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# Cropland Application of Filter Cake Sewage Sludge

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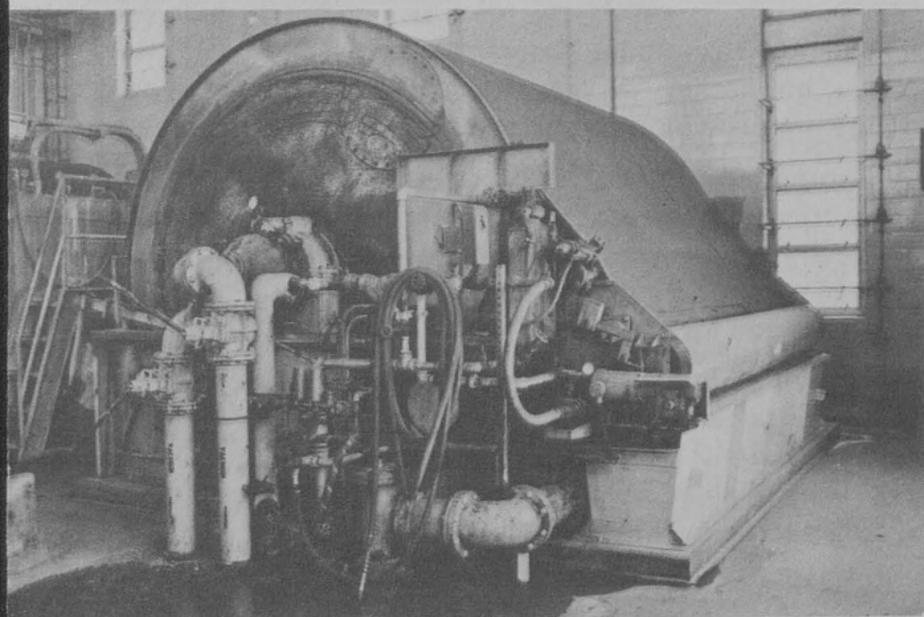
C.A. Simkins, L.D. Hanson and T.L. Wagar

About 200 million gallons of sewage are treated daily at the main metropolitan sewage treatment plant operated by the Twin Cities Metropolitan Waste Control Commission. One of the results of this cleanup process is the production of 1,200 wet tons of sewage sludge per day that is removed from the wastewater stream. Some of this sludge material is being applied on farmland in a number of Minnesota counties. The purpose of this publication is to discuss proper use of this type of sludge on cropland.

The specific type of sludge produced at the Metro plant is called lime stabilized filter cake. Researchers have shown that filter cake sludge, when properly recycled on land, provides plant nutrients and serves as a soil conditioner that can be used safely on major Minnesota crops.

The concept of "recycling" sludge on agricultural land is becoming increasingly accepted as a sound waste manage-

During the waste treatment process, the vacuum filter machine removes some of the water after the addition of hydrated lime and ferric chloride.



ment practice. In many communities, it provides the most economical as well as an environmentally sound means of dealing with these wastes.

## Content of Filter Cake Sludge

The nutrient content of the filter cake sludge is such that it will not qualify as a guaranteed fertilizer. However, the filter cake contains valuable plant nutrients that can be used as a soil amendment. Filter cake, properly used in a well-managed farm program, can increase crop yields.

It is often necessary to supplement the filter cake with commercial fertilizer to meet the nutrient requirements of a crop. Lime stabilized sludge has been treated with hydrated lime and ferric chloride to help remove water and reduce pathogens and objectionable odors. Normally after treatment, the sludge consists of 80 percent water and 20 percent solid residues. The organic matter content of the solid residues is about 65 to 70 percent.

The makeup of the solid residues varies from day to day and even hour to hour. In general, the filter cake contains the following quantity of available plant nutrients the first year of application:

**Available Plant Nutrients  
and Lime Content of Filter Cake**

	Lbs/Wet Ton	Lbs/Dry Ton
Nitrogen	4	20
Phosphate (P <sub>2</sub> O <sub>5</sub> )	14	70
Potash (K <sub>2</sub> O)	1.4	7
Sulfur	4.4	22
Boron	.01	.05
Lime (CaCO <sub>3</sub> )	48	240

The filter cake sludge also contains small amounts of manganese, magnesium, copper, zinc, chlorine and iron, which can be important micronutrients for plant growth.

Another advantage of sludge as a soil amendment is that the nutrients are released over a period of time. For example, a nine-dry-ton-per-acre rate would provide 180 pounds of available N per acre the first year, about 90 pounds the second year, and 45 pounds the third year after application.

Applying filter cake will have some liming effect on acid soils. The calcium carbonate equivalent (CCE) of the filter cake is about 12 percent. If four dry tons per acre of filter cake were applied, about 1/2 ton of CaCO<sub>3</sub> (lime) would be supplied to help neutralize acid soils.

On sandy soils low in organic matter, applying high organic matter sludge may boost yields. The plant nutrients are released over a longer period of time, and the organic matter reduces the possibility of leaching of plant nutrients. As with livestock manure, the soil conditioning effects of sludge are often of value.

### Soil Requirements for Application

Each type of soil uses sludge at a different level. The level or rate at which sludge can be applied depends on several factors, such as slope, depth of soil, soil texture (sand, silt or clay) and distance from water supplies. Soils receiving filter cake must be maintained at a pH of 6.5 or higher during application to minimize plant uptake of metal elements. If the soil analysis is lower than pH 6.5, lime applications must be made.

