AGENCY FOR INTERNATIONAL DEVELOPMENT
WASHINGTON, D C 20523

BIBLIOGRAPHIC INPUT SHEET

FOR AID USE ONLY

1 SUBJECT CLASSIFICATION

A PRIMARY
Agriculture AF25-0000-0000

B SECONDARY
Soil fertility,fertilizers,and plant nutrition

2. TITLE AND SUBTITLE
Handling,storage,and transportation

3 AUTHOR(S)
Gopp,L.W.

4 DOCUMENT DATE	5 NUMBER OF PAGES	6 ARC NUMBER
1971	17p.	ARC

7. REFERENCE ORGANIZATION NAME AND ADDRESS
TVA

8 SUPPLEMENTARY NOTES *(Sponsoring Organization, Publishers, Availability)*
(Presented at Marketing Sem.on Fertilizer Industry,Sao Paulo)

9. ABSTRACT

10. CONTROL NUMBER	11. PRICE OF DOCUMENT
PN-RAA- 187	
12 DESCRIPTORS	13 PROJECT NUMBER
Handling Storage Transportation	14 CONTRACT NUMBER PASA TA (QA) 6-69 GTS 15. TYPE OF DOCUMENT

AID 590-1 (4-74)

8

TVA 275.22

Associacao Nacional para Difusao de Adubos

HANDLING, STORAGE, AND TRANSPORTATION

By

Leonard W. Gopp
Consultant
Tennessee Valley Authority
Muscle Shoals, Alabama

Paper to be Presented at
Marketing Seminar on Fertilizer Industry

Sao Paulo, Brazil, November 21-27, 1971

HANDLING, STORAGE, AND TRANSPORTATION

BY L. W. Gopp*

The handling, storage, and transportation of fertilizer materials are of paramount importance for the success of any fertilizer venture. Unfortunately, this segment of a business venture in many instances has not been thoroughly considered by many governmental agencies, corporations, distributors, and dealers. When this happens and a strong competitive market develops, the plants producing fertilizer in many instances develop into monument of brick and mortar and are of no value. We have seen this happen not only in developing countries but also in countries considered to have the best technology and scientific know-how, market research facilities, and information.

In most instances, a new venture or project receives the most minute and detailed consideration for construction and in-plant operations. But beyond the gates of the plant the activities are often grossly overlooked or neglected. The mportance of constructing a plant for maximum efficiencies is recognized, but probably the greatest burden--the handling, storage, and transportation--appears after the product leaves the plant gates.

Time does not permit the discussion of the details involved and the methods used for creation of the greatest efficiencies regarding the subject matter. Every corporation, public, or private sector will face unique problems. These can be solved only by internal expertise of professional consultation. From several decades of observations in the fertilizer industry, it has been found that the most successful fertilizer marketers employ intelligent, knowledgeable, and innovative personnel A marketing organization's

---

*Consultant, International Fertilizer Development Staff, Tennessee Valley Authority, Muscle Shoals, Alabama. To be presented at Marketing Seminar on Fertilizer Industry, sponsored by ANDA, Sao Paulo, Brazil, November 21-27, 1971

strength and success will be determined to a great extent by the personnel in the supply and distribution section.

It is believed that if we undertake to discuss the subject matter from a marketing management point of view with cinema and slide presentations, we shall save precious time.

Storage, whether in-plant or off-site, is probably one of the most difficult items of necessity to sell to the board of directors. Many individuals look upon storage with bane and above the cost or financial investment. It is believed that this attitude exists in management because in many cases it is difficult to show a direct or measurable profit from a substantial investment. In-plant storage is somewhat easier to sell, but off-site storage usually presents some of the greatest problems for the marketing divisions.

This attitude of management is justifiable in many instances in major corporations as well as at the distributor level. Many marketing managers have been in error in their recommendations for either construction or leasing of storage facilities. Most of the errors have been in overestimating their requirements. The wisest decision is to be conservative with factual, honest market research data for any form of storage for fertilizer materials. Long-range planning is mandatory, taking many factors into consideration. For example: (a) Change in the modes and economics of transportation (b) New products (c) Change in markets (d) Competition--present and future, and many more items that could be added to this list.

Storage or warehousing is a necessary investment, particularly for the fertilizer industry. When a commodity moves in very steep peak-and-valley curves, it becomes mandatory to produce product at a maximum rate

for the lowest unit costs. Good planning and forecasting by production and marketing lead to ventures that are not only profitable to the manufacturer but to customers as well.

