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METHODS IN MONITORING EFFICIENCY AND EFFECTIVENESS OF OIL REFINERY

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OF OIL REFINERY

Introduction

Possible methods in monitoring the efficiency and effectiveness of crude oil processing technology have been presented taking as an example a oil refinery complex with a processing capacity of five million tons per year.

From the aspect of energy, the efficiency of crude oil processing is determined by comparing the cost prices of steam, generated in refinery units to the cost prices of steam generated in Refinery Power Plant, and effectiveness through the money savings realized by eliminating the differences between the target standard of energy consumption (the average energy consumption standards in Western European refineries) and self energy consumption of each refinery unit.

From the aspect of technology, determining the efficiency of crude oil processing (the production of coupled products) is presented through the following methods: the Sales Value Allocation Method, the By-Product Method, the Specific Gravity Method, the Specific Gravity and Number 1000 Method, the Heat of Combustion Method, and method Le cout moyen du traitement pour chaque unite. An analysis of differences and similarities, as well as advantages and disadvantages of outlined methods is also given.

From mentioned technological aspect, effectiveness is determined through the cost prices of finished products along with calculating the profit or loss per each oil product, separately.

ENERGY ASPECTS OF EFFICIENCY AND EFFECTIVENESS

From energy point of view, the efficiency of oil refinery is determined through the cost prices of high, medium and low pressure steam, generated as the by-product in the following refinery units: Crude Unit, Vacuum Distillation, Vacuum Residue Visbreaking Unit, Catalytic Reforming and Fluid Catalytic Cracking, because the main production of refinery units is crude oil processing.

It can be seen (Table 1) that the cost prices of steam generated in the refinery units are about twenty times lower than the cost prices of steam generated in Refinery Power Plant. The basic reason for such cost trend of high, medium and low pressure steam generated in refinery units lies in the fact that the steam is obtained as a by-product, utilizing the heat of the flue gases, in the boiler, and the heat of the products, in the heat exchangers thus offsetting the consumption of engine fuel (fuel oil or fuel gas) and it is well known that in the calculation of the Power Plant produced steam fuel bears the largest portion, its share in the total production cost structure being approximately 80%. This engine fuel consumption is completely eliminated in the Crude Unit, Vacuum Distillation Unit, Vacuum Residue Visbreaking Unit and Catalytic Reforming, while in the Fluid Catalytic Cracking Unit the fuel consumption is partially eliminated.

in $/t

		HpS	MpS	LpS

Item no.	Refinery units	Cost price	Fuel consumption	Cost price	Fuel consumption	Cost price	Fuel consumption
1	2	3	4	5	6	7	8
1	**Crude Unit**	-	-	0.47	-	-	-
2	**Vacuum Distillation**	-	-	0.44	-	-	-
3	**Visbreaking**	-	-	0.22	-	0.05	-
4	**Catalytic Reforming**	-	-	0.45	-	-	-
5	**Fluid Catalytic Cracking**	3.10	2.98	2.53	2.40	1.94	1.83
6	**Refinery Power Plant**	10.83	9.45	9.66	8.09	9.29	7.02

Table 1. The cost prices of steam and engine fuel consumption

Besides eliminating the fuel consumption (completely or partially), the methodological aspect of observing the steam as the by-product determines also the level of cost prices. Namely, in this manner, the cost prices of steam consist of the direct costs such as demineralized water, depreciation, maintenance and insurance premium, while other costs of refinery units are distributed to the oil products because the main production of refinery unit is crude oil processing.

From the aspect of energy, effectiveness is determined through the money savings realized by eliminating the differences between the target standard of energy consumption and self energy consumption of each refinery unit.

By using certain measures suggested in this Paper, taking a typical refinery as an example, which is the subject of this Paper, the significant money savings of 9.2 millions dollars/annum can be realized (See Table 2).

