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Some phases of cost accounting in the chemical industry

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NATIONAL ASSOCIATION
of
COST ACCOUNTANTS



Official Publications

Vol. III DECEMBER 1, 1921 No. 6

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Chemical Industry

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Some Phases of Cost Accounting in the Chemical Industry

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130 WEST 42nd STREET, NEW YORK CITY

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NATIONAL ASSOCIATION OF
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DECEMBER 1, 1921

National Association of Cost Accountants

SOME PHASES OF COST ACCOUNTING IN THE CHEMICAL INDUSTRY

Cost Accounting in the chemical industry presents many interesting phases of both process costs and production order costs. This article, however, deals chiefly with process costs. In some classes of chemical plants the process cost system is the prevailing type of cost system; in others, the production order type. Since some of the detailed work in the cost department of any business is more or less similar, such work is not described in this article but only the principal features of the cost accounts in a chemical concern. In a chemical plant the cost accountant should furnish such principal facts as the following: The cost of converting the raw materials, the manufacturing overhead, the manufacturing cost in bulk, the factory cost of the product packed or otherwise prepared for shipment, and the selling cost. Such problems as by-products, repairs, depreciation, obsolescence, overhead and its distribution, and containers should also be considered.

In a large chemical concern the work of the cost accounting department may be subdivided advantageously between the factory and general offices, the former having to do only with quantities of materials, supplies, productions, shipments, and inventories, and in the value of labor; and the latter having to do with the values of the quantities reported by the factory office, and the summarized labor charges. This requires the perfection of a system of prompt inter-office reports. For smaller companies, this subdivision may be unnecessary.

Another purpose of this article to discuss this subject with a view to providing monthly costs, which are desirable, yet figures covering a longer period of three or six months are likely to prove more reliable, due to the variable conditions arising in the production of chemicals.

The manufacture of chemicals requires a diversity of products and chemical strengths which makes it impossible to have complete uniformity in the cost data.

A chemical plant is divided into departments, each one manufacturing a distinct product, generally in its own special building with its own equipment. The cost records are kept by departments.

Owing to the relationship of some of the basic chemicals to the minor products, a material fluctuation in a basic chemical may affect very decidedly the cost figures of the other products. Many products are manufactured in groups, that is to say, the production

of one major product may involve one or more other products which may be manufactured either in separable steps in a continuing process, or as by-products. The cost of manufacturing the separable steps in a process can be ascertained usually, but the cost of manufacturing by-products cannot be determined accurately. Therefore it is accounted for on an arbitrary basis. The value at which by-products are brought into the cost accounts varies in accordance with the effect which the management may desire on the cost figures of the principal product, which in turn may affect the costs of several other products. By-products are accounted for as produced. Furthermore, the unit of measure and the degree of chemical strength varies between the different products. The units of measure may be either gallons, pounds, hundred pounds, net tons, or gross tons, and products may be quoted on one basis on the market and their costs recorded on another basis.

These facts of course do not vary the elements of cost, but they do make the unit cost figures of variable meaning. In the case of major products manufactured in different strengths this condition is remedied, however, by the use of chemical factors.¹

COST SHEET

The following is a form of cost sheet for monthly reports of manufacturing cost in bulk, which can be adapted to a columnar cost ledger, so as to show comparative monthly costs on the ledger.

Manufacturing Cost of _____		Month of _____ 192_____	
	Pounds @	Amount	Cost per Unit of Measure Produced
Raw Materials:			
_____		\$
_____	
_____	
_____	
		\$
Less:			
By Products	
Net Cost of Raw Materials:		\$
Conversion Cost:			
Labor	
Power, Light & Heat	
Fuel	
Supplies	
Repairs	
Total Conversion Cost		\$

¹ See Appendix for further comment.

	Pounds @	Amount \$	Cost per Unit of Measure Produced
Shop Cost			
Overhead Expense:			
Taxes		\$
Insurance	
Depreciation	
Works Expense	
		\$
Less:			
Loss from Idle Plant	
Overhead Chargeable to Production		\$
Cost in Bulk—Quantity		\$
Yield_____%			

This form of manufacturing account, as well as subsidiary accounts for raw materials, supplies, manufacturing expenses, finished goods and sales should be kept in a factory ledger and controlled by the general ledger.

