Detailed Ionic Strength Calculation Guide

# Ionic Strength Calculation for NPK Fertilizers

## Step 1: Calculate Molar Concentration for Each Ion

\*\*Formula:\*\*

Molar concentration (mol/L) = Concentration (g/L) / Molar Mass (g/mol)

\*\*For Nitrogen (NH₄⁺):\*\*

Molar mass = 18 g/mol

Concentration (100 mg N/kg) = 0.456 g/L

Concentration (200 mg N/kg) = 0.92 g/L

Molar concentration:

0.456 g/L / 18 g/mol = 0.0253 mol/L

0.92 g/L / 18 g/mol = 0.0511 mol/L

\*\*For Sulphur (SO₄²⁻):\*\*

Molar mass = 96 g/mol

Concentration (100 mg N/kg) = 0.240 + 0.115 + 0.170 = 0.525 g/L (summed from sulphates)

Concentration (200 mg N/kg) = 0.360 g/L

Molar concentration:

0.525 g/L / 96 g/mol = 0.00547 mol/L

0.360 g/L / 96 g/mol = 0.00375 mol/L

\*\*For Phosphorus (PO₄³⁻):\*\*

Molar mass = 95 g/mol

Concentration (100 mg N/kg) = 0.091 g/L

Concentration (200 mg N/kg) = 0.182 g/L

Molar concentration:

0.091 g/L / 95 g/mol = 0.00096 mol/L

0.182 g/L / 95 g/mol = 0.00191 mol/L

\*\*For Potassium (K⁺):\*\*

Molar mass = 39 g/mol

Concentration (100 mg N/kg) = 0.34817 g/L

Concentration (200 mg N/kg) = 0.68 g/L

Molar concentration:

0.34817 g/L / 39 g/mol = 0.00893 mol/L

0.68 g/L / 39 g/mol = 0.01744 mol/L

## Step 2: Calculate the Contribution to Ionic Strength for Each Ion

\*\*Formula:\*\*

I = 1/2 ∑cᵢzᵢ²

\*\*For Nitrogen (NH₄⁺):\*\*

cᵢ for 100 mg N/kg: 0.0253 mol/L

Charge zᵢ = +1

Contribution to I: 1/2 × 0.0253 × (1)² = 0.01265 mol/L

\*\*For Sulphur (SO₄²⁻):\*\*

cᵢ for 100 mg N/kg: 0.00547 mol/L

Charge zᵢ = -2

Contribution to I: 1/2 × 0.00547 × (2)² = 0.02188 mol/L

\*\*For Phosphorus (PO₄³⁻):\*\*

cᵢ for 100 mg N/kg: 0.00096 mol/L

Charge zᵢ = -3

Contribution to I: 1/2 × 0.00096 × (3)² = 0.00432 mol/L

\*\*For Potassium (K⁺):\*\*

cᵢ for 100 mg N/kg: 0.00893 mol/L

Charge zᵢ = +1

Contribution to I: 1/2 × 0.00893 × (1)² = 0.00447 mol/L

## Step 3: Sum the Contributions

For 100 mg N/kg:

Total Ionic Strength I = 0.01265 + 0.02188 + 0.00432 + 0.00447 = 0.04332 mol/L

Repeat similar calculations for 200 mg N/kg.

# Ionic Strength Calculation for Urine Fertilizers

## Step 1: Calculate Molar Concentration for Each Ion

\*\*For Nitrogen (NH₄⁺):\*\*

Molar mass = 18 g/mol

Concentration = 17.5 g/L

Molar concentration:

17.5 g/L / 18 g/mol = 0.9722 mol/L

\*\*For Phosphorus (PO₄³⁻):\*\*

Molar mass = 95 g/mol

Concentration = 2.6175 g/L

Molar concentration:

2.6175 g/L / 95 g/mol = 0.02755 mol/L

\*\*For Potassium (K⁺):\*\*

Molar mass = 39 g/mol

Concentration = 14.515 g/L

Molar concentration:

14.515 g/L / 39 g/mol = 0.3722 mol/L

\*\*For Sulphur (SO₄²⁻):\*\*

Molar mass = 96 g/mol

Concentration = 3.4675 g/L

Molar concentration:

3.4675 g/L / 96 g/mol = 0.0361 mol/L

\*\*For Calcium (Ca²⁺):\*\*

Molar mass = 40 g/mol

Concentration = 12.5 g/L

Molar concentration:

12.5 g/L / 40 g/mol = 0.3125 mol/L

\*\*For Magnesium (Mg²⁺):\*\*

Molar mass = 24 g/mol

Concentration = 0.0625 g/L

Molar concentration:

0.0625 g/L / 24 g/mol = 0.0026 mol/L

\*\*For Sodium (Na⁺):\*\*

Molar mass = 23 g/mol

Concentration = 16.7 g/L

Molar concentration:

16.7 g/L / 23 g/mol = 0.7261 mol/L

\*\*For Copper (Cu²⁺):\*\*

Molar mass = 63.5 g/mol

Concentration = 0.0025 g/L

Molar concentration:

0.0025 g/L / 63.5 g/mol = 0.0000394 mol/L

\*\*For Zinc (Zn²⁺):\*\*

Molar mass = 65.4 g/mol

Concentration = 0.0275 g/L

Molar concentration:

\*\*For Zinc (Zn²⁺):\*\*

Molar mass = 65.4 g/mol

Concentration = 0.0275 g/L

Molar concentration:

0.0275 g/L / 65.4 g/mol = 0.00042 mol/L

## Step 2: Calculate the Contribution to Ionic Strength for Each Ion

\*\*Formula:\*\*

I = 1/2 ∑cᵢzᵢ²

\*\*For Nitrogen (NH₄⁺):\*\*

cᵢ = 0.9722 mol/L

Charge zᵢ = +1

Contribution to I: 1/2 × 0.9722 × (1)² = 0.4861 mol/L

\*\*For Phosphorus (PO₄³⁻):\*\*

cᵢ = 0.02755 mol/L

Charge zᵢ = -3

Contribution to I: 1/2 × 0.02755 × (3)² = 0.123 mol/L

\*\*For Potassium (K⁺):\*\*

cᵢ = 0.3722 mol/L

Charge zᵢ = +1

Contribution to I: 1/2 × 0.3722 × (1)² = 0.1861 mol/L

\*\*For Sulphur (SO₄²⁻):\*\*

cᵢ = 0.0361 mol/L

Charge zᵢ = -2

Contribution to I: 1/2 × 0.0361 × (2)² = 0.0722 mol/L

\*\*For Calcium (Ca²⁺):\*\*

cᵢ = 0.3125 mol/L

Charge zᵢ = +2

Contribution to I: 1/2 × 0.3125 × (2)² = 0.625 mol/L

\*\*For Magnesium (Mg²⁺):\*\*

cᵢ = 0.0026 mol/L

Charge zᵢ = +2

Contribution to I: 1/2 × 0.0026 × (2)² = 0.0052 mol/L

\*\*For Sodium (Na⁺):\*\*

cᵢ = 0.7261 mol/L

Charge zᵢ = +1

Contribution to I: 1/2 × 0.7261 × (1)² = 0.3631 mol/L

\*\*For Copper (Cu²⁺):\*\*

cᵢ = 0.0000394 mol/L

Charge zᵢ = +2

Contribution to I: 1/2 × 0.0000394 × (2)² = 0.000079 mol/L

\*\*For Zinc (Zn²⁺):\*\*

cᵢ = 0.00042 mol/L

Charge zᵢ = +2

Contribution to I: 1/2 × 0.00042 × (2)² = 0.00084 mol/L

## Step 3: Sum the Contributions

Total Ionic Strength I = Sum of all contributions = 0.4861 + 0.123 + 0.1861 + 0.0722 + 0.625 + 0.0052 + 0.3631 + 0.000079 + 0.00084 = 1.861639 mol/L