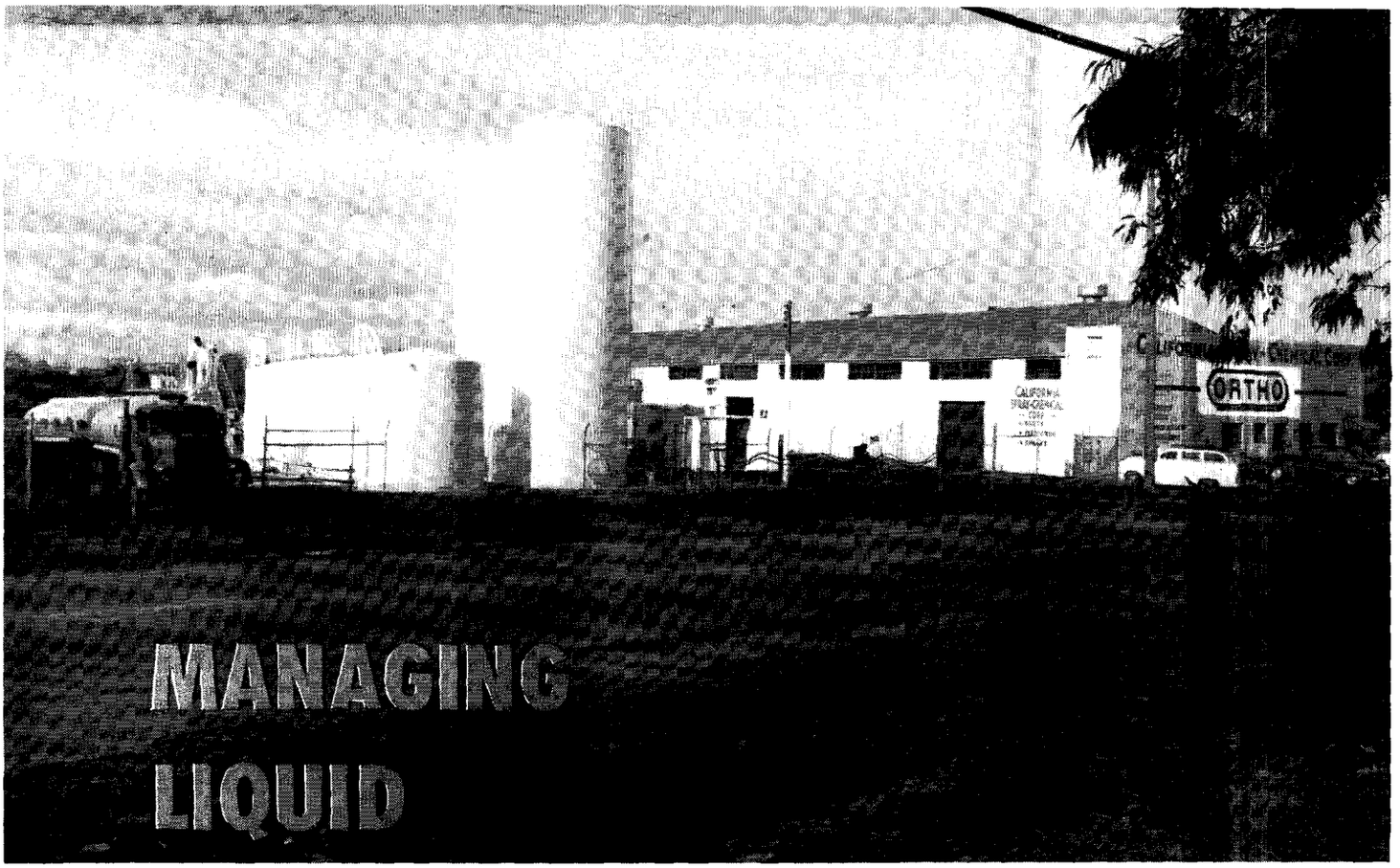


MANAGING LIQUID FERTILIZER PLANTS

A STAFF REPORT

Newcomers to the fertilizer industry's lusty baby find it's one thing to make liquid fertilizers but quite another to distribute them successfully. AG AND FOOD's nationwide look at current practice shows the industry is marked by its diversity in practice, opinion, and state of development

PICK ANY FIVE PEOPLE involved in liquid fertilizers, ask them what the outlook for liquids is, and the unanimous opinion, in a word, would undoubtedly be "bullish." Ask the same five what's the best way to make and distribute these products, and you're likely to get three different answers and a gratuitous dissertation from each on problems he faces.

Few in the fertilizer industry today would deny that liquids are anything less than a firmly established trend, and in the West more than one confirmed "dry" of 1954 has at least an aqua conversion unit tucked away in a corner of his plant in 1956. While liquids are a firm trend, they are also a trend marked by diversity in practice, opinion, and stage of development.

