

# **STANDARD CALCULATION PER PRODUCT IN THE CHEMICAL FERTILIZER INDUSTRY**

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**Abstract:** The main goal of the research is to present a way of organising the managerial accounting of totally and semi finished product obtained in chemical fertilizer industry entities. For this study, we analyzed the current principle of managerial accounting to an entity in the studied area, in order to emphasize the need of organizing and implementing a modern accounting management to control the cost and increase the performance of the entities in this area, starting from the premise that there are sufficient similarities between entities in the field. Research carried out has revealed that currently, the costing is organized in terms of using traditional methods and that it is necessary to organize and implement an accounting management based on the use of modern methods, namely the method of standard costs combined with the method of centres of costs. The major implications of the proposed system for the investigated field consist of determining a relevant cost-oriented management entity, highlighting the shortcomings of traditional methods of cost.

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## **1. INTRODUCTION**

Relevant and performing decision making is influenced predominantly by the quality of information provided to the managers, and timeliness with which they are transmitted.

Traditional methods of calculation currently used by entities in the chemical fertilizer industry, those being the comprehensive method and the phased method, present a series of drawbacks, including historical character, lack of efficiency and foresight.

Given that entities in the chemical fertilizer industry operate today in a competitive market where prices are determined by the ratio of supply and demand, and mastering costs is one of the factors that can ensure the achievement of targeted performance, that this will require the introduction of a system of managing through costs, which aims to provide operational and relevant economic information to the management process at the level of the analyzed entities.

## **2. OBJECTIVES**

From the perspective of cost optimization for increasing the performance of the entities in chemical fertilizer industry, our study aimed at improving the current methodology of cost calculation by introducing advanced calculation methods, more flexible and more effective management of the entity, taking into account the specific analyzed domain. Following investigations, we concluded that the best way to achieve the objectives pursued is

standard cost method, given the many advantages it offers compared to traditional methods used today.

In principle, the methods evolved of management through costs answer the requirements of modern management, but once taken in their individuality they present certain limits, for which we consider that the optimal organization of cost calculation, to achieve the full exploitation of the information needed to run the production processes and the orientation of activities of the entities, may be effected only with concomitant use of several methods and techniques integrated into a system that could take over from them what is essential and what is beneficial for the entity which applies them.

Based on these considerations, basically, the proposed system combines the method of standard cost, which takes technique and instruments of budgetary costs and tracking of deviations, the method of cost centre, from which it takes the instruments establishing the causes and responsibilities for found irregularities and the method of management by exception, to inform selective managers at different levels. The base of the system is the programming of costs by standardizing direct costs and indirect costs budgeting, in terms of using automatic calculation technique.

### **3. METHODOLOGY**

To carry out this study, we analyzed the current conception concerning the organization of managerial accounting for the entities from the industry of chemical fertilizers. The main methods of research used for performing the scientific demarche were of analyze and synthesis and also of qualitative research. The information about this subject were get by studying the specialized literature in our country and aboard, by analyzing the legislation in force afferent to this domain.

### **4. STANDARD CALCULATION PER PRODUCT**

The standard cost method has a specific features that allows for the determination of the estimated costs, considered as normal, used for rapid assessment of the achieved production and against which we can determine promptly the variations of the expenditures during the process of production and thus lead by exception; management control by analyzing deviations from the predetermined costs, including determining the cost of the sub-activity; dependence separation costs depending on the production volume in fixed, variable and mixed (trimmers) expenses, which allows determining the stiffness of the company.

Structurally, the application of standard cost method requires performing specific work methodology for its implementation within the following steps:

- developing standard calculations per cost centre and product;
- determination and analysis of deviations from standard costs;
- tracking costs by accounting.

The study refers only partly to the first milestone achieved for the standard cost method, namely the elaborate calculations on standard products, according to the nomenclature of production costs calculation items.

