11-1-1924

Cost Accounting in the Domestic Beet Sugar Industry

F. L. Crawford

NATIONAL ASSOCIATION
of
COST ACCOUNTANTS
Affiliated with The Canadian Society of Cost Accountants

Official Publications

Vol. VI November 1, 1924 No. 5

Cost Accounting in the Domestic Beet Sugar Industry

BUSH TERMINAL BUILDING
130 WEST 42nd STREET, NEW YORK

NATIONAL ASSOCIATION OF COST ACCOUNTANTS

Affiliated with The Canadian Society of Cost Accountants

Official Publications

Vol. VI, No. 5. November 1, 1924.

Cost Accounting in the Domestic Beet Sugar Industry

F. L. CRAWFORD,
Northern Sugar Corporation,
Minneapolis, Minn.

BUSH TERMINAL BUILDING
130 WEST 42nd STREET, NEW YORK CITY

The National Association of Cost Accountants does not stand sponsor for views expressed by the writers of articles issued as Publications. The object of the Official Publications of the Association is to place before the members ideas which it is hoped may prove interesting and suggestive. The articles will cover a wide range of subjects and present many different viewpoints. It is not intended that they shall reflect the particular ideas of any individual or group. Constructive comments on any of the Publications will be welcome.

♣

Additional copies of this Publication may be obtained from the office of the Secretary. The price to members is twenty-five cents per copy and to non-members seventy-five cents per copy.

♣

PUBLICATIONS DEPARTMENT NOTE

From the age of 18 to 24 the author spent all spare time available in studying and applying to every day work, accounting and cost principles obtained mostly from technical books and magazines. He attended country school. Feeling that his future work should be along accounting and commercial lines he left Texas in 1914 and came to Des Moines, Iowa where he secured a position with a firm Chartered Accountants and began an intensive study of accounting and cost problems under the supervision of the heads of the firm. He remained in Des Moines for one year and then went to Detroit, Michigan where he made a connection with the firm of Hollis, Tilton & Porte, Chartered Accountants, now a part of the Haskins and Sells organization. While with the Detroit concern, he was engaged entirely in public work which covered a multitude of the larger industries such as operate in Michigan, and there his greatest experience was obtained. Leaving the Detroit concern he accepted a position with the Beet Sugar Industry and since 1920 has been located at Minneapolis. His present official connections are as follows: Auditor, Northern Sugar Corporation, Minneapolis; Auditor, Minnesota Sugar Company, Minneapolis; Treasurer and Auditor, Red River Sugar Company, Minneapolis; and Treasurer, Confer Brothers, Inc., Realtors, Minneapolis.

The N. A. C. A. issued as Official Publication Volume III, No. 4, "Some Cost Problems in the Hawaiian Sugar Industry" by F. A. Haenisch.

COST ACCOUNTING IN THE DOMESTIC BEET SUGAR INDUSTRY

Sugar is a chemical. Man does not produce it. It is not manufactured in the refineries. Sucrose is the chemical name for Sugar ($C_{12}H_{22}O_{11}$) and is two molecules of starch plus one molecule of water (consisting of two parts hydrogen and one part oxygen). Nature's laboratory is able to add the one molecule of water to starch and produce sucrose. Chemists have tried for more than a century to perform the trick, but they have thus far failed. Being a chemical, sugar is sugar, whether extracted from beets, cane or rotten wood.

After the fall of the Roman Empire, the returning barbarians brought a few beet roots to Bohemia. In 1605 Oliver de Serres, the famous French agronomist, became convinced that beets contained sugar. In 1747 the Prussian chemist, Maggraf, obtained sugar crystals from beets experimentally, but did not prosecute the work to a conclusion; after Maggraf's death in 1782, his pupil, Achard, secured the financial assistance of Frederick the Great in order to conduct field and laboratory experiments. The work

ceased for a time with Frederick's death in 1786 but some years later Achard enlisted the support of Frederick's successor, Frederick William III; in 1799 he invented a method of extracting sugar from beet roots, and in 1801, with money furnished by his Sovereign, he erected at Cunern, Silesia, the first beet-sugar factory in the world where for several years he produced small quantities of sugar. Meanwhile two small factories were erected near Paris, where field and factory experiments were conducted for ten years without producing commercial sugar. Under date of March 23, 1811 Napoleon, by Royal Decree, made the beet-sugar business a going concern in France and since that date the industry has moved forward.

