Possibilities for Establishing a Potato Starch Industry In Kern County, California

1110

R. H. TREADWAY

Eastern Regional Research Laboratory*
Philadelphia 18, Pennsylvania

It is assumed that if the decision is made to establish a potato starch factory in Kern County, contact will be made with an outside source familiar with starch-making or that a technical man will be hired to supervise the construction and running of the plant. The principles involved in making starch from potatoes are simple. Clean potatoes are finely ground with lots of water added to make a thin slurry. The starch milk is then screened or treated in some other way to remove the particles of skin and pulp. The processing water, containing the soluble substances such as sugars, nitrogen compounds, acids, and inorganic compounds, is then separated from the starch by settling or centrifuging. The dewatered starch is then dried. Growers are probably not as much concerned with how starch is made as with such questions as: (1) Can this area support a plant by supplying enough culls? (2) Would a plant be economically feasible here? (3) Can processing wastes be taken care of properly?

Review of the Potato Starch Industry

The U. S. potato starch industry is old, even older than that of cornstarch. There were many small plants around 1900, mostly in Maine but also in other New England states and in the Midwest. The industry declined from 1900 to about 1938, when several modern plants were built in Maine. The total number of plants is lower today than it was about 60 years ago, but the total productive capacity in these present factories is greater than ever before. Seven modern plants were established in Idaho in the 1940's, which now turn out nearly as much starch as the 23 plants in Maine that include many small, old-type factories. Two years ago a new plant was built at Monte Vista, Colorado, and one was established at Moses Lake, Washington, one year ago. The nation's newest potato starch factory began operating in October, 1956, at Riverhead, Long Island, New York. Growers' groups have plants under consideration for upstate New York and elsewhere.

Over the years starch has proved to be the best non-food processing outlet for cull and surplus potatoes. (Livestock feeding is an excellent outlet for culls where enough animals are available. Although potatoes are usually fed in fresh form, it has been amply demonstrated that in Kern County's climate culls can be sun-dried to produce a stable product for feed or certain industrial uses.) The starch industry ordinarily uses about 15 million bushels of potatoes annually, but in the record 1950-51 season the industry used 25 million bushels to produce 150 million pounds of starch. The 1955-56 campaign (October, 1955, to June, 1956) approximately equaled the 1950-51 season for potato starch production.

Potato Starch Uses

Potato starch is used for paper sizing, textile sizing, in food processing, for manufacture of dextrins and glues, and for many miscellaneous applications. It is a specialty starch, while cornstarch is the general starch used in the United States. Although potato starch is made in much smaller tonnage than cornstarch, it is superior to the latter in several applications. It gives a clearer paste, with less tendency to gel upon standing and with stronger adhesive properties.

Until about 10 years ago textile sizing was by far the largest outlet for potato starch. Potato starch is excellent for sizing cotton, worsted, and spun rayon warps. Its paste penetrates well into the interstitial space between fibers of the warp and the dried film imparts unusual strength and abrasion resistance to the warp, so important during weaving in the loom. However, the increasing use of synthetic fibers that require no size, or are sized with materials other than starch, has decreased the demand for all starches in the textile field. Textile sizing has dropped to second position in the uses of potato starch.

The paper industry has grown at a phenomenal rate during the past 10 years. A great expansion in the demand for starch in paper production has more than compensated for the loss in textiles. Paper sizing and coating now use more potato starch than any other single application. Potato starch is preferred by some to cereal starches for coating smooth, white paper such as that used in magazines. The unusually strong binding power of potato starch for the white pigments and clay is advantageous here. Potato starch is said to have replaced much casein formerly used in paper coating.

Marketing

While California is not noted for its paper manufacture or for the type of textile industry that uses starch, the diversified industries of the Los Angeles and San Francisco areas undoubtedly use much starch for miscellaneous applications. Farther away from Kern County, but still much closer to this area than the nearest cornstarch plants located in Iowa, are the giant paper mills of Oregon and Washington that use large tonnages of starch. The high transportation costs encountered today give a distinct advantage to the product that is manufactured closest to its market.

Although data are continually being accumulated concerning new and extended uses of potato starch in various applications, present demand for this product is great. It has been estimated by a spokesman in the industry that three times the present output of potato starch could easily be sold.