There's no doubt a strong case can be made for liquids on paper—low plant investment; minimum labor costs; buy raw materials in a stable market, upgrade them to almost specialty status, and sell at a substantial gross margin—at least up to the recent past. That the case for liquids is more than a paper case is amply demonstrated by their rapid spread. There's more to liquid fertilizers, however, than product formulation. They also must be distributed and sold. How, then, are these new companies managing plants and distributing products?

Complete liquid fertilizers are still new in the Midwest—this is essentially only their fourth year—but already over 50 plants are in operation or under construction. Marketing is the big problem. "I worry a lot more about moving it than I do about making it," is a typical comment.

It's possible for a newcomer to the business to build a plant "on a shoe string" all right. Second hand tanks, mixers, and perhaps an old building help in keeping initial plant investment to a minimum. But immediately he may find he has to invest almost as much again in distribution and application equipment before he can sell anything. So far—even in areas

where liquids have been sold for several seasons—only a small proportion of the farmers have application equipment of their own. Neither aluminum rigs used for nitrogen solutions nor equipment used for weed killers are very satisfactory. Stainless steel is widely used—in critical parts of the applicator at least—to guard against corrosion by products presently formulated in the area.

If he does not go into any retail sales himself, a plant operator may be able to rely on dealers to provide application equipment. However, he may have to set up storage tanks for them.

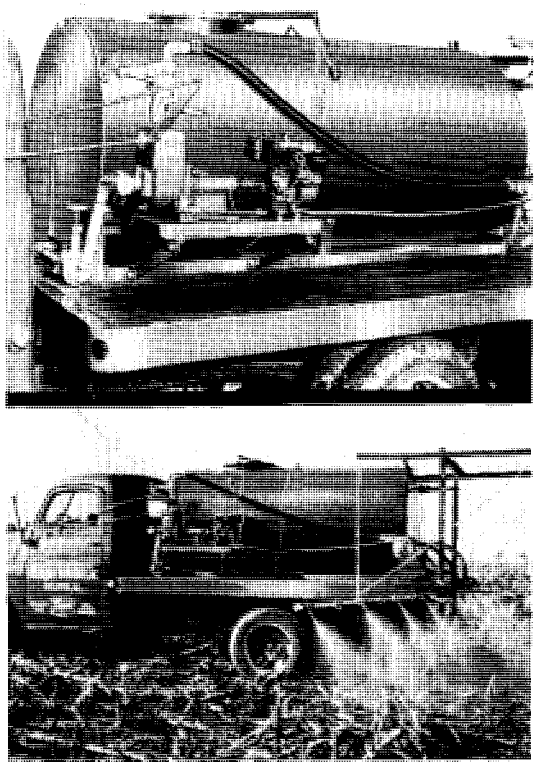
Associated Businesses

Midwest operators find one of the most successful ways to set up a liquid fertilizer distribution system seems to be to combine it with an already-going activity which sells to farmers in the area. Aylward of Sullivan, Ill., a Midwest pioneer in liquid fertilizers, had run a feed elevator for some years before organizing its liquid fertilizer company. Marquiss Farm Supply at Clinton, Ill., was already an established business selling limestone, phosphate rock, anhydrous ammonia, nitrogen solutions and agricultural chemicals; it also had a dry fertilizer mixing plant. Addition of complete liquids gave the company a complete line of fertilizer goods. Chemilizer Corp. of Springfield, Ill., is connected with K. G. Cole Chemical Co., a distributor of agricultural chemicals.

The season for liquid fertilizers in the Midwest is short—usually 90 days is the figure given, although it may be less—and having a fertilizer business connected with other businesses has the additional advantage of smoothing out the work load and avoiding seasonal employment.

Distribution in the Midwest is either wholesale, retail, or a combination of both. Dealers per wholesale plant range from half a dozen to about 25. A plant may sell retail and do custom application within a radius of about 10 miles, but some go up to 15 or 20 miles; dealers may be as far as 60 to 80 miles away.

Dealers are usually already engaged in fertilizer, feed, or other business. The dealers are, of course, extremely important in the distribution set up. But a dealer who is successful in selling liquid fertilizers often becomes a manufacturer, and a successful plant may find itself surrounded on all sides by other plants within a couple of years.



Liquid fertilizer sprayer by Tryco Mfg. Co., Inc.

Most fertilizer plants in the Midwest put out 1000 to 5000 tons per year. Percentage profit increases as tonnage sold goes up, but if demand exceeds a certain point, say 9000 tons, it is usually thought economical to build a second plant rather than enlarge the first one and expand the distribution system required to handle larger tonnages. Therefore, some liquids people have made cooperative arrangements with successful dealers in setting up new plants. A few larger plants are in operation, however, such as Continental Fertilizer's at Nevada, Iowa. This plant, built by J. C. Carlile Corp., has a capacity of about 200 tons a day (upwards of 20,000 tons a season).