Item no.	Refinery units	Q'ty of inlet feed in tons	Difference between target and self consumption in $/t	Money savings in $

1	2	3	4	5
1	**Crude Unit**	**5 000 000**	**0.94**	**4 700 000**
2	**Vacuum Distillation**	**2 122 065**	**0.60**	**1 273 239**
3	**Vacuum Residue Visbreaking Unit**	**973 085**	**0.40**	**389 234**
4	**Bitumen**	**94 314**	**1.16**	**109 404**
5	**Catalytic Reforming**	**380 605**	**1.44**	**548 071**
6	**Fluidized Catalytic Cracking**	**821 239**	**0.62**	**509 168**
7	**Hydrodesulfurization jet fuel**	**141 471**	**2.11**	**298 504**
8	**Hydrodesulfurization gas oil**	**244 419**	**1.24**	**303 080**
9	**Alkylation**	**59 053**	**19.3**	**1 139 723**
10	**Total savings**			**9 270 423**

Table 2. Money savings realized by eliminating the differences
between the target standard and self energy consumption
(processing capacity of 5 000 000 t)

By observing table 2 it can be seen that in Crude Unit possible money savings are 4.7 million dollars per annum, in Vacuum Distillation possible money savings are 1.2 million dollars per annum, in Vacuum Residue Visbreaking Unit 0.4 million dollars per annum, in Bitumen 0.1 dollars per annum, etc.

In the continuation of the Paper, proposed method for determining money savings is demonstrated taking as an example one refinery unit named Crude Unit, possible money savings of which is 4.7 millions dollars.

	Specific energy gross consumption		
Bearers of energy	**Q'ty of inlet feed (crude oil 5 000 000 t)**		
Fuel gas	**5 000 000 t**	**(627.6 MJ/t x 0.0027 $/MJ) =**	**8 472 600 $**
Fuel oil	**5 000 000 t**	**(40.4 MJ/t x 0.00305 $/MJ) =**	**6161000 $**
Low pressure steam	**5 000 000 t**	**(150.1 MJ/t x 0.00334 $/MJ) =**	**2506670$**
Medium pressure steam	**5 000 000 t**	**(263.2 MJ/t x 0.00316 $/MJ) =**	**4 158 560 $**
Heat sources	**5 000 000 t**	**(1081.3 MJ/t x 0.002914 $/MJ) =**	**15 753 930 $**
Electric energy	**5 000 000 t**	**(20.2 MJ/t x 0.0167 $/MJ) =**	**1 686 700 $**
Energy bearers	**5 000 000 t**	**(1 101.5 MJ/t x 0.003167 $/MJ) =**	**17 440 630 $**
	Specific energy gross consumption		
Fuel gas		**(627.6 MJ/t x 0.0027 $/MJ) =**	**1.694520 $/t**
Fuel oil		**(40.4 MJ/t x 0.00305 $/MJ) =**	**0.123220 $/t**
Low pressure steam		**(150.1 MJ/t x 0.00334 $/MJ) =**	**0.501334 $/t**
Medium pressure steam		**(257.2 MJ/t x 0.00316 $/MJ) =**	**0.812752 $/t**
Heat sources		**(1075.3 MJ/t x 0.002914 $/MJ) =**	**3.131826 $/t**
Electric energy		**(20.2 MJ/t x 0.0167 $/MJ) =**	**0.337340 $/t**
Energy bearers		**(1 095.5 MJ/t x 0.003167 $/MJ) =**	**3.469166 $/t**
Heat sources:			
Own net energy consumption		**1075.3 MJ/t x 0.002914 $/t =**	**3.13 $/t**
Target net energy consumption		**780 MJ/t x 0.002914 $/t =**	**2.27 $/t**
Difference: Heat sources:			**0.86 $/t**
Own net energy consumption		**1095.5 MJ/t x 0.003167 $/t =**	**3.47 $/t**
Target net energy consumption Difference:		**800 MJ/t x 0.003167 $/t =**	**2.53 $/t** **0.94 $/t**

Table 3. Target standard of net energy consumption and specific energy consumption in typical Crude Unit Process (in $)

From analytic aspect of view, mentioned money savings which can be realized in Crude Unit of 4.7 millions dollars (5 000 000 t x 0.94 $/t) is a result of three following factors:

- the quantity of crude oil processing: 5 000 000 t,
- the inefficiency index of Crude Unit: 137% and
- the values of MJ fuel oil, fuel gas, low and medium pressure steam and electric energy.

Mentioned money savings, realized in this unit and in the other refinery unit, can be realized by eliminating the causes of inefficiency.