In general, marketing of potato starch has not been a problem. However, sales of the product have been hampered at times by lack of continuity of supply, irregularity in quality, and price fluctuation. A quality improvement has been effected in recent years, though. Before World War II the industrial consumer paid 6 cents per pound for potato starch against 3 cents per pound for cornstarch. In recent years these two starches have sold at about the same price. Corn has become a more expensive material while potatoes have risen but little. On November 2, 1956, cornstarch sold at $7.27 to $7.42 per hundred pounds in New York City and potato starch at $8.25 to $9.25. Potato starch at Idaho plants brought $6.00 and at Maine plants, $6.25. Most of the potato starch is sold through brokers or starch suppliers who charge 5 per cent commission. These firms offer technical service to customers, which is a necessary feature. One who sells starch must be prepared to service complaints.

Potato starch from Holland and other European countries is at times in competition with American starch. Tapioca starch from the Netherlands East Indies was

*A laboratory of the Eastern Utilization Research Branch, Agricultural Research Service, United States Department of Agriculture.

imported in large quantities prior to World War II. Tapioca is now imported in relatively small amounts from Brazil and Thailand.

Requirements for Establishing a Factory

Two of the crucial points raised early in this discussion will now be considered in detail, namely: (1) cull supplies needed to make operation of a starch factory feasible and (2) necessity for waste disposal or treatment facilities. In regard to cull supply, a minimum of 700,000 bushels of potatoes per season should be available. The plant should have a capacity to produce at least 25 tons of starch per day. Maine and Idaho starch plants try to operate over a season of 200 operating days. It is a rare season, however, when cull potatoes are available in abundance at a starch factory every operating day from October until [illegible]. The 700,000 bushels of culls would provide for an average production of nearly 11.7 tons of starch per day throughout the season, or nearly one-half the daily capacity. This would total about 2,300 tons or about 4.6 million pounds of starch for the operating season. The raw material estimate is based on potatoes that contain about [illegible] per cent starch early in the season (typical for Maine) and about 10 per cent late in the storage period. Assumption is made of an 11 per cent over-all yield of saleable starch from the potatoes ground throughout the season. Recovery efficiency in potato starch manufacture is usually somewhat below 80 per cent of the total amount of starch present. Potato starch as sold contains 18-20 per cent moisture. This presence of approximately 20 per cent moisture in the final product as it is sold largely offsets the amount of starch lost in processing.

Production capacity of U.S. potato starch plants ranges from 5 to 60 tons of starch per day, at least 25 tons for most of the newer plants. Actual production in plants of all sizes, however, is below capacity much of the time. Cullage from concentrated areas of potato production in Kern County should easily support a plant built for 25-30 tons daily starch capacity, with the potatoes required being available within a radius of about 25 miles of the plant. A [illegible] plant with this capacity would require a building no larger than the old type, 5-ton vat factory, and it could be equipped with modern machinery costing very little more than modern equipment for a smaller-capacity factory.

A study made several years ago by the Eastern Regional Research Laboratory[illegible] indicated that Maine starch factories, in making 12 tons of starch, used 50,000-100,000 gallons of water daily to wash the potatoes and 60,000-[illegible],000 gallons or more to process the starch. This was in an area in which water is usually plentiful. It is believed that recent changes in methods of washing and [illegible] starch may make it possible to reduce appreciably the water requirement. In an area of limited water supply, like Kern County, it would certainly pay to [illegible] water for washing the potatoes. Starch factories are usually located along streams that provide water for washing the potatoes and also facility for carrying away the [illegible]. Stream water, if of sufficiently high quality, is used for washing the starch; otherwise well water is ordinarily employed. Well water, of course, would have to be used [illegible] for starch processing in Kern County.

Wastes are in the form of the wet extracted pulp or [illegible] and the wash water ("protein water" [illegible]) that has been used in processing the [illegible]. [illegible] of the Eastern Regional Research Laboratory [illegible] indicated that about five tons [illegible] of wet extracted pulp containing 0.25 ton of [illegible] was discharged to waste for each ton of starch [illegible]. At the same time about 45 tons of processing [illegible] containing 0.55 tons of dissolved and suspended solids is discharged per ton of starch produced. Such a discharge of plant effluents into streams would be prohibited by some states and localities.

It has been [illegible] that one of the most modern [illegible] requires less water than [illegible] by the older equipment [illegible]. Hence, there would be less water discharged [illegible] a modern plant than indicated in our study of [illegible] as it existed several years ago. We do not have data on this point, however.

[illegible] being [illegible] dried and sold as a feed component by one Maine factory. [illegible] of this process has not been generally [illegible] yet. The Eastern Regional Research Laboratory is working on [illegible] of saleable products from starch [illegible] waste. This is still in the laboratory stage, though, with no commercial process to recommend at present. Until such a process is developed, it seems best to spray [illegible] and to impound it in lagoons.