In many non-chemical concerns such items as power, fuel, supplies and repairs are generally considered as overhead, and not as direct costs. In a chemical plant, however, where each product for all practical purposes is an independent manufacturing unit, these items are considered as direct operating costs in converting the raw materials into the desired finished chemical. Power is used in stirring or heating the contents of the large mixing tanks, or for refrigeration in other cases. Fuel is used in boiling down liquids or heating salts in the extraction of gases. Supplies, such as water and sundry items, are necessary. Repairs to the buildings and apparatus are also constantly necessary, owing to the action of the chemicals.

RAW MATERIALS

Raw materials are either purchased in a state ready for immediate consumption, or in a state which requires grinding, drying or other treatment before they are suitable for use.

A record of all materials received is kept in the receiving department and reported to the cost department, and should correspond with the quantities shown on the invoice after adjusting the differences between the invoice weights and the receiving department's weights.

Separate accounts properly controlled are kept for each raw material in quantity and amount. In these accounts all charges

such as invoice cost, inward freight and hauling, containers, duties and insurance, and handling charges are accumulated; as well as credits for salvaged incoming containers, for materials lost due to evaporation, and similar items which affect the cost of the raw material delivered at the plant.

If the raw material must be ground or otherwise treated and such treatment is of sufficient volume to make it practical, it is accounted for separately as a distinct process. The separate accounts show the original material, the cost of grinding, or conversion, which would include labor, power, supplies, and repairs, and a proportion of factory overhead. This separate information is of value when comparing the cost of the raw material treated at the factory with the cost of purchased material suitable for consumption when received.

Brief mention might be made of the relation of incoming containers to the purchases of raw materials. Raw materials are received in bulk, or in containers, such as bags, barrels, carboys, drums or cylinders. These containers may be either non-returnable or returnable. Non-returnable containers are charged into the cost of the material. It may or may not be advisable to separate returnable containers from the cost of the raw material. In the case of bags, for instance, the number which can be salvaged is not always easy to determine. In such a case it is more practical to charge them into the cost of the materials, and credit them out when salvaged. Returnable containers which are easily separated are charged direct to "Containers Returnable to Vendors." This latter account is also charged with returnable containers formerly charged into the material cost when they are salvaged, at which time a credit is made to the raw material account.

When all the proper charges to raw materials for the month have been recorded on the accounts, the raw materials used during the month must be charged out, as well as any losses sustained. In order to do this, a report of the monthly consumptions and of any losses which may have occurred must be obtained. This report can not always be prepared accurately and in detail. Materials handled in small quantities are easily accounted for. Materials handled in large quantities, however, necessitate the use of the best estimates that can be obtained.

Owing to the fact that a chemical plant is generally spread out over considerable territory, and in the interest of economy, raw materials handled in large quantities must be received and stored at a point which is the nearest possible one to the place of consumption. From a practical standpoint, this condition does not permit a constant watch over all the raw materials in order to obtain detailed accuracy in the recording of quantities used.

As the materials are consumed they are measured and reported, or, in some cases, they may be taken without any record being

made. In the former case daily records of quantities consumed are kept and summarized monthly. In such cases where no record is made of each withdrawal from stock the monthly consumptions must be arrived at by deduction.

This procedure is also followed in testing the monthly consumptions of those materials for which daily reports of withdrawals from stock can be obtained.

The closing book inventory is tested with the actual inventory as often as possible. The consumption of large quantities cannot be measured exactly. Consequently, this periodic test of inventories is necessary to avoid large errors, and the consequent adjustments.

Where the difference is not of consequence and is not due to causes, such as evaporation or dissolution, it can be distributed over the departments using the raw material on the basis of consumptions.

At the end of each month the works accounting department reports to the cost department the amount of the different raw materials on hand at the works, stating the amount in quantities of the opening inventory, purchases, consumptions, adjustments, losses, and closing inventory. The opening inventory, purchases, and sales should reconcile with the general books.

The credits for amounts consumed or lost are then recorded in the books and charged to the proper accounts at an average price arrived at by dividing the amount of the opening inventory plus the total cost of the purchases during the month, by the total of the quantities of each of the above items.