Mr. E. H. Dyer in 1870 erected at Alvarado, Calif., the first beet sugar factory in the United States to make a commercial success of producing sugar from sugar beets. Dr. Lewis S. Ware of Philadelphia, Dr. William McMurtrie, Dr. Harvey W. Wiley, Truman G. Palmer and Hon. James Wilson, Secretary of Agriculture, all of Washington, D. C. have rendered valuable assistance to the industry in its years of growth*

Most all of the beet sugar produced in the United States comes from factories located in Michigan, Ohio, Wisconsin, Minnesota, Iowa, Idaho, Utah, Colorado, Wyoming and California.

Primarily, beet sugar manufacturing is a branch of the agricultural industry. The two are inseparably interwoven. A discussion dealing with the costs of producing Beet Sugar is incomplete unless considerable reference is made to the cost of the principal raw material—Sugar Beets—which are grown under the agricultural branch of the business.

Some of the companies own large tracts of land on which they produce most of the sugar beets which they consume, others purchase their beet supply from independent farmers located within the vicinity of the plant.

This discussion will be limited to mills operating East of the Missouri River and which purchase their raw sugar beets from the farmers.

Cost Bases

In the industry the cost of production is generally shown on two bases. In one case the unit is 100 pounds (one bag) of sugar and in the other case the unit is a ton of sugar beets. However, practically all the discussion of the cost of producing sugar is based upon the sugar produced. In this connection it should not be assumed that an attempt is ever made to establish a direct or indirect cost for each individual bag packed. Such would, in my opinion, be impossible. The very nature of the costs necessary to be incurred in order to obtain the required raw material pre-

*I am indebted to Truman G. Palmer, of Washington, D. C., who has made a life study of the problems of the industry, for the historical data contained herein.

cludes the determination of a direct or indirect individual cost per bag. And if such costs could be determined, I fail to see where any special benefit could be obtained therefrom. In this connection the reasons for and benefits to accrue from uniform cost accounting methods do not wholly apply in the Beet Sugar Industry. They would not apply to the agricultural industry, and since the beet sugar industry is so closely related thereto, the same condition holds true.

Details of Elements of Cost

The following cost elements make up the cost of beets.

AGRICULTURAL COSTS—COST OF BEETS

1. Procuring Beet Acerage
2. Procuring Beet Laborers
3. Transporting and Locating Beet Laborers
4. Maintenance of Beet Laborers
5. Superintending Beet Fields
6. Excess Cost of Labor in Beet Fields
7. Portable House Expense
8. Agricultural Implement Expense
9. Agricultural Stable Expense
10. Field Insect Prevention and Extermination
11. Transferring Labor on Beet Territory
12. Special "Stay Over" Allowance to Laborers
13. Contract Price Paid Farmers for Beets
14. Freight Inward on Beets
15. Beet Receiving Station Operation and Maintenance
16. Piling, Siloing and Handling Beets at Stations
17. Receiving and Unloading Beets at Factory
18. Depreciation on Farm and Beet Station Equipment
19. Welfare Work

Although the sugar beets are purchased from well established farmers, it is necessary for the company's agriculturists to carry on an unending campaign of education among the farmers, coaching them in scientific soil grading, soil selection, diversified farming, cultivation of crops and soils, insect prevention and extermination.

Sugar beet cultivation similar to truck farming is largely hand operation. This calls for a great number of additional farm laborers who must be located in the cities each Spring and transported to the farms and individually placed. The economical position of these laborers makes it necessary for the sugar companies to furnish transportation for the workers and their household effects and in many cases sustenance until the workers are on an earning basis. The beet workers are paid by the farmers for their services on an acreage basis. This acreage fee is agreed

upon by and between the farmers and laborers before the latter leave the cities to begin the farm operations. This agreed acreage fee is the sum total the farmer will pay in any form for hand labor. If, due to unfavorable weather conditions, extraordinary weedy and grassy fields, it becomes necessary to supply additional help on the fields, the cost of which exceeds the above mentioned acreage fee, the excess must be paid by the company and constitutes the Excess Labor Cost. When the extra and temporary labor is moved to the farms, housing facilities are required. Some farms are equipped with permanent buildings for this purpose, and where this condition does not govern, the company furnishes a type of house built in sections which is portable, and convenient for moving from farm to farm. To prevent the great loss which would otherwise occur from an attack of farm insects the company maintains equipment, chemicals and men for the purpose of putting down any appearance of insects when first discovered. The Special "Stay Over" Allowance made to laborers is to induce them to remain in the community over winter and be ready for the beet crop the following spring. This serves two purposes, i. e., provides experienced workers and reduces the cost of labor transportation as the "Stay Over" Allowance per capita ranges less than the average transportation cost.