Economic Considerations

One of the questions originally brought up concerned the [illegible] feasibility of establishing a potato starch factory in Kern County. This has been touched upon indirectly in discussions including the demand for potato starch, industries that use potato starch, and locations where potato starch is consumed in bulk quantities. Another important factor for an early—or intermediate—crop area to consider pertains to storage of cull potatoes to be used for starch-making. Although potato starch plants ordinarily operate nine months of the year, the economical season of operation could perhaps be shortened to six months or even less in areas where this is necessary.

Let us assume that harvesting begins around April 15 and continues until July 15, a period of three months. Culls left in the packing sheds on July 15 would be expected to keep in condition for starch processing for some time, depending on the date when they were dug. There is apparently very little experience in the storage of Kern County potatoes. However, if these potatoes conform to the usual physiological pattern, they should be expected to remain "in the rest period" [illegible] for about [illegible] months after digging, without refrigerated storage. The cost of refrigerated [illegible] to be used in starch processing [illegible]. The potatoes might be kept [illegible] months [illegible]

[illegible]

ence in the laboratory extraction of starch from potato slices that had been sun-dried in Idaho. The tissue of the dried potatoes was hard and dense and long soaking was required before grinding for starch extraction. The starch had a rather poor color. For these reasons, it did not appear promising to extract starch from dehydrated potatoes. It would also be difficult to collect dried potatoes from the surface of an airstrip without removing much contaminating material at the same time.

Maine starch processors paid about 35 cents per hundred pounds during the 1955-56 season for diversion potatoes not considered good enough to ship but still better than culls. The Government program paid a 50-cent subsidy per hundred pounds for 2 inches diameter minimum No. 2 grade or better potatoes going into starch, feed, or flour from the fall up to December 31. The schedule from January 1 to March 31 involved a 40-cent subsidy. This subsidy dropped to 30 cents per hundred pounds of potatoes during the April 1-June 30 period. The U. S. Department of Agriculture has a similar diversion program this year, with the same subsidies in effect. Thus when processors pay 35 cents per hundredweight for diversion potatoes, the grower receives a total of 65-85 cents per hundredweight under such a program. These figures define the cash return to growers during the last two years. There is no assurance, of course, that diversion programs will be in effect in the future.

Ordinary culls sold outside the diversion program bring only 20-25 cents per hundredweight. Although there has been a great range in the price paid for potatoes at the starch plants in recent years, it has perhaps averaged for all grades about 35 cents per hundredweight paid by the processor. This means a raw material cost of somewhat above 3 cents per pound on the starch produced.

Capital costs for establishing a 25-ton plant and cost to produce the starch were estimated by the Eastern Regional Research Laboratory in 1950. The estimate called for $384,000 total fixed costs and $75,000 working capital to make a grand total of $459,000. Fixed costs included the following major items: machinery and equipment, $101,000; building, $45,000; engineering fees, $46,000; contingencies, $31,000; erection of machinery and equipment, $25,000; piping and d[illegible], erection of piping and ductwork, $10,000. This estimate is believed to be good for what it represents—assumptions made, equipment used at that time, and price index at that time. New equipment recently introduced, however, permits high productive capacity in a much smaller building than formerly possible. New centrifugals replace vats and tables for washing the starch. Another new machine replaces the screening equipment with accompanying saving of space. Although this new equipment is expensive, we have no data as to what effect the changes make on the 1950 cost estimate. An idea of the present cost of establishing a starch plant and making starch can better be given by an experienced processor in that industry. We have been told by representatives of the Maine starch industry that it requires approximately $250,000 to build and equip a modern potato starch factory, including a waste pulp recovery system and working capital. This figure does not include allowances for cost of erecting equipment, engineering fees, contingencies and certain other items.

Conclusion

There is little doubt that any difficulty will be encountered in selling the product of an expanded potato starch industry. History proves that diversion of substandard potatoes to starch processing, although the cash thereby realized by growers is small, helps raise the total cash return from the crop. The problems of obtaining sufficient cull potatoes year in and year out, of obtaining enough processing water, and of providing for recovery or disposal of wastes are faced by growers' groups in most sections of the country where initiation of starch production is being considered. A special problem in Kern County, as in any other early-producing area, is concerned with storing potatoes long enough to permit economical operation of a starch factory. Potato storage is apparently the most difficult of the various problems associated with establishment of a Kern County starch industry. If these problems can be solved, however, then growers may wish to proceed with investigations of plant financing and recruitment of technical personnel to establish and run a starch factory. [END]