



# Current Report

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## USE OF SEWAGE SLUDGE AS A FERTILIZER

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Farmers and many others are interested in the value of sewage sludge as a source of fertilizer. It contains organic matter, N, P, K and many other elements. Sludge coming from some industrial sites may also contain some potentially toxic compounds. Some sludge samples may contain pathogenic microorganisms.

salts and N content are reduced by further treatment. The activated sludge can also be applied to the land in a liquid or dried form. The amount of sludge that may be applied depends on its composition and the adsorption capacity of the soil.

### HOW IS SLUDGE DERIVED?

The separation of solids from waste-water starts with settling of easily separable solids (primary treatment). Then the waste-water can enter aeration tanks where nutrients are settled out by formation of a biological floc or slurry. Physical-chemical processes can also be used to form a slurry. This is known as secondary treatment. The thickened slurry plus the primary settled solids are then stabilized by a heated, anaerobic digestion process leaving material called activated sludge. Activated sludge can be discharged to storage lagoons where more solids are settled and volatile solids, soluble

### COMPOSITION OF THE SLUDGE

Some of the sewage sludge samples analyzed at the OSU Soil and Water Testing Lab are shown in Table 1. The results are reported on an "as received" basis, meaning that this would be the actual analysis if applied to the land in the form tested. The differences between samples 1 and 2, for example, are due mainly to the differences in water content.

The average water content of several types of liquid sludge is shown in Table 2.

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Average analysis of dry sludge samples collected from various areas of the United States are shown in Table 3.

TABLE 1: Analysis of Sludge Samples Received at OSU Soil and Water Testing Lab

Sample	% N	% P <sub>2</sub> O <sub>5</sub>	% K <sub>2</sub> O	Sample Appearance
1	1.60	1.60	0.23	Dry
2	0.06	0.01	0.005	Liquid
3	0.06	0.09	0.02	Liquid
4	0.44	0.44	0.04	Slurry
5	0.90	1.15	0.06	Dry
6	0.06	0.37	0.02	Liquid
7	0.02	0.19	0.02	Liquid (Slaughter plant)

TABLE 2: Water Content of Sludge

Type of Sludge	Water %
Primary sedimentation	95
Activated sludge	98-99
Well digested sludge	
Primary treatment	85-90
Activated sludge	90-94

The nitrogen, phosphate and potash values are high because the sludge is in a dry form. Activated liquid sludge from municipal sewage treatment plants usually contains 98-99% moisture as shown in Table 2. Therefore, the amount of N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O in a ton of sludge containing 99% water is as follows:

Plant nutrient	lbs/ton*
Total Nitrogen	0.7-1.3
Total P <sub>2</sub> O <sub>5</sub>	0.4-1.7
Total K <sub>2</sub> O	0.04-0.16

\* When sludge contains 99% moisture.

When the above results are compared with the liquid sludge tests from the OSU Soil and Water Testing Lab, we see that liquid sludge available for use in Oklahoma is similar to that of other areas (Table 4).

#### ECONOMIC VALUE OF SLUDGE COMPARED TO FERTILIZER

The value of the Oklahoma sludge can be determined by assigning a price of \$ .25 per pound of N, \$ .25 per pound of P<sub>2</sub>O<sub>5</sub> and \$ .15 per pound of K<sub>2</sub>O and multiplying by the pounds of nutrients per ton. We find the total benefit of the sludge to range from \$ .37 to \$2.25 per ton.

TABLE 3: Average Concentrations of N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O for Dry Sludge

Plant Nutrient	%	lbs/ton for dry sludge
Total Nitrogen	3.5-6.4	70-128
Total P <sub>2</sub> O <sub>5</sub>	1.8-8.7	36-174
Total K <sub>2</sub> O	0.2-0.8	4-16

Since half or less of the N is readily available the first year, the true value on a plant nutrient basis is somewhat less than the value listed above. One hundred tons of sludge contains a total of 120 pounds of N, but since only about one-half of it is available, the actual rate of N is 60 pounds per acre. If the sludge was being applied only for its nitrogen content, then the value of the sludge would be about \$ .15 per ton.

#### RATES OF SLUDGE APPLICATION

The rate of sludge application will depend on its nitrogen content and on its heavy metal content. From a soil fertility standpoint, the rate of sludge application should be based on nitrogen content because nitrogen is the most mobile plant nutrient and will percolate toward the ground water at a faster rate than phosphorus or potassium. The best way to monitor the nutrient build-up is by soil tests. Soil tests can also be used to determine build-up of heavy or toxic metals.

An application of 113 tons per acre approximates a one inch thickness of material. A guideline for application of liquid sludge -- apply 1 to 1½ inches of material every year for best availability of plant nutrients. Monitor sludge effects by soil tests.

TABLE 4: Plant Nutrient Content of Liquid Sludge Samples Received at the OSU Soil and Water Testing Lab

Plant Nutrient	Sample 2	Sample 3	Sample 6
	<u>pounds/ton</u>		
Total N	1.2	1.2	1.2
Total P <sub>2</sub> O <sub>5</sub>	0.2	1.8	7.4
Total K <sub>2</sub> O	0.1	0.4	0.4