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Before discussing the accounts of a Portland cement mill a few words relative to the product may be in order. The cement which is generally used in the construction of concrete roads, tunnels, bridges, buildings, etc., is known as Portland cement. It is the strongest and most durable form of cement and will set or harden under water. The name was derived from its resemblance in color to a natural stone found at Portland, England. There is no definite chemical formula for Portland cement, although the concrete made from it must meet certain requirements from a structural point of view.

Portland cement is made by burning a mixture of pulverized materials that contain compounds of calcium carbonate, silica, alumina and iron oxide in the proper proportions. The forms of calcareous matter used are limestone, chalk or marl and for convenience will be referred to hereinafter as "material No. 1." For the silica, alumina and iron contents, which will be referred to as "material No. 2," clay, shale, slate or blast-furnace slag is used.

The manufacturing process may be described briefly as follows:

The first step is the excavation of the raw materials. As the plant is usually situated in proximity to the quarries, the raw materials are carried directly to the rock crushers and grinders.

The second step is the crushing, grinding and mixing of the raw materials. If the "dry process" is to be used, proper proportions of material No. 1 and material No. 2 are mixed after being thoroughly dried. The "wet process" is more common, however, as the mixing can be done more efficiently with the aid of water. The mixture is a thin mud known as "slurry." As the quality of the cement depends upon the fineness of the mixture as well as its composition, the slurry is stored in large tanks until it has been analyzed and approved by the chemical laboratory.

The third step is a chemical process, being the burning or calcining of the raw materials. The slurry is fed into the upper end of the kiln, which is a slightly inclined, revolving cylinder from five to nine feet in diameter and from sixty to two hundred

feet in length. The kiln is made of sheet steel lined with fire brick, and is heated to a temperature of from 2,000° to 4,000° F. by the combustion of jets of oil or pulverized coal and air which are blown in at the lower end of the kiln. The water evaporates immediately and the mixture forms a chemical combination known as Portland cement clinker. The clinker, in the form of small pebbles, rolls out at the lower end of the kiln into another revolving cylinder where it is cooled by passing a current of air over it. The current of air is thereby heated and is used to facilitate the combustion in the kiln. The clinker is then placed in storage until it has seasoned, when it is ready for the finishing mill.

The fourth and final step is the grinding of the clinker, to which is added a small quantity of gypsum to prevent the cement from setting too rapidly when it is used. The product is now Portland cement and is conveyed to immense bins where it is stored awaiting shipment, at which time it is packed into barrels, cloth sacks or paper bags.

Accounts

It is not intended to describe in detail the accounting systems which have been devised by the trade associations and are being used by the cement companies, but the following condensed chart of accounts may serve to indicate the nature of the accounts:

Plant accounts:
- Mill land
- Buildings
- Machinery
- Quarry lands

Investments

Inventories:
- Cement
- Clinker
- Raw materials
- Gypsum
- Coal (kilns—power house)
- Packages (sacks, barrels, paper bags)
- Stores

Accounts receivable:
- Customers'
- Advances

Bills receivable

Cash

Deferred charges:
- Shut-down expense

Insurance unexpired
Taxes prepaid
Capital stock
Bonds
Current liabilities:
Bills payable
Trade accounts payable
Unclaimed sacks
Payroll accrued
Bond interest accrued
Taxes accrued
Royalties accrued
Reserves:
Depreciation of buildings
Depreciation of machinery
Depletion of quarry lands
Contingencies
Doubtful accounts
Redemption of sacks (unearned profit)
Surplus
Profit and loss
Manufacturing expenses:
Quarrying
Raw grinding
Clinker burning
Clinker grinding
Mill overhead
Sack and shipping expenses:
Sack cost
Sack handling
Sack allowances
Packing and loading
Selling expenses:
Sales office salaries
Sales office expenses
Salesmen's salaries
Salesmen's expenses
Advertising
Commissions
Association dues
General and administrative expenses:
Officers' salaries
Office salaries
Rent, heat and light
Stationery and printing
Telegraph and telephone

