Reclamation Using Biosolids: A Primer on Economics and Other Concerns

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Introduction

A great deal of research has been done on the science of reclamation, but the key to successful large projects lies in creating economically affordable options. It is important to create ecologically viable sites, but if dollar per acre restoration costs are excessive, then good projects may stall for economic reasons. The challenges of restoration are usually consistent: we are posed with the problems of large barren areas with poor water retention, low carbon levels, low nutrient availability, pH/pollutant problems, and a limited budget. The last problem is the most difficult technical hurdle. In most basic terms, the goal of reclamation is to move soil or soil amendments (especially those containing carbon) to sites and place enough of them on the ground to maintain a vegetative cover. To meet this goal we need to find sources of suitable reclamation material and get them applied onsite as efficiently as possible.

With most sites the amount of amendment material needed is very large. Most plot studies use 50-150 tons of amendments per acre reclaimed. Finding this much carbonaceous material, and transporting it, it the limiting factor in a successful project from both the ecologic and economic standpoint. It is difficult to find this kind of tonnage of desirable amendments, much less transport and spread them affordably. Good homework can reveal many potential amendments in the area surrounding a given site. The list can include wastewater treatment sludge (biosolids or industrial sludge), water treatment plant sludge (spent lime), manures, food wastes, old sawdust piles, green wastes, debris from damaging storms, etc.

Biosolids is one of the best choices for an amendment because it is produced in steady quantities and cities are under pressure to find application sites for the material. Many urban treatment plants are squeezed off suitable land application sites as suburbs grow around them. This forces them to seek land applications options which are dependable over time. This combination of excessive supply and low product demand creates a strong economic advantage for the use of biosolids. Many pilot projects have been based on a demonstration that biosolids are a desirable product. In Region VII we have made the assumption that biosolids are proven as a beneficial product and have focused on the concept of biosolids usage as an economic experiment. We are working to find the most economic ways to use biosolids.

Biosolids Products

Liquid Biosolids are composed of 2-6 % solids (depending on the level of stabilization) and are usually just a settled material pumped off a clarifier in a treatment plant and thickened by storage and decanting. Alternately, anaerobically treated sludge is thickened to create a liquid product. This type of product is usually of low solids content and is really only suitable as a fertilizer source to improve previously reclaimed sites. Some cities have large sludge storage lagoons

which are emptied once or twice per year. These large events can be a n opportunity to pick up some tonnage, but the product is still too thin for direct reclamation use. The best sources of liquid biosolids are old treatment lagoons needing a cleanout. These ole lagoons can contain a twenty year savings of biosolids which have been very well stabilized and have thickened considerably (up to 8-10% solids). This provides both a large amount of tonnage and a more desirable product.

Liquid products are very expensive to transport. The ability to pump the material makes loading of trucks and application easier, but the cost of hauling the water is prohibitive. This means that the lagoon and the reclamation site must be very close together. Few cities can afford to haul liquids more than 8-10 miles.

Recently, the City of Bonne Terre, MO had a lagoon cleanout and needed land application sites. Very little suitable acreage existed near Bonne Terre. The Desloge Tailings pile, about 8 miles away, was used as an application site and this created a win-win solution. The city spent about $250,000 on the cleanout, essentially subsidizing the reclamation project. They would have spent the money on the cleanout either way, but use of a reclamation site cut the amount of acreage they needed, and allowed an easier application method, this provided some economy to the City on the cleanout project. As a result, 2360 dry tons of material were applied, at about 29.5 dry tons per acre, to reclaim about 80 acres. The 80 acres have been seeded and we are monitoring the results.

Public acceptance of liquid products is usually good since the concentrated product is transported in tankage and then disbursed. Complaints tend to be based on visual concerns of a black liquid being spread. When working with liquids it is very important to consider runoff control.

Sludge Cake is a dewatered product (20-25% solids) created by adding polymers and belt pressing a liquid sludge. This is usually a follow up to anaerobic digestion. Due to the high capital and operating costs of belt presses, only medium to large treatment plants can afford them, but larger cities tend to use this method of dewatering. Belt pressing costs treatment plants about $35-40 per day ton, but allows much more flexibility in storage and transport. Cake is usually trucked to a site and then applied with manure spreaders. Sometimes live-bed trucks with spreaders are used. Cake is very desirable product for reclamation and has a strong capacity to absorb and store moisture.

The choice of a treatment plant to dewater is a complex economic trade off. Small towns with low funding and available land nearby tend to use liquid passed technology. Larger cities find the costs of trucking past the suburbs to be expensive and tend to consider solid based technology. Storage of solids is much easier; if you run out of liquid tankage you are in deep trouble, with cake you simply make another pile. Large cities are under constant pressure by the amounts of tonnage they produce and the need for storage or available land application sites. Daily production is ceaseless, but agricultural cycles are seasonal. The ability to have dependable application sites is a strong incentive to a larger city and they are willing to truck a little farther or invest in equipment which allows them to utilize the sites. This can be a means to subsidize reclamation activities.