For the entities of chemical fertilizer industry, as in other industrial entities, the standard product calculation shall be made for those products, works and services which are part of the structure of the commodity production.

We also use standard calculation of own production, consumed productively in the establishment and support activities for those serving basic production: heating, steam, recycled water etc.

The development of standard calculations per product serves for detailed cost analysis, for calculating the profitability of each product, to identify concrete opportunities in order to reduce production costs and to take corrective measures<sup>1</sup>.

The standard calculation per product is based on the structure of production costs on calculation items and chronologically it follows the standard calculation developing on productive centres and related cost centres, because it is extracted from the latter. So, first of all, the costs of cost centres by which the products go by are established, The standard calculation on product is based on the structure of production costs on calculation items and chronologically it follows the standard calculation developing on productive centres and related cost centres, because it is extracted from the latter. So, first of all, the costs of cost centres by which the products go by are established, and which have the character of direct costs towards the generating sites. Then, the standard product calculation is performed, within only some expenses are directly related to the product and the rest of the costs are indirect, respectively costs of maintenance and machine operation within the productive centres, general costs of the department, general administration costs, packaging costs and the costs of opening, within the related centres. The existence of these indirect costs to the product, requires prior knowledge of their total production cost centre or productive costs or connected ones, whereupon they are distributed to the products manufactured in that cost centre, based on conventional criteria.

In developing the standard calculations per product, calculation of standard costs for articles is different from the calculation of expenses, which consists of simple and straightforward expenses, to complex calculation and indirect items.

Thus, the items of calculation consist of straightforward expenses determination of standard costs, and it is usually done by multiplying the standard quantity per unit of product manufactured (standard specific consumption for standard work, etc.) to the standard value unit (unit price standard, standard unit cost, standard pay rate, etc.) and the amount of production standard that will be manufactured for the concerned product.

The question is, first, to determine the size and value of the quantity of the standards taken into account.

In order to do this, the production process is carefully analysed by both the technical compartment and the economic compartment, the analysis settling quantitative standards - technical compartment's task and value standards - economic department's task.

Methodology for the elaboration of standard product calculation, for costing items made of simple and direct expenses (raw materials, direct auxiliary materials, transport and purchasing expenses, semi-finished good from own production, technological utilities, recoverable and reusable materials, direct amortization, direct labor, social security and social protection taxes related to direct labor), is the same standard calculation used in developing the productive cost centers.

The difference is that while the calculation standard on centers productive cost is drawn up for the entire production of that center, whether it is the production of goods or not, the calculation standard product shall be made only for those products which are part of the company's production of goods.

In the methodology for standard product calculation, there are some particularities in relation to the methodology for developing standard calculation on productive cost centres, regarding the costing items which consist of indirect and complex costs (costs of maintenance and machine operation, general costs of the department, general administration costs,

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<sup>1</sup> Călin, O. (2002). Management Accounting, Economic Tribune Publishing House, Bucharest, page 155.

packaging costs and the costs of opening). There are two distinct moments in these costs category, namely: first of all, their standard level is set on the cost centre that generated them and then a share will be assigned on each kind of product manufactured within that centre<sup>2</sup>.

Considering the first moment, the methodology for determining the standard level of the complex and indirect expenses per cost center has been presented previously.

Within the second moment, the order of the allocation of indirect product costs is as follows<sup>3</sup>:

- First, repartition of the machine operation and maintenance expenses on products manufactured within the costs centre that generated them;
- Then, repartition of the department's general costs within the related costs centre made at a certain department, on the products manufactured in that department;
- Thirdly, general administrative expenses from the related costs centre of the entity are distributed on the products constituting the merchandise production.
- Next, the distribution of packing costs from the packing installation, on products packaged at this facility;
- Finally, repartition of opening expenses within the related cost centre, constituent of the distribution sector, on the products constituting the merchandise production.

