The Soil and Water Quality Link – Using Composted Products for Effective Stormwater Management

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Abstract

The link between water quality and soil quality is finally becoming clearer. When native soils are plentiful and left undisturbed, water quality increases. However, the urbanization of American landscapes has caused significant disruption to this native layer of soil and as a result, Phase II NPDES has been enacted. University research, private research, field demonstrations, and now commercial use of compost for erosion and sediment control show it works as well or much better than most BMPs available today, yet it continues to suffer an identity crises. Here are the facts after reviewing some of the commonly referenced papers that have been available over the last several years. Since compost mimics the layers of native soils, it should be considered as an option in the new Toolbox of the contractor to stay in compliance with Phase II.

Keywords: compost, water quality, erosion control, stormwater management

Introduction

According to the U.S. Department of Agriculture, the United States loses more than 2 billion tons of topsoil each year through erosion (U.S. EPA 1997). The link between water quality, sediment control, erosion, and eventually water quality has widespread impacts on our sustainable future. Stormwater runoff pollution is 80% of water quality violations in many states and is the first line of defense when it comes to creating proactive, sustainable cultures (ESTS 2000).

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Worldwide, estimates indicate erosion may cost us as much as $400 billion annually. There are literally hundreds of products to control sediment and erosion. Very few commercial products involve the use of compost and the composting industry is suffering from an awareness problem relating to the benefits of compost in environmental applications. One of the main identity problems is credible sources that claim compost works. This article focuses on the review of these papers indicating the effectiveness of the use of compost.

Phase II NPDES became effective in March of 2003 and promises to deliver some very strong regulations which should favor the use of compost because of its proven effectiveness and local availability. Compost is available in every major city in the U.S. Phase II has several key points, which should be noted - most importantly is that the requirement for a stormwater management plan drops from five acres to one acre. This five-fold increase will immediately have an impact on sites that are inspected. Many permit issuers are saying at this point, they will not be giving out permits without a stormwater management plan up front. This may be easier to manage and could definitely hold up the permitting process.

Composters should be happy about Phase II because of the opportunity it holds for developing a new market in erosion and sediment control. Erosion prevention (keeping soil from moving off of slopes) is about 90-98% effective. Trying to control the mud and sediment once moving (sediment control) is normally less than 50% effective when using other commercially BMPs like silt fence. Therefore, compost blankets should become a leading tool, especially for challenging projects. The following are reviews of research from using compost over the last several years.

Reasons to Use Compost for Erosion Control as Blankets and Filter Berms

- Construction can run it over and it still works – and it is easy for them to fix with a shovel
- Re-use of material afterwards makes it twice as good – in landscaping or seeding activities
- It works better than standard BMPs like silt fence and straw bales
- Berms offer more actual filtration than coir rolls, silt fence or straw bales
- Compost is annually renewable
- Compost is 100% recycled & locally made
- Compost is all organic & all natural
- It helps create an annual market in all municipalities that generate compost of some kind
- Compost is critter friendly – aquatic wildlife can negotiate berms
- Compost is a biobased product while other common products are a petroleum based product
- Compost provides chemical, biological and physical filtration while others provide only physical filtration
- Compost is less expensive when construction, maintenance, removal and disposal costs are considered

W&H Pacific Demonstration Project Using Yard Debris Compost for Erosion Control

This report is considered by many to be the landmark paper on using compost for erosion control because it points out several items that are crucial to this developing marketplace. There are over 70 references and many projects (including many of my own field demos) have been tailored after this simple project design and report. Bill Stewart, as one of this project's investigators, has gone on to show many benefits of treating stormwater with compost (pelletized compost filters) as well as using compost for treating aerosols via biofilters.

Two main themes brought out in Stewarts' work include issues relating to vegetation establishment. One problem with vegetation establishment currently is that most construction site soils are heavily compacted. As such, they offer little means for water penetration and have normally high runoff rates (Figure 1). Compost applications, in the form of compost blankets, slow down water, allowing greater infiltrations. When seeding with the use of compost blankets, huge performance differences exist over any current leading method. The industry standard, hydroseeding, is sure to lose market share to compost seeding technologies because of these results. Compost offers moisture holding capacity, slow release nutrients, complete coverage of seed, and a depth of ¼" to 2" which hydroseeding cannot offer. Finally, the layers of seed that germinate in a 2" deep compost blanket that is seeded are tremendously beneficial because they offer a matting effect and can withstand harder and longer intensity rainfalls than the hydroseeding counterparts.