BY-PRODUCTS

The production of by-products absorbs labor, power, supplies, repairs, and factory overhead, but these costs cannot be ascertained and apportioned accurately. The main product should receive credit for the by-product, as produced, but the value is generally arbitrary, and depends in most cases upon the showing desired in the costs of the main product, and upon market conditions. However, a uniform practice must be adopted and followed consistently, and the method of valuing the by-product must be a conservative one. There is a difference of opinion as to whether the value of the by-products is a credit to the raw material cost, or to the total manufacturing cost of the main product in bulk. It would seem more logical that the by-product credit should be applied to the total manufacturing cost rather than to give a single element benefit for the entire value, because the former cost includes the other elements of labor, power, repairs, depreciation, and overhead, although its amount is arbitrary. On the other hand, it is desirable to show the raw material cost at a figure which might

be compared with the price of the material, after the by-products are extracted, on the theory that the main product should absorb all production charges, and that the by-product value should be based on material cost only. This question is one which affects merely the presentation of cost figures, because the total manufacturing cost of the product is not changed by either method.

CONVERSION OF THE RAW MATERIALS

When the raw material has been prepared for consumption the next step is to convert it into the finished product, which require labor, power, fuel, supplies and repairs. These costs are grouped as elements of "Conversion Cost."

Productive Labor

When one visits a chemical plant, the scarcity of laborers is very evident, because many processes are run without interruption and mechanical devices are used to a very great extent. The labor required by various processes depends upon the mechanical devices available and the importance of the product. The handling of materials and finished products requires the largest percentage of the labor, the other operations being performed by a few skilled chemists and foremen.

In order to arrive at the direct and indirect labor costs the time clock cards are extended and summarized weekly by employees and by departments. The summary is made on sheets which provide for monthly totals. From this record, a monthly report of payroll distribution can be prepared. This report serves as a basis for a monthly journal entry distributing the labor charges for the month.

The transfer of materials from their storage place to the department where they are to be used may involve the expenses of handling by teams within the yard. This expense is a cost to be added to the labor cost, although not included therein when distributing overhead. The total cost of operating yard teams is kept in a separate account, and distributed monthly on the basis of the work reported done by the teams.

Power, Light and Heat, and Fuel

A considerable amount of power and heat is required for the treatment of materials in their conversion into the finished product. If an independent power plant is maintained, the cost of the power produced will be represented by the cost of operating the power plant. From the meter readings, the power produced and the power consumed in the various departments can be ascertained. The power cost is distributed on the basis of the report of those readings. If the power is purchased outside, the necessary read-

ings of power purchased can be obtained from the invoices. Power used in the various departments may be ascertained from meters installed in those departments, or if no meters are installed in the various departments the best possible distribution must be used. The manufacture of some chemicals requires the use of large furnaces involving large expenditures for coal or fuel oil. Fuel is generally purchased in large quantities and charged out as it is used. The cost of each of the various kinds of fuel is kept in separate accounts, both in quantity and in value, similar to a raw material account. The quantities used are charged out at average unit costs.

Supplies

The supplies used in and about a chemical plant are quite numerous, depending upon the size of the plant. A perpetual inventory of the supplies in the storehouse should be maintained. At the end of each month, a report of requisitions filled should be prepared. The total expense of operating the storehouse for the month should be ascertained. This storehouse expense should then be distributed on the basis of the value of supplies requisitioned, and the combined value and expense should be charged as the cost of supplies used in the various departments.

Any supplies not under storehouse control, should be kept in accounts similar to the raw material accounts and should be charged out to the various departments when used, as per reports thereof, at an average unit cost.

Repairs

The chemical action of the products on the machinery and buildings necessitates frequent repairs. It is difficult to anticipate the extent of these repairs in the course of a year with any degree of accuracy.

These repairs, as well as that portion of any replacements which do not add to the value of the equipment as it was, prior to the replacement, are proper charges to costs and, on account of the departmentalization of the plant by products, are directly chargeable to the products. Their occurrence, however, is not constant in amount, so that if they were charged direct to costs as they occur, the monthly cost figures would be disturbed. Therefore, in order to spread the item of repairs evenly over the monthly cost figures, an amount is set aside each month as a reserve for repairs, and the actual expenditures when made are charged against that reserve.