For example, a corporation in the United States producing 1,000 tons per day of ammonia, has less than 10 days storage at the plant site. Since most of the product is moved by pipeline to market areas, it gains an additional 22-25 days of storage of product in the pipeline. This adds to a total of approximately 32-35,000 tons of storage with a minimal capital investment while the product is moving to the market area some 1200-1500 miles distance. It is estimated that a 10,000-ton storage facility investment today is close to $3 million. This company further reduced capital requirements by arranging long-term supply contracts with users of ammonia at a favorable price, with a good return on investment, where the customer had to construct his own storage facilities. Also, the plant was constructed and located in an area with abundant natural gas supplies, eliminating expensive gas transmission costs.

Florida producers have taken advantage of off-site storage for liquid and solid phosphate materials through the utilization of barges for shipment of materials from Tampa, Florida, to the upper extremes of the Midwest. The fertilizer industry is fortunate in the United States in that the grain markets commenced at an early date to ship grain via water to terminals for the export market. Many barges were returning without cargo as far as 1500 miles from port. Obtaining fertilizer as cargo was a bonanza, not only to the grain haulers but the producers of phosphates as well.

During the open-water season, the total travel time encompassed 21-30 days. Each barge carries from 1200-1500 tons of product to the market area for fertilizer materials. Barges have been more than adequate

when properly coordinated since the grain movement is much greater tonnage-wise than fertilizer materials. It is a common practice for the major producers to have as much as 20,000 tons of product in-transit, relieving storage requirements at plant-site during the winter season. The fertilizer producers were also able to take advantage of earlier shipments by barge if late fall or winter production was creating storage problems. The rivers beyond St. Louis, Missouri are not navigable during the months of November to April; therefore, the empty grain barges would be loaded with product and shipped as far as St. Louis and moored until navigation resumed on the river in the spring. Due to competitive situations, the barges were leased for a nominal amount for a 5-month period to store product aproximately halfway to destination.

The ammonia producers in the Gulf of Mexico vicinity and the lower portions of the Mississippi river have also utilized water transportation as in-transit storage. However, these barges are handicapped in that the primary cargo to date is only anhydrous ammonia and no cargo is available in quantity for the return trips.

In areas where water transportation is not available, or where economics prohibit the combination of water-rail-truck movement, some of the producers of fertilizer materials in Canada (potash) and Florida (phosphates) are also utilizing in-transit storage to advantages. The in-transit privilege granted to manufacturers consists of the published rate to final destination plus a nominal charge of approximately 10 percent for discharge of product at an intermediate point for storage. Since these storage points usually are located near use areas, delivery time often can be shortened by approximately 2-5 days. Some of the storage facilities are leased from private owners and in some cases abandoned ammoniation plant facilities are used by the basic producer.

Many producers of fertilizer materials also use the unit train concept for off-site storage of products. The rail cars or wagons are leased from the railroads, usually for a period of 10 years, and temporarily become the property of the manufacturer. The manufacturer ships cargoes of 4000-6000 tons from plant site and distributes these cars (usually of 100-ton capacity) to leased railroad sidings at strategic points for quick delivery to customers. This method of operation in the United States has progressed very rapidly and since hundreds of rail cars do become involved, computers have been used to assure maximum utilization of wagons and good service to customers.

In-transit storage obviously produces many advantages if well planned and organized. The outstanding advantages are as follows:

(1) Reduces capital requirements in the construction of off-site or on-site storage. Some storage facilities have been decreased by as much as 50 percent in capacity of anticipated storage. This consideration alone has made certain projects feasible from a capital standpoint.

(2) Service to the customer is greatly improved by shortening the time of delivery. Since, in the majority of cases, customer storage is very limited, service becomes of paramount importance. In some areas of the United States, 70 percent of the total annual volume of a bulk blend operation is moved in a period of 6 weeks. The manufacturer with the best delivery services is in a position to command the customer's business in most instances. A good and experienced marketing division working closely with the supply and distribution system has a major advantage over a competitor not staffed as well. This marketing tool is one of the finest tools in its possession; and if used wisely, it quickly leads to domination of marketing areas.

Other than in-transit storage, additional facilities must be considered in the overall storage plan. There are many philosophies as to whether on-site or off-site storage is the most practical. Marketing-oriented organizations usually are the greatest proponents for off-site storage. Production-oriented organizations seem to lean to the idea that product should be stored on-site for greater utilization of labor and equipment. In the United States, the major fertilizer producers are using off-site storage and its combination of in-transit storage to a maximum when plant expansions are necessary. This is particularly true in the ammonia industry. The phosphate and potash producers ventured into off-site storage combinations with rapid expansion in the early 1960's. When we still find off-site storage expansion progressing in ammonia and solutions, we find that, as with the solid phosphates and potash, the major producers have well-established, permanent points for specific areas. Through the process in the early 1960's--often on a trial-and-error basis--many points were eliminated because of poor economics. Some of these errors were very expensive experiments. Today, we find a sophisticated and well-justified system of off-site storage for phosphates and potash in a great majority of instances.

