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Analyzing and measuring the joint costs of petroleum products and showing their impact on profits: Applied research in Aldora refinery

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Abstract:

The research dealt with the topic of analyzing and measuring the joint costs of petroleum products and showing their impact on profits. The research problem was represented by not relying on modern scientific methods of cost accounting to determine and measure the joint costs of petroleum products, which leads to an increase in the costs of petroleum products and then a decrease in the overall profit. The research aimed to delve into the joint costs and methods of calculating them in the oil sector, and to analyze and measure the joint costs of petroleum products, in addition to stating the impact of the decrease in joint costs on the overall profit. The application was applied to the products of the Dora refinery, and the research reached a set of conclusions, the most important of which are There are four methods for allocating joint costs, but any method we use to allocate joint costs, the researcher believes that the best method is the total value of sales at the point of separation because it is easy to implement as well as it is the best measure of the benefits achieved when compared with other methods of allocating joint costs.

Introduction and importance of Research:

Cost is defined as a sacrifice of the resources of the economic unit in exchange for obtaining a specific purpose (good or service) and since the main objective of cost accounting is to determine the costs of the product in order to be able to price and sell it at a suitable profit, so the importance of research lies in focusing on the costs of the oil sector products and calculating the common costs of those products According to the scientific methods of cost accounting with the aim of accurately determining the cost of those products, reducing them, and then increasing the total profit to achieve the goals of the economic unit efficiently.

Keywords: Cost, joint costs, gross profit, profitability analysis.

Research methodology

Research problem:

The research problem was represented by not relying on modern scientific methods of cost accounting to determine and measure the joint costs of petroleum products, which leads to an increase in the costs of petroleum products and then a decrease in the overall profit.

Research objective:

The research aimed to delve into the joint costs and methods of calculating them in the oil sector, and to analyze and measure the joint costs of petroleum products, in addition to stating the impact of the decrease in joint costs on the overall profit.

Importance of research:

The importance of the research lies in the fact that it is a method for calculating the costs of petroleum products in the presence of joint costs, using the scientific method to calculate those costs, arriving at a statement of the total profit, in addition to stating the best method that achieves the highest profits.

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Hypothesis:
The research is based on the hypothesis that "the correct and accurate determination of the joint costs by relying on modern scientific methods of cost accounting strengthens control over the cost of oil products and their pricing, and then reflects the true profitability of those products."
Theoretical approach:
Addressing the concept of cost and its objectives, identifying common costs and methods of calculating them in the oil sector, identifying, analyzing and measuring the joint costs of petroleum products, and stating the effect of the value of joint costs on the total profit.
Data and methodology:
The researcher applied modern scientific methods to calculate the joint costs of petroleum products in the Doura refinery and indicate their impact on the overall profit in the oil sector.
Estimation and analysis:
The researcher used mathematical methods to calculate the cost of petroleum products, including joint costs, as well as preparing an income statement to determine the total profit.
Results and discussion:
The researcher indicated that the allocation and measurement of the value of joint costs affects the value of profitability in the oil sector and explained the effect of the decrease in joint costs on the total profit.

Theoretical framework:

Important concepts for identifying and measuring joint costs

Joint cost

They are the costs that occur before the point of separation, or the costs of the production stage, resulting in multiple products at once.

Separable Costs

It is the additional costs that occur after the point of separation to purify the product and sell it at a price higher than its price in its condition at the point of separation.

Split-off Point

It is the point at which the raw material separates into more than one product.

Why allocate shared costs and how to allocate them:

Shared costs are allocated to determine the storable costs and the cost of goods sold and for the purposes of preparing the internal report and analyzing the profitability of the departments and the performance of the managers of those departments. There are two entries for allocating shared costs, the first one - using specific market-based data such as revenues, and the second is the allocation of joint costs using a physical measurement such as weight, volume, or cubic foot.
(Professor H uddart,2009, p2)

Common cost allocation methods of joint costs

1. physical –measure method

The physical measurement method allocates the joint costs of joint products on the basis of the relative weight of volume or other physical measures at the point of separation of the total output of those products.

2. Sales value at Split off method

The Sales Value on Separation method allocates joint costs to joint products on the basis of the total relative sales value at the point of separation resulting from the total output of those products.