A careful study of plant conditions and past experience will enable the cost department, in co-operation with the factory engineers, to arrive at a fairly close estimate of anticipated repair charges for the year by departments. Monthly journal entries should then be made charging one twelfth of the estimated neces-

sary reserve to costs and crediting the reserve. If a department is not operating for a whole month, it is assumed that it will not necessitate making repairs, and consequently no reserve is set aside.

The actual outlay and the reserves for repairs must be watched closely, because it may be found necessary to adjust the monthly reserve charge, during the course of the year, in order to take care of unexpected repairs. The difficulty in anticipating repairs makes it desirable, as well as conservative, to adjust the reserves to the actual expenditures, in the last month's cost figures, of each year. This adjustment should appear as a separate figure so as to aid the comparisons with former months. This procedure will result in annual cost figures which are based on actual repairs and does not require the carrying forward on the balance sheet of a deferred debit or deferred credit of questionable value.

OVERHEAD EXPENSES

The segregation of overhead expenses, as set forth on the cost sheet on page 5 shows four items, namely, taxes, insurance, depreciation and works expense. Taxes and insurance are handled in the usual manner.

Taxes

Taxes are distributed on the basis of the values in the various departments as shown by the records of plant values.

Fire and Liability Insurance

Liability insurance, especially workmen's compensation, presents a problem, when distributing the expense thereof to costs, owing to the diversity of operations which may be covered under a blanket rate. The distribution of this expense to costs can best be done in the light of the conditions stated in the policies obtained but if those conditions are too involved an average rate may be used. As the premium for this insurance is based on payrolls, the distribution of the premium is based on the cost of labor.

For those plants where insurance, especially against fire, is hard to obtain, it is advisable to build up an insurance fund by charging costs and crediting the reserve fund monthly with the approximate legal reserve cost of the insurance if purchased outside. This will in time provide a fund of sufficient size to take care of any fire losses. However, the risk of loss in the early years before the fund has assumed sufficient proportions presents an argument against the initial establishment of such a fund unless adequate insurance can be carried during the accumulation of this reserve and then reduced as the reserve increases.

Depreciation and Obsolescence

The depreciation of machinery in the chemical industry depends on so many factors that the rate, which will vary from 10

per cent to 20 per cent, or more, can best be determined by a careful study of the conditions existing.

Obsolescence is a material factor in the chemical industry, due to the frequent changes in manufacturing equipment and, in the case of minor chemicals, the discovery of other chemicals to replace the use of those now being produced. To determine this factor of obsolescence is most difficult, yet it is an element of cost which can not be overlooked. The amount is determined by studying the facts in each case, and by the judgment of the chemical engineers acquainted with the particular problem. To enable the proper distribution of this element of cost as well as those other elements of cost which are based on plant values, it is essential to maintain careful and detailed departmental records of the investment in the plant.

Works Expense

The works expense in a chemical plant includes such items as superintendence, indirect labor, laboratory expense, general works expense, works office expense, watchmen, insurance, first aid expense, plumber shop expense and the costs of other service departments. The number of classifications kept depends on the detailed data desired.

Many of these items are easily distributed on separate and equitable bases. For example, first aid expense which would represent the cost of conducting a works hospital can best be distributed to the various departments on the basis of the number of treatments received by the employees of those departments during the month.

Some of the service departments such as carpenters' shop, plumbers' shop and machine shop present individual cost problems in production order cost accounting. Service departments are primarily concerned in repairs, renewals, and additions to the plant. Rather than charge repairs with the overhead of these service departments or capitalize the overhead, it is more conservative to charge this overhead into manufacturing expenses. This method also avoids the pyramiding of overhead on account of interdepartmental charges and credits.

For those items of overhead which can not be distributed on a special basis, an equitable plan of distribution must be adopted.

After giving due consideration to all factors involved the "man rate" seems to be the most satisfactory, whereby each process is charged a portion of overhead based on the number of dollars expended for labor in that process, in its relation to the total productive labor cost. The labor employed in a chemical plant ranges from ordinary manual labor required in handling materials and furnaces, to the skilled labor required to watch the chemical processes. This condition makes the use of the man hour method unsatisfactory.

Owing to the large capital investment in a chemical plant some consideration has been given to a plan for the distribution of manufacturing overhead on the basis of the investment in the buildings and equipment in each department. This method raises questions regarding the idle plant and the use of cost or depreciated capital values. For some companies this method may be more equitable than any other.