Midwest Plants Differ Widely

Plant costs and modes of operation vary tremendously depending upon the particular conditions. Here are some examples:

▶ **HyGro Liquid Fertilizer Co.** at Converse, Ind., is a new company, and its plant is in its first full spring season this year. The plant was built with all new equipment and material and sells nothing but liquid fertilizers. Ellsworth Engineering and Equipment Co. of Indianapolis did the engineering work. Valves, meters, mixing

Plant Construction

Engineering firms offer many different types of construction contracts. Some may merely call for delivery of equipment. Others may call for equipment and engineering supervision but for the purchaser to supply much of the construction labor. Still others call for a turnkey job, including initial operation of the plant.

Attitude toward the liquid fertilizer business shows up in plant construction. An operator with capital and long-range optimism can put up a smoothly functioning, carefully constructed plant. On the other hand, someone with only limited capital may use only salvaged equipment. He may be just as successful in the long run, but he pays a certain price in somewhat higher operating costs. Maintenance difficulties may plague him, and a breakdown in a crucial period could be devastating.

Cost of the final plant is also determined by the manufacturing process used. Major choices include batch or continuous operation and whether to use anhydrous or aqua for the initial neutralization reaction. Weigh tanks for measuring ingredients are usually cheaper than automatic meters, but they are not as easy to operate. Choice between anhydrous and aqua depends on many factors, including the market as fertilizers for each within the company's area.

Opinions differs on the amount of storage facilities needed. Service from raw material producers is generally quick, but demand can rise so suddenly that many feel a large storage capacity for finished goods is a requirement if any substantial tonnage is to be sold.

Some of the engineering firms also arrange financing. One, who so far has not been taken up on it, even offers to finance 80% of receivables. Another offers a leasing arrangement. Many sell their paper to banks or other loan agencies.

Liquid fertilizer engineering and construction firms include: Butler Mfg. Co., Kansas City; J. C. Carlile Corp., Denver; Ellsworth Engineering & Equipment Co., Indianapolis; Fabricated Metals, Inc., San Leandro, Calif.; Midstate Machinery Co., Decatur, Ill.; Acme-Fisher, Louisville; Pioneer Iron Works, Sioux City, Iowa; Standard Steel Mfg. Co., Indianapolis; Columbia Steel Tank Co., Kansas City, Mo.

tank, and agitator are stainless steel. A railroad siding permits direct raw material unloading. The plant is run by two men, and the company has two salesmen in the field.

Distribution is through six dealers within a 20-mile radius. These dealers are custom applicators—usually as a sideline to running an elevator, feed store, or some other business. The dealer drives to the plant in his application truck, places an order for two to five tons of some specified grade of fertilizer, and waits about 20 minutes until the batch is mixed and pumped into his tank.

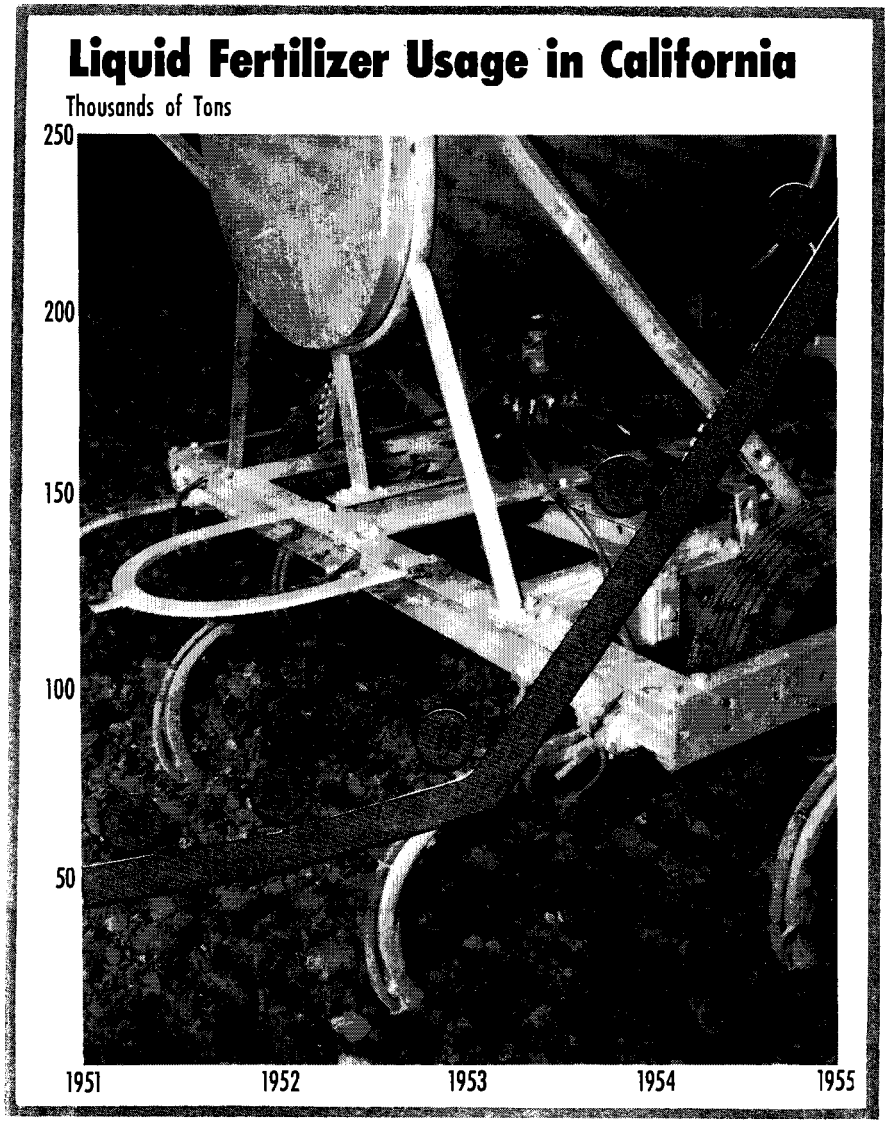
Mixing can be almost automatic. When an order for a certain quantity of one of 15 grades offered comes in, meters are set according to a previously worked out scheme, and nitrogen solutions and phosphoric acid are run into the mixing tank and cut off automatically. Urea may be added by hand from bags. Potash from a bin is weighed on a hopper scale and carried to the tank by belt conveyor. When mixing is complete, the batch is metered into the waiting truck. The operator can almost get away with wearing a business suit while operating the plant.