3. Net Realizable value (NPV) method

The net realizable value method allocates joint costs of joint products on the basis of the relative net realizable value - final sales value minus the post-separation costs of total output from joint products.

4. Net realizable value method on a fixed gross margin ratio

The realizable value net method allocates the gross margin ratio on the joint costs by the method that makes the gross margin ratio completely similar to the individual products. This method relies on three basic steps: 1) calculating the total gross margin ratio for all the joint products together 2) the margin ratio is multiplied The total in the final sales values for each product to calculate the gross margin for each product, and the gross margin for each of the final sales value for each product is subtracted to obtain the costs that will be charged for each product, 3) costs after

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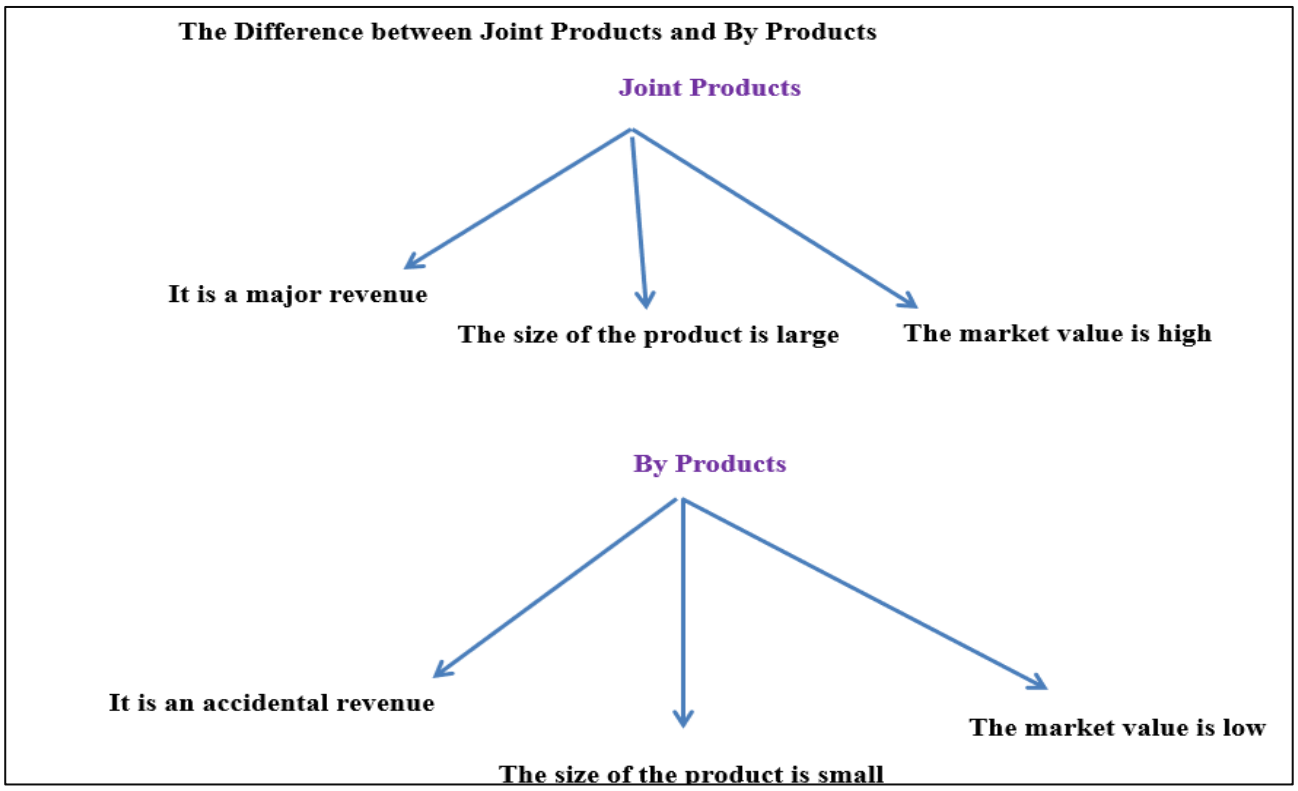
separation are subtracted from the total costs that will be charged for each product. We obtain an allocation of joint costs. (Horngren,2012, p578-579)



Shapes prepared by the researcher

Therefore, the cost accountant in the transitional industries faces difficulties in determining the costs of joint and incidental products. Therefore, it is necessary in this case to follow scientific methods for allocating and extracting the cost of each product separately for the purposes of pricing and preparing financial statements, including income statement.

