Saturated Paste Extract Guidelines

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The soil paste extract test is a water-soluble test that helps identify what is happening in the soil short term. It is a good educational tool for determining what nutrients are soluble in the soil solution, including high sodium or salt levels. It is also very effective in identifying solubility of calcium. On calcareous sand-based greens, it can be of great importance in helping understand what nutrients are soluble in the soil, leading to better recommendations. When interpreting a paste extract test, it is critical to note that the need exists to maintain both strategic nutrient levels and a balanced ratio of nutrient levels.

Several factors can influence a paste extract soil test and need to be considered when interpreting results:

- Weather conditions; including the direction of storms, amount of rainfall, and influence of acid rainfall
- Irrigation
- Poor water quality
- Recent fertilization applications (i.e. water soluble nutrients may be in solution)
- High bicarbonate levels
- Compaction layers
- Plow pan
- Black layer
- Improper aerification and/or topdressings
- Very low exchange capacities/no buffering capacity

Testing protocol:
These tests should not be done as a stand-alone test; instead, they should initially be done in conjunction with a standard soil test on the same site. As a monitoring tool, these tests can be run on a 6-8 week schedule.

Approximate Optimum Levels

pH	Levels may or may not be the same as standard soil tests.
Soluble Salt	High soluble salt levels are undesirable and may directly injure turfgrass. Excessive concentrations can be leached from the root zone by periodic intense irrigations, but can only be accomplished with good subsoil drainage and exceptional soil permeability. **< 960 ppm (same guidelines as soil test)**
Chlorides	Chloride concentrations contribute to the total soluble salt concentration. Due to the fact that chloride salts are quite soluble, they will readily leach from soils with good drainage. High levels will reduce biological activity.
Bicarbonate	High levels will tighten the soil, and are an indication of either poor drainage or improper watering practices. High levels will cause calcium to precipitate in the soil forming calcium carbonate, which, in the presence of sodium; will cause a potentially serious reduction in permeability of the soil. **< 50 ppm**
Phosphorus	Not very soluble; high levels of aluminum & iron tie-up phosphorus. **1 – 3 ppm**
Calcium	As a percentage, calcium should always be greater than the combination of Mg & K. As a %, the Ca: Mg ratio should be 3:1 or a ppm ratio of 5:1. **40 – 60 ppm (ideal range 55 – 60%)**

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Magnesium	Magnesium plays a key role in chlorophyll production. Deficiencies are often associated with low CEC, acidic (ph<5.5) soils subject to leaching, high inputs of Ca as lime or gypsum, and high K fertilization. **8 – 12 ppm (ideal range 18 – 20%)**
Potassium	Should always be higher than sodium (Na) as a percentage, especially when bicarbonate levels are high. Very soluble. Becomes easily fixed in the presence of certain clay types. **15 – 20 ppm (ideal range 9 – 10%)**
Sodium	Should always be less than K as a percentage. The negative effects of sodium are especially critical where there is heavy traffic. Compaction of clay soils results in a decrease in aeration, water infiltration and percolation of soil water. As results rise above the optimum level, soil biology is weakened. **< 20 ppm (8 – 2%)**
Sulfur	As biology increases, so will sulphates. Sulfur deficiencies are most prevalent on sandy soils subject to leaching, soils with low organic matter content, high nitrogen use, and when clippings are removed. **5 – 10 ppm**
Boron	A water soluble, essential micro-nutrient for plant growth. While turfgrasses are generally tolerant of boron, soil accumulation can be problematic because boron can form chemical complexes that do not easily leach from the soil. Availability is reduced when soils have been recently limed to pH > 6.5 or in calcareous soils with high Ca content. **0.1 ppm**
Iron	High levels can tie-up phosphorus, while deficiencies are often associated with poor rooting or root viability conditions, pH > 7.0, high P levels at high pH, excess thatch, and low organic matter soils. **0.3 ppm**
Manganese	Availability is reduced on high pH soils, calcareous soils, acid and heavily leached sands, peat and muck soils at pH > 7.0, and during dry, warm weather. **0.1 ppm**
Copper	Deficiencies are most common on organic soils, heavily leached sands, high pH, and with high levels of P, Fe, Mn, Zn and N. **0.08 ppm**
Zinc	Deficiencies are most common on alkaline soils, during cool, wet weather, on highly weathered acid, coarse textured soils, and with high levels of N, P, Fe, Cu and Mn. **0.08 ppm**
Aluminum	High levels can tie-up phosphorus.

Please note: With all trace nutrient levels, an acceptable range of variability for the ideal levels would run plus (+) or minus (-) 0.02 ppm.

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