IDLE PLANT

In a chemical concern maximum earnings require capacity production. This is difficult to maintain due to frequent breakdowns, seasonal products, weather conditions, market conditions, and the concentration at times on the production of profitable products, at the expense of the unprofitable ones.

In any system of cost accounting it is highly desirable to show in the accounts the unabsorbed burden, which avoids the inflation of inventories. The many different processes and conditions existing in a chemical plant would make a budgetary control of production and overhead impracticable, since it can not be estimated in advance what the ratio of overhead to each unit produced should be.

However, a close approximate cost of idleness or unabsorbed burden in the various departments can be ascertained. In order to do this, daily records are kept of the idle departments which are summarized at the end of each month. As a practical matter, it is advisable to set a minimum number of idle days, five for example, below which no account will be taken in figuring idle plant. These may or may not include Sundays and holidays depending on whether the process is operated continuously or not.

At the end of the month, the same proportion of those manufacturing expenses which remain constant whether the plant is operating or idle, which the actual number of idle working days in the month bears to the normal number of working days in the month, represents a loss from idle plant.

Occasion may arise when a department uses a small amount of labor during a month with a consequent charge for works expense, and yet in such a case there may be no production during that month. The purpose of such labor would generally be to improve the product for the market. As such it is charged (labor and works expense) into finished goods, and the other overhead expense is charged to loss from idle plant. The proper treatment in the cost and general accounts of the loss from idle plant depends upon the cause of the idleness. It may represent a proper charge against production, a selling expense, or a direct charge to the profit and loss account.

DETAILED OVERHEAD EXPENSE REPORTS

As further information for the factory management in regard

to the items which enter into the manufacturing overhead expenses, are monthly reports of these overhead expenses. These reports can be prepared easily in columnar form so as to show monthly comparisons. By stating therein the principal charges to each of the expense accounts, the reasons for fluctuations can be investigated readily and immediate steps can be taken to eliminate unnecessary burden.

COST IN BULK

When the manufacturing cost figures have been accumulated to the point that shows the manufacturing cost in bulk, it is divided by the units produced, the result being the unit cost for the month.

It is advisable to show the manufacturing costs on the cost department's reports in terms of the commercial strength as well as the standard strength, where those strengths differ.¹

Comparison of this figure for different months may show questionable discrepancies which may be accounted for by the "yield," or by errors in the reports of production or of raw materials used.

By yield, is meant the average volume of production which should be obtained from a certain quantity of raw materials consumed. The skilled chemists can supply this information to the cost accounting department and from that data the percentage of efficiency can be ascertained and shown on the cost sheets.

The competent cost accountant must read his reports very critically in order to present clear statements with concise comments regarding the fluctuations in costs.

With a few exceptions no account is kept of goods in process, because there are but few products which might be in process at the end of the month and which can be separated. Theoretically, there is a portion of each chemical in process at the end of every month, but this is overlapping and cannot be arrived at readily. When the product is completed it is either sold or used in another process in the same plant.

It should be emphasized that the elimination of the goods in process account is not at all general in other industries.

PRODUCTION REPORTS

The works accounting department supplies the cost department with the quantities produced monthly. There are some processes in which the product is constantly being used as produced, thus making it very difficult, if not impossible, to ascertain directly the quantities produced.

Under such conditions productions are determined by deduction. The stock on hand at the beginning of the month is known,

¹ See Appendix for further comment.

and by measuring the tanks, in the case of liquids, or by weighing or estimating, in the case of solids, the stock on hand at the end of the month can be ascertained. From the shipping department the sales can be obtained and from the receiving department the purchases, if any. The closing inventory plus sales, less the opening inventory plus purchases gives the production, after taking into consideration any necessary adjustments. The production thus arrived at should reconcile with the quantities reported as received in the departments which use the product. Any differences, which often occur due to evaporation, leakages, and similar conditions, are either absorbed by the departments using the product, or if the discrepancy is abnormally large, are charged off to profit and loss. The production of a certain chemical may involve the production of two or more distinct elements in the final product. Information regarding quantities produced and the manufacturing cost of each element in such a group is often of great value. Therefore in accounting for the cost of such a product, it is treated in the accounts as two or more distinct products, and later the cost of each product is combined.