▸ **Marquiss Farm Supply Co.** at Clinton, Ill., has installed liquid facilities in the same building with its dry mixing equipment. In this plant, which was engineered by Midstate Machinery of Decatur, Ill., mixing is done in a weigh tank to avoid meters. Bins for potash and urea extend out over the edge of the tank so that these materials can be added directly. Like phosphoric acid and ammonia, these are weighed in.

This is Marquiss's fourth year of operation. Its dealers number about 25, some of whom are 80 miles away. Retail sales are made in a 20-mile area. There is a great deal of storage capacity for finished products, so an order can be filled in about five minutes.

▸ **Chemilizer Corp.,** Springfield, Ill., set up its plant 15 months ago. K. G. Cole, whose company own Chemilizer, does not know exactly what the capacity of the plant might be if operated at the highest level, but he does not expect to have any trouble making the 3000 tons he hopes to sell this year.

The plant was converted from an old bulk petroleum plant. This provided 105,500 gallons of storage capacity, and 12,000 more have been added. Cole has about $35,000 invested in the plant, with another $20,000 tied up in inventory. Urea-ammonium nitrate solutions are also sold from the plant.



Distribution is entirely on a wholesale basis, and liquids are trucked up to 80 miles in 8-ton tankers. Dealers are franchised and confined to an agreed trade area. It is difficult to assess operating costs, because billing and administration are handled by the parent organization, K. G. Cole Chemical Co. The equivalent of one full-time man is kept at the plant, and supervision is a part time duty of the sales manager.

▸ **Indian Point Farm Supply,** Athens, Ill., had its first spring season with complete liquid fertilizers this year. Two partners of this company, Loren E. Hopwood and J. Kennedy Kincaid, Jr., have adjoining farms. A few years back they realized the need for a soil testing service in the area and set up a small soil testing laboratory. Then in the fall of 1954 they started selling no-pressure nitrogen solutions, and this led them to consider complete liquid fertilizers.

To learn a little about complete liquids and to introduce them to the neighborhood, Hopwood and Kincaid became dealers doing custom application of mixed liquids. By-passing any engineering concern, the partners designed their own plant, shopped around and bought equipment, and constructed it on one of the farms for about $23,000.

Now they have eight dealers, one of whom is also an anhydrous dealer. Because of this special arrangement they can buy anhydrous from him on short notice, and do not need extensive NH_3 storage capacity. It is used directly from the 1000-gallon delivery tanks. Determination of the exact number of people required is difficult because the two partners also run their farms, and hired labor moves among jobs connected with the farms, the plant, and retail application.

For retail sales there is one application truck and some "do-it-yourself" rigs. The rig adopted is of their own design and consists of a 550-gallon tank on a four-wheel trailer for tractor towing. The tank is mild steel and the booms are stainless. When extended, booms cover a 33-foot width. From a chart which correlates speed (read on a speedometer mounted on

the front of the rig) and nozzle type, the applicator knows just how fast to move in order to apply at a given rate per acre.