Since oil is an important resource in the present and future of Iraq, as well as a source of economic development, the costs of petroleum products should be determined accurately and according to an appropriate scientific method, so the main characteristics of the oil industries must be known:

- The oil industry is characterized by its complex processes that require technological development and technology.
- Depends on a small number of people, but they are highly skilled and experienced.
- The high age of the oil field.
- There is a correlation between the various stages of the industry during production.
- The risk is high.
- It requires large capital.
- The high cost of investment in scientific research.

As for the stages of the oil industry, they are as follows:

• The reconnaissance and exploration phase
• The drilling and development stage
• The stage of production and pressure of oil and gas. (Dr. Abdel Khaleq,2011p41-42)

The application of these methods depends on the strength of the internal control system and its information, which must be of high quality in order to reach an accurate cost analysis. (Thijeel, et al,2019, p 569), And he sees the al ghabban Increasing profits by increasing sales revenue, whether by increasing sales volume or selling price, is not easy to achieve in the presence of intense competition (Al ghabban,at al ,2007,p199).

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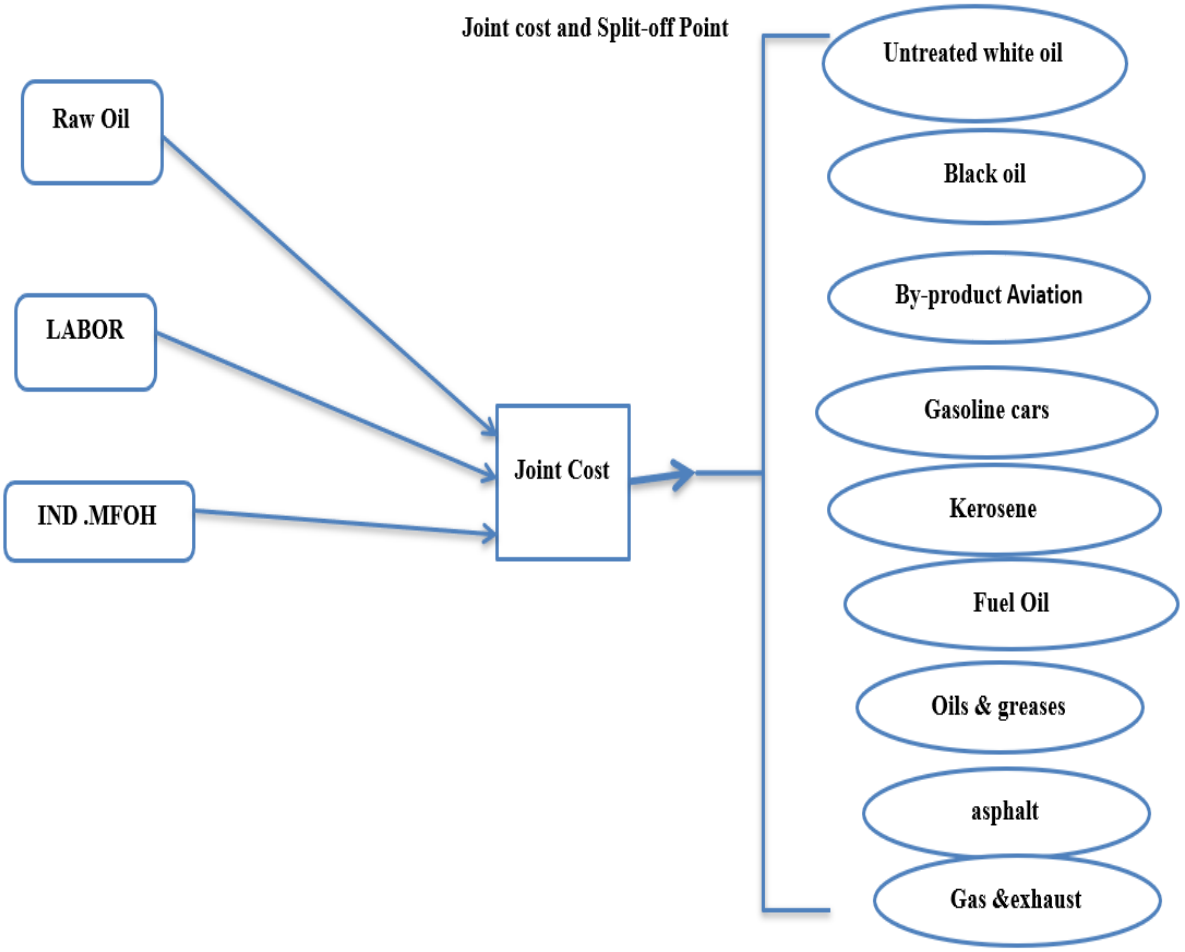

