

Formulas and Conversion Factors for Working with Biochar

Weights and Measures

Length

1 inch = 25400 micron (μm)

1 micron = .004 thousandths of an inch

1 micron = 1000 nanometers

Volume

1 cu ft = 7.5 gal

5 gal = $\frac{2}{3}$ cu ft

1 cu yd = 202 gal (4 not-quite-full 55 gal drums)

1 cord (4'x4'x8') = 4.75 cu yd

1 m³ = 1.3 cu yd = 264 gal

Area

1 ha = 2.47 ac

1 ha = 10,000 m²

1 ac = 43,560 sf

Weight

1 kg = 2.2 lbs

1 metric tonne = 2,204 lbs

1 US short ton = 2000 lbs

Biochar Physical Characteristics

Density

Solid or skeletal density is the mass per unit volume of the solid carbon at the molecular level

Bulk density or apparent density is the mass per unit volume of a collection of biochar particles. It includes the macroporosity within the particles and the inter-particle voids.

Solid density of graphite = 2.25 g/cm³

Typical dry solid density of biochar = 1.5 – 1.7 g/cm³

Typical dry bulk density of biochars and activated carbons = .25 - .75 g/cm³

Porosity

Pore size classification (from *Biochar for Environmental Management*):

Micropore is less than 2×10^{-3} μm

Mesopore is bigger than 2×10^{-3} μm and smaller than 50×10^{-3} μm

Macropore is bigger than 50×10^{-3} μm

Biochar Application Rates

*Assuming biochar bulk density = 0.4 g/cm³ and soil bulk density = 1.2 g/cm³

Rate in t/ha divided by 10 = rate in kg/m²

Divided by 4 = rate in liters/m²

Divided by 1.82 = rate in g/kg soil

Divided by 0.71 = rate in ml/kg soil

Divided by 0.59 = rate in ml/liter soil

Divided by 40 = cm depth spread on soil before incorporation

For example, to achieve a 10 ton/ha application rate on a field, spread biochar in a layer .25 cm thick on the soil surface. To achieve a 10 ton/ha application rate in a pot, add 17 ml biochar per liter of soil in the pot.

Chemical Names and Formulas

Carbon

CO₂ – carbon dioxide

Molecular weigh of CO₂ is 3.67 time molecular weight of C

1 ton of mineral C is equivalent to 3.67 tons CO₂

Nitrogen – forms of N:

N₂ = dinitrogen gas

NH₃ = ammonia (gas)

R-NH₂ = organic N

NH₄⁺ = ammonium (liquid)

NO₂⁻ = nitrite

NO₃⁻ = nitrate

NO = nitric oxide

N₂O = nitrous oxide

Soil Cations

calcium (Ca⁺⁺)

magnesium (Mg⁺⁺)

potassium (K⁺)

ammonium (NH₄⁺)

hydrogen (H⁺)

sodium (Na⁺)

Soil Anions

chlorine (Cl⁻)

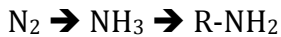
nitrate (NO₃⁻)

sulfate (SO₄⁼)

phosphate (PO₄³⁻)

The Nitrogen Cycle

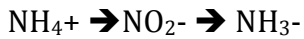
Fixation



Mineralization



Nitrification



Denitrification



Volatilization

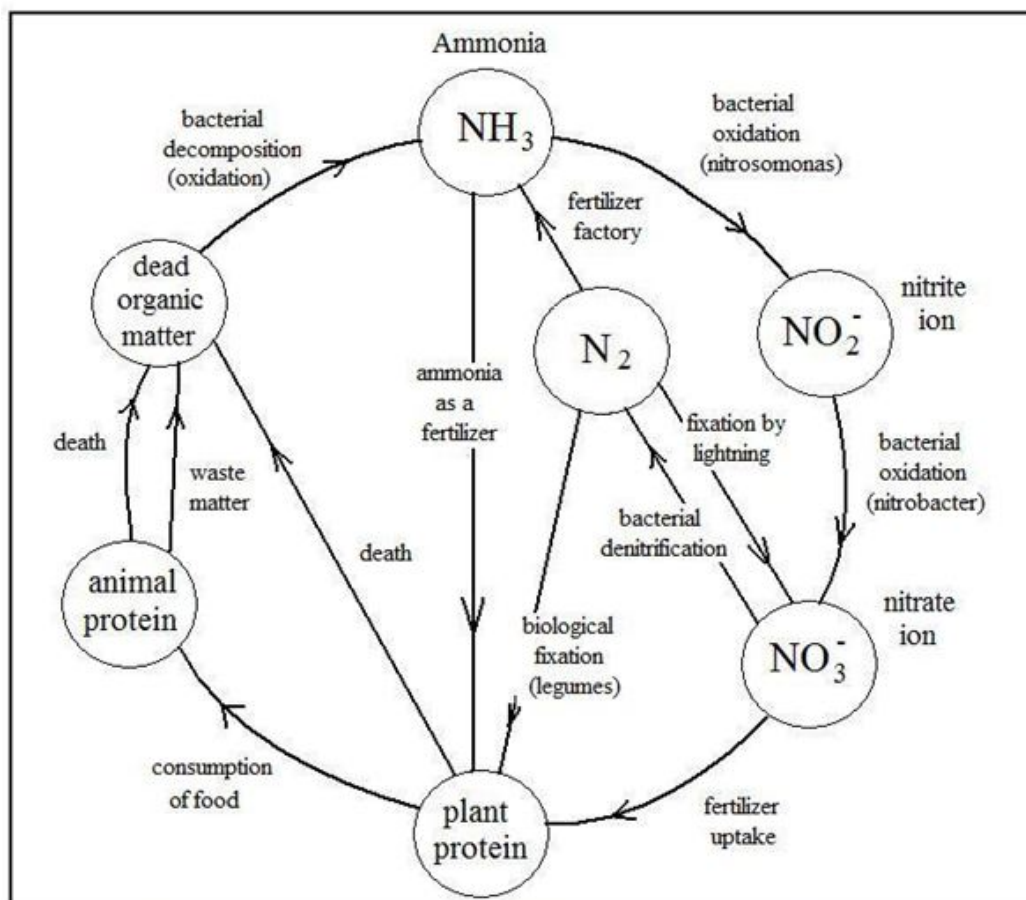


Immobilization



Leaching

Crop Uptake



More Comprehensive Nitrogen Cycle Diagram