▶ **Crop Service Co.** at Champaign, Ill. has installed and designed a continuous-flow neutralization plant to produce an 8-24-0 concentrate, from which final formulations are made. Phosphoric acid is neutralized with anhydrous ammonia as it is unloaded from the tank truck. The two streams flow together and the neutral stream is immediately cooled in a spray-tower heat exchanger. The neutral solution can be stored in ordinary tanks, so corrosion-resistant phosphoric tanks are eliminated, as well as the mixing tank. A tank truck of acid can be neutralized in two and a half hours.

Tanks from railroad tank cars are used for much of the plant's storage capacity, and two dissolvers for dissolving potash or urea in the 8-24-0 are made from tank car domes. Solids are changed into the dissolvers, and liquid is circulated through them until all solids are in solution. One man can operate both dissolvers.

Output of the plant is about 100 tons per 10-hour day. Henry J. Schultz, the partner who manages the plant, was already an anhydrous dealer, and he now has about 15 dealers in liquids. Crop Service does a little application on a retail basis, but not too much. Dealers (up to 80 miles away) all have tanks for storage.

Midwest Outlook

Newer developments which have come along in dry fertilizers are also being adopted for liquids. Insecticides (aldrin or dieldrin), trace elements, chelates, and other additives are being tried. Agronomically, they seem to compare favorably with dry fertilizers.

Complete liquids have really boomed in the Midwest, but percentage of the total fertilizer market remains quite small. Big companies are watching the small liquid plants with interest. Some think big companies will never put up the numerous small plants which the industry seems to call for. Others say there are places where the traditional dry mix companies should establish liquids plants.

Davison has started up an experimental plant at Wakarusa, Ind., engineered by Fabricated Metals, Inc. It plans to have a full line of liquids, from aqua through 9-9-9. Purpose of the plant is to test processing, sound out markets, and get experience.

This year liquids are moving in the East for the first time. Cheaper acidulated rock and different farm conditions have slowed up development there, but plants are appearing in New Jersey, Pennsylvania, and North Carolina. Southern states have also been slow in taking up liquids, although acceptance in Louisiana may indicate a growing market for them.

West May Be 3 to 5 Years Ahead

The liquid fertilizer industry in the West is still predominantly a California industry, and a glance at accompanying charts will show the place liquids have reached to date. With a longer history in liquids behind it, the California industry has reached a more advanced stage of development, and it appears the Midwest is about where California was three to five years ago —a statement not universally admired in the Midwest, where the reaction is apt to be, "It's not a question of who is ahead, since we may be 'evoluting' in a different direction."

Evolution aside, several differences between California and Midwest practice are apparent, each of which has important bearing on plant operation and product distribution. First, the average California liquid fertilizer formulator deals in a greater diversity of products in volume—aqua ammonia, neutral fertilizer solutions, ammonium nitrate solutions (20 and 40% N, elsewhere known as "no-pressure" and "low-pressure" nitrogen solutions), and phosphoric acid.

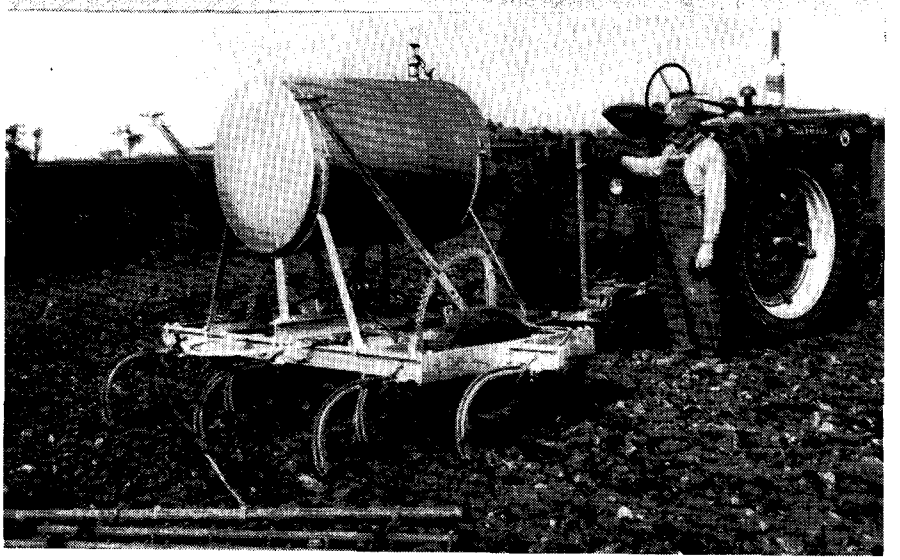
Much more important than diversity, however, is relative importance now has two neutral solutions plants of various types in the two regions. In the West, the liquid industry is in large measure an aqua ammonia industry, with neutral solutions farther down the tonnage scale, at least to date (176,000 tons of aqua in 1955 in California, compared to 38,600 tons of neutral solutions). In the Midwest, the reverse is true, with aqua virtually unknown. This difference is not surprising, of course, in light of the West's preference for simples in contrast to Midwest preference for mixes.