Source: prepared by the researcher

Practical framework:

The research was applied to the Al-Dawra Refinery is considered one of the oldest large refineries in Iraq and represents the real beginning of the revival of the modern oil industry. The factory is located southeast of Baghdad. Construction of the refinery began in 1953 with the contribution of a group of international companies and began operating in 1955. On petroleum products and the information was taken from the production department for the year 2022 due to its availability, thee information on petroleum products is as shown in Table 1.

JOINT PRODUCTS (1)

ITEM	Quantity M^3	Density degree rate	Density-adjusted quantities M^3	Quantities sold M^3	selling price
Untreated white oil	535872	48	25721856	24435763	567.37
Black oil	2767244	15.2	42062109	41220867	550.00
Gasoline cars	976540	80.6	78709124	75560759	561.46
Kerosene	279951	60	16797060	15789236	573.40
Fuel Oil	931272	38.8	36133354	35410687	550.00
Oils & greases	85788	32.1	2753795	2616105	567.37
asphalt	622193	15.3	9519553	8948380	573.40
Gas &exhaust	15877	122.3	1941757	1941757	507.08

Source: Prepared by the researcher based on the data of Dura refinery.

After knowing the joint products, we apply the methods of calculating joint costs:

Firstly physical –measure method:

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Physical –measure method (2)

ITEM	Density-adjusted quantities	(Relative weight)	physical –measure method (JOINT COST)
Untreated white oil	25721856	0.1204	10270187302
Black oil	42062109	0.1969	16794501057
Gasoline cars	78709124	0.3684	31426870825
Kerosene	16797060	0.0786	6706707025
Fuel Oil	36133354	0.1691	14427275911
Oils & greases	2753795	0.0129	1099531482
asphalt	9519553	0.0446	3800954035
Gas &exhaust	1941757	0.0091	775302066
Total	213638608	100%	85301329702

Source: Prepared by the researcher based on the data of Dura refinery

It is evident from the foregoing that the joint costs amounted to 85301329702 Dinar, and that this method relied on the r elative weight of the quantity, i.e., its physical measurement, in the distribution of joint cost, and here the cost per unit is fixed for all joint products 85301329702 /213638608=399.279 per unit, this calculation is imprecise and affects the overall profitability of those products. This can be clarified in the income statement as follows:

Income statement by physical measurement method (3)

item	Untreated white oil	Black oil	Gasoline cars	Kerosene	Fuel Oil	Oils & greases	asphalt	Gas &exhaust
Sales revenue	13864118853	2267147685	4242434374	9053547922	1947587785	1484299494	5131001092	98462614
Cost of good cold								
Joint cost	10270187302	16794501057	31426870825	6706707025	14427275911	1099531482	3800954035	775302066
+B(INV)	0	0	0	0	0	0	0	0
-E(INV)	(513509445)	(335890265)	(125707602)	(4024029)	(288545757)	(5497672)	(2280573)	0
Cost of goods Sold	9756677857	16458610792	30169794796	6304304066	14138730154	1044554757	3572896651	775302066
Gross profit	41074409	6212866058	1225454895	2749243856	5337147696	4397447	1558104441	20932407

Source: Prepared by the researcher based on the data of Dura refinery

The income statement revealed that the profit was approximate due to the unit cost of the ending inventory; the period was fixed for all products because it is the method of physical measurement in addition to the cost of joint costs. It was a single cost for all products; whose value was 399 dinars per unit, the period was fixed for all products because it is the method of physical measurement in addition to the cost of joint costs. It was a single cost for all products, whose value was 399.279 dinars per unit.