The City of Springfield, MO is growing rapidly and it has been more difficult for the city to get access to nearby sites for liquid application. When land is unavailable the city starts stockpiling cake onsite for transport to more distant fields. With 20 dry tons per day of production the cake can pile up rapidly and the city needs more flexibility with access to application sites. Region VII has provided some funding and now Springfield is trucking the cake for application at old lead mining sites in the Joplin area. The 80 mile haul distance is an economic hurdle. The Region is working with the city to find a means of splitting costs equitably.

One important concern when working with cake are the conditions of storage and staging for land application. A product that has been anaerobically digested and then dewatered can easily go anaerobic again with stored in a pile and generate odors. For this reason, storage sites and staging areas should be carefully chosen to avoid neighbors. When piles are broken and the cake is spread there can also be off-gassing and odor release. Once spread and incorporated this odor dissipates, but can be a nuisance in the short run. Hot weather is the most important factor in odor complaints since the biological processes are so rapid in a hot pile. If working in areas with nearby neighbors it is wise to consider winter application.

Biosolids Compost is a product created by aerobic breakdown of municipal sewage sludge with some form of bulking agent such as yard waste, sawdust, cow manure, or alternate products. Class B compost, suitable for agricultural or reclamation use, can be produced easily given the appropriate agents and turning equipment. Class A compost, suitable for public distribution, is more difficult to produce due to the need for careful process control. Compost is expensive to produce since it adds additional production steps. First, sludge (untreated or anaerobically treated) must be dewatered and the mixed with a bulking agent. The pile is then mixed periodically with special equipment. The final product is very desirable, but total costs of production can be $150-$200 per dry ton of sludge consumed. There is also the problem of locating bulking agent and that the final product requires distribution or the original sludge plus the additional bulking agent: this means more tons of product to deal with. For sites, which take in more yard wastes, the compost option is often a way of dealing with two disposal concerns at one time.

Compost is probably the most desirable product for land reclamation. It has good physical qualities, low odor, and the optimal carbon to nitrogen ratio. Unfortunately, this is probably the least available product. Compost is always in demand by farmers and the public. Once a city has invested in a desirable product, especially Class A Biosolid, they are going to distribute it locally. Few projects could compete against the demand.

Springfield, MO has the ability to produce compost, and we were very eager to use the material in the Joplin area. Estimates of cost showed that economics strongly favor trucking of cake rather than compost. The compost, while much drier and less expensive to transport, was so much more expensive to produce that the total cost of treatment and transport was far higher. In addition, each ton of compost shipped out of Springfield only relieved the city of a partial ton of sludge produced. This did not meet the ultimate goal of keeping up with daily production of the most efficient manner.

Heat Dried Biosolids are a palletized material dried to 90-95% solids. A product with such low water content is very economical to transport and has very little odor. Heat dried biosolids could serve very well as part of a solid mix for reclamation, but are not always easily available.

This is a very specialized product produced precisely because it is economical to ship. The larger cities of the Northeast, such as New York and Boston, have very little access to available land application sites. For this reason, they have invested in air-drying facilities and ship the final product by rail. Destinations have included Texas, Colorado, Florida, ect. The production from these cities is very large and the shipping is covered by a complex system of contracts, which are bid periodically. Cities request bids on transport of a guaranteed minimum and maximum each month. Contracts go for several years and are then re-bid. Potential brokers line up dependable destinations and appropriate transportation links and then bid based on the ability to move biosolids to a good home for the lowest dollar.

Reclamation sites can be very attractive to these brokers because of the ability to receive large tonnage on a flexible schedule. The key to receiving these materials lies in the ability to become part of the contract process and work with a broker (or several brokers) to serve as an intended destination used in the bidding. Calls to producer cities can be helpful as a means of understanding the bidding cycle.

Transportation Links

The discussion above focused on available products and costs of producing them. Once you understand the products, it is important to understand how these work with transportation links. Total costs, treatment and transportation, are an important interaction and should be looked at as a combination. There are several key variables, which drive the total cost of treatment and shipping. Primarily, it costs money to dewater sludge or provide additional treatment. It costs money to ship water. The two costs must be weighed against each other. For short haul practical for a liquid product is 8-10 miles. As hauls get longer, dewatering becomes essential to keep total cost down. Cake can be concentrated up to 25% solids, but hauling a load that is 75% water is still expensive. Where longer hauls are occurring, then heat drying becomes the logical option.

Each **handling event**, such as loading, unloading, or switching vehicles, imposes as cost in transportation. This cost starts at the treatment works and ends when the site is ready to seed. Many facilities create usable products, but are not well connected to transportation links. Larger facilities, such as Chicago or New York, can load train cars directly by conveyer. Once the main transport has been done, there may be more handling needed at the receiving site. This could include loading from train to truck, dumping into a staging area and then another pick up for spreading. All these steps should be considered carefully. Never pick it up or set it down unless you have to. Use automation when available. Front-end loaders aren't as cheap to operate as you think they are.