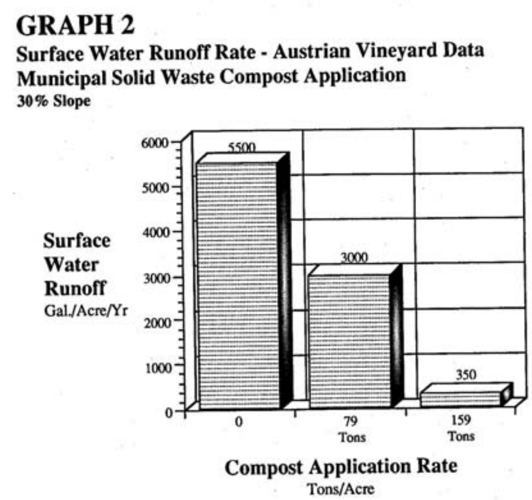

Figure 1. (Source: Stewart 1993).

Based on the work by W&H Pacific, they determined: "based on the results, all three yard debris composts are at least as effective as the conventional erosion control measures currently specified (i.e., silt fence). The erosion effectiveness of the composts, measured in terms of soil loss (suspended solids), was better than that measured from sediment fences…(Stewart 1993)."

Many people confuse TSS with turbidity. Turbidity is "a measurement of the clearness or transparency of water. In addition to soil particles, colloidal organic matter in particular will scatter or absorb light and thus prevent its transmission, resulting in increased turbidity. Turbidity is measured in NTU units. The turbidity of a clear lake will have a turbidity of 20 to 25 NTU (Stewart 1993)."

How do compost blankets stay on steep slopes? Just look at any material yard the next time it rains and you are sure to see the conical piles consistently perform in preventing and resisting erosion. The soil piles next to them become rilled and begin eroding after the very first rain event. This is due to the compost acting like a shingle roof on the slope. Think of compost as a wet bunch of paper towels overlapped on a slope, two or three layers deep. Because compost does not roll, it resists erosion. Soil is round and when it begins to roll downhill with the force of water behind it, the combination acts like a sandblaster to other soil in the way. The fibers of compost also have the ability to interlock with one another and this interlocking mechanism allows materials to hold slopes and some amount of directional flow of water. Even fine ground materials have this interlocking system, on a smaller scale.

The W&H Pacific study included three types of yard debris compost, coarse, medium and fine and also included leaf humus. These are the most common types of compost available today in most metropolitan areas, where urban wastes have been turned into valuable products via the compost process. Our company has repeated not only the types of products used in the initial study, but also basically the same type of demonstration set up in the field. Although we did not collect data, the visual results are obvious when comparing to other BMPs in the field that are properly installed.

As the Stewart work continued to study various key elements about the benefits of compost use for erosion, it indicates a tremendous opportunity in the reducing of both suspended and settleable solids from entering waterways (Figure 2).

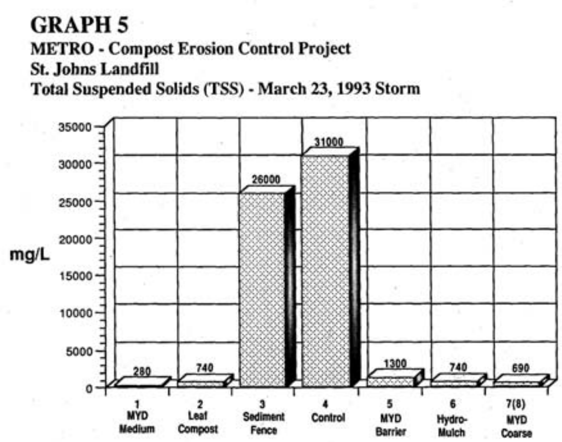

Figure 2. (Source: Stewart 1993).

Figure 2 shows the impact of control plots as well as sediment fence (silt fence). Note the comparison of any compost application, including blankets or berms (MYD barrier) is over 10 times as effective as using silt fence. This is what the new Phase II regulations will be targeting, so the use of compost as a tool is bound to become more popular.

Other chemical binding properties were noted by the Stewart (1993) study: "At a construction site, in addition to its erosion control benefit, a good quality compost is capable of binding and removing pollutants from storm water runoff including oil and grease, fuel from accidental spills, heavy metals, herbicides, pesticides, and other potentially hazardous substances associated with construction or pre-construction activities."

