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## GOVERNMENT REGULATIONS ON THE USE OF MUNICIPAL ORGANIC MATERIALS ON AGRICULTURAL LANDS

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The Environmental Protection Agency (EPA) has issued guidance and is in the process of preparing and issuing regulations on land disposal and utilization of solid wastes and sewage sludge.

### Guide to sludge management

A technical bulletin entitled "Municipal Sludge Management: Environmental Factors" (2) was the first guidance issued by the Agency in this area. The bulletin was prepared to assist EPA Regional Administrators in evaluating grant applications for construction of publicly owned wastewater treatment works. It also provided designers, engineers and others with information helpful to the selection of sludge management options including, but not limited to, land application alternatives. The bulletin addressed factors important to the environmental acceptability of the various sludge management options in a general manner to allow maximum flexibility in addressing Regional and site specific needs. It was designed to permit use and/or disposal of sludge from municipal wastewater treatment plants with minimal, not zero risk (7).

The sludge technical bulletin made general recommendations for good sludge land application practices, including:

- a) Soils to which sludges are applied should have the pH maintained at 6.5 or above.
- b) Sludge should be stabilized by some means yielding a product equivalent to that obtained by anaerobic digestion for 10 days at 35°C (95°F). Under certain conditions (e.g., due to State regulatory requirements controlling public access), even greater deactivation of pathogens may be required.
- c) Sludges are often applied to land based on the nitrogen needs of the crop to be grown. For the general case, this will insure protection of groundwater quality. Other limitations may be necessary at higher rates in excess of crop nitrogen needs to avoid unacceptable degradation of ground and surface water.
- d) Sludge application rates should not cause heavy metal (zinc, cadmium, nickel, lead and copper) additions to land exceeding certain recommended amounts (annual and total accumulations).

The sludge technical bulletin also identified 3 categories of agricultural utilization of municipal sewage sludge:

1. Privately owned agricultural lands
2. Publicly controlled agricultural lands
3. Sites dedicated for disposal

Varying degrees of monitoring were suggested for the different categories to establish an assured quantity and quality of the sludge applied and of crops produced.

The bulletin recommended that heavy metal additions be most restricted and the least amount of sludge be applied to privately owned agricultural land. Since the levels of sludge and metals added to this category of land would be low, the level of monitoring suggested is also minimal. On publicly controlled and dedicated disposal sites, the suggested maximum sludge application rates are higher. Likewise, the degree of necessary control, via monitoring, permits, etc., increases. In other words, where the potential for pollution is greater, the level of control and monitoring should also be greater.

The sludge technical bulletin took over 5 years to develop and involved intensive effort on the part of many individuals in EPA, USDA, Food and Drug Administration and land grant universities as well as from other Federal and State agencies. A key role that was necessary in allowing the development of the bulletin was played by the scientists and engineers actively involved in research in this area. Recommendations for usage of sludge based on nitrogen and metal limitations are similar to those developed by the North Central Regional Committee (NC-118) and the Western Regional Committee (W-124). A land application guidance document jointly developed by these committees has been reprinted by EPA (6).

### Criteria for solid waste disposal facilities

On February 6, 1978, the "Criteria for Classification of Solid Waste Disposal Facilities" were proposed in the *Federal Register* for public comment. Once finalized, these proposed criteria are to serve as the foundation upon which State regulations are to control the disposal of all non-hazardous solid waste on land, including municipal sewage sludge. These criteria will be issued under the joint authority of Section 4004 of the Resource Conservation and Recovery Act of 1976 (PL 94-580) and Section 405(d) of the Clean Water Act of 1977 (PL 95-217).

The criteria differ from the sludge technical bulletin in that they are regulatory criteria which cover all non-hazardous solid wastes. Furthermore, with respect to land spreading, they single out cadmium as the heavy metal to limit in solid waste application to land for the growth of food-chain crops. The land application portion of the criteria was published in interim final form in the *Federal Register* on September 13, 1979 (40 CFR Part 257).

