0045] The silt fence used for generating the ASTM 7351 data demonstrated excellent effectiveness in retaining test soil, with a 97.44% effectiveness value. The silt fence also demonstrated water retention effectiveness of 21.83%.

[0046] The same silt fence material identified in Table 1 as Sample E, used above in the ASTM 7351 test, was also subjected to a Sediment Control evaluation, using ASTM D 5141. A silty clay soil type was employed, in a vertical test configuration. The method was used to determine the filtering efficiency and flow rate of the filtration component of the silt fence. Filtering efficiency indicates the percent of sediment removed from sediment-containing water. Taken as an average of three runs, the flow rate of the silt fence material was 0.007 m.sup.3/m.sup.2/min, or 0.177 gallons per minute per square foot, and it had an average filtering efficiency of 99.7%.

[0047] The various embodiments of the invention shown and described are merely for illustrative purposes only, as the drawings and the description are not intended to restrict or limit in any way the scope of the claims. Those skilled in the art will appreciate various changes, modifications, and improvements which can be made to the invention without departing from the spirit or scope thereof. The invention in its broader aspects is therefore not limited to the specific details and representative apparatus and methods shown and described. Departures may therefore be made from such details without departing from the spirit or scope of the general inventive concept. The invention resides in each individual feature described herein, alone, and in all combinations of those features. Accordingly, the scope of the invention shall be limited only by the following claims and their equivalents.

## Claims

**1**. A geotextile which is biodegradable, resistant to ultraviolet degradation, and contains essentially no petroleum-based materials, comprising: a first sheet layer comprised of spunbond nonwoven natural fibers; a second sheet layer comprised of natural fibers, the second sheet layer brought into adjacent alignment with the first sheet layer; and natural fiber thread inserted through the aligned first and second sheet layers to maintain contact of the first sheet layer with the second sheet layer prior to biodegradation of the geotextile.

**2**. The geotextile of claim 1 further comprising posts attached to the geotextile to produce a silt fence, the posts with an extending portion for insertion into soil.

**3**. The geotextile of claim 1 wherein the spun bond nonwoven natural fibers are comprised of polylactic acid (PLA).

**4**. The geotextile of claim 1 wherein the natural fibers are comprised of coconut fibers.

**5**. The silt fence of claim 2, with a water flow rate of about 6 to about 14 gallons per minute per square foot.

**6**. The silt fence of claim 2, with a water flow rate of about 8 to about 11.5 gallons per minute per square foot.

**7**. The silt fence of claim 2, wherein the geotextile prior to use weighs about 80 g/m.sup.2.

**8**. The geotextile of claim 1 with a first sheet layer apparent opening size (AOS) in the range between about 20 and about 100 US Standard Sieve.

**9**. The geotextile of claim 1 with a first sheet layer apparent opening size (AOS) in the range between about 40 and about 70 Standard Sieve.

**10**. The geotextile of claim 1 with a first sheet layer apparent opening size (AOS) of about 70 US Standard Sieve.

**11**. The geotextile of claim 1 with a second sheet layer aperture size in the range of about 1/32″× 1/32″ to about ⅛″×⅛″.

**12**. The geotextile of claim 1 with a second sheet layer aperture size of about 1/16″× 1/16″.