The most important causes of inefficiency which can be eliminated by technical/technological and organizational solutions are as follows:

- preheating the fuel by steam in heat exchanger,
- inefficient preheating of combustion air using the heat of flue gases,
- energy unintegration of the plants,
- non economical combustion in the process heater,
- inefficient preheating of feedstock etc.

TECHNOLOGICAL ASPECTS OF EFFICIENCY AND EFFECTIVENESS

Efficiency of refinery units and effectiveness of oil refinery are observed through the cost prices of half-finished and finished products.

Accent is given on the problems and dilemmas that management has to face in choosing the methodology for determining the cost prices of half-finished products, as the instruments for determining the technological efficiency, and the cost prices of finished products, as the instruments for determining the effectiveness of oil refinery.

Mentioned problems are caused by the complexity of crude oil processing technology (production of "coupled products") and by the complexity of possible methodology for determining the cost prices of half-finished products and finished products.

Concerning the complexity of crude oil processing technology it should emphasis that the basic characteristics of coupled production is generation of coupled products where qualitatively different products are simultaneously derived from the same raw material and which are then blended into final products.

Concerning the complexity of possible methodology for determining the cost prices of half-finished products it should emphasis that some methods can be only applied for determining the cost prices of finished products, but some methods can be applied for determining the cost prices of finished products as well as the half-finished products.
In the continuation of the Paper the demonstration of six methods for determining the cost prices of half-finished and finished products, as well as an analysis of the differences and similarities and advantages and disadvantages of these methods, follows.

The Sales Value Allocation Method is one of the simplest cost price determination methods frequently encountered in literature. According to this method, the cost price is determined so that the sales value of oil derivative is decreased by actual profit equal amount per each ton of derivative, and/or increased by actual loss, also in equal amount per each ton derivatives.

An example of using the mentioned calculating method is given in Table 4, taking one oil refinery as an example:

Oil derivatives	Selling price in $/t	Profit per 1 ton in $/t	Price cost in $/t
1	**2**	**3**	**4**
Propane	**254.6**	**6.4**	**248.2**
Butane	**273.5**	**6.4**	**231.1**
Special medical gasoline	**315.8**	**6.4**	**309.4**
Benzene	**393.6**	**6.4**	**387.2**
Toluene	**298.0**	**6.4**	**291.6**
Regular gasoline	**356.8**	**6.4**	**350.4**
Premium gasoline	**400.4**	**6.4**	**394.0**
Straight - run gasoline	**209.8**	**6.4**	**203.4**
Jet fuel	**226.2**	**6.4**	**219.8**
Diesel fuel D1	**276.7**	**6.4**	**270.3**
Diesel fuel D2	**282.4**	**6.4**	**276.0**
Bitumen 60	**197.7**	**6.4**	**191.3**
etc.			

Table 4. Determining the Cost Price by the Sales Value Allocation Method

Positive aspect of this method is its simplicity and possibility of application in a very short period of time. On the other hand, there is much more criticism on account of this method's application, e.g.

- Application of this method is possible only for determining the cost of the finished products.

- Assuming that profit is equal per each product would mean that from the importance standpoint all product are equalized, which is absolutely illogical, viewed either through product value or product usability.

- When determining the cost of product one should not start from the sales costs but from the cost of crude and operational costs of refinery units and select the most appropriate cost point to cost carrier allocation method.

The By-Product Method is based upon the premises that sales of gasoline is the most important source of income and that the entire profit is made on this product.

Other products make income at their production cost levels, i.e. , they make neither profit or loss.
An example of using the mentioned calculating method is given in Table 5, taking one oil refinery as an example:

Oil derivatives	Selling price in $/t	Profit per 1 ton in $/t	Price cost in $/t
1	**2**	**3**	**4**
Propane	**254.6**	**-**	**254.6**
Butane	**273.5**	**-**	**273.5**
Special medical gasoline	**315.8**	**-**	**315.8**
Benzene	**393.6**	**-**	**393.6**
Toluene	**298.0**	**-**	**298.0**
Regular gasoline	**356.8**	**34.1**	**322.7**
Premium gasoline	**400.4**	**34.1**	**366.3**
Straight - run gasoline	**209.8**	**-**	**209.8**
Jet fuel	**226.2**	**-**	**226.2**
Diesel fuel D1	**276.7**	**-**	**276.7**
Diesel fuel D2	**282.4**	**-**	**282.4**
Bitumen 60	**197.7**	**-**	**197.7**
etc.			