The grain transporters or brokers have had a great influence in the fertilizer industry for off-site storage in the United States. To attract fertilizer cargo for maximum utilization of their barges, storage facilities for fertilizer materials usually were established adjacent to their grain terminals. This was an ideal situation for the fertilizer industry to obtain the best truck or rail service from these grain terminals. The grain movement into the terminals was either by truck or rail. The trucking industry in particular was most happy to obtain a backhaul to either a fertilizer plant or customers. Locating where rail service already existed helped to assure good service to the customer and quick loading and switching.

The storage facilities varied in capacity from 10,000 tons to 70,000 tons for fertilizer storage. The fertilizer manufacturer usually contracted for a minimum throughput of tonnage on an annual basis. Sometimes existing buildings were converted for fertilizer storage by installing modern conveyors and handling equipment. Sometimes storage facilities were constructed by the grain terminal owners and leased on long-term contracts to recoup their investments, and to support barge operations for backhaul of fertilizer materials. The handling and storage charges (from barge-storage-loading into wagons or trucks) range from $3.50 per ton to $5.50 per ton. The demand by industry for storage dictated the rates per ton. The location depends on the market areas, availability of modes of transportation, handling equipment, and volume of throughput of product by the grain operators and fertilizer manufacturers.

Storage or warehouse facilities not located on the waterways or tributaries that are suitable for fertilizer storage are usually difficult to find. Rail sidings, roads, handling equipment, weighing facilities, markets, etc. are the limiting factors in many instances. However, when a facility was found that proved to be adequate, charges usually were in the range of $4.00 per ton. Some of the suitable buildings for conversion to fertilizer storage have been abandoned railroad buildings, airport buildings with rail sidings, obsolete plants, and outmoded fertilizer plants because of new technology or marketing systems. In one instance, a large grain storage facility at a brewery was converted into an excellent fertilizer storage facility.

Probably the cheapest form of off-site storage is shown in this slide. You will note it is outside and covered with polyethylene and chicken wire. Also, a large number of lines are used as weights to keep the covering in place. It has been successfully used for the protection of potash and DAP. This should be considered only as temporary at the best. It has protected potash for a period of 4-5 months for snow, rain, and freezing conditions. The pad or base was of asphalt material to prevent absorption of moisture from the soil. There was a creation of crust about 2-3 inches in thickness, but could be broken easily. The formation of the crust apparently was desirable, since it prevented further gathering of moisture and caking. The same situation applies for DAP. Materials such as urea, ammonium nitrate, ammonium sulphate, or mixed fertilizers with hygroscopic materials will not tolerate this type of storage. If this may be of any interest to any in attendance, we shall be most happy to send you further information. A substantial amount of information has been gathered by TVA personnel as to protective materials, methods of handling, construction of piles, and various experiences encountered with this method of storage. However, it probably should only be used in emergency.

Plant or on-site storage will only be mentioned since there are mountains of information as to the proper equipment and design of structures. Time does not permit entering into this matter because of the variety of products, location, climate, etc. and the excellent facilities that many of you now possess

TRANSPORTATION

Transportation, storage, and handling of fertilizer materials are of paramount important in the cost of product in developing countries. Of the three items, transportation to and in a country represents more than half of the total cost of getting fertilizers to farmers in several developing nations.

A good marketing manager must understand and know in detail the capabilities and limitations of the transportation facilities available to him for proper exploitation or expansion of his markets at a profit. It has been estimated that 75 percent of the marketing costs consist of transportation, storage, and handling. Thus, it is obvious why the supply and distribution program is of major importance to a successful marketing venture. Many corporations are now placing the responsibility of transportation, storage, and handling in the marketing divisions. This has been done with the sole purpose of creating a true picture of a profit center and eliminating the philosophy that movement of tonnage is of paramount importance. We have been amazed to find out in discussions with various corporations on a confidential basis throughout the world that the marketing department talked of tonnages and not profits. Upon further discussions and probing, it was found that the profits were not satisfactory because of competitive conditions and the high cost of supply and distribution primarily transportation costs. When one recognizes his problems something must be initiated to correct the situation. In the area of supply and distribution, when innovation and imagination are applied with desire, there are great opportunities for a marketing manager.