For all these categories allocation of indirect costs centres on the products, entities in the chemical fertilizer industry, like other industries, use various procedures, namely:

- the process of simple division;
- the supplementing process;
- the coefficients of equivalence process.

Regarding the allocation of costs for maintenance and operation of machines, those cost centres where the production process results in a single product (semi manufactured) can apply the process of overall distribution by simple division, meaning there is no calculation for allocating separate such expenditure. In such situations, all those expenses affect directly the cost of the product cost (semi manufactured) obtained for the specific installation. They relate to the amount of resulting production reporting with other direct expenses for calculating the unit cost. As a matter of fact, in this case, the department's general costs are distributed similarly to the allocation of costs of maintenance and machine operation.

If some installations/ plants produce more products (half-finished materials), then the maintenance and operation costs are distributed by the supplementation process, in its classic form, using as a criterion for distribution the "time-facility operation." Such distribution of those costs in relation to working time that you require every product installation, ensuring a more precise location of these expenses according to the working time of equipment, maintenance, wear and value. This requires knowledge of costs for each installation and determination of hourly-cost installation.

This method of distribution allows not only the determination of a real cost, but also provides the elements necessary to find ways of rational use of machinery in order to choose the most cost-effective process technology for the manufacturing, establishing effectiveness and enabling maximum use of the facilities.

In conclusion, we can say that for allocating the costs of maintenance and operation of machines on products, plants which manufacture more products in the subsequent stage, the criterion of employment that ensures the best possible causal link with the expenses allocated and, while the lowest approximation in the calculation of cost per product, is the "time-facility

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<sup>2</sup> Călin, O. (2002). Op. cit., page 156.

<sup>3</sup> Călin, O. (2002). Op. cit., page 157.

operation." In favour of using this criterion for allocating pleads the fact that it increases efficiency in determining the cost of sub-activity as a category of offenses or irregularities capacity, identify, in certain circumstances, with this cost.

Mathematically expressed, calculating the allocation of costs of maintenance and machine operation, you can play the following connections:

$$K_{\text{CIFU}} = \text{Ch}_{\text{CIFU}} / \sum_{i=1}^n O_i, \quad \text{and } R_i = K_{\text{CIFU}} \times O_i \quad (1)$$

on condition that:

$$\sum_{i=1}^n R_i = \text{Ch}_{\text{CIFU}} \quad (2)$$

in which:

$K$  = coefficient of distribution (additional);

$\text{Ch}$  = costs allocated;

$\text{CIFU}$  = machine operation and maintenance expenses;

$O_i$  = number of operating hours of the facility for the particular product;

$n$  = number of products for the allocated expenditure;

$R_i$  = share of expenditure allocated to a product.

It should be noted that when an installation/ plant produces two or more products, in successive stages, which are homogeneous or can be homogenized, applying a variant of the coefficients of equivalence process, may be used as a criterion for allocating the amount of manufactured products, expressed either in physical units of measurement or in equivalent units of measurement, for the repartition of maintenance and operation of machines costs.

Regarding the allocation of overheads of the department on products produced in the respective entities fertilizer, we apply the process of overall distribution by simple division, in sections where there is manufactured a single product and the process of supplementing, in its classic form in sections where they make more products.

We believe that sharing overheads of the department on products showing the smallest error, thereby determining accurate cost per unit, can be made to entities in the industry of chemical fertilizers, using the same criteria as cost allocations for maintenance and machine operation, namely:

- the hours-activity criterion that can be used when the entire activity of the department can be expressed in number of hours, on the one hand, and on the other hand, it is possible to establish when manufacturing the product;
- the quantity of products manufactured or packaged, expressed in physical units or conventional criteria that can be used when track time is achieved with difficulty.

Mathematically, calculation relations used in the distribution of the department's general costs resemble those of allocating the costs with maintenance and machine operation.

Once two categories of indirect costs have been allocated, i.e. costs of maintenance and operation of equipment and the department's general costs, we can calculate the cost of production of each product (half-finished material) by adding direct expenses with the share of indirect costs.