Table 5. Determining the Cost Price by By - Product Method

Positive aspect of this method is simple application; its drawback is that the cost prices of all products, main and by-product, are directly related to sales prices, which, realistically viewed should not be related at all, expect for the last stage when the cost ascertained is analyzed from the sales value standpoint through the actual profit / loss level.

The By-Product Method is applicable only for determining the cost prices of finished, and not of half-finished products since prices are dictated only for finals.

Method Le cout moyen du traitement pour chaque unite is based upon cost determination at the average operational cost level per each unit/plant and is dependent on the number of units through which the feedstock passes.

An example of using the mentioned calculating method is given in Table 6, taking one refinery unit named Crude Unit as an example:

$ / ton

Average processing costs of Crude Unit	192.77
Liquid petroleum gas	**192.77**
Light gasoline	**192.77**
Straight - run gasoline	**192.77**
Jet fuel	**192.77**
White spirit	**192.77**
Diesel fuel	**192.77**
Light residue	**192.77**
Slop	

Table 6. Determining the Cost Prices by Method Le cout moyen du traitement pour chaque unite

Positive aspect of this method is that is convenient for calculating the cost of both finished and half-finished products.

This method is rather simple since it is based upon cost calculation per each place of cost. Therefore, if in the primary refining section, Crude Unit, for example, average crude and processing costs amount to 192.77 $/t then, all the half-finished products obtained in this section (liquid petroleum gases, light gasoline, straight-run gasoline, jet fuel, diesel fuel, light and heavy gas oil, white spirit and light residue) should have the cost 192.77 $/t.

All this leads to the conclusion that the essential thing for cost calculation is correct determination of cost by their location since prices of all half-finished products obtained in refinery units are expressed at an average unit cost level. This exactly is the drawback of this method since it does not deal with the problem of cost allocation from cost location to cost carriers, depexiding on the product importance, as is emphasized by those who speak in favor or by-product method.

The Specific Gravity Method implies relating crude oil cost to oil derivatives based upon specific gravity relations or, according to currently used terminology, density relations. This method assumes that it is extremely important to correctly relate the basic feedstock cost to products since oil share in the product cost breakdown goes up to 80%.
An example of using the said calculating method is given in Table 7.

CRUDE UNIT
Calculating base: The Specific Gravity

Item no.	Oil products	Q'ty in tons	Q'ty from 1 ton	Specific gravity (gr/cm^3)	Equivalent numbers	Conditional units	Cost of conditional unit	Cost price $/t	Cost of feedstock in $	(%) for distributing prop.cost	Cost of feedstock in $
1	2	3	4	5	6	7(4x6)	8	9(6x8)	10(3x9)	11	12
1	Liquid petroleum gas	31458.2	-	0.545	-	-	-	176.57	5554574.374	-	5554574.374
2	Light gasoline	72897.1	24.49	0.646	1	24.490702	233.09756	233.09756	16992135.841	0.0323312136	17101368.274
3	Straight - run gasoline	247049.3	83.00	0.725	0.89	73.896181	233.09756	207.53202	51270639.651	0.097553481	51600228.394
4	Gasoline C70-175 C	321898.8	108.15	0.744	0.86	93.4963934	233.09756	201.5166	64867950.659	0.123425306	65284948.505
5	Jet fuel	91450.5	30.72	0.79	0.82	25.173818	233.09756	190.98961	17466095.358	0.0332330241	17578374.597
6	Wajtspirit WS	1234.4	0.41	0.781	0.83	0.3424721	233.09756	192.49347	237613.93382	0.0004521119	239141.41384
7	Petroleum for blending	22825.8	7.67	0.79	0.82	6.2833175	233.09756	190.98961	4359490.647	0.0082948738	4387515.2445
8	Diesel fuel	1121	0.38	0.82	0.79	0.2964318	233.09756	183.47033	205670.24476	0.0003913321	206992.37762
9	Light gas oil	691412.9	232.29	0.83	0.78	181.3352	233.09756	181.96648	125813971.03	0.2393882914	126622754.94
10	Heavy gas oil	73334.7	24.64	0.87	0.74	18.279598	233.09756	172.94335	12682748.536	0.0241316722	12764278.456
11	Light residue	1453297	488.25	0.94	0.68	333.90238	233.09756	159.40865	231668114.45	0.4407986939	233157372.3
12	Slop	3743.1	-	1	-	-	-	176.57	660919.167	-	660919.167
			1000.0								
13	Total	3011722.8	2976521.5			757.49404	-	-	531779923.89		535158468
									6215493.5		6215493.5
									525564430.35	1	528942974.5
14	Loss	19177.6									
15	TOTAL	3030900.4									