May I use an actual example where innovation, imagination, and desire lead to a successful venture. (Overhead) Here we see a map of the United States with phosphate reserves in Florida and others commercially exploited in Montana and Idaho. The market for concentrated phosphates in the state of California was approximately 125,000 tons of P_2O_5. The Florida producers were precluded from entering this market because of excessively high freight rates of $18 per ton on phosphate rock. The distance by rail was about 2800 miles. The cost of phosphate rock was in the range of $7 per ton in Florida. The cost of western phosphate rock was about $8.00 but the freight rate was only $12-$13. The highest costs for western rock were $21.00 delivered versus $25.00 delivered for Florida rock. There was no method for overcoming this price differential until it was discovered that a vessel, a self-loader, was delivering 120,000 tons of rice to Puerto Rico and begging for a return cargo to the West Coast. Many journeys were made without cargo. With this information in hand by a phosphate producer, a 5-year contract with an evergreen clause was signed for delivery of the phosphate rock for $4.50 per ton F.O.B. Stockton, California, plus $2.25 storage and handling charges for a total delivered cost of $13.75 or a savings of $7.25 per ton to the customer. This was the first movement in the history of Florida phosphate operations of a volume of phosphate to the West Coast. This operation commenced in 1963 and is still in effect. Opportunities do arise and this is only used to point out that the marketing manager must know his market, competition, and modes of transportation in detail.

Many believe that the United States has the best developed cargo transportation system in the world. It has taken approximately 200 years and investments of billions of dollars to accomplish this.

Unfortunately, the cost for construction of railroads, highways, and internal waterways is most expensive. The developing nations are particularly handicapped because of limited funds and so many other demands upon their financial resources.

During the process of development of transportation systems in the United States, we find that during the early stages the cheapest or lowest cost cargo transport was rail. This has changed over the last several decades where we now find that water transportation is the cheapest. They rate as follows:

1. Water
2. Rail - approx. 3 times that of water
3. Truck - approx. 7 times that of water

In many developing countries they are rated as follows:

1. Truck
2. Rail
3. Water

Since many of the developing countries are in a volatile state of development of transportation systems, it is difficult to make comparisons or ratios of costs.

It is believed that a comparison of the different modes of transportation as to advantages and disadvantages as found in the United States should be mentioned. This comparison is made for its application to the fertilizer industry only.

(Overhead) Map of U.S. Rivers & Rail

Water - delivery time from Florida ports to uppermost navigable river ports - Minneapolis/St. Paul - 21 to 28 days transit time - cost from plant to destination port, $6.65 per ton to $8.00 per ton. Barge rates are negotiable because of volume contracts. Distance approximately 1,800 miles.

Rail - delivery time from plant to customer in comparable area - 7-10 days. Published rates $17.70 per ton.

Trucks - no published rates. Not practical or feasible. Maximum distance trucks used to haul fertilizer materials, except in emergency, is 200 miles. Rates become practical and economical on backhaul from ports to final destination within 200 mile distance. Delivery from port to destination is a maximum of one day - average about 12 hours.

It is interesting to note the manpower required to move tonnages on a comparable distance. Tampa, Florida - Minneapolis/St. Paul, Minn.

Barge 15-20 men -- 30,000 tons

Rail 20 men -- 10,000 tons

Truck 2 men -- 20 tons

The barge systems vary in numbers depending greatly upon the capacity or horsepower of the vessel moving cargo. Because of stringent labor union requirements and interchanges of rail systems, the numbers quoted for rail will vary as to location of plant destination and distances. It has been estimated on the conservative side that 20 men will be required. Relative to trucking, it will require a crew of two men to keep the truck moving constantly. The 20 ton figure per truck is stated because of the limitations by certain states as to maximum gross weight to preserve their highway systems.

The unit-train concept was briefly mentioned in connection with storage. However, a more important role is played in actual transportation of fertilizer materials. The unit-train concept consists of 40-60 'Jumbo' rail cars of 100-ton capacity. Freight rates are reduced by as much as $6.00 a ton because the rail systems are able to establish economies with this mode of handling of cargo. It is now used by the various potash producers to ship product into the United States at comparable savings.

Some rail systems have established 'multiple-car' freight rates for shipment of phosphates from Florida and North Carolina. These again are freight savings to customers that are able to store 1,000 tons or better but are not able to take advantage of low water transportation costs. It is anticipated that this will expand in the very near future and negate some of the low water rates now in existence. If this happens, it is believed that the presently low rates for water transportation may become even lower. Competition among the various railroads as well as competition between railroads and barge systems is very keen in the United States. There is a constant battle for tonnages by the various transportation systems with the ultimate result that farmer will benefit the most because of lower transportation costs.

