Manufacturing of Liquid Fertilizers

In the United States, 40% of all fertilizers are fluid, 60% solid. Mixtures applied in liquid form total about 30 million tons, with the typical analysis being approximately 9% N, 3.9% P, and 7.5% K.

There are two general methods of manufacturing liquid-mixed fertilizers. The first and most simplest method, known as the batch process, consists of merely dissolving solid plant-food carriers such as ammonium phosphates, urea, or potassium chloride in water in proportions that will yield a final product of the desired grade. The weighed constituents are dissolved in the proper amount of water with a suitable mixing device. The solution may be heated to facilitate the dissolving process. The relatively high cost of raw materials generally limits the use of this method to small operations or to companies engaged in manufacturing specialty grades.

The second, most widely used method is based on neutralizing phosphoric acid with ammonia. Anhydrous or aqueous ammonia, or ammonia-ammonium nitrate or ammonia-urea nitrogen solutions, are reacted with phosphoric acid solutions, after which solid sources of nitrogen and/or potash are added. Potassium chloride is the usual source of potash. The density of most common liquid mixtures is approximately 10 lbs per gallon.

Soluble Sources

The liquid fertilizer applied in foliar feeding enters plants directly by penetrating leaf cuticles or stomata, then enters the cells. The method enables plants to utilize nutrients more rapidly than does soil treatment. Research also has shown that the physical form of the nutrient, whether dry or fluid, has no measurable effect on its agronomic value, such as the total amount of plant growth it produces. Quickly available nitrogen sources denote rapid availability of nitrogen to turfgrass plants following fertilizer application. These quickly available nitrogen sources have a high potential for foliar burn due to their salt-like characteristic of dissolving readily in water to form cations (positive ions) and anions (negative ions). When these hydrophilic (water-loving) ions are in direct contact with the leaf surface, they quickly absorb moisture from the plant, giving it a brown, burned appearance. The more free cations and anions there are in soil solution or on the plant surface, the greater the potential for fertilizer burn. This problem arises when quickly available liquid nitrogen forms, generally in excess of 1 lb N per 1,000 sq. ft., are used. Most reports recommend that foliar fertilization occur during periods of low temperature and relatively high humidity, in the early morning or late evening. Hopefully, new liquid fertilizer technology will minimize some of these problems.

Because of its water solubility, urea is the most widely used fertilizer material; often it is mixed with ammonium nitrate or potassium nitrate. Liquid urea is characterized by a quick turf color response and a medium-to-high burn potential. Frequent application of low rates of liquid urea is required to promote even turf growth and color and to minimize burn potential. A fine, powdered form of UF also can be used for liquid fertilization.

An aqueous nitrogen solution marketed as *Formolene* contains more than half its nitrogen as monomethylol urea and the remainder as free urea and ammonia. Formolene is a 30-0-2 formulation containing 3-1/4 lbs nitrogen per gallon. This is basically a soluble nitrogen source.

III. Slow-Release Sources

Several new materials with better slow-release characteristics are now commercially available. These materials allow less frequent applications at heavier rates without undesirable surges in growth or color; they also minimize turf foliar burn potential.