Sustainable Landscaping Basics, Options & Issues

By: Ron Alexander

Principal, R. Alexander Associates, Inc. 5/24/12

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WHY COMPOST? WHY SUSTAINABLE METHODS?

- Landscape architects, designers and contractors are forced to rehabilitate problematic sites
- Shrinking budgets

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Poor Soil Qualities, Structure…..

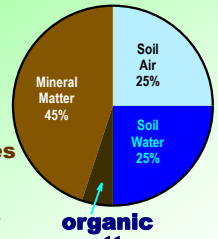
- **Topsoil** – the surface or upper part of the soil profile, naturally generated medium consisting of sand, silt, clay, organic matter, trace amounts of nutrients
- **Subsoil** – are often devoid of organic matter and nutrients, and do not possess the physical structure required for optimum plant growth

-We are not often left true topsoil on project sites
-Compost improves soil structure, can even turn subsoil (and sand) into functioning landscape soils

Soil Components

Characteristics of an ideal soil… *we never have it !*

About ½ of the soil volume is solid particles



About ½ of the soil volume is pore space

Plus nutrients, microbes, other life forms …..

Fix soil to improve plant survivability

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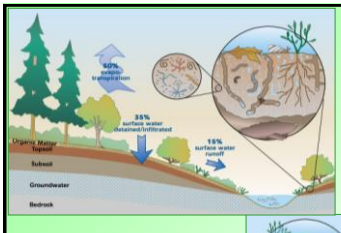
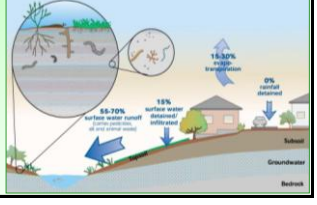


Changing Regulations

NPDES Phase II

Storm water management (and related erosion) is a greater issue

Source: www.SoilsforSalmon.org



Interest in 'Green' Building

- EPA – '*Green Building': practice of maximizing the efficiency with which buildings and their sites use resources, while minimizing building impacts on human health and the environment, throughout the complete building life cycle.*
- US Green Buildings Council - focuses more on the 'building' itself
- LEED = Leadership in Energy & Env'l. Design - credit system
- New building construction (LEED-NC credits)
  - *Compost contributes in 3 (of 6) categories:* ***Sustainable Sites****,* ***Water Efficiency, Materials & Resources***
- Compost usage concepts: restoring habitats, decreasing storm water, helping to decrease urban heat islands & water use, using recycled & locally manufactured materials

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LEED Sustainable Site Credits

- Category divided into 15 subcategories
  - Compost BMPs can contribute credits in 5 categories:

-Prerequisite 1 – Construction activity pollution prevention
-SS Credit 5.1 – Site Development: Protect and Restore Habitat
-SS Credit 6.1 – Storm Water Design: Quantity Control
- SS Credit 6.2 – Storm Water Design : Quality Control
-SS Credit 7.2 – Heat Island Effect: Non-Roof
-SS Credit 7.2 - Heat Island Effect: Roof
-WE Credit 1.1 – Water Efficiency Landscape: Reduce 50%
-WE Credit 1.1 – Water Efficiency Landscape: Reduce 50%
-WE Credit 1.2 - Water Efficiency Landscape: Reduce 100%
-WE Credit 2 – Innovative Waste-water Technologies
-MR Credit 4.1 – Recycled Cont: 10%
-MR Credit 4.2 - Recycled Cont: 20%
-MR Credit 5.1 – Reg'l Materials: 10%
-MR Credit 5.2 – Reg'l Materials: 20%
-MR Credit 5.1 – Rapidly Renewable Materials

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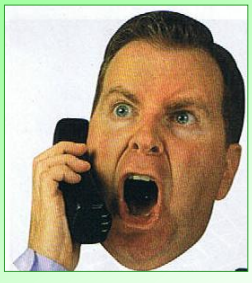
Sustainable Sites Initiative

•The Sustainable Sites Initiative™ (SITES™) is an effort of the ASLA, the Lady Bird Johnson Wildflower Center (University of Texas at Austin) and the United States Botanic Garden to create voluntary national guidelines and performance benchmarks for sustainable land design, construction and maintenance practices.
• National rating system for sustainable landscapes
• Compost is specified for use in:
  - SSI Prerequisite Credit 7.2 – Restore Soils Disturbed During Construction
  - SSI Prerequisite Credit 7.3 – Restore Soils Disturbed by Previous Development
  - Innovation credits – *may ways to use here*

SSI methods = LEED credits (?)