Concerns with movement of nutrients and heavy metals has not been widely documented with the use of compost for erosion control applications. Testing for this requires precise science, controlled conditions, and normally significant funding. Stewart placed a high importance on using mature compost. The majority of the scientific community agrees that mature compost helps prevent movement of some nutrients (nitrogen) because it is largely contained in the organic form. However, due to the amount of water passing through compost filter berms, there is more research needed in the area of nutrient transfer, leachability of nutrients and heavy metals. When compost is used in situ, or in soil, it has more complex binding relationships with the parent materials. When used as a compost blanket or filter berm, the bonding relationship can only occur at the compost soil interface because the material is not mixed into the parent soil.

"These data indicate that the composts tested do not release heavy metals significantly greater than that released by soils and, in fact, can result in a reduction in heavy metal runoff from soils which contain higher quantities of these elements. However, it is important to note that compost quality and background heavy metal quantities in the compost is a factor to be carefully evaluated (Stewart 1993)."

Quilceda-Allen Watershed Erosion Control Program: Water Quality Monitoring Report

Although the regs for the burying depth of silt fence varies, most states require some depth to be achieved. Because this practice is not inspected heavily (or often from the vehicle), installers are able to 'get away with' not trenching in the silt fence. Without the trench and weight on the bottom of the fence, the silt fence may simply allow sediment and water to run underneath. More recent studies indicate that the fine particles in some of the soils are finer than the openings on the sediment fence and are not affected at all. “When the bottom of the silt fence is properly buried, then the silt fencing acts as a water barrier, but the turbidity is not reduced. A mulch berm provides filtration as runoff passes through (Caine 2001).”

The project included compost berms along with coir rolls and other possible BMPs for controlling erosion. “When used in conjunction with appropriate ground cover, silt fencing is assumed to provide stormwater runoff with adequate turbidity treatment. Monitoring of water quality from actual construction sites, however, indicated that silt fencing did not provide adequate water quality treatment (Caine 2001).”

According the results from Snohomish County, berms also absorb water more than we originally thought, which may give them higher density when wet. “By blowing the compost to form the berm, the compost had a lot of pore space. Consequently, the berm absorbed a volume of water equal to approximately 30% of the volume of the berm. It took approximately 17-26 minutes after water flowed onto the berm for water to percolate through the berm and the water was released at a very slow rate and at multiple locations along the length of the berm (Caine 2001).”

In the data, comparisons show that a mulch berm reduced turbidity compared to silt fence and coir fiber rolls used as BMPs. In fact, the mulch berm reduced the turbidity to 33% of the entering level while the silt fence and coir roll remained at 100% (Caine 2001).

Settling of water is a leading mechanism for getting sediment out of water and sediment ponds or detention/retention basins are leading recommendations among engineers when all other items fail. A sediment pond allows water to settle out over a long term prior to discharge back into the waterway being protected. However, there are problems with this design as well because in severe events (remember, designs for capacity do not include severe events) the overflow of these ponds occurs sooner and the water goes directly into the protected watershed. In some cases, the detention area or pond allows the water to heat and the extra temperatures play havoc with aquatic life downstream due to temperature increases. “Water released from detention ponds, however, exceeds existing allowable thermal limits between May and October (Caine 2001).”

The Snohomish county project had a very clear purpose for the endangered species act and saving the Salmon that were endangered from sediment… “The purpose of this project is to reduce the sediment input into streams and wetlands in the Quilceda-Allen watershed, thereby improving the water quality in the streams and decreasing sediment clogging of fish spawning gravels (Caine 2001).”

Compost: New Applications for an Age-Old Technology - U.S. EPA

Another landmark publication was produced in 1997 by the U.S. EPA. The familiar green publication is perhaps best known for putting compost on the map for all of the remedial properties compost provides in various application technologies. The publication is available on the EPA web site and has been widely distributed in the U.S.

According to U.S. EPA (1997), “Depending on the length and height of the slope, a 2-3 inch layer of mature compost, screened to ½ to ¾ of an inch and placed directly on top of the soil, has shown to control erosion. On steep slopes, berms of compost at the top and bottom can be used to slow down the velocity of water and provide additional protection to the receiving waters.”