Value ending inventory using physical measurement method (4)

Unit cost (E.INV)	Quantities (E.INV)	Value(EINV)
399.279	1286093	513509445
399.279	841242	335890265

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399.279	3148365	1257076029
399.279	1007824	402402959
399.279	722667	288545757
399.279	137690	54976725.5
399.279	571173	228057384
399.279	0	0

Secondly Total sales value

The joint costs amounted to 85301329702 Dinar

Total sales value method (5)

ITEM	Density-adjusted quantities M^3(1)	selling price (2)	Total sales value (3)	Cost per quantities M^3 (4) = joint costs / Total sales value	Total sales value method JOINT COST (5) = (4) *(1)
Untreated white oil	25721856	567.37	14593809439	0.7142	10422898701
Black oil	42062109	550.00	23134159950	0.7142	16522417036
Gasoline cars	78709124	561.46	44192024761	0.7142	31561944084
Kerosene	16797060	573.40	9631434204	0.7142	6878770308
Fuel Oil	36133354	550.00	19873344700	0.7142	14193542785
Oils & greases	2753795	567.37	1562420669	0.7142	1115880842
asphalt	9519553	573.40	5458511690	0.7142	3898469049
Gas &exhaust	1941757	507.08	984626140	0.7142	703219989

It is clear to us that the total sales value method allocated the joint costs on the basis of the total joint costs, dividing the total sales division and extracting the unit cost and through it we determined the share of the joint costs for each product by multiplying the unit cost by the quantity of each product.

Income statement by Total sales value method (6)

item	Untreated white oil	Black oil	Gasoline cars	Kerosene	Fuel Oil	Oils & greases	asphalt	Gas &exhaust
Sales revenue	13864118853	22671476850	424243437 48	9053547922	19475877850	1484299494	5131001092	9846261 40
Cost of good cold								
Joint cost	10422898701	16522417036	31561944084	6878770308	14193542785	1115880842	3898469049	7032199 89
Separable Costs	10270280 0	16794125 7	31426715 8	6706390 54	1442701 38	10995341	3801027 2	775389
+B(INV)	0	0	0	0	0	0	0	0
-E(INV)	(526280157)	(33380709 4)	(1275048466)	(4529647 42)	(286756227)	(56343911)	(2361886 85)	0
Cost of goods sold	9999321344	16356551199	30601162776	7096444621	1405105669 6	1070532272	3700290636	7039953 78
Gross profit	3864797509	6314925651	1182318097 2	1957103301	5424821154	4137672222	1430710456	2806307 62

Source: Prepared by the researcher based on the data of Dura refinery.

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It is clear to us from this method that it depends on the total sales value to extract the joint costs, and for the purpose of extracting the net income, we extract the cost of goods sold that is equal to the joint costs plus the additional costs and we subtract from it the stock of the last period

Value ending inventory using Total sales value method (7)

Unit cost (E.INV)	Quantities (E.INV)	Value (EINV)
409.208	1286093	526280157
396.803	841242	333807094
404.987	3148365	1275048466
449.448	1007824	452964742
396.803	722667	286756227
409.208	137690	56343911
413.515	571173	236188685
362.556	0	0

Third Net Realizable value (NPV) method
Net Realizable value (NPV) method (8)

ITEM	Sales value (Quantities product M^3 x selling price)	Separable Costs	Net Sales value
Untreated white oil	14593768825	102702800	14491066025
Black oil	23134159950	167941257	22966218693
Gasoline cars	44191893579	314267158	43877626421
Kerosene	9631505681	670639054	8960866627
Fuel Oil	19873344700	144270138	19729074562
Oils & greases	1562416321	10995341	1551420980
asphalt	5458552199	38010272	5420541927
Gas &exhaust	984633624	775389	983858235

Source: Prepared by the researcher based on the data of Dura refinery.

It is clear to us that this method depends on the sales value and reduces the additional costs of extracting the net sales value after the point of separation for the purpose of distributing the joint costs on the basis of the total net sales value of each product, as follows.

Economic unit data showed that the allocation joint costs amounted to (joint costs 85301329702- sales revenue Aviation fuel (By Products) 6824106376) =78477223326 Dinar, we will calculate the share of each product in the joint costs by dividing the share of each product by the total net sales value.