Price and Method of Payment

We now come to one of the most interesting and the largest element found in the cost of a bag of sugar, namely, the direct cost of the beets from which the sugar is extracted. From three to five months before the farmer plants his crop of beets the sugar company announces the guaranteed minimum price per ton it will pay the farmer for beets to be delivered eight to ten months subsequent thereto. In addition to this minimum guaranteed price, the following sliding scale is quoted in the contract:

It is understood and agreed that the price paid by the Company for beets delivered and accepted under this contract shall be based upon the average price of Standard Granulated Beet Sugar, as hereinafter determined, and shall be in accordance with the following schedule, viz:

	If the average price of sugar is	The price of beets will be
Under	$6.00 per 100 lbs. sugar	$5.50 per ton beets
	$6.00 per 100 lbs. sugar	$6.00 per ton beets
	$6.50 per 100 lbs. sugar	$6.75 per ton beets
	$7.00 per 100 lbs. sugar	$7.50 per ton beets
	$7.50 per 100 lbs. sugar	$8.25 per ton beets
	$8.00 per 100 lbs. sugar	$9.00 per ton beets

For sugar over $8.00 per 100 lbs. beets to continue $1.00 per ton over the price of sugar.

Fractional advances in the average price of beet sugar above $6.00 per 100 lbs. will be paid for in the same proportion as set out in the above schedule.

An initial payment of $5.50 per ton shall be made by the Company on the 20th day of each month for beets delivered and accepted up to and including the 20th day of the preceding month.

Final settlement will be made on February 15th, 19—, when any additional amount that may be due under this contract will be paid.

The average price of beet sugar, per one hundred pounds, shall be determined from the Official New York net cash, base price, furnished by Willett & Gray for Western Standard Granulated Beet Sugar for (territory in which beets are purchased,) for the period from October 1st, 19—, to January 31st, 19— inclusive, by adding together the net base prices of beet sugar so furnished for the working days of said period, and dividing the total by the number of said days.

Thus it is obvious that no wide range of the imagination is required to sense some of the difficulties here encountered from the standpoint of determining costs as well as measuring taxable income, in the event the taxable year closes before the period of price quotation ends. Furthermore, some of the contracts put out quote a price to be paid for beets based on the average selling price obtained for the sugar taken from the crop of beets on which price is quoted. Under this method, the price period may run from September to September of the following year. This extended period defers the date of final cost determination and with the "wild" markets that have obtained the past four years no mind can approximate the final costs. It is necessary, therefore, in closing the books for a fiscal year to estimate the additional scale price that must ultimately be paid for the beets. If finally this estimate is too high, costs for the period are overstated and if too low, are understated, and when final costs are determined it then becomes necessary to file amended tax returns showing corrected taxable income and redetermine actual costs for the period.

Factory Costs—Operating and Idle Season

Factory costs may be grouped under two main sections: operating Season and Idle Season.

The Operating Season Costs are as follows:

1. Fuel
2. Coke
3. Limestone
4. Chemicals and Laboratory Materials
5. Sugar Bags and Twine
6. Beet Slicing Knives and Files
7. Filter Cloth

8. Lubricating Oils and Waste
9. Electric Power and Light
10. Tool Expense
11. Depreciation Factory Machinery, etc.
12. Miscellaneous Operating Supplies consisting principally of repair parts, etc.
13. Direct Factory Labor, covering stations of Washing, Slicing, Diffusing, Carbonation, Heating, Filtering, Evaporating, Boiling, Spinning, Drying, Packing, Steffenizing and Power House.

There are two distinct sections in each fiscal year, i. e., Operating and Idle or Non-operating. The mills are in actual operation about 100 days—running 24 hours per day, and seven days in the week. This gives approximately 2400 hours per year (equivalent to 300 days of 8 hours each). Adverse weather conditions cause sugar beets to deteriorate rapidly. After nature produces sucrose (sugar) in the beets, if it is not extracted before fermentation sets in, nature will add another molecule of water and convert the sucrose into equal parts of glucose and fructose as shown in the following equation:

$$\underset{\text{Sucrose}}{(C_{12}H_{22}O_{11})} + \underset{\text{Water}}{(H_2O)} = \underbrace{\underset{\text{Glucose}}{(C_6H_{12}O_6)} + \underset{\text{Fructose}}{(C_6H_{12}O_6)}}_{\text{Invert Sugar}}$$

These are non-crystallizable products and are of no value to the sugar manufacturer. The process of manufacturing sugar consists principally of eliminating the water and impurities of the juice largely by a succession of boilings. Each time the juice is boiled, some large portions of the sucrose are converted into glucose. This inversion is to the sugar manufacturers, Banquo's ghost which will not down. It occurs to some extent at every station of the factory. Daily closing down and starting up would increase this loss. Therefore, continuous operation is necessary.

