CONSIDERATIONS FOR SEWAGE SLUDGE USE ON LARGE TURFGRASS AREAS

There has been increased interest in recent years in using sewage sludge to provide plant nutrients and/or organic matter for crop production, for reclaiming lands and for turfgrass establishment and maintenance. Several factors contribute to this increased interest. The cost of fertilizers, the steadily increasing annual production of sewage sludges, a ban against the ocean-dumping of sludges, the high energy costs of sludge incineration and the impracticality of landfilling liquid sludges are some reasons why the direct land application of sewage sludge is becoming more common.

Milorganite, a dried and processed Milwaukee, Wisconsin sewage sludge by-product, has been used for many years as a turfgrass fertilizer. A number of other organic, slow release turfgrass fertilizers on the market are formulated in large measure from sewage sludges. Today, liquid sewage sludes (2 to 6% solids content) from Pennsylvania municipal wastewater treatment plants are being spread on a variety of turfgrass areas such as sod farms, golf courses, grassed parking lots, parks, cemeteries, and athletic fields. Is this a safe and beneficial practice? Are there any legal restrictions regarding such applications? What are some of the practical things one should consider before using these sludges as a fertilizer and/or soil conditioner? The purpose of this article is to address these questions relative to sewage sludge use on large turfgrass areas.

Since sewage sludges are a by-product of municipal wastewater (sewage) treatment plants they contain almost every conceivable element, compound or substance found in human, home, commercial and industrial wastes. Research at The Pennsylvania State University has shown that sewage sludges from plants across the Commonwealth contain appreciable but variable quantities of essential, major and minor, plant nutrients such as nitrogen, phosphorus, and potassium, calcium, magnesium, iron, manganese, boron, molybdenum, zinc and copper as well as non-essential elements like chromium, lead, nickel, mercury, cadmium and exotic organics such as polychlorinated biphenyls (PCB's) and pesticides. A number of these elements and substances can be toxic to plants at low soil levels and some, notably cadmium, represent a food chain hazard. The heavy metal elements such as zinc, copper, chromium, lead, nickel, and cadmium are held tenaciously by the soil complex and will accumulate and persist in the soil. Once in the soil they cannot be removed by current technology except by stripping and removing the contaminated soil. Hence the application of sewage sludges containing appreciable heavy metals is of concern to future as well as to present uses of that land.

To insure that sewage sludge applications to turfgrass areas are safe and beneficial one must know what the sludge contains. A complete chemical analysis including sludge content of total nitrogen, phosphorus and potassium plus the percent solids and heavy metals content is needed so that appropriate application rates may be determined. Sludge testing and interpretation service is available from the Agronomy Department at Penn State through your County Agricultural Extension Office. Table 1 shows the ranges in composition found in sewage sludges from over 100 wastewater treatment plants analyzed by this service program. Obviously, it is not possible to make accurate generalizations about sewage sludges of Pennsylvania except to conclude that they are extremely variable in composition. It is not possible to predict the fertilizer value or potentially hazardous nature (heavy metals content) of sewage sludges without a chemical analysis.

The Pennsylvania Department of Environmental Resources (DER), recognizing the potential public health implications of land applied sewage sludges, adopted new Solid Waste Management Rules and Regulations in June of 1977. These regulations require a permit by the municipality and/or hauler before sludges can be land applied. Before a permit is granted the sludge must be chemically analyzed and the proposed spreading site evaluated. If you plan to haul and spread sewage sludge onto any kind of land you need a permit. If someone else proposes to haul and spread sewage sludge onto your land that person needs a permit and your land must be evaluated for suitability as part of that persons' permit. Hence there are legal restrictions involved in the use of sewage sludge on land in Pennsylvania. For more information and guidance on obtaining a sewage sludge use permit contact your local DER office.

As an integral part of these Solid Waste Management Regulations, DER adopted Interim Guidelines which are used to determine appropriate application rates for agricultural lands based on sludge analyses. Table 2 shows the maximum heavy metal loading rates for municipal, septic tank and holding tank sludge residues listed in these Interim Guidelines. Crops grown and sludge nutrient content are also important factors considered in these guidelines but are not shown here. These guidelines are termed "Interim" because they are subject to change. As research is completed these guidelines will be revised and updated to reflect the current state of technology.