THE SUSTAINABLE SITES INITIATIVE

Customers are Demanding it



Irrigation & Green Industry Magazine : 'green' & 'eco-friendly' methods are in growing demand

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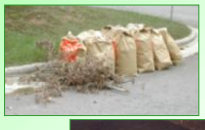
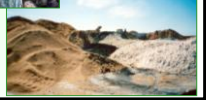
Recycling has Expanded

- **Yard trimmings**
- *Food residuals*
- Biosolids
- Industrial by-products
- Woody materials
- Manure
- MSW





So, KEY product is more accessible…

Commercial Compost Production

1) Feedstock preparation: grinding & mixing

2) High-temperature composting phase

3) Lower-temperature curing phase

4) Screening (sizing for specific applications)

Compost / Composting

Various types of composts in California

- 100 Commercial Licensed

- Many unlicensed – *be careful*

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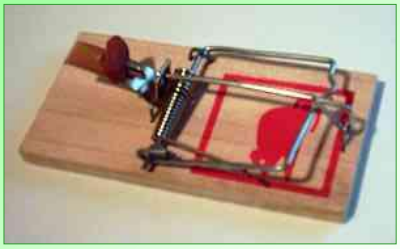

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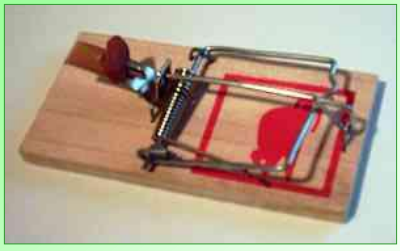

We' ve Built a Better Mousetrap !

FILTREXX™

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Choices…….

are many in the marketplace

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Choices…….

are many in the marketplace

THEY'RE JUST NOT AS FUNCTIONAL !!

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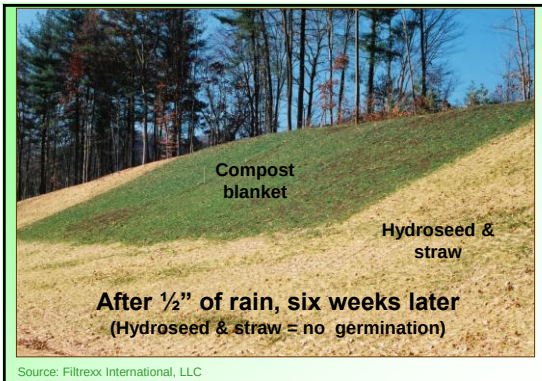
Typical installation and use scenarios

Source: Filtrexx

Source: TCEQ



Source: Filtrexx International, LLC

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Source: Filtrexx International, LLC

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Bio-Based Options

Bioengineering Sites with Compost

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Compost Works Because it Provides Various Benefits

Physical:
- Improves soil structure
- Moisture management

Chemical:
- Modifies and stabilizes pH
- Increases cation exchange capacity
- Supplies nutrients

Biological:
- Supplies soil biota
- Suppresses plant diseases

Other:
- Binds/degrades contaminants
- Binds nutrients

…And can be modified

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Soil Structure: Physical Modification

Oxygen, water, nutrient, pesticide movement,

pore space

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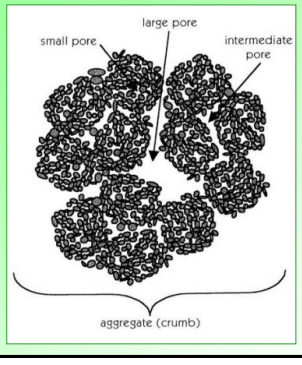
Soil Aggregation