The criteria will not apply to agricultural wastes, including manures and residues, returned to the soil as fertilizers or soil conditioners. They also will not apply to the land application of domestic sewage or liquid effluent from the treatment of domestic sewage, although they will apply to the disposal of sludge resulting from the treatment of domestic sewage. They will apply specifically to the application of municipal sludge and other solid waste to land used for the production of food-chain crops (i.e., tobacco, crops grown for direct human consumption, and feed for animals whose products are consumed by humans).

**Cadmium.** Limits are placed on both annual and cumulative cadmium loadings (Table 1-3).

The annual limitation of 0.5 kg/ha/yr applies immediately to leafy vegetables, tobacco and root crops. The general annual limits, however, are scheduled to be phased in with industrial pretreatment requirements. Industrial pretreatment is expected to effectively lower the cadmium content of municipal sludges such that more sludge can reasonably meet the lowering annual application limits. The cumulative limits placed on cadmium additions from solid waste are not to exceed those specified in either Case A, B or C below.

#### Case A

In Case A, the pH of the solid waste and soil mixture is to be maintained at 6.5 or greater at the time of application unless the cadmium concentration is 2 mg/kg (dry weight) or less. Note that this case only requires maintenance of soil pH at 6.5 or above at the time of solid waste application.

#### Case B

Case B applies only to soils with a background pH of less than 6.5, where the pH of the solid waste and soil mixture is 6.5 or greater at the time of solid waste application or whenever a food-chain crop is planted.

#### Case C

If the only food-chain crop produced is animal feed, then cumulative and annual cadmium limitations do not apply, provided:

i) The pH of the solid waste and soil mixture is 6.5 or greater at the time of solid waste application or at the time the crop is planted, whichever occurs later, and this pH level is maintained whenever food-chain crops are grown.

ii) There is a facility operating plan which demonstrates how the animal feed will be distributed to preclude ingestion by humans. The facility operating plan describes the measures to be taken to safeguard against possible health hazards from cadmium entering the food chain, which may result from alternative land uses.

iii) Future property owners are notified by a stipulation in the land record or property deed which states that the property has received solid waste at high cadmium application rates and that food-chain crops should not be grown, due to a possible health hazard.

**Polychlorinated biphenyls.** Solid waste containing concentrations of polychlorinated biphenyls (PCB) equal to or greater than 10 mg/kg (dry weight) must be incorporated into the soil when applied to land used for producing animal feed, including pasture crops for animals raised for milk. However, incorporation is not required if it is assured that the PCB content is less than 0.2 mg/kg (actual weight) in animal feed and less than 2.5 mg/kg (fat basis) in milk. "Incorporated into the soil" means injection or mixing of the solid waste beneath the surface of the soil.

**Pathogens.** The following pathogen reduction practices/precautions are required for different land application techniques:

1. Sewage sludge that is applied to the land surface or is incorporated into the soil must be treated by a process to significantly reduce pathogens, prior to application or incorporation. Public access to the facility must be controlled for at least 12 months, and grazing by animals whose products are consumed by humans must be prevented for at least 1 month. Processes to significantly reduce pathogens are defined in the criteria. These include anaerobic and aerobic digestion, composting, lime stabilization, heat treatment, heat drying, and other methods that may be shown to be equivalent.

2. Septic tank pumpings applied to the land surface or incorporated into the soil are treated by a process to significantly reduce pathogens, unless public access to the facility is controlled for at least 12 months, and grazing by animals whose products are consumed by humans is prevented for at least 1 month.

3. Sewage sludge and septic tank pumpings that are incorporated into the soil by a landfilling or trenching operation do not re-

Table 1. Annual cadmium limits for food-chain crops.

Years	Annual Cd loading limitations (kg/ha)
Present to June 30, 1984	2.0
July 1, 1984 to Dec. 31, 1986	1.25
Beginning Jan. 1, 1987	0.5

Table 2. Cumulative cadmium limits for food-chain crops – Case A (Soil pH at  $\geq 6.5$  only at time of application).