A comparison of the ranges of heavy metals found in Pennsylvania sewage sludges listed in Table 1 with the recommended heavy metal concentrations of the DER Interim Guidelines in Table 2 illustrates the reasons for concern in using sludges without chemical analyses. For example, the maximum recommended sludge concentration of cadmium is 50 ppm (Table 2) and Pennsylvania sludges have been found to contain from 2 to 3000 ppm of cadmium (Table 1). Applications of a 3000 ppm, or even 300 ppm, of cadmium containing sludges could render a soil contaminated for future cropland uses. Sludges containing concentrations of heavy metals equal to or less than the maximum listed in column 2 of Table 2 can be used at a rate not to exceed 10 dry tons per acre per year for no more than 3 years (30 total dry tons). Sludges containing concentrations of heavy metals exceeding these guideline amounts can be used but at considerably lower yearly and total application rates. It is further recommended that sludged soils be sampled and analyzed for heavy metal buildup after 3 years of sludge treatment in order to determine if any further application of sludge can safely be made. These special tests for soil heavy metal content are also available through your County Agricultural Extension Office.

Assuming one has access to a domestic type sludge low in heavy metals and containing appreciable plant nutrients and has the necessary land application permit, what are some other things worthy of consideration?

Public Acceptance:

There is always reluctance on the part of some people to walk on or even live near sludged-turfgrass areas. You will likely have to answer their concerns. Digested, stablized sewage sludges have an earthy type odor which is not offensive but nevertheless is noticeable, especially when first spread. This odor is not harmful. Research indicates that almost all (99%) of the bacteria, viruses and pathogenic organisms in sewage sludges are killed by the high

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temperatures and pH's achieved in digesting and stablizing the sludge. The remaining viable organisms die off quickly in the hostile soil environment. Hence there is little threat to human or animal health if reasonable precautions are followed. Sludges spread onto the surface of golf fairways, parks, athletic fields or similar areas should be done in off-season or well in advance of periods of active use for obvious reasons.

Fertilizer Value:

An average municipal sludge contains 4% total nitrogen, 2% phosphorus and 9.5% potassium on a dry weight basis. This translates to about 80 pounds of total nitrogen, one-half which is available the year of application (40 pounds available nitrogen, 40 pounds of phosphorus and 10 pounds of potassium per dry ton of sludge. However, most sludges are liquid and seldom contain more than 5% solids. On the average, 1 dry ton of sludge would be equivalent to 5,000 gallons of liquid sludge. To supply 4 pounds of available nitrogen per 1000 square feet with this sludge, 500 gallons per 1000 square feet (20,000 gallons per acre) would be needed. Such an application would provide 4 pounds of phosphorus per 1000 square feet but only 1 pound of potassium per 1000 square feet. The sludge application would have to be supplemented with a potash fertilizer. Such amounts of sludge are more easily applied and soil incorporated during seedbed preparation of turfgrass areas. Sewage sludge use in the establishment of turf may be more practical than maintenance type fertilizer applications. The practical and economic aspects of 20,000 gallons per acre applications depends on many questions only the user can answer. Is the sludge free or is there a charge? Will the sludge be hauled and spread by the municipality or hauler or by me? If I haul the sludge what equipment do I need? How far must I haul? Does the sludge nutrient content justify the time, labor and costs involved? Will the municipality pay me to accept it or to haul it or both? If I become a hauler of sewage sludge I will need a permit. Do I want to go to that trouble or not? These are some of the questions you may wish to ask yourself in your consideration of using sewage sludge on large turfgrass areas.

Table 1. Ranges in composition of sewage sludges from Pennsylvania municipal wastewater treatment plants

Major Plant Nutrients and Solids, %			Heavy Metals ppm, dry wt. basis	
Nitrogen	< 1	-36	Zinc	400-16,000
Phosphorus	< 1	-6	Copper	200- 6,000
Potassium	< 0.1	-4	Chromium	100-14,000
Solids	< 1	-97	Lead	100- 8,000
			Nickel	20- 1,500
			Cadmium	2- 3,000

Table 2. Maximum heavy metal loading rates for municipal, septic tank, and holding tank sludge residues

Element	Maximum Sludge Concentration, ppm dry wt. basis	Maximum Loading Rate, lbs/acre/yr	Lifetime Maximum
Zinc	2000	40	
Copper	1000	20	
Chromium	1000	20	
Lead	1000	20	
Nickel	200	4	
Cadmium	50	1	3 lbs/acre

Credit - Pennsylvania Turfgrass Council, 1978
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