This is not to imply that neutral solutions are not significant in the California fertilizer industry, however, nor that they will not become more so in the future. In fact, neutral solution formulators undoubtedly eye California's 200,000-odd-ton dry mix sales as one potential for the future. It does mean, however, that the liquid industry in the West has a slightly different structure, and a number of traditional "dry" companies fit in the liquid category, although they may have nothing more elaborate than an aqua conversion unit and aqua storage. (They cannot be dismissed, however, for their aqua sales loom quite large in some cases.)

Secondly, type and size of farms differ between the West and Midwest and Southeast. Western farms are larger, and agriculture is more diversified even within local regions. Large farms mean unit application costs are lower; crop diversity means application peaks are spread over a longer season. These should theoretically tend to reduce western application costs. Reduction is largely theoretical, however, for the successful dealer or formulator is apt to sell more than his equipment can handle during peaks, and he will juggle application and delivery equipment just as frantically as any one in the country.

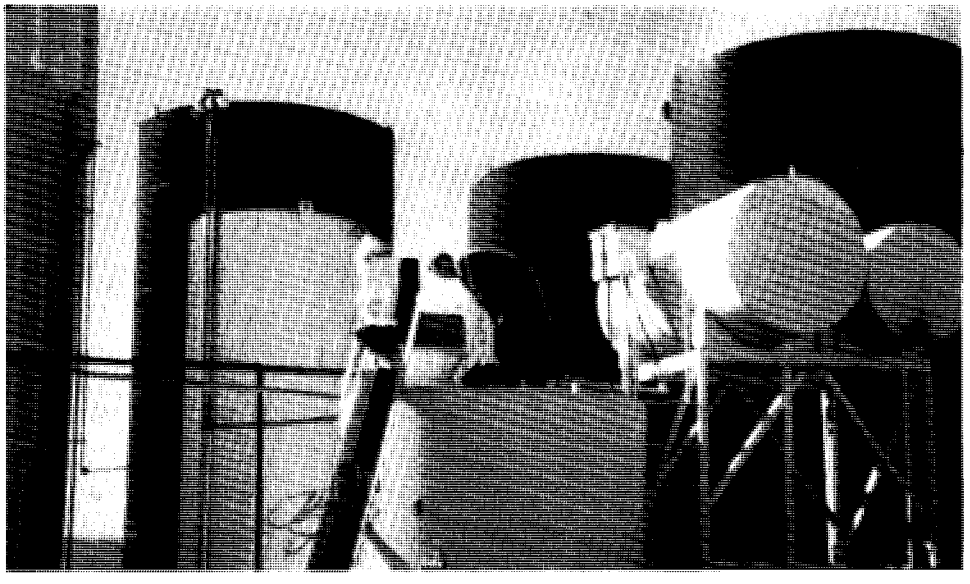
Third major western difference is in application method—most liquids are either injected directly into the soil or applied via irrigation water, in contrast to Midwest-Southeast practice which by and large is "spray-on-plow-down." Thus, application in the West

In the Midwest, most complete liquids are applied by spraying, although some rigs have been built for injection, such as this one. A Graham Hoeme plow was specially modified. Gravity flow takes the solution to plow shares



(neglecting irrigation application) will be slowed, more expensive, and require different equipment. Furthermore, this need for injection equipment means the break-even point is higher in the West than elsewhere for farmer ownership, a goal ardently sought by some liquid companies in the West. In North Carolina, for instance (AG AND FOOD, April 1956, page 316), a farmer can get by with $100 worth of equipment to spray ammonium nitrate solution on as little as 17 acres a year. In California, an injection kit for a wheel tractor runs $500 to $600, and at least one liquid company calculates this is a worthy purchase for a 160-acre farm.

(There are schools of thought on a farmer ownership of liquid application equipment, and they're as far apart as "yea" and "nay." The yea's feel application and field storage equipment is a red ink item from start to finish: "My dry competitor across the street there tosses 20 tons on his truck, rolls out to his farmer customer, dumps it in his barn, and he's through with it. I put 20 tons in my tanker, haul out a storage tank, bring the farmer an application rig, and then pick up rig and tank when the job is done," is a typical reaction from this group. The nay's by contrast reason that a dealer should give service, that once he stops he invites basic producers to step in and take him over.)



Sure-Gro's liquid fertilizer plant at Plattsburg, Mo., has outdoor mixing tank

Liquids in the Southwest

There are fewer complete liquid fertilizer plants in the Southwest than in either the Midwest or West. Practice, however, closely parallels that in the West, in part because of similarity in agricultural practices.