Soil cation exchange capacity (meq/100g)	Maximum cumulative loading limitations (kg/ha)	
	Background soil pH < 6.5	Background soil pH $\geq 6.5$
< 5	5	5
5	5	10
> 15	5	20

Table 3. Cumulative cadmium limits for food-chain crops – Case B (Maintenance of soil pH  $\geq 6.5$  whenever a food-chain crop is planted).

Soil cation exchange capacity (meq/100g)	Maximum cumulative loading limitations (kg/ha) Background soil pH $\geq 6.5$
< 5	5
5 – 15	10
> 15	20

quire treatment by a process to significantly reduce pathogens prior to incorporation.

4. Sewage sludge or septic tank pumpings that are applied to the land surface or incorporated into the soil must be treated by a process to further reduce pathogens, prior to application or incorporation, if crops for direct human consumption are to be grown within 18 months subsequent to application or incorporation. Such additional treatment is not required if there is no contact between the solid waste and the edible portion of the crop; however, in this case the solid waste is treated by a process to significantly reduce pathogens prior to application; public access is controlled for at least 12 months; and grazing by animals whose products are to be consumed by humans is prevented for at least 1 month. Processes to further reduce pathogens include composting, heat treatment and heat drying. In addition, pasteurization and gamma and beta ray irradiation (as defined in the Criteria) will further reduce pathogens.

#### Section 405 regulations/give-away/sale

Additional new regulations are currently being drafted on give-away, sale and home use of sewage sludge. These regulations will be part of a new sludge regulatory package covering all sewage sludge disposal and utilization practices. These new regulations will be issued under authority of Section 405(d) of the Clean Water Act of 1977 (PL 95-217) and will be developed by the Office of Water and Waste Management. The regulations are expected to contain sections on the following:

1. general monitoring requirements
2. landspreading to food-chain and non-food chain crops
3. landspreading for reclamation and high rate disposal
4. give-away/sale/home use practices
5. landfilling practices
6. disposal in surface impoundments
7. thermal conversion (incineration/heat treatment, etc.)

It is too early to tell just what the give-away/sale/home use regulations will contain, even in draft form. They hopefully will recognize the concept of a "good sludge" for wide-spread general use by the public with few or no restrictions based upon certain minimal requirements being met. Minimal requirements to define a "good sludge" for unrestricted use might include specific limiting concentrations for cadmium, PCB's and lead; a requirement for a minimal content of lime as an internal protection against heavy metal availability; adequate stabilization to eliminate pathogens and malodor; and controlling the cadmium to zinc ratio in the sludge as another

internal protective mechanism to preclude problems with cadmium in the diet.

If the sludge did not meet these minimum conditions, then labeling might be required to indicate restrictions on use (e.g., lime in the sludge would not be desirable for some ornamental crops). If sludge were used as a filler in a high analysis fertilizer, appropriate ordinary state fertilizer regulations might apply, assuming applications of the high analysis fertilizer would be sufficiently low to minimize metal applications.

It is possible that the municipal wastewater treatment authority would be required to obtain a permit and implement certain necessary monitoring practices. One possibility of permitting would be under the National Pollution Discharge Elimination System. Monitoring would likely be geared to the potential degree of risk associated with individual projects. For example, there might be sludge quality, sludge application rate, and site monitoring requirements on high rate non-food chain land spreading sites. For programs involving the give-away, sale or home use of a "good sludge", only product monitoring might be required.

Obviously, scientific support for this guidance on the proper use of the different types of sludges for amending soils will be needed. This type of scientific support should come from studies in horticulture and in other agronomic fields.