A well aggregated soil has a range of pore sizes. This medium size soil crumb is made up of many smaller ones. Very large pores occur between the medium size aggregates. Occurs physically and biologically

Less wind and water erosion, better accepts water

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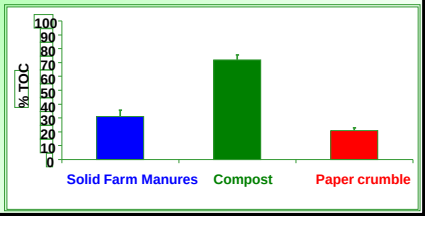
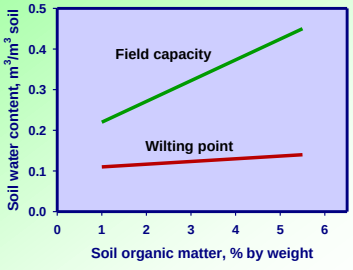
Improved
- **Tilth**
- **Reduced bulk density**
- **Improved rooting**

Long Lasting Organic Matter –
Lignin as % of Total Organic Carbon



Effect of Organic Matter on Available Soil Water



ATTRA – each increase of 1% OM can increase soil WHC by 16,500 gallons H_2O/A

Reduce irrigation 30-50% by 'fixing' soil first

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Compost Restores Stormwater Infiltration Capacity

Source: University of Washington trials on glacial till soil. Reduce runoff by up to 50%

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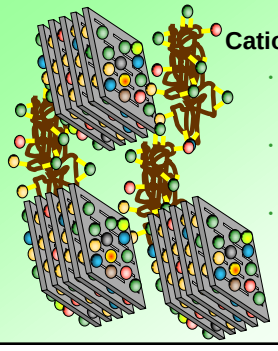
Compost Supplies Macro and Micro Nutrients

So can modify pre-plant fertilization packages
Also can replace lime and gypsum application

SOM is a Nutrient Reservoir:

Cation exchange capacity



- Cation exchange capacity (CEC) is the total amount of cations that a soil can retain
- The higher the soil CEC the greater ability it has to store plant nutrients (reservoir) > *long-term fertility?*
- Soil CEC increases as
  - The amount of clay increases
  - The amount of organic matter increases
  - The soil pH increases

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Composting Creates High Temperatures:

(Naturally)

- Weed free
- Human/animal pathogen, and
- Plant disease destruction

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Suppresses Soil-Borne Diseases

4 Mechanisms of Disease Suppression, via beneficial organisms:

1. Induced systemic resistance (ISR) or systemic acquired resistance (SAR) – turns on plant's natural disease-fighting mechanisms
2. Antagonism (kills/harms disease organisms)
3. Competition for nutrients (and energy)
4. Competition for root colonization

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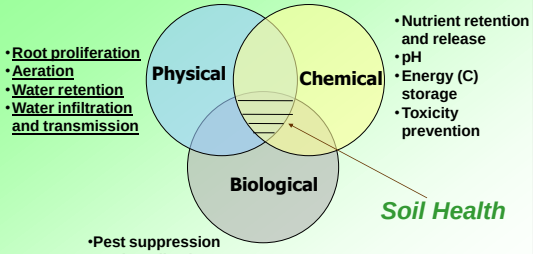
Soil Health



- Root proliferation
- Aeration
- Water retention
- Water infiltration and transmission

- Nutrient retention and release
- pH
- Energy (C) storage
- Toxicity prevention

- Pest suppression
- N mineralization
- OM decomposition
- Habitat protection

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How to Choose a Compost Product

Understand

- Compost characteristics
- Soil characteristics
- Application (specific end use)

Best for your internal and crop requirements

Know

- Your supplier
  - Staff, process, facility
- Go by the 'spec'