FINISHED GOODS PURCHASED

At times it is necessary to purchase from outsiders goods which are produced by the plant in order to meet the demands of the trade as well as the requirements of other products which use such finished product as a raw material in their process. Such purchases must be kept separate in the accounts so that the costs of the same product produced at the plant shall not be affected, (generally increased), and so that the earnings on such transactions may be ascertained separately. These purchases are handled in accordance with the same principle as raw materials are, as already explained. In charging out these purchased goods to manufacturing costs, it is desirable to use the cost of production of the similar product within the plant, and then to show the excess, that is the difference between the production and the invoice costs, as a separate charge for raw materials to the department in which they are used.

TRANSFERS OF FINISHED PRODUCTS

Inter-departmental transfers of finished products should be made at cost without any element of profit. The cost to be used may differ. Where a product is pumped, as produced, direct into another process, as a raw material, the use of the current month's manufacturing cost in bulk is justifiable, whereas in case a product is produced and stored away in stock and is drawn on from stock for use in other departments, the average stock cost of the product so transferred is used.

Many of the departments are dependent upon one or more of the other departments. This inter-departmental relationship makes it necessary to start each month's costs by using the average

cost of the opening inventory, for that month, of that finished product which is a basic element used in manufacturing the plant's most representative product. When the inter-departmental transfers have thus been started, the other products can readily be costed for the month.

COST OF PACKING AND PREPARING PRODUCTS FOR SHIPMENT

The labor and consequent overhead involved in packing and preparing certain products for shipment is not separable from the manufacturing labor, in all cases, as the same labor that attends to the manufacturing process attends to the packing of the product. However, in such cases the cost of the containers used can readily be ascertained. On the other hand, the packing of some products involves a separate process, such as grinding, which is accounted for through separate manufacturing accounts. Earlier in this article consideration was given to the item of containers as it affects the cost of raw materials. The relation of containers to the cost of finished goods prepared for shipment will now be discussed.

The cost of containers used must be considered from two viewpoints, namely: non-returnable and returnable containers. Non-returnable containers such as slack barrels, small kegs, boxes and cartons are purchased in large quantities and are kept in separate accounts both as to quantities and values. As they are used, they are charged out at average stock costs. The problem of returnable containers is a more difficult one. Space will not permit of a complete discussion of this problem.

The most important of the returnable containers used in a chemical concern are carboys, tight barrels and drums. A chemical concern generally maintains separate departments for making and repairing carboys, tight barrels, and drums. Separate accounts are kept showing the total costs of operating these departments. In order to separate the maintenance charges from the cost of making new containers in these departments, records must be kept of parts on hand, received and used, and the number of new containers or container parts made. The capitalizable portions of these accounts are separated on the conservative basis of the average quantity of materials used in the manufacture of the containers and at their average cost. This average basis is adopted because it is practical and does not fluctuate. The balance of the account represents maintenance charges which are absorbed.¹

In addition to the cost of maintaining returnable containers, there is the element of depreciation. The depreciation of each type of returnable container is figured on the estimated life, and the average number of trips which the returnable container will make, after allowing for the estimated salvage value, if any. The amount of depreciation thus arrived at is used uniformly as an element of the cost of packing. No distinction is made between

¹See Appendix for further comment.

the containers packed and the containers shipped, as for practical purposes they are the same, because the containers are generally always packed only as required for shipment.

The container cost, for goods shipped in containers which the customer has the privilege of returning, consists, therefore, of maintenance and depreciation. The maintenance charge for each type of returnable container are distributed on the basis of the number of such containers shipped each month. Likewise the depreciation charge for each container shipped is charged to the various products and credited to the reserve for depreciation of each type of returnable container. Any losses of materials sustained in packing are absorbed in the packing cost.

There are two groups of accounts kept for containers in the general accounts. One group of accounts represents an asset and is kept under the title of Packages—subdivided by types, at the cost price of containers purchased or made, which are to be used as returnable containers. This account is credited with the cost of such packages when sold or destroyed. Another group of accounts represents a liability and is kept under the title of liability for the Redemption of Containers in Customers' Hands. The liability is to the customers for returnable packages charged to them and in their possession which they have the privilege of returning, if not damaged, at the same value at which they were originally charged to the customers.

