Celebrating 30 years: Fluid Fertilizers Go Back A Long Way

But it took innovation and drive to convince doubters of its advantages over granular.

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While you can look back at Englishman Sir Humphrey Davey as early as 1808 (see Fall 2011 issue of Fluid Journal), one of the earliest liquid fertilizer plants to locate in the United States was that of G & M Liquid Fertilizer Co. in Oakland, California. Built in 1923, the plant used soluble fertilizer dissolved in water. Expanded use of these soluble fertilizers was made possible by the "Prizer Applicator" developed by Prizer Brothers in 1928, which allowed a soluble fertilizer to be metered through a gravity-flow or pressure system. Small-scale use of fertilizer materials in solution was advanced in the 1930s and 1940s by the new hydroponic industry. Unfortunately, perceived disadvantages--primarily economic--were not adequately explained or understood, dooming many commercial projects to failure. Another early use of the new domestic supply of nitrogen was made by the injection of ammonia into irrigation water, pioneered by Shell Chemical Company in 1932.

"Solution 32." Solutions containing ammonia with urea or ammonium nitrate were not used for direct application until 1942, when they were applied in a cane field in Louisiana. Allied Chemical Corporation began testing a solution of urea and ammonium nitrate, which permitted a nitrogen concentration of 32 percent without the vapor pressure of ammonia. A small group of farmers working with a Howard Lathrope, extension agronomist at Purdue University, and Walter S. Colvin, chief agronomist of the Barrett Division of Allied Chemical, made the first farm application of "Solution 32." This early development, interrupted by World War II, was later revived in 1951 via the persuasive efforts of a small band of fluid believers. A carload of "Solution 32" was applied with a herbicide sprayer on the Charles Schenk farm south of Vincennes, Indiana. Owing to the large supplies of inexpensive nitrogen available after World War II, the use of fluid fertilizer was greatly spurred.

Phosphoric fluids. The use of liquid fertilizers was also stimulated by the production of large amounts of phosphoric acid, produced mainly by the electric furnace method in California in the 1940s. Shell Chemical Company had already demonstrated in 1937 the feasibility of adding phosphoric acid directly to irrigation water. The first commercial use of this method took place in 1940. Early use of phosphoric acid was also pioneered by the John Pryor Company of Salinas, California and the Hayward and Wood Company of Oxnard, California.

Liquid mixed fertilizers were produced by the Leslie-Agriform Company in Newark, California as early as 1946. Originally, the mixes were sold in 15- and 30-gallon wooden barrels but later replaced by high capacity tanks.

Mixed fertilizer production took a major step forward in 1953 as the Liquilizer Corporation of Vincennes, Indiana started neutralizing phosphoric acid with ammonia and dissolving potash in the resulting hot solution. At first a 4-10-10 grade was produced but later formulations such as 9-9-9, 12-6-6, and 12-8-4 were produced using solid urea in ammoniating the solution.

Superphosphoric acid. The production of superphosphoric acid began in 1956 and the first shipment was made in June 1957 to the West Kentucky Liquid Fertilizer Company of Hopkinsville. There the superphosphoric acid was ammoniated to produce a liquid fertilizer with the approximate analysis of 11-33-0. Superphosphoric acid was used later in 1960 to produce 10-34-0 and in 1962 to produce the first tankful of 11-37-0. These ammonium phosphate solutions, either for direct application or as a starting base for many liquid fertilizers, had become so popular by 1967 that Allied Chemical built a plant.

Pipe reactor. TVA filed for a patent in 1971 for the pipe reactor process, which makes possible production of high poly-base solutions from wet-process superphosphoric acid. In this simple, energy efficient process, ammoniating wet-process superphosphoric acid from 68 to 70 percent P_2O_5 (20 to 30 percent as polyphosphate) produced a melt of high polyphosphate content, which was further dissolved in water and ammoniated to produce 10-34-0 containing 60 to 75 percent of the P_2O_5 as polyphosphate. The efficiency of this process was reflected in its rapid adoption by the industry. At least 130 commercial plants were using the process by 1980. By 1992, more than a million tons were used in the United States.