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Buy a Certified Product

U.S. Composting Council

Seal of Testing Assurance Program

Specific nutrients, pH, OM, EC, moisture, heavy metals, particle size, pathogens, stability, maturity, and more

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BASICS - Participating Composters:

- Complete on-going product testing
  - -Operate on-going sampling/testing regime
  - -Using uniform sampling and analytical testing methods (from the TMECC)
  - -Using only STA Program certified labs
- Disclose test data results (lab analyses) and provide appropriate end use instructions to end users

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DOTs Requiring STA Certification

- **California - *Caltrans***
- Colorado
- Georgia
- Iowa
- North Carolina
- Pennsylvania
- Oregon
- South Carolina
- Texas
- Washington State
- Working - MI, MN, NY, WI

This is what a "good" compost looks like

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Compost Application

Soil Incorporant
- Turf establishment
- Garden bed preparation
- Reclamation/remediation
- Nursery production
- Roadside Vegetation

Surface Applied
- Garden bed mulch
- Erosion control media
- Turf topdressing

Growing Media Component
- Container/potting substrates
- Landscape (e.g. rooftop, raised planters)
- Backfill mixes (tree and shrub plantings)
- Golf course (e.g. tee, green, divot mixes)
- Manufactured topsoil

Lots of applications,
Staple of landscape industry

Summary
Will discuss, as per Caltran specs

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General Landscape Applications

- Planting Beds
- Backfill Mixes
- Turf Establishment

Soil Amendment (Compost)

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Apply 1-2" layer *(specify within spec)*
Incorporate to a 6-8" depth

(6 CY / 1,000 SF)

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Remove clods, stones, etc. over 2"

Smooth planting area

Plant as specified

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Water plants in well

(fertilizer, lime, gypsum)

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Reforestation project by the Presidio Trust

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Excavate planting hole 2-3 width of rootball

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Blend compost and existing soil – typically 2 : 1 by volume

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Place plant

Backfill hole with soil blend

Firm occasionally

Water

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Apply 1-2” layer (sometimes more)

(specify within spec)

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Remove clods, stones, etc. over 2”

Incorporate to 6-8” depth

Smooth prior to seeding or laying sod

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Water and fertilize

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Soil Amendment (compost) - Physical and Chemical Requirements

Property	Test Method	Requirement
pH	TMECC 04.11-A Elastometric pH 1:5 Slurry Method pH Units	6.0–8.0
Soluble Salts	TMECC 04.10-A Electrical Conductivity 1:5 Slurry Method dS/m (mmhos/cm)	0–10.0
Moisture Content	TMECC 03.09-A Total Solids & Moisture at 70+/- 5 deg C % Wet Weight Basis	30–60
Organic Matter Content	TMECC 05.07-A Loss-On-Ignition Organic Matter Method (LOI) % Dry Weight Basis	30–65
Maturity	TMECC 05.05-A Germination and Vigor, % Relative to Positive Control Seed Emergence Seedling Vigor	 80 or Above 80 or Above
Stability	TMECC 05.08-B Carbon Dioxide Evolution Rate mg CO_2-C/g OM per day	8 or below
Particle Size	TMECC 02.02-B Sample Sieving for Aggregate Size Classification % Dry Weight Basis	Inches % Passing 5/8 95% 3/8 70% Max. Length 4 inches
Pathogen	TMECC 07.01-B Fecal Coliform Bacteria < 1000 MPN/gram dry wt.	<1000 (Pass)
Pathogen	TMECC 07.01-B Salmonella < 3 MPN/4 grams dry wt.	<3 (Pass)
Physical Contaminants	TMECC 02.02-C Man Made Inert Removal and Classification: Plastic, Glass and Metal % > 4mm fraction	Combined Total: < 1.0
Physical Contaminants	TMECC 02.02-C Man Made Inert Removal and Classification: Sharps % > 4mm fraction (Sewing needles, hypodermic needles)	None Detected

NOTE: TMECC refers to "Test Methods for the Examination of Composting and Compost," published by the United States Department of Agriculture and the United States Compost Council (USCC).