SELLING COST BY PRODUCTS

The selling and administrative overhead and its proper distribution must be given careful consideration. It includes the cost of maintaining the selling, shipping and administrative departments. In distributing this overhead to the various products, several bases are advisable. The selling and shipping expenses are distributed in various ways such as on the basis of the quantities shipped, or on the basis of the cost of sales, or they may be charged directly to the product. The basis of distribution cannot be fixed for each case. It must be made in the most equitable way after giving careful consideration to the facts peculiar to each case. Unless monthly selling costs by products are desired, the results are of a more practical value if this distribution is made quarterly or semi-annually, because the selling and administrative overhead may fluctuate widely from month to month. The selling cost data thus obtained, together with the manufacturing cost in bulk of each of the products referred to above should then be combined in report form by the cost department. A pro-forma selling cost report, which also reflects the gross profits from sales, is shown on page 17. This form of report is arranged so as to set forth, primarily, the total selling cost. If desired, it may be followed with a condensed Trading Profit and Loss Statement for each product, which also may be provided with percentage ratios.

Selling Cost of _____

Month of _____ 192_____

	Quantity Sold	Amount	Per Unit of Measure
Manufacturing Cost of			
Net Sales in Bulk		\$ . . . .	. . . .
Grinding Costs		. . . .	. . . .
Packing Costs		. . . .	. . . .
		<hr/>	<hr/>
Total Factory Cost			
Prepared for Shipment		\$ . . . .	. . . .
Selling and			
Administrative Overhead:			
Selling and			
Shipping Expenses	\$ . . . .	. . . .	. . . .
Administrative Expenses	. . . .	. . . .	. . . .
	<hr/>	<hr/>	<hr/>
	
		<hr/>	<hr/>
Total Selling Cost		\$ . . . .	. . . .
Gross Sales		\$ . . . .	. . . .
Less:			
Returns and Allowances	\$ (enter in red)		
Freight Out	<hr/>	. . . .	. . . .
Net Sales		. . . .	. . . .
Deduct:			
Total Factory Cost			
Prepared for Shipment		. . . .	. . . .
		<hr/>	<hr/>
Gross Profit		\$ . . . .	. . . .
Deduct:			
Selling and			
Administrative Overhead		. . . .	. . . .
		<hr/>	<hr/>
Net Trading Profit		\$ . . . .	. . . .
		<hr/>	<hr/>

APPENDIX

The following supplementary remarks to the main body of this article may be of interest to those unfamiliar with chemical cost accounting and some of the terminology used in the chemical business.

An idea of what is meant by chemical factors may be gained from the following. The Manufacturing Chemists' Association has established certain factors for reducing the varying strengths of

Sulphuric Acid, Hydrochloric (Muriatic) Acid, and Nitric Acid to one strength. For example, Sulphuric Acid may be produced in strengths varying from 50 to 66 degrees Baume. In the cost accounts an account may be kept for the cost of manufacturing the weaker acid, say 50 to 60 degrees Baume, and another account for the stronger acid, say 60 degrees Baume and over. It is customary for the factory office to obtain reports of the separate quantities of each strength produced, and then to reduce this production to one strength, 50 or 66 degrees. To make this reduction the above mentioned table of Sulphuric Acid factors is referred to, and by the use of the necessary factor, the total production in the terms of the strength desired may be calculated. Chemical factors are based on percentage. To calculate them is merely a matter of arithmetic.

The meaning of commercial strength and standard strength is brought out in the following. The standard strength of oil vitriol (Sulphuric Acid) is 100%, but in commercial terms Oil of Vitriol is thought of in terms of 66 Baume degrees, which is slightly less than 100%. In making certain reports and comparisons, especially for statistical purposes, the 100% standard equivalent of the acid, shown on the books in terms of its commercial strength, must be ascertained. This also involves the use of factors mentioned above. This relation of standard and commercial strength holds true in regard to other chemicals as well.

With regard to the balance of the Containers' Department account referred to on page fifteen, it might be said that after taking out the cost of the new containers produced at a fixed average cost, the balance represents the cost of repairing the old containers, and keeping them in usable condition. This balance is then distributed to the various productive departments on the basis of the number of such containers shipped each month as explained on page sixteen.

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