For every product Joint Cost (9)

ITEM	JOINT COST (1)	Net Sales value For every product (2)	ratio net sales value (3)	JOINT COST For every product (4) (4) = (1) *{(3)
Untreated white oil	78477223326	14491066025	0.122825761	9639024691
Black oil	78477223326	22966218693	0.194660854	15276443339
Gasoline cars	78477223326	43877626421	0.371905204	29186087741
Kerosene	78477223326	8960866627	0.075951987	5960501079
Fuel Oil	78477223326	19729074562	0.167222936	13123191662
Oils & greases	78477223326	1551420980	0.013149789	1031958940
asphalt	78477223326	5420541927	0.045944321	3605582735
Gas &exhaust	78477223326	983858235	0.008339147	654433139
Allocation joint costs amounted				78477223326

Source: Prepared by the researcher based on the data of Dura refinery.

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Income statement by net Realizable value- NPV- method (10)

item	Untreated white oil	Black oil	Gasoline cars	Kerosene	Fuel Oil	Oils & greases	asphalt	Gas &exhaust
Sales revenue	13864118853	22671476850	42424343748	9053547922	19475877850	1484299494	513100092	984626140
Cost of good cold								
Joint cost	9639024691	1527644339	2918608741	5960501079	13123191662	1031958940	360558735	654433139
Separable Costs	102702800	167941257	314267158	67063905 4	14427013 8	10995341	380102 72	775389
+B(INV)	0	0	0	0	0	0	0	0
-E(INV)	(487086375)	(308887692)	(1180014196)	(397868408)	(265349236)	(52147714)	(218615580)	0
Cost of goods sold	9741727491	1544438 4596	2950035 4899	6631140133	13267461800	1042954281	364359 3007	655208528
Gross profit	4122391362	7227092254	1292398 8849	24224077789	62084160 50	44134521 3	148740 8085	329417612

Source: Prepared by the researcher based on the data of Dura refinery.

It is clear to us from the results of the income statement that the total profit increased according to this method because the unit cost changed and was not fixed, in addition to the cost of the stock at the end of the period. It was variable for all products and was not fixed, which affected the total profit and thus the profit rate, knowing that the unit cost was calculated by adding, the joint costs of each product with the additional costs and divided by the amount of production after that multiplied by the quantity of stock at the end of the period and here the joint costs reduced by the sales value of the incidental product jet fuel.

Value ending inventory using net Realizable value (11)

Unit cost (E.INV)	Quantities (E.INV)	Value (EINV)
378.733	1286093	487086375
367.180	841242	308887692
374.802	3148365	1180014196
394.780	1007824	397868408
367.180	722667	265349236
378.733	137690	52147714
382.748	571173	218615580
337.431	0	0

Fourthly Net realizable value method on a fixed gross margin ratio

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Joint Cost using Net realizable value method on a fixed gross margin ratio (12)

item	Untreated white oil	Black oil	Gasoline cars	Kerosene	Fuel Oil	Oils & greases	asphalt	Gas &exhaust
Sales revenue (quantities product M3 x selling price)	14593768825	23134159950	44191893579	9631505681	19873344700	1562416321	5458552199	984633624
fixed gross margin ratio 27%	3940317583	6246223187	11931811266	2600506534	5365803069	421852407	1473809094	265851078
Separable Costs	102702800	167941257	314267158	67063905 4	144270138	10995341	38010272	775389
allocated Joint Cost	383761 4783	6078281930	1161754 4108	192986 7480	522153 2931	41085 7066	1435798822	2650756 89

Source: Prepared by the researcher based on the data of Dura refinery.

The gross profit margin method uses the percentage of gross margin that is extracted from (the quantity of production multiplied by the selling price) minus (the joint costs plus the additional costs), and then we extract the result net profit on the total sales value of the production, and here it is 27%, Accordingly, the joint costs were allocated through the sales value minus the amount of the 27% of the sales value, and then the additional costs were subtracted from them.