Regarding the allocation of general administration expenses in cost of products, which for the fertilizer entities is made by the process of supplementing the need to use such a criterion that takes into account the connection between this expenditure and the size and structure of production, respectively its value represented by all direct and indirect costs that

are known so far on each product. In other words, the allocation of overheads for administration, the most appropriate basis for allocation is the cost of production, since, as we know, is a general indication and complex, which is influenced by all the factors that have participated in the production process and thereby provides causal link required.

Distribution of general administration expenses by the supplementing process resembles the allocation of costs of maintenance and operation of equipment, but in this case, it is used as a distribution cost criterion, the production cost.

Once general administrative expenses have been allocated, for those products that are sold unpackaged to customers it can be calculated the full cost, by adding the cost of production of each product, with the share of general administrative costs. Products sold in packed condition for achieving this cost will be added the share of the costs of packaging, determined by a calculation of apportionment, as previously discussed.

It should be noted that the design methodology standard cost, distribution overheads of administration, as the overheads of the department, the products can also be done on another path, slightly circuitous, namely by allocating them first on installations as places (centres) activity and then, within them, the products manufactured. The methodology and the results do not differ from those presented, but by a higher volume of calculations, it creates the possibility to obtain full information about the cost and installation level.

Another problem with the allocation of general administration expenses is that, from this calculation, unlike the current methodology from own production semi manufactured goods and auxiliary sections works and services intended for domestic consumption should be excluded. Their exclusion from the allocation of overheads of administration offers a number of advantages, namely:

- reducing the amount of internal circulation;
- avoiding double entries of administrative overheads in the cost of production;
- creating the possibility for a perfect correlation between the volume of administration overheads budget under the total of these expenses, from cost of freight entire production (taking into account the amounts distributed on unfinished production when there is such a situation);
- facilitation of the operation for calculating the cost of the finished product, whereas if the half-finished materials of its own production contain a share of general administrative expenses don't mind the expenses of the half-finished materials, because otherwise, the share of the general administration expenses would be included twice in the cost of the finished product.

The half-finished materials for sale must include the cost and the share of the general administrative expenses.

Based on the determination of standard costs per item calculation, according to the presented methodology, a calculation is developed for a standard product. Such calculations for the products: ammonium nitrate 34.5% N<sub>2</sub>, N<sub>2</sub> and expressed 100% calcium ammonium nitrate 27% N<sub>2</sub>, expressed 100% N<sub>2</sub>, are shown in Tables no. 1 and 2.

These two products are obtained in successive stages from the same plant, which is part of the Division of ammonium nitrate, so we are in a situation where the same facility is established as a place of costs for two main products distinctly produced and no auxiliary product.

The exact calculation is as follows:

- for the calculation articles "direct auxiliary materials"; "semi manufactured from own production"; "technological utilities' the calculations were made on the basis of quantity and value standards that can be set per unit of product manufactured for each of the two products;

- for the calculation article "freight-supply," the standard level of these expenses was determined by weighting the standard unit costs for direct auxiliary materials coefficient cost allocation of the standard transport-supply;

- for other calculation items, indirect expenses to the two products manufactured; of these expenses we allocated shares in the products as follows:

Direct wages total 78.288.000 lei were distributed according to the number of operating hours of the plant, which is as follows:

- 536 hours for ammonium nitrate
- 134 hours for calcium ammonium nitrate

Total basic allocation 670 hours

In this situation, the additional factor is determined as follows:

$$K = 78.288.000 / 670 = 116.848 \text{ lei/hour}$$

The share of direct wages for each product is:

- ammonium nitrate:	536 x 116.848 = 62.630.528 lei
- calcium ammonium nitrate:	134 x 116.848 = <u>15.657.472 lei</u>
Total	78.288.000 lei

The share of direct wages per unit of product is:

- ammonium nitrate:	62.630.528 : 6.900 = 9.077 lei/ton
- calcium ammonium nitrate:	15.657.472 : 1.350 = 11.598 lei/ton

Expenses with social security and social protection were determined by the percentage of the unit direct wages of 23% (15,8% CAS, 5,2% CASS, 0,5% unemployment, etc.).