Big problem, according to one formulator, is the amount of service connected with liquids, and he's had difficulty lining up a dealership organization. Therefore, he moves about two thirds of his production direct to farmers (50 mile radius) and the balance through dealers. His plant cost $35,000, turns out 300 tons of aqua and 100 tons of neutral solutions per day (three shift basis). Since much of his business is direct, he's put an additional $65,000 into distribution and application equipment and into storage. In an operation such as his he figures the break-even point is about $300,000 gross sales per season with a 40% return on gross sales.

A second formulator, by contrast, moves about 90% of his production through dealers. In his opinion, dealers have no difficulty in making a profit on a 9% mark-up, the same as on dry goods (application equipment supplied by the formulator; where dealers supply their own equipment, mark-up ranges 20 to 30%). With his more extensive dealer organization, he operates up to 150 miles from his formulating plant.

Much of the liquid fertilizers in the Southwest is used on cotton, in which case the cotton gin can be an important cog in the distribution set-up. Line up a few gins as your dealers and you almost have assured customers in farmers who bring their cotton to these gins. Gins are a mixed blessing, however, in that they normally do not offer credit like a regular dealer will. This means that the Southwest formulator who works through gins will need greater working capital in order to pass credit along to his farmer customers.

Western Future: Well-Engineered Plants

Although much variation still exists both in size and manufacturing technique among plants now operating in California, the day of the Jerry-built, backyard-blacksmith approach to new plant construction has passed. Many an independent operator in the past has been able to start with a simple set-up, but entrance of big, diversified manufacturers into the field, coupled with a general tightening of profit margins within the past 12 to 18 months, probably means only those with well engineered plants will be able to compete in the future.

Manufacturing approach in California is therefore shaking down into a fairly standard pattern: Anhydrous ammonia is converted to aqua and stored. Aqua is then taken from storage and is reacted continuously with phosphoric acid in a small (about 100 gallons usually) stainless steel vessel. Automatic control of the process is based on monitoring pH of the ammonium phosphate product. This reaction results in either 8-24-0 or 8-25-0, standard neutral solution formulations and basic stocks for other grades. Batch formulation of the basic stock with urea or ammonium nitrate(solid or solution), and potash gives popular grades such as 9-4-0, 10-20-0 and 9-18-0, 15-15-0, 10-10-5, 5-10-10, and 9-9-9.

Most recent California plants are in the 200-ton-per-day range and turn out about 20,000 to 30,000 tons a season. Plant costs vary, depending in large measure on finished goods storage at the plant site. Usual tab for the complete works—land, operating equipment, storage, construction—ranges from $75,000 to $100,000.

Sharply peaked seasons are not new to the fertilizer industry generally, and the liquid industry is no exception. Most plants, therefore, provide some on-site storage. A minimum for a diversified formulator who approaches a 200-ton-per-day capacity might be 10,000 gallons for acid, 60,000 gallons for aqua, and 40,000 gallons for neutral solutions. Somewhat farther up the storage scale is Agriform at Woodland, Calif., with 420,000 gallons for aqua, 20,000 gallons each for 8-25-0 and 9-4-0, and three 10,000-gallon tanks for neutral solution formulations. This totals about 10 days' production (2000 tons).

Apparently at the top is Brea Chemical (but in somewhat of a special category inasmuch as it is a basic producer as well as a liquid fertilizer

formulator). At Fresno, Calif., Brea has 2.3 million gallons for aqua storage, 420,000 gallons for 8-24-0; at Brea, Calif., its capacities are 6.7 million gallons for aqua, 210,000 for 8-24-0. As a basic producer of ammonia who is "going the aqua route," Brea has considerably more storage than smaller independents, of course.

As in other sections of the country, biggest problem facing the liquid fertilizer industry in the West is distribution and sales. Basic raw materials apparently are holding fairly firm, with ammonia pegged at $91 per ton f.o.b. plant. Phosphoric acid dropped $5.75 per ton to $81.75, however, last winter. But while raw material costs have been holding relatively firm, profit margins on liquids have narrowed. One liquid company, for instance, notes that its fiscal 1955 dollar volume was up only 9% over 1954, whereas sales were up 18% to 20%.

Western liquid fertilizer distribution systems run the entire gamut from very localized (within a few miles of a small plant) to area-wide distribution by companies having several plants. Among the latter are Agriform, which distributes primarily through what it calls consignee applicators, and Brea, which distributes through certified dealers. In addition, two large companies are just entering the liquids in California—Swift and Calspray, both of which have a potential for more than localized distribution.

Company size distribution and western agriculture's diversity means there's virtually no such thing as a "typical" distribution set-up. Specific methods and figures, therefore, are meaningful only for the community within which a given company operates. "Typical" of the liquid industry, however, is that toes are stubbed more often on distribution and application than on any other facet.