In general, fields selected for application should have a slope of less than six percent. The depth of the soil to bedrock and/or groundwater must be at least six feet on coarse, textured soils and four feet on medium or fine textured soils. The land must also be a designated distance from dwellings, wells, roadways and surface waters. For example, with surface-applied sludge, the separation distance should be 200 feet from a well or dwelling and 600 feet from a residential development.

The Minnesota Pollution Control Agency (MPCA) determines the suitability of a given soil for application of filter cake sludge. For permission to apply filter cake, a farmer or landowner must get a permit from the MPCA. Specific information on the permit process is available from the Metropolitan Waste Control Commission.

### Crops on Which Filter Cake Sludge Can Be Used

Filter cake can be used on most field crops grown in Minnesota. However sludge should not be applied on land where vegetable crops are to be grown in the same year of application.

Filter cake can be applied on lands where corn, wheat, barley, oats, soybeans and alfalfa are grown. Sludge may also be applied on established forages immediately following cutting or during periods of little vegetative growth. Forage harvesting should be delayed for at least two weeks after applying filter cake sludge.

### Rates of Use of Filter Cake Sludge on Cropland

The amount of filter cake that can be applied to cropland depends on four main factors:

- Quantity of nitrogen and heavy metals in the filter cake.
- Soil texture.
- Crop to be grown.
- Quantity of filter cake previously used.

The Minnesota Pollution Control Agency makes recommendations as to the maximum allowable quantity of filter cake that can be used.

In general, the rates of sludge that can be applied vary from 20 to 45 wet tons or 4 to 9 dry tons per acre. These rates will normally supply 80 to 180 pounds of available nitrogen (over the first growing season) and 280 to 630 pounds of phosphate ( $P_2O_5$ ) over a period of time. These rates will supply potash ( $K_2O$ ) in the range of 28 to 63 pounds per acre.



## Rate Limits Due to Heavy Metals

The filter cake sludge contains heavy metals such as lead, zinc, nickel and cadmium in higher concentrations than are already present in the soil. For this reason, the total amount of sludge that can be applied per acre is regulated by the sludge heavy metal content. The organic matter content and the CEC (cation exchange capacity) of the soil also will have some bearing on the maximum allowable metal additions. In general, the maximum allowable metal additions per acre are:

Lead	1,000 lbs/acre
Zinc	500 lbs/acre
Copper	250 lbs/acre
Nickel	100 lbs/acre
Cadmium	10 lbs/acre

Maintaining soil pH at 6.5 or higher minimizes the plant uptake of these metals.

A small concentration of PCB's (polychlorinated biphenyls) occurs in many municipal sludges. In 1978 the average concentration was 4.2 ppm in the Twin Cities Metro plant sludge. This amount is slightly higher than the concentration allowed in fish (2.0 ppm) for human consumption. Such a small concentration is not an environmental hazard when applied to soil, as PCB's are not taken up by plants. However, the sludge should not be applied on pasture lands where it could be directly ingested by animals.

The filter cake will be analyzed for metals and PCB's before application and the recommended rate controlled to prevent possible contamination of agricultural lands.

## Spreading Filter Cake on Cropland

The filter cake sludge is similar in consistency to fresh cattle or horse manure. As with animal manure, incorporating the sludge into the soil shortly after spreading is recommended to minimize ammonia nitrogen loss.

Farmers wishing to use filter cake sludge must be prepared to handle the material efficiently. Applying 25 tons per acre of filter cake on large areas will require more spreading equipment than is normally needed for livestock manure.

For example, a spreader with a capacity of 150 bushels per load, or about 2.5 tons, will require 10 trips per acre. So if a larger spreader is available, the spreading job will go faster.



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## Monitoring

To protect the environment, a comprehensive monitoring program will be carried out on fields where filter cake sludge is applied.

This monitoring will be the responsibility of the Metropolitan Waste Control Commission. A qualified soil scientist (working with the Soil Science Department) is responsible for collecting the appropriate soil and plant tissue samples. These samples will be analyzed in the laboratories of the Soil Science Department, University of Minnesota, to assure proper use of the sludge.

## Summary

- Filter cake sludge from the Twin Cities Metropolitan Wastewater Treatment Plant can be used as a soil amendment on selected Minnesota cropland.
- USDA—Science and Education Administration and University researchers have shown crop yields from the use of filter cake sludge, properly incorporated, to be excellent.
- Filter cake sludge is normally low in potassium, and it may be necessary to apply supplemental potassium on those soils that are low in this element.
- Supplemental nitrogen and phosphorus may be applied to meet the nutrient requirements of a crop.
- Lands with level to gently rolling topography are best suited for filter cake sludge application. Good soil conservation practices must be followed to prevent runoff of the material into streams and lakes.
- Soils receiving sludge should be maintained at a pH of 6.5 or higher.
- The Minnesota Pollution Control Agency prescribes the procedures and makes recommendations for land application of municipal wastewater sludges. Individual counties also may have inputs regarding sludge use.
- Spreading of the filter cake sludge by the farmer will require adequate spreading equipment.
- Monitoring of land application of filter cake sludge from the Metropolitan Wastewater Treatment Plant will be carried out by the Metropolitan Waste Control Commission.
- Contact the Metropolitan Waste Control Commission at (612)222-8423 for specific information on land application of filter cake sludge.

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