Expenditure with maintaining and functioning of machinery of 94.995.000 lei were distributed for the two products based on the functioning hours of the facility, as follows:

The supplementing coefficient will be:

$$K = 94.995.000 / 670 = 141.784 \text{ lei/hour}$$

The share of the expenditure with maintaining and functioning of machinery for each product is:

- ammonium nitrate:	536 x 141.784 = 75.996.224 lei
- calcium ammonium nitrate:	134 x 141.784 = <u>18.998.776 lei</u>
Total	94.995.000 lei

The share of the expenditure with maintaining and functioning of machinery for each unit of the product is:

- ammonium nitrate:	75.996.224 : 6.900 = 11.014 lei/ton
- calcium ammonium nitrate:	18.998.776 : 1.350 = 14.073 lei/ton

The general expenditure of the ammonium nitrate facility of 127.683.000 lei were distributed according to the number of functioning hours of the machineries of the section, as follows:

- for ammonium nitrate	536 hours
- for calcium ammonium nitrate	134 hours
- for liquid fertilizers	<u>670 hours</u>
Total distribution base	1.340 hours

The supplementing coefficient will be:

$$K = 127.683.000 / 1.340 = 95.286 \text{ lei/hour}$$

The share of general expenditure of the section for each product is:

- for ammonium nitrate:	536 x 95.286 = 51.073.296 lei
- for calcium ammonium nitrate:	134 x 95.286 = 12.768.324 lei
- for liquid fertilizers:	670 x 95.286 = <u>63.841.380 lei</u>

Total:

127.683.000 lei

**Table no. 1**  
**Standard calculation per product**

Cod / Section name: 40 000 ammonium nitrate

Cod / Facility name: 40 100 ammonium nitrate / calcium ammonium nitrate

Cod / Product name: 14 000 ammonium nitrate

Standard physical quantity: 240 000 tons/year

Standard quantity 100% N<sub>2</sub>: 82 800 tons/year

Code of the calculation article	Name of the expense	M/U	Unit quantitative standard	Unit price	Standard value
200	Direct auxiliary materials				
208	Polyethylene sacks	Pcs.	58,55	938	54.920
210	Sulphuric acid	Tons	0,01448	179.800	2.604
211	Agero 100% s.a.	Kgs	1,30	1.210	1.573
212	Diatomite	Tons	0,082	118.465	9.714
Total of direct auxiliary materials					68.811
300	Freight-supply expenditure		0,18	68.811	12.386
500	Own production semi manufactured goods				
501	Ammonia	Tons	0,6296	558.421	351.582
502	Nitric acid	Tons	2,304	226.782	522.506
Total own production semi manufactured goods					874.088
600	Technological utilities				
601	Electricity	Mwh	0,065	142.394	9.256
602	Recirculated water	thousands cubic metres	0,060	67.425	4.046
604	Heating	Gcal	0,600	70.692	42.415
605	Steam	cubic metres	0,850	4.566	3.881
Total technological utilities					59.598
800	Direct wages	lei			9.077
900	Social contributions for direct wages	lei	0,23	9.077	2.088
1000	Expenditure with maintaining and functioning of machinery	lei			11.014
1100	General expenditure of the section	lei			7.402
	Standard production cost	lei			1.044.464
1200	Administrative expenditure	lei			8.220
1300	Packing	lei			19.239
	Complete standard cost	lei			1.071.923