Postage
Legal expenses
Miscellaneous expenses
Interest paid
Bad debts
Federal income taxes
Sales:
Sales allowances
Discount on sales
Interest received
Discount on purchases
Unclaimed sacks
Foreign sacks unclaimed
Miscellaneous income

Subsidiary ledgers are kept for the plant accounts, inventories, accounts receivable, etc. The operating accounts, which are found in the cost ledger, may be summarized under the following general groups which embrace the accounts up to "bin cost":

1. Quarrying:
   Operating labor
   Operating supplies
   Repair and maintenance labor
   Repair and maintenance materials
   Power
   Fuel
   Explosives
   Quarry overhead
   Insurance
   Taxes
   Depreciation
   Depletion of quarry lands
2. Raw grinding:
   Raw materials used
   Operating labor
   Operating supplies.
   Repair and maintenance labor
   Repair and maintenance materials
   Power
3. Clinker burning:
   Fuel
   Operating labor
   Operating supplies
   Repair and maintenance labor
   Repair and maintenance materials
   Power

4. Clinker grinding:
   - Clinker used
   - Gypsum used
   - Operating labor
   - Operating supplies
   - Repair and maintenance labor
   - Repair and maintenance materials
   - Power
5. Mill overhead:
   - Superintendence
   - Mill office and storeroom
   - Laboratory
   - Machine-shop overhead
   - Shut-down expenses
   - Maintenance of yard and buildings
   - Insurance
   - Taxes—state and local
   - Depreciation of buildings
   - Miscellaneous

The "bin cost" of cement, as determined by a summary of the above accounts, is transferred to the cement inventory account. By summarizing the quantities shown in the daily production and sales reports a book inventory is obtained from which the average cost per barrel, as well as the value of the inventory at the end of the period, can be determined. The cost of cement sold is obtained by crediting the cement-inventory account with the inventory at the end of the period. By adding the shipping expenses the "cost on board cars" is obtained.

The determination of costs depends upon the accuracy of the production figures and the physical inventories. The production figures are estimates and may be calculated, for instance, from the amount of slurry that has been extracted from the slurry tanks. It is necessary, therefore, that periodical physical inventories be taken to check the accuracy of such records. But the physical inventory is also an estimate because of the difficulty of measuring the cement in the bins. The bins are almost inaccessible to the surveyor, whose task is complicated further by the extent to which the cement is packed down. Monthly physical inventories are therefore out of the question. A check upon the book inventories may be maintained, however, by comparing the quantities shown by the bin records with the actual quantities in such bins as can be gauged accurately, particularly bins which have been emptied.

A similar situation exists in the records for quarrying, except that here the accuracy of the records is not of such importance because the values involved are not so great. The quantity of rock produced does, however, determine the amount charged for depletion of quarry lands, which is calculated on the following basis:

From the cost of the quarry lands is deducted the residual value, if any, of the lands after quarrying. This amount divided by the number of tons of rock or clay which it is estimated by the engineers is commercially available will give the depletion charge per ton, which is added to the cost of every ton of raw material quarried.

The mill-overhead accounts do not contain any unusual items except perhaps the account "shut-down expense." It is customary for many mills to suspend operations during the winter months on account of the falling off of orders and the increased cost of operation, particularly in the quarries. As the kilns operate continuously for twenty-four hours a day during the remainder of the year, an opportunity is afforded during the shut-down period for general overhauling and repairs. The cost of such repairs, as well as the mill-overhead expenses for the shut-down period, are charged to a deferred-asset account which is written off to manufacturing costs in equal instalments during the remainder of the fiscal year.

Portland cement is generally quoted in terms of barrels containing 380 pounds, but the cement is seldom shipped in barrels. It is sometimes shipped in paper bags at the customer's risk of breakage. The almost universal method of shipment, however, is in cloth sacks, each of which contains one-fourth of a barrel of cement. The customer is charged a standard price for the sacks and the company agrees to repurchase such second-hand sacks as are returned by the customer in good condition.