The pipeline mode of transportation for anhydrous ammonia is a new concept for the fertilizer industry. Rail tank wagons have been replaced to a great extent by the pipeline simply because of lower transportation costs. Using a pipeline has reduced costs for ammonia transportation in the range of 40%-60%. Anhydrous ammonia on a negotiated contract has been moved at less than $7.00 per ton on a journey of approximately 1,500 miles. We now have in existence more than 2,000 miles of pipeline from the Gulf of Mexico to the

heart of the Midwest. At the present time, the barge rates are comparable to pipeline transportation. Also, some of the manufacturers of ammonia are compelled to use barge facilities because of long-term leases with penalty clauses. The pipeline has opened new markets for ammonia, particularly where water transportation did not exist. The pipeline has also placed a great burden upon some existing landlocked ammonia plants. These plants were located in high-cost natural gas areas and were successful when competing with rail transportation; however, the advent of the pipeline has had a profound effect upon the profits of several plants. In several instances, it was necessary to close operations because ammonia was cheaper to purchase than to produce.

Up to this point, we have been discussing subject matter related to the inputs of product to the agriculturist or farmer. Aggressive marketing organizations are always interested in improving or expanding markets. This, indeed, should always be uppermost in the mind of a Marketing Manager. However, it has been discovered, particularly in developing countries, that the Marketing Manager was capable of expanding his market--but for a very short period of time. For example, he may have conceived a method of moving a ton of fertilizer at a profit into a new area but had overlooked the fact that the output from the agriculturist or farmer was 5-10 tons of product, and storage and transportation was not adequate to cope with the bountiful crop increase. This immediately created a local surplus of the crop produced lowering the prices drastically, and the farmer was not in a position to pay for the fertilizer. This situation in certain developing countries has actually discouraged the use of fertilizer. Studies made by various organizations have established the ratios--that 1 ton of input, primarily fertilizer, will

produce 5-10 tons of output. Of course, the degree of sophistication of agricultural practices, soils, and crops will affect these ratios.

If your organization cannot cope with a situation such as this when you plan to expand or enter new markets, it is advisable to delay your plans. You do not have a viable market. Only a 'seeding' program becomes practical--if on the horizon you are able to envisage good storage and transportation facilities.

At this point we wish to present a cinema prepared in Vancouver, British Columbia, by a private sector corporation named Vancouver Wharves, Inc. It is located approximately 1,200 miles from the mining and refining sources of potash, sulphur, and several large facilities for the production of DAP and triple superphosphate. Prior to the advent of potash and sulphur, the Vancouver port area was primarily concerned with bulk shipments of Western Canada's production of grain, ore concentrates, lumber and paper. These facilities you are about to observe have been in existence for approximately 10 years.

You will observe many operations that we have mentioned, such as automated handling, unit trains, modern warehousing, and loading of ocean-going vessels for worldwide distribution of potash and sulphur.

You will note that the equipment and engineering are very basic in concept, and it is my understanding that you now possess facilities comparable to this in Santos. A few major problems were encountered in engineering because of tides of approximately 4½ meters, strict pollution control enforcement, and climatic conditions.

Automation was mandatory for the greatest efficiencies to attract shipowners and shippers. Loading and discharge equipment was of the latest design. Tonnages will be mentioned in the cinema. The shippers needed fast turnaround for the unit trains--and unloading of potash and loading with phosphate rock

was most satisfactory. It has been said that a picture is worth ten thousand words--to conserve time, we feel the cinema will more than accomplish this in the next 20 minutes.

(after the film)

It is not the intent of TVA to promote any corporation or concern rendering either services or products when you do view the various slides or cinemas at this seminar. These films were chosen and were purchased by TVA because they illustrate the various points of our subject matter better than any others that we have previewed or screened for this presentation.

Brazil is unique in comparison to many nations. The opportunities in agri-business are second to none. They are most exciting and challenging. You have been gifted with good climate, bountiful natural resources, virgin and good soils, plentiful moisture, and a strategic location on this earth not only to serve your country well, but the rest of the world as well, if and when you desire and are capable of accomplishing this feat. Your people are ambitious, have a great desire to prosper, and live in a better world. You have at your disposal the scientific developments of the world. Much of this you already have incorporated into many of your programs and without question many are in your future plans, others you must draw upon as quickly as possible to conserve time. In the meantime, initiate research and development to that which is most applicable and adaptable to Brazilian agri-business.

Agriculture, as you well know, is of major importance to any nation. Fertilizer is the keystone to its success, and this segment of agri-business must be managed with the least amount of error. Remember that intelligent, well-planned marketing organizations will lead to success. Storage and transportation will play one of the most important roles in your success--in the Art and Science of Marketing.

Thank you.