**Table no. 2**  
**Standard cost calculation per product**

Cod / Section name: 40 000 ammonium nitrate

Cod / Facility name: 40 100 ammonium nitrate / calcium ammonium nitrate

Cod / Product name: 15 000 ammonium nitrate

Standard physical quantity: 60 000 tons/year

Standard quantity 100% N<sub>2</sub>: 16 200 tons/year

Code of the calculation article	Name of the expense	M/U	Unit quantitative standard	Unit price	Standard value
200	<b>Direct auxiliary materials</b>				
208	Polyethylene sacks	Pcs	74,815	938	70.176
210	Sulphuric acid	Tons	0,0185	179.800	3.326
211	Agero 100% s.a.	Kgs	2,0	1.210	2.420
212	Diatomite	Tons	0,090	118.465	10.662
213	Dolomite	Tons	0,760	52.000	39.520
<b>Total of direct auxiliary materials</b>					<b>126.104</b>
300	Freight-supply expenditure		0,18	12.699	22.699
500	<b>Own production semi manufactured goods</b>				
501	Ammonia	tone	0,720	558.421	402.063
502	Nitric acid	tone	2,600	226.782	589.633
<b>Total own production semi manufactured goods</b>					<b>991.696</b>
600	<b>Technological utilities</b>				
601	Electricity	Mwh	0,090	142.394	12.815
602	Recirculated water	thousands m <sup>3</sup>	0,090	67.425	6.068
604	Heating	Gcal	0,600	70.692	42.415
605	Steam	m <sup>3</sup>	0,850	4.566	3.881
606	Methane	mii m <sup>3</sup>	0,0043	334.070	1.437
<b>Total technological utilities</b>					<b>66.616</b>
800	Direct wages	lei			11.598
900	Social contributions for direct wages	lei	0,23	11.598	2.668
1000	Expenditure with maintaining and functioning of machinery	lei			14.073
1100	General expenditure of the section	lei			9.458
<b>Standard production cost</b>					<b>1.244.912</b>
1200	Administrative expenditure	lei			9.797
1300	Packing	lei			19.239
<b>Complete standard cost</b>					<b>1.273.948</b>

The share of general expenditure of the section for each unit of product is:

- ammonium nitrate:  $51.073.296 : 6.900 = 7.402$  lei/ton

- calcium ammonium nitrate: 12.768.324 : 1.350 = 9.458 lei/ton

The share of general administrative expenses incumbent on each of the two products is determined by weighting the standard percentage of the allocation of these expenses (0,7870%) with standard unit cost of production, thus:

- ammonium nitrate: 1.044.464 x 0,7870 % = 8.220 lei/ton

- calcium ammonium nitrate: 1.244.912 x 0,7870 % = 9.797 lei/ton

For the packing costs amounting to 379.97.000 lei, the products were distributed according to the amount of conventional packaged products, which are as follows:

- urea	11.500 tons 100% N <sub>2</sub>
- ammonium nitrate	6.900 tons 100% N <sub>2</sub>
- calcium ammonium nitrate:	<u>1.350 tons 100% N<sub>2</sub></u>
Total distribution base	19.750 tons

The supplementing coefficient will be:

$$K = 379.970.000 / 19.750 = 19.239 \text{ lei/hour}$$

This coefficient is actually the share of spending packing plant that returns per unit of packed product

After we performed the allocation of indirect costs on the two products manufactured at the ammonium nitrate / calcium ammonium nitrate facility, by adding shares of these expenses, the costs directly determined per unit of output, we get the cost per unit at completely standard level on which we intend to perform standard calculation.

## 5. CONCLUSIONS

The standard calculation on the product can thus be considered the highest level of forecasting expenditure, on which we base the absolute consumption standards determined by scientific methods.

Elaborating the standard product calculation of expenditure required to report certain business conditions (optimal or normal) leads to determining the costs per unit of production, which are cleaned by random fluctuations and inefficiencies. This comes even closer to the calculation method standard cost, better basing the concept according to which the calculation standard may take us very close to the actual expenditure per unit of product.

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