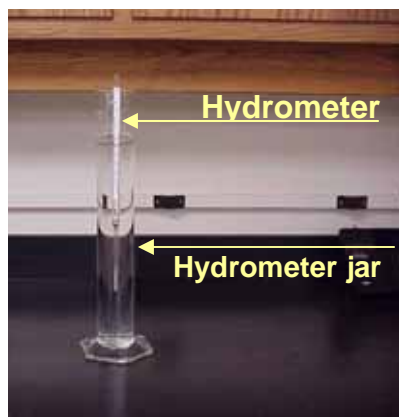


# Use of a Soil Hydrometer to Determine Nitrogen and Phosphorus in Liquid Swine Manure

*Jun Zhu, Department of Biosystems and Agricultural Engineering*

An important component of on-farm nutrient management is estimation of nutrient contents in liquid manure prior to land application. However, to date, there have been few techniques easy to use by animal producers to quickly test the nutrient contents in the liquid manure, such as total nitrogen (TN) and phosphorus (TP). By and large, it is difficult, and usually inaccurate, to measure the concentrations of TN and TP in bulk liquid in storage facilities even during agitation. A better alternative is to take real-time measurements during application. In a recent study, the UMN researchers have developed an improved method using a soil hydrometer to measure the specific gravity of liquid manure and then relate it to the nutrients concentrations in the manure. Having been tested on 6 gestation, 6 finishing, and 5 nursery farms, the method is believed to be able to present reliable results in determining TN and TP in liquid manure from pigs at different growth stages.

## What You Need to Run the Measurement



**Figure 1. The hydrometer and the jar used in the measurement**

The tools involved in the measurement are quite simple, i.e., a soil hydrometer (see Figure 1), which can be purchased from the ColeParmer Company (catalog number: A-08292-16, with precision at 0.0005 divisions; cost: \$25.50), a hydrometer jar also from ColeParmer at \$16.05 (catalog number A-06135-65, 500 mL), a brush of any type but has to fit into the jar for agitation, and three sets of equations for manure from pigs at three growth stages, which are presented below.

$$\text{TN} = -178128 + 177348 \text{ SG} \quad (\text{finishing})$$

$$\text{TP} = -29430 + 29407 \text{ SG} \quad (\text{finishing})$$

$$\text{TN} = -102806 + 102609 \text{ SG} \quad (\text{gestation})$$

$$\text{TP} = -95802 + 95564 \text{ SG} \quad (\text{gestation})$$

$$\text{TN} = -192739 + 192510 \text{ SG} \quad (\text{nursery})$$

$$\text{TP} = -26347 + 26333 \text{ SG} \quad (\text{nursery})$$

Where TN, TP = total nitrogen and total phosphorus (ppm),  
SG = specific gravity measured by the hydrometer.

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### Steps To Do the Measurement

- Fill the hydrometer jar with the manure sample
- Use the brush to thoroughly mix the sample in the jar
- Place the hydrometer in the jar immediately after mixing and take a reading within 10 seconds
- Calculate TN and TP concentrations using respective equations based on the hydrometer readings

### What Are the Error Ranges by Using This Method?

Based on our analysis, the error ranges for nutrients estimation could be  $\pm 17\%$  for TN and  $\pm 12\%$  for TP for finishing manure,  $\pm 10\%$  for TN and  $\pm 11\%$  for TP for gestation manure, and  $\pm 13\%$  for both TN and TP for nursery manure.

### Possible Ways to Reduce Errors In Estimation

- Make sure the collected sample is representative, which means the sample is well mixed and thus uniform.
- Make sure the sample in the hydrometer jar is thoroughly agitated using the brush to suspend all the solids before placing the hydrometer.
- Make sure that the readings are taken within 10 seconds after mixing to avoid the settlement of solids.
- The procedure can be repeated two or three times to get replicate readings and averages.

### An Example of Calculation

Assuming the hydrometer reading for nursery manure is 1.009 (SG) and referring to the equations for nursery pigs, the concentrations of total nitrogen and total phosphorus in the manure will be:

$$\text{TN} = -192739 + 192510 \times 1.009 = 1504 \text{ ppm} = 1.504 \times 10^{-3} \text{ kg/L}$$

$$\text{TP} = -26347 + 26333 \times 1.009 = 223 \text{ ppm} = 0.223 \times 10^{-3} \text{ kg/L}$$

By converting the results to the unit commonly used by the producers (lb/1000 gallons of manure), we have:

$$\text{TN} = 1.504 \times 10^{-3} \text{ kg/L} \times 2.2 \text{ lb/kg} = 3.309 \times 10^{-3} \text{ lb/L} \times 3785 \text{ L/1000 gal.} = 12.5 \text{ lb/1000 gal.}$$

$$\text{TP} = 0.223 \times 10^{-3} \text{ kg/L} \times 2.2 \text{ lb/kg} = 0.491 \times 10^{-3} \text{ lb/L} \times 3785 \text{ L/1000 gal.} = 1.86 \text{ lb/1000 gal.}$$