In handout…

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Cost Comparison

Based on an area of 5,000 SF

Option 1 (install 6" of topsoil)

- Topsoil required: approx. 93 CY
- Unit price would be anywhere from $30 - $35/CY installed

GRAND TOTAL: $3,022 (Approximately $26,000/A)

Option 2 (Install 2" of compost and amend into 6 inches of existing soil)

- Compost required: approx. 31 CY
- Unit price to install and amend would be anywhere from $40 - $45/CY installed

GRAND TOTAL: $1,318 (Approximately $11,500/A)

Source: RAA / McGill Env'l Systems

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General Landscape Applications

- Mulching

Mulch > compost based

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Apply uniform 2-3" layer
(specify within spec)

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Smooth evenly and water

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- Specify and use coarser, woody fraction for best results
- Avoid tree/shrub/plant trucks/stems, don't apply within 4' of drainage ditches

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Mulch - Physical and Chemical Requirements

Property	Test Method	Requirement
pH	TMECC 04.11-A Elastometric pH 1:5 Slurry Method pH Units	6.0–8.5
Soluble Salts	TMECC 04.10-A Electrical Conductivity 1:5 Slurry Method dS/m (mmhos/cm)	0–10.0
Moisture Content	TMECC 03.09-A Total Solids & Moisture at 70+/- 5 deg C % Wet Weight Basis	N/A
Organic Matter Content	TMECC 05.07-A Loss-On-Ignition Organic Matter Method (LOI) % Dry Weight Basis	30–100
Maturity	TMECC 05.05-A Germination and Vigor, % Relative to Positive Control Seed Emergence Seedling Vigor	 N/A N/A
Stability	TMECC 05.08-B Carbon Dioxide Evolution Rate mg CO_2-C/g OM per day	N/A
Particle Size	TMECC 02.02-B Sample Sieving for Aggregate Size Classification % Dry Weight Basis	Inches % Passing 3 99% 3/8 <25% Max. Length 4 inches
Pathogen	TMECC 07.01-B Fecal Coliform Bacteria < 1000 MPN/gram dry wt.	<1000 (Pass)
Pathogen	TMECC 07.01-B Salmonella < 3 MPN/4 grams dry wt.	<3 (Pass)
Physical Contaminants	TMECC 02.02-C Man Made Inert Removal and Classification: Plastic, Glass and Metal % > 4mm fraction	Combined Total: < 1.0
Physical Contaminants	TMECC 02.02-C Man Made Inert Removal and Classification: Sharps % > 4mm fraction (Sewing needles, hypodermic needles)	None Detected

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Landscape / Restoration Application

- Site Restoration / Natives

Compost (incorporate)

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Apply 4" coarse, compost

Typically used on hot, dry sites where natives are established (low nutrient requirements)

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Incorporate to a depth of 12-18"

Avoid pavement edges (within 2')

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Rake and compact, as required

Seed/Vegetate

Apply erosion control measures

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Brockway Summit Water Quality Improvement Project-2004

(near Lake Tahoe)

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Caltrans research found….

Deep incorporation of compost improves soil characteristics including:

- Infiltration and permeability
- Water holding capacity
- Texture
- Nutrient levels and cycling
- Micro-organism populations
- Rooting depth
- Oxygen exchange and air space
- Vegetation Coverage

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Compost (Incorporate) - Physical and Chemical Requirements

