Example Calculation: Nitrogen Loading In Land Application

The following agronomic loading rate is calculated as outlined in the TN Department of Environment and Conservation (TDEC) Land Application Guidance Document using the plant available nitrogen (PAN). The crop nutrient requirement is provided by the local University of TN Agricultural Extension Service and is based on wheat, hay, and rye for the average yields of this geographic region.

Assumptions/Given:

Field size = 25 ac
Background Nitrogen in soil = 18 lb/acre
TKN (sample) = 5000 mg/kg
Ammonium N (sample) = 1000 mg/kg
Nitrate N (sample) = 10 mg/kg
Nitirite N (sample) = 0 mg/kg

Calculation

Plant Available Nitrogen (PAN) loading rate:

1. Available nitrogen from waste
    a. TKN (lbs/ton) = TKN (mg/kg) x 0.002 = 5000 mg/kg x 0.002 = 10 lbs/ton
    b. Ammonium N (lbs/ton) = NH_4-N (mg/kg) x 0.002 x volatilization factor = 1000 mg/kg x 0.002 x 1 = 2.00 lbs/ton
    c. Nitrate + Nitrite N (lbs/ton) = NO_3/NO_2-N (mg/kg) x 0.002 = 10 mg/kg x 0.002 = 0.02 lbs/ton
    d. Total inorganic N (lbs/ton) = (1b) + (1c) = 2.00 + 0.02 = 2.02 lbs/ton
    e. Total Organic N (lbs/ton) = (1a) - (1d) = 10.00–2.02 = 7.98 lbs/ton
    f. Available organic N for first year application = (1e) x mineralization factor = 7.98 lbs/ton x 0.20 = 1.60 lbs/ton
    g. Available N = (1f) + (1d) = 1.60 + 2.02 = 3.62 lbs/ton
2. Available N in soil
    a. Soil test result for background N (lbs/acre) = 18 lbs/acre
    b. Estimate of available N from previous application (lbs/acre) = 0 lbs/acre
    c. Total available N in soil = (2a) + (2b) = 18 + 0 = 18 lbs/acre
3. Available N from other sources
    a. N from fertilizers (lbs/acre) = 0
    b. N from water (lbs/acre) = 0
    c. N from previous crop (lbs/acre) = 0
    d. Others (lbs/acre) = 0
    e. Total (lbs/acre) = (3a) + (3b) + (3c) + (3d) = 0

4. Total N from existing sources = (2c) + (3e) = 18 + 0 = 18 lbs/acre
5. N requirement for wheat, hay, and rye at 2.5 tons per acre = 100 lbs/acre
6. Supplemental N requirement = (5) – (4) = 82 lbs/acre
7. Agronomic loading rate = (6) / (1g) = 82 / 3.62 = 22.65 tons/acre

Sludge Density Calculation

1. Total solids from analytical (%) = 18%
2. Lb solids / lb liquid sludge = 18 / 100 = 0.18 lb
3. Lb water / lb liquid sludge = 1 – 0.18 = 0.82 lb
4. Gallon water / lb liquid sludge = 0.82 lb / 8.33 lb/gal = 0.098 gal
5. Liquid sludge density = 1 lb / 0.098 gal = 10 lb/gal

Final conversion calculations

1. Truck liquid capacity = 6000 gal
2. Truck solids capacity = 6000 gal x (10 lb/gal) x (0.18 lb solid/lb sludge) / (2000 lb/ton) = 5.4 tons
3. Agronomic loading rate = 22.65 tons/acre / 5.4 tons/truck = 4.2 trucks / acre
4. Field Capacity = 4.2 trucks/acre x 25.0 acres = 105 trucks