Our company has verified these results in the field in at least ten different states where we have worked on projects. Most notably, even when the slopes are not covered with compost blankets, compost filter berms still reduce overall erosion because they allow run-on water to be converted from rills back into sheet flow down the slopes and the overall velocity is reduced as well.

When used as a filter berm, compost is ‘nature's coffee filter,’ leaving the residue from stormwater behind in a tell tale thin film that is easy to see on the berm surface after water drains through or subsides. Many people confuse filtration, bioremediation and biofiltration. Chemicals trapped by the coffee filter mechanism of the berms are often remediated. “Biofiltration implies physically separating particles based on their size. Bioremediation, by contrast, implies biological change as contaminants or pollutants are metabolized by microorganisms and broken down into harmless, less stable constituents, such as carbon dioxide, water and salt (U.S. EPA

1997).” Depending on the concentration, there is very good chance that compost can bioremediate some of these compounds within the berm *while it is filtering out more sediment.*

There is little research on this particular topic, however, EPA has recognized that the need for ‘prescription’ composts that are specially made to remediated particular spills or situations are definitely a possible common product in the future. “The metal binding capacity of compost can be improved by the addition of inorganic materials. For example, the addition of soluble iron and phosphate salts to compost increases lead immobilization as a result of forming complex lead-iron-phosphate minerals. Similarly, research by several investigators indicated that some clay minerals interact with lead to form lead-containing minerals in which the bioavailability is remarkably low. Addition of such clay may enhance the ability of compost to decrease lead availability (U.S. EPA 1997).”

The prescription process for special problems in the environmental contamination game are just beginning to unravel. Brownfields contaminated with heavy metals and unable to establish vegetation also pose huge opportunities due to the ability of compost to establish vegetation. Phytoremediation, (the use of plants to help immobilize or degrade compounds), can also be a tool with the use of compost. “Difficulties in establishing plants in toxic, contaminated matrices, and in compacted and barren materials that are not conducive to plant growth…can be overcome with the addition of compost (U.S. EPA 1997).”

As Phase II is implemented, perhaps many of the prescription products will evolve to target specific cleanup concerns. Compost has proven effective in degrading or altering many types of contaminants, including chlorinated and non-chlorinated hydrocarbons, wood preserving chemicals, solvents, heavy metals, pesticides, petroleum products and explosives. The contaminants are digested, metabolized, and transformed into humus, inert byproducts like CO_2, water and salts (U.S. EPA 1997).

At worst case, compounds absorbed or adsorbed by compost as stormwater passes through could be remediated by composting the materials at a compost site if the product can be collected and transported to the compost site after its effective life at the construction site.

Costs for the application of compost are issues that vary around the country and with each type of application technology. We hope to cover costs more thoroughly in another report issued later this year.

Performance Specifications for Wood Waste Materials as an Erosion Control Mulch and Filter Berm, and Use of Wood Waste Materials for Erosion Control - NETCR

Dr. Ken Demars for the New England Transportation Consortium recently completed another study in March of 2001. This study was unique in that the design called for the use of glass beads of a known size and an erodible soil from a field test site, which was mixed with water and passed through the testing apparatus (a tilt table with controlled irrigation). The suspended solids of the effluent, including a portion of the glass beads, which were analyzed, were used as a measure of filter effectiveness.

The study points out some excellent mechanics of how berms work. “There are two aspects of filtration: retain the soil particles and allow the water to drain away. The retention of particles is a function of the opening sizes in the berm and the sizes of the soil particles. The opening sizes in the berm are in turn related to the sizes of the wood particles (mulch). The ultimate filtration achieved is actually a function of both the opening sizes and the particle sizes. A berm will retain certain sized particles, the retained particles will in turn retain smaller sized particles (Demars and Long 2001).” The Demars study concluded that the mulches used were more effective than geosynthetic silt fence or hay bales.

The particle sizes finer than the #20 mesh sieve were found to be important because they affected the size of port openings in the mulch through which suspended solids may be transported (Demars and Long 2001). This means that in filter berms the ideal percentage of fines vs. coarse materials, regardless of weather or not it is mulch or compost, need to be considered for trapping suspended solids in the #20 mesh sieve size area.

Demars’ work included trying dry products and wet products, thinking the moisture would assist in removing a higher percentage of fines. Adding moisture helped when the tests included Pine Bark Mulch, but did not improve when Ground Stump Mulch was used (Demars and Long 2001).