Since the pipe reactor process used in 10-34-0 and 11-37-0 production used superphosphoric acid, it also changed the superphosphoric acid industry to primarily producing a lower grade. Producing and handling of 68 to 70 percent P_2O_5 acid were relatively simple. The acid could be produced in a single-stage stainless steel evaporator. Its lower viscosity permitted ready transfer.

Suspensions. Interest in the new form of fluid fertilizer prompted the first shipment of TVA's 12-40-0 base suspension in January of 1960 to Nutra-Flo Chemical Company in Sioux City, Iowa. Demand continued to grow and was further accelerated by the first aerial application of suspension fertilizer made jointly by TVA, Agrico Chemical Company, and Theriot Chemical Company in southern Louisiana. In 1967, TVA also introduced its 13-39-0 suspension made from furnace-grade acid. Increased suspension fertilizer usage was also generated by the shortage of certain conventional fluid fertilizer raw materials in 1973 and 1974. This shortage prompted the use of mono-ammonium phosphate (MAP) and di-ammonium phosphate (DAP) in suspensions. Investigation of these materials had been made earlier by TVA and the industry, but the practices did not become widespread until the shortage existed. By 1974, suspensions accounted for 25 percent of total mixed fluid fertilizers sold in the United States and rose to 40 percent by 1984. However, they declined to less than one-fourth of the market by 1992. Other developments involving the inclusion of crop protection products (herbicides, insecticides, fungicides, and nematocides) or lime with fertilizers involved the use of suspensions and became well established.

Equipment. The rapid expansion of fluid fertilizers was possible because of the simultaneous development of the means of storing, transporting, and applying fluid fertilizers.

Beginning in the early 1950s a series of developments was initiated. Ken Standard Corporation of Evansville, Indiana made application equipment for farmers in the Vincennes area who were starting to use fluid fertilizers. Tryco Manufacturing Company of Decatur, Illinois developed an air pressure unit to handle low-pressure nitrogen solutions, just new on the market. Tryco, along with Butler Manufacturing Company and Beeson Tank Company, was among others who exhibited equipment at a Nitrogen Solutions Field Day held in Centerville, Kentucky.

The application of fluid fertilizers was revolutionized in 1956 when Ward Commons Manufacturing Company of Scio, Oregon introduced a "super-wide tire" made by Goodyear Tire and Rubber Company as a means of supporting a vehicle to apply fertilizer on marshy lawn grass fields in the Williamette Valley south of Portland, Oregon. The applicator, known as the Wolverine Swamp Buggy, was forerunner to high flotation equipment.

In 1959, General Metals Company began making nurse tanks with flotation tires. At the 1965 National Fertilizer Solutions Association (NFSA) Convention in St. Louis, Missouri, Rickel, Inc. of Niles, Kansas introduced their "Big A" applicator fitted with flotation tires. Walls Research Corporation of Indianapolis, Indiana exhibited a Dodge Power Wagon modified with Goodyear ***Terra Tires.*** It was not long before others followed with their brand of flotation equipment, including Modified Soil Equipment Company of Biglerville, Pennsylvania, and Tryco Manufacturing.

Better means of mixing, storing, and applying fluids also contributed to the development of fluid fertilizers. Pumps, nozzles, storage tanks, and transportation vehicles were developed to cope with corrosion caused by fertilizer materials and to do a better job of handling fluid fertilizer. Scores of pull-type spreaders with fold-out booms were built. Nozzles used for dispensing fluid fertilizers were developed from a slit cut in a pipe by a hacksaw. Spraying Systems Corporation, Delevan Manufacturing Company, and others pioneered this work.

Best yet to come

Indeed the journey has been a remarkable one made possible by the vision, determination, and undying efforts of a dedicated group of believers who formed the National Solutions Fertilizer Association and later its research and development division the FFF, determined never to give up. The best years are yet to come and the beneficiaries will be those who grow crops more abundantly in a rapidly increasing world population that is evermore dependent on maintaining an adequate supply of food.