Income statement by Net realizable value method on a fixed gross margin ratio (13)

item	Untreated white oil	Black oil	Gasoline cars	Kerosene	Fuel Oil	Oils & greases	asphalt	Gas &exhaust
Sales revenue	13864118853	22671476850	42424343748	9053547922	19475877850	1484299494	5131001092	9846261 40
Cost of good cold								
Joint cost	3837614783	6078281930	11617544108	1929867480	5221532931	410857066	1435798822	265075689
Separable Costs	102702800	167941257	314267158	67063905 4	144270138	10995341	38010272	775389
Production costs available for sale	3940317583	3940317583	3940317583	3940317583	3940317583	3940317583	3940317583	3940317583
-E(INV)	(197015879)	(124924464)	(477272451)	(156030392)	(107316061)	(21092620)	(8842 8546)	0
Cost of goods sold	3743301704	6121298723	1145453816	2444476142	5258487008	400759786	1385380548	265851078
Gross profit	1012081726 3	1655017802 8	3096980 4955	6609072010	1421739 0798	1083539849	3745620441	7187750 61

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It is evident from the method of gross fixed margin percentage that it was fixed for all products at a rate of 27% according to which the joint costs were allocated. In addition to that, the inventory of the last period whose cost was calculated on the basis of the cost of production available for sale divided the units produced

Value ending inventory using Net realizable value method on a fixed gross margin ratio (14)

Unit cost (E.INV)	Quantities (E.INV)	Value (EINV)
153.189	1286093	197015879
148.500	841242	124924464
151.594	3148365	477272451
154.819	1007824	156030392
148.500	722667	107316061
153.189	137690	21092620
154.819	571173	88428546
136.913	0	0

The ratio of total profitability to allocation of shared joint costs (15)

allocation methods	Percentage of gross profit	Classification according to profitability
physical measurement method	29 %	The second
Total sales value method	27 %	The third
net Realizable value- NPV- method	31 %	The First
Net realizable value method on a fixed gross margin ratio	27 %	The third

It is evident that the highest profitability was for the net realizable net sales value method, where profitability reached 31%, followed by the physical measurement method with a percentage 29 %, As for the total sales value and the gross fixed margin ratio, they were less profitable and reached a percentage 27%.

How to account for the by-product and this is done through two methods, the first is the production method and the second is the sales method, and the main product is black oil and the by-product Aviation fuel, The cost of the materials and the conversion cost is 24870033795 dinars, and sales value, 6824106376 dinars, 8000,000 Quantities sold, selling price 853.01, Quantities product 7000,000.

Therefore, the total profit margin can be extracted according to the two methods as follows

Accounting for the main and byproduct (16)

Item	Sales method	Production method
Sales revenue		
main product (Black oil)	22671476850	22671476850
by-product (Aviation fuel)	+6824106376	-
Total Sales revenue	29495583226	22671476850
Main production cost (Black oil)	25037975052	25037975052
sales value of the by-product (Aviation fuel)	-	(6824106376)
Total manufacturing costs	25037975052	18213868676
E(INV) Main production	(607410200)	(441860397)
Cost of production sold	24430564852	17772008279
Gross profit margin	5065018374	4899468571
Percentage of gross profit	!7%	22%
Note E(INV) Aviation fuel	0	853013297

It becomes clear to us that the gross profit margin percentage was 17% in the Sales method and reached 22% in the production method, as for the ending inventory, it was calculated by multiplying (1000000+ 41220867) x Total manufacturing costs for each method, Total manufacturing costs are calculated by adding the material cost, conversion cost and additional costs 24870033795 Plus 167941257 Equal 25037975052.

Conclusions:

1. There are four methods for allocating joint costs, but any method we use to allocate joint costs, the researcher believes that the best method is the total value of sales at the point of separation because it is easy to implement as well as it is the best measure of the benefits achieved when compared with other methods of allocating joint costs.
2. The method of physical measurement is not preferred because it does not depend on a clear and purposeful basis that is appropriate for the perceived benefits.
3. When selling prices at the point of separation are not available, the net realizable net sales value method can be used, but it is complex to apply and assumes that all profit can be attributed to the joint operation and not to the costs of separation.
4. All products are considered a single product. Gross profit margin method is fixed and thus easy to apply. Therefore, the profit margin ratio is equal and fixed for all products.
5. Accounting for by-products the method of recognition at production this method is impractical because the production will not be sold. The method of recognition on sale is a process that represents the real reality.
6. The allocation and measurement of the value of joint costs affects the profitability value in the oil sector as well as the cost of inventory at the end of the period.

Data Availability:

The data used to support the results of this study has been included in the article.

Conflict of Interest :

The authors declare that they have no conflicts of interest.

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