Property	Test Method	Requirement
pH	TMECC 04.11-A Elastometric pH 1:5 Slurry Method pH Units	6.0–8.0
Soluble Salts	TMECC 04.10-A Electrical Conductivity 1:5 Slurry Method dS/m (mmhos/cm)	0–10.0
Moisture Content	TMECC 03.09-A Total Solids & Moisture at 70+/- 5 deg C % Wet Weight Basis	30-60
Organic Matter Content	TMECC 05.07-A Loss-On-Ignition Organic Matter Method (LOI) % Dry Weight Basis	30–65
Maturity	TMECC 05.05-A Germination and Vigor, % Relative to Positive Control Seed Emergence Seedling Vigor	80 or above 80 or above
Stability	TMECC 05.08-B Carbon Dioxide Evolution Rate mg CO_2-C/g OM per day	80 or below
Particle Size	TMECC 02.02-B Sample Sieving for Aggregate Size Classification % Dry Weight Basis	Inches % Passing 3 99% 3/8 <25% Max. Length 4 inches
Pathogen	TMECC 07.01-B Fecal Coliform Bacteria < 1000 MPN/gram dry wt.	<1000 (Pass)
Pathogen	TMECC 07.01-B Salmonella < 3 MPN/4 grams dry wt.	<3 (Pass)
Physical Contaminants	TMECC 02.02-C Man Made Inert Removal and Classification: Plastic, Glass and Metal % > 4mm fraction	Combined Total: < 1.0
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Erosion/Sediment Control

- **Erosion Control (Compost blanket)**
- **Compost Sock**

Sheet vs. concentrated flow

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Compost Blankets

1-2" depth *(specify within spec),*

onto up to 2:1 slopes, apply 3' above the top of the slope and into existing vegetation

Apply any necessary erosion control techniques

Source: TxDOT and TECQ

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Coarse compost particles absorb rain energy, fine particles absorb water

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Compost Blanket - Physical and Chemical Requirements

Property	Test Method	Requirement
pH	TMECC 04.11-A Elastometric pH 1:5 Slurry Method pH Units	6.0–8.0
Soluble Salts	TMECC 04.10-A Electrical Conductivity 1:5 Slurry Method dS/m (mmhos/cm)	0–10.0
Moisture Content	TMECC 03.09-A Total Solids & Moisture at 70+/- 5 deg C % Wet Weight Basis	30–60
Organic Matter Content	TMECC 05.07-A Loss-On-Ignition Organic Matter Method (LOI) % Dry Weight Basis	30–65
Maturity	TMECC 05.05-A Germination and Vigor, % Relative to Positive Control Seed Emergence Seedling Vigor	 80 or Above 80 or Above
Stability	TMECC 05.08-B Carbon Dioxide Evolution Rate mg CO_2-C/g OM per day	8 or below
Particle Size	TMECC 02.02-B Sample Sieving for Aggregate Size Classification % Dry Weight Basis	100% Passing, 3 inch 90-100% Passing, 1 inch 65-100% Passing, 3/4 inch 0 - 75% Passing, 1/4 inch Maximum length 6 inches
Pathogen	TMECC 07.01-B Fecal Coliform Bacteria < 1000 MPN/gram dry wt.	<1000 (Pass)
Pathogen	TMECC 07.01-B Salmonella < 3 MPN/4 grams dry wt.	<3 (Pass)
Physical Contaminants	TMECC 02.02-C Man Made Inert Removal and Classification: Plastic, Glass and Metal % > 4mm fraction	Combined Total: < 1.0
Physical Contaminants	TMECC 02.02-C Man Made Inert Removal and Classification: Sharps % > 4mm fraction (Sewing needles, hypodermic needles)	None Detected

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Filter Socks

Advantages:

- Can be staked into place to allow use in concentrated flows of water
- When filled, socks are very heavy and have good soil contact (don't have to 'dig in')
- Continuous socks can be created, unlimited length
- Are 3 dimensional, sediment is caught in the organic mass (pore spaces)
- Coarse particles allow water to flow through, while finer particles trap sediment

Modified from: Filtrexx International, LLC

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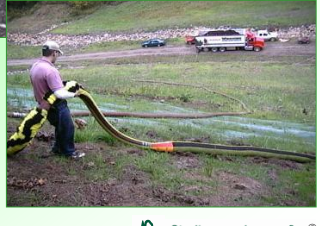
12" diameter sock,
1 year durability



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Compost Sock - Physical and Chemical Requirements