Trucking point to point is the most flexible option for short range hauling. Large dumps or live bed trucks allow more options in application. Even small changes, such as dumping loads throughout the site rather than in a central staging area can save resources. When bidding

trucking, be sure to consider the details: how will trucks be loaded efficiently, how far is the haul, is this along good highways, and is there a suitable means for unloading at the reclamation site? The size and scheduling of the project is important to bidding. Larger, dependable projects get bigger bids than small, piecemeal hauls. It is also helpful to work off-seasons. Since much of the equipment used for hauling and applying biosolids are used in agriculture it is wise to avoid expensive competition during peak agricultural periods.

Trains are the most efficient method for long-range travel, but the loading and unloading sites must be appropriate to take advantage of rail service. As stated above, several large cities are making heat dried biosolids for rail transport, but the receiving site is important as well. If you need to make a rail to truck transfer, cost can go up. Most rail shipping is done in containers, which can be loaded by crane (fixed or mobile) onto truck chassis. A well-placed crane on a siding is a cost advantage; mobile cranes cost more to keep onsite. Reclamation sites are often associated with mining and this can include natural advantage to rail transport: the old rail sidings used to transport out the ore can be used for importing biosolids close to application sites.

Points of Negotiation

With the basic understanding of the basics of biosolid products and transport, it is possible to do homework in seeking the most economical sources for a specific site. Assess closet potential producers first and then work outward by distance. Consider the product that each local town or city produces. Check on treatment processes, the tonnage produced, and the chemical qualities (metals, pathogens, solids content, ect.) of the biosolids, gain information on their current use/disposal practice and see how your site needs would alter the pattern. Compare as many potential sources as possible.

Cities budgets a certain amount of money to treat and land apply biosolids. This becomes an important baseline in any negotiation with a producer. If you create an option, which saves money or creates dependable land application sites, then it is possible to get biosolids delivered and even applied with little investment. Any city is eager to be part of a beneficial project, which meets the current status quo on expenses. If the combined cost of treatment plus transport to site require additional expense, then it may be necessary to pick additional costs as part of the remediation cost of the site. Even so, this can be a substantial subsidy to the cost of reclamation.

The definition of "status quo" cost to a city is highly variable and can have non-monetary aspects. It pays to research these carefully. A little town with excess pasture ground nearby becomes used to very lost costs, while large Northeastern cities have been forced to bear huge costs in order to facilitate export of the product. Based on the idea of status-quo cost assessment, the local small town might have not urge to alter practices, while a more distant city, faced with larger production pressures and used to higher costs, will be more willing to work with you. Smaller facilities have more operational flexibility, but not capital investments. Larger facilities are more bound to their higher dollar infrastructure investments, but in the long run they can afford to invest big if it will help the bottom line. Larger cities often have access to more equipment and are more likely to use several options of sludge treatment as a manner of allowing more use/disposal options.

Working with the producer city in choosing a product can be a good strategy. Suppose the city is used to paying an average status quo price per ton. If you can accept a product that is less expensive to produce, the city may be willing to spend additional money, up to status quo costs, to subsidized transportation to your site. Remember that goal of reclamation is to get organic material transported to a site, the goal of the producer is to spend the least amount possible ont eh combination of treatment and transport. If you can help save on treatment costs, while meeting regulatory limits, you can provide savings to the overall process.

Additional Materials and Loading Rates

The science of soil mixes and amendments is very complex. It is important to remember; however, that desirable materials may not be available locally. Part of the science of creating site specific amendment mixes should be based on the practical limitations of material, which are economically available. Assess what you can get onsite and then consider potential mixes. It pays to be innovative with alternate sources of amendments: many forms of manures and production wastes can be good sources of carbon. It is wise to consider both physical/chemical qualities of the waste and the transportation costs of using the waste.

Loading rates should also be considered from and economic standpoint. Plot studies show that there is a threshold amount of amendment needed to foster minimal growth, and that more amendment leads to better growth up to some cut-off point. It is tempting to load up to this cut-off point in order to gain optimal results. As an economic point, it should be noted that once site preparation has occurred, that more amendment costs increase the dollar per acre reclamation cost. Doubled amendment tonnage means doubled transportation and application costs. It is important to assess the loading rate that is sufficient to meet site goals. The might be something short of the optimal loading rate.

Know Your Regulator

Work carefully with your State and Regional Biosolids Coordinators. The part 503 Regulations require that the permitting authority (in most cases this is EPA) give written authorization to apply biosolids at reclamation rates. In addition, regulators often have first hand knowledge of facilities, access to key records, and personal connections with treatment plant operators. This can be very helpful in opening the door to using biosolids as an economical soil amendment.

It is also important to be proactive in dealing with the public. The public can be the most important regulator of the site activities. Carefully consider the negative impacts of a project from the view of nearby neighbors. Most concerns are based on odor, truck traffic, or visual impacts. Minimize these impacts through good planning and then communicate this planning effort to the public. Be honest about avoidable negatives. When the public is aware of the goals for the site and has a reasonable knowledge of what to expect, there will be far fewer complaints. If there are complaints, work directly with the neighbors to improve the situation.