In the above chart of accounts the item "unclaimed sacks," which is shown as miscellaneous income, represents the elimination from the accounts of the liability for returned sacks, the shippers of which could not be ascertained or which were not claimed by customers. The liability is carried for at least two years before it is written off. Customers sometimes inadvertently return sacks branded with another cement company's trade-mark. Such "foreign sacks" are held for the customers' instructions for

a period of thirty days, after which they are deemed to have been forfeited by the customers and may then be sold to the respective cement companies.

The treatment of the sack accounts presents an interesting problem in accounting. Before the war the price quoted for a barrel of cement included 40 cents for the four cloth sacks. The sacks ordinarily cost the company less than 10 cents each when new, so that the problem here was whether the excess of selling price, 10 cents, over cost was an earned profit, in view of the fact that the company agreed to repurchase the sacks at 10 cents, and also contracted to count, inspect, clean and if necessary repair sacks when returned. Various solutions were offered, the soundest of which provided for the setting up of the unearned profit as a reserve for redemption of sacks.

During the war, however, on account of the advance in the price of cotton, the cost of new sacks increased to about 25 cents each. The standard price to the customer was therefore raised by some companies during 1918 to 25 cents.

The proper redemption of the sacks is accomplished by keeping a memorandum of the number of sacks in the hands of each customer at the various prices, and the sacks themselves bear some distinguishing mark to indicate to which lot they belong. When a customer returns sacks which he has purchased at 25 cents each, his account is credited with 25 cents; but the sack inventory account is charged with only the average cost which prevailed at the time when the sacks were sold to the customer, the difference being charged to the reserve for redemption of sacks. Inasmuch as sacks lose their identity as soon as shipped, the cost which prevailed at the time the sacks were sold is determined for practical purposes by crediting to the inventory account the oldest relative portion of the reserve.

At the time when 25-cent sacks are being returned, 10-cent and 15-cent sacks are also coming in for redemption, for which perhaps no reserve has been provided because the average cost at the time of sale was more than 10 cents or 15 cents, respectively. It seems reasonable, in this case, to charge the inventory account with the price at which the sacks were repurchased, namely, 10 or 15 cents.

The sack inventory account then reflects an average cost per sack which is not in excess of original cost, but below cost in

some instances. The average cost will be reduced toward the present selling price of 10 cents as the inventory is turned over, so that the loss will be absorbed in costs over the period during which the high-priced sacks are used. It is therefore customary to state the inventory of sacks at average cost and as they are sold to charge the excess of cost over selling price to shipping expenses. If the selling price, however, is greater than cost, conservatism demands that such profit be regarded as unearned until the particular lot of sacks is no longer in use.

In the case of a company which has on hand a large number of sacks that were acquired at high prices, it would seem that the inventory should be stated at the present selling price rather than at average cost. Although this would be the conservative course to follow, many companies do not wish to charge such a radical reduction in the value of their sack inventory to the earnings of any particular period. The accounting procedure described above, whereby the values are reduced gradually, has therefore met with favor. As to reducing the sack inventory to market it will be seen that the market quotations for new sacks have no bearing upon the value of sacks which are branded with the company's trade-mark. Regardless of their value, they will be sold to customers and repurchased from them at the present arbitrary price of 10 cents each. The question remains as to whether or not the books should reflect the liability of the company for the repurchase of sacks in the hands of customers. The company is contingently liable, and, theoretically, the liability should be reflected in the balance-sheet. A going concern, however, may safely ignore such liability because it will need the second-hand sacks which it purchases from its customers and it can sell them again for the same price which it pays for them. It is true, however, that where the company has contracted to pay 15 cents or 25 cents for a sack which it will resell for only 10 cents, a loss will be incurred for which due provision should be made. The reserve for redemption of sacks mentioned above will provide for the difference between 15 cents or 25 cents and the cost when the sack was sold to the customer, but the cement companies do not always provide for the further reduction to 10 cents. The conservative thing to do, however, is to provide a reserve for redemption of sacks which will be adequate to provide for a 10-cent valuation of all sacks which are to be redeemed at higher prices.