#### Impacts of current guidance/regulations on sewage sludge utilization and disposal.

Weddle (9) recently discussed the impact of EPA rule making on sludge utilization and disposal and indicated that industrial pretreatment requirements should increase the amount of sludge suitable for land application. He also discussed, in more detail, the interrelationships of the "Criteria for Solid Waste Disposal Facilities" with the 405 sludge utilization/disposal regulations now being drafted. He recognized one of the most important aspects of sludge utilization — that of public perception, and how it is influenced by the Agency's rule making activities. He stated that EPA can minimize possible adverse impact on public perception by strongly encouraging beneficial utilization practices which comply with the regulatory standards that are developed.

Ettlich and Lewis (3) discussed user acceptance of sewage sludge compost. Composted sewage sludge is a form that will likely receive widespread utilization by horticulturists. Two recent publications by Gouin and Walker, and Hornik et al. (4, 5) indicate the usefulness of this form of material.

Chang and Page (1) have analyzed the impact of the sludge technical bulletin and the criteria upon land utilization of sludges in the United States. They show how these documents affect the rates of application of various types of sludges to agricultural land. Their

analysis is of particular interest in that it represents an agriculturist view of the impacts from outside of EPA.

Walker (8) gave an overview of costs, benefits and problems in utilizing sludges. He noted that an estimated \$100-\$500 million could be saved in annual operating and capital costs by 1990 if the current level of sewage sludge utilization of about 30 percent is increased to 50 percent. He also pointed out that certain risks are inherent in sludge utilization as with any other sludge management practice.

EPA has the responsibility to both guide and regulate utilization practices to minimize risks while maximizing the benefits. If regulations are overly stringent, an increase in sludge utilization along with a realization of dollar savings and other benefits would not be possible.

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## SEWAGE SLUDGE: PROCESSING AND MARKETING CONVERTS A PROBLEM INTO BENEFICIAL PRODUCTS

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In recent years a decided change has become evident throughout many areas of the United States: *sewage sludge is a valuable natural resource, not a problem to be disposed of!* Yet this knowledge is something Kellogg Supply in cooperation with the Los Angeles County Sanitation District, has been using to advantage for crops, lawns, gardens and landscaping for over 52 years (Fig. 1, 2).

Processing is what turns a potential detrimental product into one of beneficial uses. Most often, wet sludge from a digester and/or after it has been air dried, has been detrimental to plants when used as a soil amendment. Even when centrifuged and stockpiled, the sludge often contains silicas and toxic substances.

*Composting* makes the difference!! It is this process that converts the organic waste into a biologically highly active, humus-type product. After undergoing 14 days of anaerobic digestion, the wet sludge undergoes double centrifuging. The centrifuging accelerates drying, but it also removes significant amounts of sands and silicas, along with other non-biodegradable objects and excess soluble salts.

There is a distinct difference between stockpiling and composting! The sterile residue is hauled to composting beds. First, dry, bio-

logically active material, is blended with wet material from the centrifuge. The composting process begins. The mixture is thoroughly turned twice daily for the first 5 days with a Cobey Rotoshredder machine. Thereafter, turning is done once a day, 30 to 40 days.

After composting is complete, the product is trucked to Kellogg Supply yards for additional processing. However some is sold as is to grower nurseries as part of their planting medium. For many years, the product passed through a 3/8 inch (0.95 cm) screen and then was sold in bags or bulk. This product is known as "Nitrohumus" and is widely used as a soil amendment and for topdressing of turfgrasses, gardens, and landscape plantings. Sales demand over the past 6 years has nearly tripled, while the amount being produced has remained relatively the same. To extend the limited supply, nearly all of the "Nitrohumus" is now blended with other organic materials and is sold as speciality planting or topdressing mixes.

These special blends also receive additional composting to make them uniform. The "Nitrohumus" is mixed with shredded rice hulls, composted barks and/or wood shavings according to designated uses. For the many alkaline soils in California and other areas of the West, a product called "Gromulch" has acidifying agents and micronutrients added. Another product, "Topper", is composted with micronutrients and wetting agents and is sold as a seed cover. Still

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