Compost filter berms are somewhat three-dimensional. As the face of these berms clogs with sediment, the 'coffee filter' mechanism is apparent. Demars found where the filter cake was developed on the face of the berm, some of the flow would pass over the top of the cake and into the berm where no cake had yet formed (Demars and Long 2001). This is obviously similar to water rising up the height of silt fence except that compost has depth that can also filter water inside the berms. As these berms clog, the face of the berm becomes more saturated with soil particles, and water flow rises over this layer to the next available filtration area. We believe this three dimensional situation gives berms their effectiveness compared to other one-dimensional, gravity oriented BMPs.

There is a limitation to the system design, however. The limitation of the filtration process is that the smaller particles reduce the permeability of the system so that the reduced permeability will eventually cause the system to be overtopped during severe rain events, allowing some sediment to escape (Demars and Long 2001). We have seen this in the field and the regulatory field simply wants to make sure berms are maintained as silt fence or other BMPs are maintained throughout the life of the project.

A study commissioned by the New England Transportation Authority (Demars et al. 2000) indicated that wood waste materials are effective in minimizing erosion when applied to the soil surface as a blanket with a thickness of at least 3/4 inches or greater. The untreated control in these experiments produced over 50 times the sediment than the treated surfaces (Demars et al. 2000). The study went on to further indicate other benefits: Wood waste materials were particularly effective at reducing runoff during storms under ½ inch by absorbing rainwater (Demars et al. 2000). This is critical and data from the Bill Stewart work in 1993 suggests the same reduction in runoff water. A reduction in runoff water absolutely increases water infiltration, and cannot help but benefit efforts towards re-vegetation and initial seed germination. These would be especially crucial items for those projects that just need a little more rain to allow germinated seed to fully establish.

Demars also studied filter berms made from wood waste and found they were more effective than either hay bales or geosynthetic silt fence at controlling erosion. Both hay bales and silt fence released one order of magnitude more sediment than the wood waste filter berm (Demars et al. 2000). Of course, wood waste is not compost. The purpose of this study was to determine if the physical properties of wood waste would assist in erosion and sediment control, similar to the project conducted by the same team with compost in 1998. The wood waste materials still underwent a litany of tests, including a solvita test for stability. The previous work in 1998 resulted in a CONEG specification recommending that erosion control materials should be very stable to stable which was not the case for the fresh ground wood waste materials (Demars et al. 2000). A particular test in this research shows similar data in the 10-fold effectiveness claim for the performance of wood waste filter berms. In this case, the wood waste filter berms were 8 times as effective as silt fence and 10 times as effective as hay bales, when the data is compared directly (Demars et al. 2000).

USCC Soil-Water Connection

A leading handout from the U.S. Composting Council entitled, the Soil-Water Connection has been widely referenced and has a number of solid references relating to erosion control using compost. "Research in Kennebec, Maine has shown that surface-applied compost performs as well or better than traditional erosion control techniques. A yard trimmings compost – spread two to four inches over the surface (a compost blanket) – outperformed a jute mat and ground wood waste for erosion control at five sites (USCC 1997)."

Compost was as effective as the standard erosion materials used for protection, but surpassed them in cost effectiveness, vegetation establishment, and slope protection. Costs for compost applications were about 1/3 of the cost of traditional synthetic blankets (USCC 1997).

Compost applied as erosion control tools are often incorporated into the soil after use, offering further benefit and environmental impacts that we are not measuring currently. "Soils rich in organics store, degrade, and immobilize nitrates, phosphorous, pesticides, and other substances that can become pollutants in air or water. Compost, because it adds organic matter to soil, has the ability to bind pollutants to soil systems, reducing both their leachability and absorption by plants (USCC 1997).

Note the majority of this article deals with research regarding composted products. The U.S. Composting

Council has a program entitled the Seal of Testing Assurance, under which many of the products used for erosion control are enrolled. Composting of the materials prior to application offers numerous benefits. There is a growing interest in using mulch for many of these applications and although mulch may physically perform some of the same functions as compost, it cannot offer the diverse microbial remediation properties nor the chemical bonding or scrubbing action compost provides. Other concerns about mulch or woody materials being composted are real and are related more to health and safety concerns.

Why compost first?