When one company entered the liquid business about two years ago, for example, it would send a truck to the farmer's field and then pump the farmer's tractor or tow rig full every half dozen or so passes as the farmer trundled up and down his field. Thus, a man and a truck were tied up at one customer's field all day at a cost for labor and equipment approaching $40. This was soon abandoned.

Closest approach to standardization in western liquid distribution is a portable field storage tank which has been evolved to overcome high distribution costs. This $1400 unit is a 2500-gallon tank mounted on aircraft landing gear wheels, with a gasoline-powered pump to transfer the contents to an application rig. A dealer hooks this up to his tank truck, tows it to his customer's field, and fills it from his truck. The farmer, then, fills his tractor or tow rig himself every half dozen passes over his field. When he begins to work on sections of his field at some distance from the portable storage tank, he pulls the tank down the field with his tractor.

The dealer, meanwhile, has a number of these field storage tanks spotted at farms within his service area, and he fills each one three or four times for approximately every 160-acre field the farmer fertilizes. Each of the dealer's tank trucks can serve eight to 10 portable field tanks per day.

Where the dealer operates within a fairly large radius of his main storage (over, say, 20 miles), he may spot semiportable storage tanks at strategic spots for every three or four portable tanks he has out. The semiportable job is usually a 7500-gallon tank that is towed empty, blocked up (its wheels are not designed to carry a load), filled, and then used to supply portable field tanks at farmers' fields.

Cost in California for such distribution to farmers a maximum of 40 miles from the plant runs up to $8.00 per ton. Where the farmer has on-farm storage for a minimum 20-ton load, delivery cost might drop to $3.00 per ton. Delivery to the farm is only one side of the distribution picture. The other side, application, was covered in the May AG AND FOOD, page 389.

Exact or even approximate pattern of the liquid fertilizer industry two years from now in the West is difficult to predict. Basic fact of today appears to be that basic ammonia producers have assumed a stronger position in the industry than elsewhere in the country to date. Thus, Brea Chemicals moved immediately to liquids when its ammonia plant came on stream in 1954, marketing aqua ammonia. Brea uses a one-step distribution chain through certified dealers and its products move throughout California, up into Oregon and Washington, and out to Hawaii.

Shell Chemical, the other basic producer, moves its ammonia as anhydrous. Although the material is anhydrous, it moves through an area-wide dealer organization that cannot be overlooked when assessing future distribution patterns for liquids. Furthermore, the Shell chain has shortened slightly in recent months in that Paul Greening, its anhydrous distributor in parts of California, has retired and has not yet been replaced.

Now Shell and Brea are about to be joined by a third major company, Calspray. Calspray will be basic in ammonia via its Standard Oil of California parent, and it will produce a line of both drys and liquids.

Consequently, some among the independent formulators, eying these developments warily, wonder what their ultimate position will be in an era of generally increased competition in the fertilizer industry.

Typical Estimates of Selling Price of 10–10–10 Liquid Fertilizer[a]

(Sales volume, 40,000 tons/yr.[a])

	South Atlantic Region		Pacific Region	
	$/ton material	$/ton product	$/ton material	$/ton product
Anhydrous ammonia	95.00	3.80	95.00	3.80
Phosphoric acid, 75% H_3PO_4	85.00	15.73	85.00	15.73
Urea	101.00	14.95	114.00	16.87
Potassium chloride	37.75	6.42	37.75	6.42
Water	0.02	0.01	0.02	0.01
Total raw materials	...	40.91	...	42.83
Operating labor	...	1.20	...	1.20
Maintenance[b]	...	0.17	...	0.17
Electricity	...	0.20	...	0.20
Supplies	...	0.02	...	0.02
Analyses	...	0.20	...	0.20
Property tax	...	0.09	...	0.09
Insurance	...	0.09	...	0.09
Depreciation	...	0.66	...	0.66
Plant overhead	...	0.60	...	0.60
Total operating cost	...	3.23	...	3.23
Total production cost	...	44.14	...	46.06
Selling expense	...	3.00	...	3.00
Return, 30% of total investment	...	3.92	...	3.97
Selling price, f.o.b. plant, $/ton product	...	51.06	...	53.03
Selling price, f.o.b. plant, $/unit plant food	...	1.70	...	1.76
INVESTMENT ($/annual ton)				
Process plant	...	4.12	...	4.12
Product storage	...	5.00	...	5.00
Working capital	...	3.92	...	3.92
Total investment for return	...	13.04	...	13.04

[a] Plant operates 6 mo./yr. to produce 40,000 tons.
[b] 3% process plant investment plus 1% storage investment.
SOURCE: From Z. A. Stanfield, TVA, Wilson Dam, Ala.