The materials above apply specificially to the Operating Season and are consumed principally in processing the juices and packing the extracted sugar. The quantity of supplies used is governed by the tons of beets sliced and sugar content at the time the beets enter the factory. Daily charges are made from stores to the operating material accounts and assuming a given cost for beets f.o.b. factory it is possible to approximate the cost of sugar being bagged.

The direct labor is charged to the various stations in the plant and the total cost divided by the bags of sugar passing out to the warehouse. Daily checks are made on both direct labor and material costs and every effort is made to keep within a certain range of cost per bag of sugar packed.

The idle season costs are as follows:

1. Repairs—Labor
2. Repairs—Material
3. Repairs—Overhead

The idle season is that period of the year when the plant is not packing sugar. A skeleton plant organization is maintained throughout this period and their time is devoted torepairing and reconditioning the plant so that when the next slicing season begins, a minimum amount of repairs will be required to carry the plant through the operating season. The labor and material costs of each station are carefully determined and comparative cost figures prepared from year to year. The overhead costs consist of Supervision, Power, Store and Timekeeping Cost and Machine Shop expenses. No attempt is made to distribute this overhead cost over the various stations. It is treated as a single item.

By-Products

Until about a decade ago the importance attached to the by-products of beet sugar houses was negligible. However, within the last few years this branch of the industry has developed, through improved machinery and market conditions, to a very considerable extent. The two principal by-products now obtained are Dried Beet Pulp and Refuse Molasses. Experiments are now under way for the recovery on a commercial scale of a third, i. e., potash,

DRIED BEET PULP

For the recovery and preparation of dried beet pulp very expensive machinery is required which is unnecessary for straight sugar house operation. Immediately the sugar is taken from the beets, which is the first operation after beets are washed and sliced, the beet pulp is discarded from the regular sugar processing and then sent to a pulp drier where the moisture content is reduced to about 14% (under normal weather conditions the pulp will absorb moisture to about this extent). The pulp is then packed in No. 100 bags and shipped out for dairy feed. Its price is determined by the price of other dairy cattle foods.

For the Pulp By-product Department the following cost accounts are operated.

1. Coal (Used in furnaces for drying)
2. Coal (For steam and power)
3. Bags and Twine
4. Oils, Waste and Miscellaneous Supplies
5. Drier Labor
   (a) Supervision and Foremen
   (b) Engineers and Furnace Men
   (c) Pulp Pressmen
   (d) Packers
   (e) Warehousemen

6. General Overhead
   (a) Depreciation
   (b) Insurance
   (c) Repairs

It will be noted that no charge is indicated for the wet raw pulp which comes from the factory sugar department. No satisfactory method has yet been found for making such a charge to Drier operations and credit of like amount to the cost of the Sugar Department.

The pulp operations (production and selling) are kept entirely separate from other factory costs until the net return from pulp through sales is determined. This net is then credited in a lump sum to the total sugar production costs after determination, irrespective of all by-product credits.

REFUSE MOLASSES

This by-product, refuse molasses, is spun off by centrifugal force from the sugar. It is the non-crystallizable portion of the juices. After the centrifugal operation which separates the crystallized sugar from the molasses, the latter is sent directly to tank cars and shipped to the Chicago market where it is distributed to commercial alcohol manufacturers. The net return from sales is credited to cost of sugar packed, similar to that from Dried Pulp Sales.

GENERAL OVERHEAD AND MISCELLANEOUS

The General Overhead and Miscellaneous Expenses are as follows:

1. Administrative Expenses
2. Taxes
3. Interest
4. Depreciation (Miscellaneous)
5. Rentals
6. Miscellaneous Gains and Losses

The Administrative Expenses, Taxes, Interest and Rental items present no serious difficulties over similar problems encountered in the average industry. Depreciation provisions are based, by the several companies, on at least three different factors:

(a) Bags of Sugar packed
(b) Customary annual rates for similar equipment
(c) Length of operating season

No attempt is made to distribute overhead costs to any particular batch or "strike" of sugar.

The net results from Miscellaneous Operations are important. Most all of the larger companies have departments dealing in: Sugar Beet Seed, Commercial Fertilizer, Agricultural Implements

and Commissary Supplies for labor, and many other less important operations incident to the business. The net results of all these are finally applied to the cost of the principal product, similar to the credits for the by-products.