Weed seed problems

If the material is not composted, you could end up weed seeds like Kudzoo, purple loosestrife, dock, velvetleaf, wild cucumber, or other recognized noxious weeds being spread onto your slopes. Weed seeds are normally killed during the composting process. Kudzoo is a real problem in much of the Southeast and grows rampant along expressways where it takes over like a jungle. The last thing we need is a mechanism to assist its natural spread and composting helps to make sure we will not spread noxious weed seeds. Reasons given by growers for not wanting to use un-composted green materials in California include fear of disease and weed seed problems (CIWMB 2000). The Southeast recently reported estimated losses of $35.5 Billion from the infestation of alien weeds (ESTS 2000).

Insect larvae or egg problems

The health and safety factors compost provided during proper heating is important. The grinding process alone does not necessarily destroy insect larvae, so composting makes sure the cycle is broken. Consider the spread of Gypsy Moths, Borers or other pests that are now causing quarantine restrictions on shipping of nursery stock from state to state. Many of the mulch materials, especially those from yard wastes or land clearing debris include the infested feedstocks that can rapidly spread once used as a mulch. Composting this feedstock first is a key quality control ingredient. Examples of losses indicate this is a severe problem as the Southeast estimates they lose $20 Billion per year from foreign insects (ESTS 2000).

Disease or fungi problems

Fungi and diseases can also be spread but this is even a more serious nature. Cankers, blights, and other diseases, when introduced to a new area via a carrying mechanism like non-composted organics, could easily find a home and become a huge problem. Again, quarantines already exist for many of these problems. Woody wastes from diseased trees, tree trimmings from line clearing companies and other horticultural wastes all may contain some form of infested feedstock that needs to be composted to be safe.

To limit the spread of pitch canker, an endemic disease of Monterey Pine in the coastal area around Santa Cruz, it is recommended that uncomposted materials not be transported to other forested areas in the state (CIWMB 2000). Estimates in the Southeast are significant, including $6.5 Billion in annual losses due to diseases (ESTS 2000).

Vegetation establishment is normally the goal, EVENTUALLY

Regardless of the initial reason for using any kind of a commercially available BMP on slopes, the eventual goal is normally to allow native vegetation to grow and permanently stabilize the slope. Using mature compost allows application of known materials, which enhances plant growth. In tests conducted at the Texas Transportation Institute, Hydraulics and Erosion Control Field Laboratory, vegetation establishment was around 50% when tackified wood chips were used (CIWMB 2000). As a result, this product was disallowed under the Texas DOT standards. Another project at Caltrans used green material mulch and the distinction was made clear. “The materials utilized were variously called “mulch” and “composted mulch” but were, in fact, not compost. Composted materials are those that have undergone thermophillic decomposition and organic matter stabilization (CIWMB 2000).”

The latest in R&D with compost – public and private

Environmental impacts of compost applications on construction sites – Iowa State University

Recent public research completed in 2003 at Iowa State University concluded that compost blankets helped reduce runoff, decrease soil erosion, was successful at replacing soil normally specified for DOT slopes, reduced weed competition, and improved chances for establishing vegetation during extreme climatic conditions. Dr. Tom Glanville's research clearly show that concerns about leaching nutrients from compost is not well founded and in fact, compost helped to reduce overall chemical discharge from the system when compared to control slopes. The total mass of nutrients and metals were significantly lower in the compost plots compared to soil control plots.

This research is important because few systems are measuring success of procedures and practices already accepted and in the Product Acceptability Listings (PAL) of most state DOTs. For instance, normally questions are raised about the addition of nutrients to a watershed via the addition of compost, with a significant nutrient content. However, according the work recently completed by Glanville, even nutrient dense composts like Biosolids did not leach more nutrients than the control. Glanville's work does a good job of separating soluble nutrients contributed from the liquid phase (or those in suspension) compared to those that are adsorbed to the soil surface. When adsorbed to the soil surface, the nutrients are often transported to a water environment (i.e., settling ponds) where they can become more reactive. The 'system' of using compost compared to the 'system' of normal soil seeding generates far less overall nutrients in both categories. In Glanville's report details, many chemicals are from 10-100 times more in the control soil plots vs. the compost applications. This leads us to accept the fact that not all practices are performing as well as some of the new products being introduced, yet little work has been done to measure, study or quantify their impact.