Property	Test Method	Requirement
pH	TMECC 04.11-A Elastometric pH 1:5 Slurry Method pH Units	6.0–8.5
Soluble Salts	TMECC 04.10-A Electrical Conductivity 1:5 Slurry Method dS/m (mmhos/cm)	0–10.0
Moisture Content	TMECC 03.09-A Total Solids & Moisture at 70+/- 5 deg C % Wet Weight Basis	<60
Organic Matter Content	TMECC 05.07-A Loss-On-Ignition Organic Matter Method (LOI) % Dry Weight Basis	30–100
Maturity	TMECC 05.05-A Germination and Vigor, % Relative to Positive Control Seed Emergence Seedling Vigor	 N/A N/A
Stability	TMECC 05.08-B Carbon Dioxide Evolution Rate mg CO_2-C/g OM per day	N/A
Particle Size	TMECC 02.02-B Sample Sieving for Aggregate Size Classification % Dry Weight Basis	Inches % Passing 3 99% 3/8 30-50% Max. Length 2 inches
Pathogen	TMECC 07.01-B Fecal Coliform Bacteria < 1000 MPN/gram dry wt.	<1000 (Pass)
Pathogen	TMECC 07.01-B Salmonella < 3 MPN/4 grams dry wt.	<3 (Pass)
Physical Contaminants	TMECC 02.02-C Man Made Inert Removal and Classification: Plastic, Glass and Metal % > 4mm fraction	Combined Total: < 1.0
Physical Contaminants	TMECC 02.02-C Man Made Inert Removal and Classification: Sharps % > 4mm fraction (Sewing needles, hypodermic needles)	None Detected

NOTE: TMECC refers to "Test Methods for the Examination of Composting and Compost," published by the United States Department of Agriculture and the United States Compost Council (USCC).

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Other Applications

Not outlined in the Caltrans specifications

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Topsoil Manufacturing

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Use in landscaping, (subsoils/sand) reclamation, brownfields, contaminated sites, etc.

On-site soil blending/ improvement

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Instead of spec'ing 6" of topsoil (of unknown quality), spec 2" of compost and incorporate into site soil

R. Alexander Associates, Inc.©

Financial savings, plus superior soil

Transport 270 CY, instead of 540-810 CY

Can be ½ the cost…

but must make sure that the landscaper follows through

R. Alexander Associates, Inc.©

Can use the same technology for…

Reclamation, Revegetation, Brownfields

R. Alexander Associates, Inc.©

Polkemmet Case Study

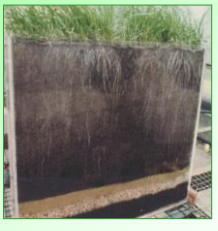
Constructions of two 18 hole golf courses using in situ materials which consist of colliery waste and compost to a ratio of 70% colliery waste and 30% compost.

The colliery waste is crushed to 10mm and the compost is added after the waste has been applied.

Incredible project cost savings

R. Alexander Associates, Inc.©

Sports Turf Establishment & Maintenance



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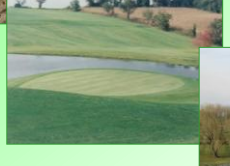
Compost is used as organic matter source in sand based media

Same green 18 years later

1987



85:15 v/v sand to compost blend can meet STRI/USGA standards

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Turf Topdressing

- Turf Maintenance
- Partial Renovation

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Athletic fields

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Other Stormwater Management *(and High Tech)* Applications for Compost

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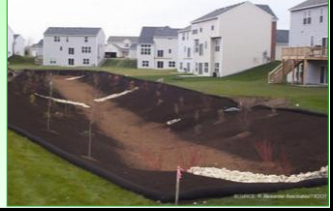
Green roofs

Source: IDNR, R. Alexander Associates, Inc., Erth Products, LLC

R. Alexander Associates, Inc.©

Source: SOCCRA

Rain gardens and bioretention ponds



Living or green walls

Source: Filtrexx International, LLC

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QUESTIONS

More info: urbancompost.com

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