In discussing Beet Sugar Costs, it should be borne in mind that the industry is closely allied to agriculture; that it is a seasonable operation; and that once the beet crop is started, the process must continue until the finished product is ready for market.

With 100,000 farmers in the United States now growing Sugar Beets, with $150,000,000 invested in the domestic Industry; with the country producing only 25% of the sugar we consume; with the country's attention focused on the agricultural industry and the direct dependence of all other industry and commerce thereon—the cost problems involved in the direct farm costs alone are stupendous.

Vol. II

No. 9—Cost Accounting for Public Utilities, *E. D. Bistline*
No. 16—A Method of Distributing Factory Payroll, *Matthew Perosky*
No. 17—Coal Production Costs, *K. W. Gardiner*
No. 18—Uniform Cost Accounting Methods in the Printing Industry, *W. B. Lawrence*
No. 19—A Cost System for an Electric Cable Plant, *Fred F. Benke*

Vol. III

No. 4—Some Cost Problems in the Hawaiian Sugar Industry, *F. A. Haenisch*
No. 10—List of References on Interest as an Element of Cost
No. 19—Normal Burden Rates, *Charles Van Zandt*

Vol. IV

No. 3—First New England Regional Cost Conference.
No. 5—Steamship Operating and Terminal Costs, *Joseph J. Mulhern and Urban Robert*
No. 6—Cost Practices and Problems in the Production of Coke, *C. C. Sheppard*
No. 7—Production Costs in the Manufacture of Phonograph Records, *C. J. Borton*
No. 8—Cost Problems in the Wrought Iron Industry, *Carl G. Jensen, Comp.*
No. 10—Cost Accounting for Cranes and Hoists, *P. E. Stotenbur*
No. 11—Cost Accounting in the Tool Steel Industry, *John J. Keefe*
No. 16—Standard Costs—How to Establish and Apply Them. *William F. Worrall*
No. 17—A Method of Collecting Direct Labor Costs and Statistics, *George H. Friesel*
No. 18—Cost Accounting for Self Laying Track Tractors, *Percy Ehrenfeldt*
No. 19—Papers and Discussions—Third New England Regional Cost Conference
No. 21—Cost Accounting in Relation to Business Cycles, *John R. Wildman*
No. 22—Cotton Mill Costs, *W. A. Musgrave*
No. 23—A. Punched Card System of Inventory Control, *W. V. Davidson*

Vol. V

No. 3—A Method of Costing Partially Completed Orders, *C. B. Williams*
No. 6—Cost Accounting in the Production of Motion Pictures, *William R. Donaldson*
No. 7—An Introduction to Predetermined Costs, *George Rea*
No. 8—A Practical Method of Cost Accounting in a Shipbuilding or Ship Repair Plant, *L. V. Hedrick.*
No. 9—Getting the Most Out of Business Records, *Matthew L. Carey.*
No. 10—The Expense of Power and Building Service, *James P. Kendall.*
No. 11.—Indirect Labor, *Harry J. Ostlund*
No. 13.—Fourth New England Regional Cost Conference.
No. 15.—Construction Cost Accounting From the Viewpoint of Both the Contractor and the Customer, *Weston J. Hibbs.*
No. 16.—Budgetary Control, *William Carswell*
No. 17.—A Foundry Cost System, *Machinery Builders' Society.*
No. 18.—Methods of Supplying Cost Information to Foremen, *Hugo Diemer.*
No. 19.—Cost Accounting in a Metal Stamping Plant, *E. H. Wildt.*
No. 20.—Use of Accounting Information and Statistical Data in a Department Store, *A. C. Hodge.*
No. 21.—A Basis for Cost Accounting in Banks, *Gordon Wilson*
No. 22.—Importance of the Cost of Idleness in Equipment Industries, *E. F. Du Brul*
No. 23.—Controlling the Labor, *W. O. Cutter and others.*

Vol. VI

No. 1—Executive Uses of Costs, *Howard Berry.*
No. 2—Operating Ratios and Costs as Guides to Management, *Urban F. von Rosen*
No. 3—The Use of Budgets in Reducing Overhead, *Ray W. Darnell.*
No. 4—Distributing the Overheard, *Nelson J. Bowne.*
No. 5—Cost Accounting in the Domestic Beet Sugar Industry, *F. L. Crawford*

Copies of the above publications which are not out of print may be obtained from the office of the Secretary of the Association, 130 W. 42nd Street, New York City, at the price of 75 cents per copy.