Perhaps the best info in the Glanville work was two fold. First, the time it took water to run off from compost slopes was 8-10 times slower than soil plots. This means that compost has water retention capabilities that are important for conserving moisture for processes like germination. The slower runoff times also translated into lower total runoff volume. Compost generated nearly 20 times less volume of runoff during the same 25-year storm event depicted. This data showed that compost, because it protects soil from movement on the slope, can add significantly to the design parameters currently used in common engineering practices. It also should be taken into account that perhaps with the use of compost, some of the retention and detention ponds designed today could be downsized in order to accommodate less predicted overall runoff. These facts may translate into a significant value for the use of compost in trade for additional building lots that used to be in the space of a retention pond. The value of local real estate in some areas will help to drive this equation, but awareness about the benefits of compost must first be generally known.

Private Research

Two other private companies have performed significant private research. Rexius Inc. in Eugene, Oregon and Filtrexx International, LLC, in Grafton, Ohio, have both used compost commercially in their international erosion control programs. Work concluded in 2002 from Rexius indicated that their Micro blend additive helped reduce total solids 96% when used in a formed filter berm application system. This system, called Eco-Berm, successfully trapped a larger portion of suspended solids than many other tools that have been studied. Compost berms are generally known to have especially good effects on suspended solids, which have proven difficult to trap with geosynthetic systems. The Rexius work shows many similar conclusions to the earliest work conducted by Bill Stewart, in 1993. However, the Rexius work also indicates a large increase in the population of microbes responsible for the absorption and degradation of hydrocarbons. Since this data was published, the company has continued to conduct research on efficacy of using compost for removal of hydrocarbons.

In 2003, Filtrexx International tested a variety of compost products, wood products and mulches to identify flow through rates of each material. Flow through rates are required so that engineers can correctly calculate and predict storm flows when using various tools. Since compost is available in many forms, from many feedstocks, the samples used were indicative of products commonly available in most major metro areas of the U.S. Results from these tests indicated that composted products filtered slightly better than non-composted products, but that when particle size dropped below a certain level, performance of flow through was diminished. The message from this data means that the proper sizing of products used in berms, FilterSocks or other such devices, should be considered.

As an example, wood chips, a common organic material available in most areas, resulted in a 55% reduction in solids > 63um and had a void space of 62%. The flow rate through wood chips was extremely high compared to normal composts. Since wood chips have not been screened, the fines associated with both flow through and filtration is not present. Nor is there any punky mantle around the edges of the carbon chips, which is thought to add significantly to the filtering capabilities of mature composts. A specially screened yard waste compost was also tested and yielded much more favorable results. The yard waste product was approved as a Filtrexx Certified product and removed 100% of the solids in water > 63um, with a flow through rate of 11 gals/min/lin ft. and void space 57%. Other testing with mini bark nuggets indicated that although they had similar pore space to the Filtrexx material (56%), the removal rate was only 12% of solids >63 um. Again, this suggests that composted products somehow filter slightly better than non-composted materials. The Filtrexx data was not repeated in replicate and testing is currently underway to repeat many of these experiments at universities this fall.

Conclusions

Compost is the only 'silver bullet' (if there was only one) to combat many of our environmental challenges and is actually the least expensive opportunity for us to revert to a sustainable culture. Immediately after understanding the benefits of compost when used for erosion control, we wonder about the natural extension into wetlands, and other environmental applications. Of course we realize compost must be used in a BMP approach, integrated with other effective tools, which are also effective at achieving our erosion reduction goals.

Future immediate research needs include understanding how various types of compost perform when screened to a number of particle sizes. Many regulators have expressed concern about berms ponding water when fine composts are used. We need answers to questions about nutrient leaching, binding capacities for all of the chemicals that could be targeted as clean up products and what type of fertilizer, if any, if needed when compost blankets are used. What is the permeability of various types of compost used for filter berms? How long of a slope can effectively drain to a compost berm before needing to add more berms to handle the flow? Is the system currently used (i.e., seed, fertilizer and straw) generating more 'leachate' or nutrients adhered to soil particles than the proposed system using compost products because of the nutrients immediately available in commercial fertilizers? If so, can we promulgate regulations shifting to the new proposed practices? How long will that take? Is compost approved in every state as a BMP?

Due to the number of various composts available, and to the number of soils and rainfall capacities that are in every city, this research will take a long time. However, for the main types of compost produced currently (yard trimmings, biosolids, etc), it is an option that performs at least as well as the other tools currently available for erosion and sediment control.

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