Table 7. Determining the Cost Prices by the Specific Gravity Method

Resulting equivalent numbers applied to the quantities produced provide certain calculating units by means of which respective units are reduced to the basic unit.

To calculate the cost of one conditional unit it is necessary to divide the average price of one ton of crude oil fco refinery by the sum of conditional units and with the value obtained multiply the conditional units per each product. Relating other costs to derivatives is possible in the same manner as applied in the crude cost distribution, i.e., through equivalent numbers or by adding same in an identical amount to each ton of products.

Analyzing the results obtained by using the Specific Gravity Method for determining the equivalent numbers, on the example of inlet feed which presents about 92 % of total costs of this unit, it can be seen that the main drawback of this method is very small range between the highest and lowest cost price which is 1 : 1.46 (See Table 7, Column 9):

The Specific Gravity and Number 1000 Method is based upon the difference between the specific gravity and number 1000 (specific gravity of the water) do not differ very much in approach from the specific gravity relations method, but the results obtained substantially do.
Namely, instead of calculating equivalent numbers by mean of specific gravity related to selected reference derivatives the afore-said relations will incorporate the difference between the specific gravity of oil derivatives and number 1000 (See Table 8, Column 10).

This manner of calculation eliminates the essential drawback of the Specific Gravity Method where the range between the lowest and highest cost of the product obtained in the same plant is very small; with the Specific Gravity and number 1000 Method we have the other extreme - this range being 1 : 5.9.

The Heat of Combustion Method is one of the methods also mentioned in literature. This is the cost calculating method based upon equivalent numbers obtained from the derivatives' heat of combustion (See Table 9).

CRUDE UNIT
Calculating base: The Specific Gravity and Number 1000 Method

Item no.	Oil products	Q'ty in tons	Q'ty from 1 ton	Specific gravity (gr/cm^3)	Difference betw.specif. gr.and 1000	Equivalent numbers	Conditional units	Cost of conditional unit	Cost price $/t	Cost of feedstock in $	(%) for distributing prop.cost	Cost of feedstock in $
1	2	3	4	5	6	7	8(4x7)	9	10(7x9)	11(3x10)	12	13
1	Liquid petroleum gas	31458.2	-	0.545	0.455	-	0	-	176.57	5554574.374	-	5554574.374
2	Light gasoline	72897.1	24.49	0.646	0.354	1	24.490702	403.9788	403.9787919	29448882.39	0.05603287	29638193.17
3	Straight - run gasoline	247049.3	83.00	0.725	0.275	0.78	64.47688	403.9788	313.8253327	77530328.76	0.147518225	78028728.91
4	Gasoline C70-175 C	321898.8	108.15	0.744	0.256	0.72	78.20725	403.9788	292.1428551	94040434.49	0.178932274	94644969.1
5	Jet fuel	91450.5	30.72	0.79	0.210	0.59	18.22607	403.9788	239.6484358	21915969.28	0.041699873	22056855.08
6	Wajtspirit WS	1234.4	0.41	0.781	0.219	0.62	0.256559	403.9788	249.9190831	308500.1162	0.000586988	310483.295
7	Petroleum for blending	22825.8	7.67	0.79	0.210	6.24	47.874469	403.9788	2522.014492	57566998.38	0.10953367	57937065.18
8	Diesel fuel	1121	0.38	0.82	0.180	0.51	0.191499	403.9788	205.412945	230267.9114	0.000438135	231748.178
9	Light gas oil	691412.9	232.29	0.83	0.170	0.48	111.5512	403.9788	194.0011147	134134873.3	0.255220619	134997153.2
10	Heavy gas oil	73334.7	24.64	0.87	0.130	0.37	9.04775	403.9788	148.3537936	10879480.95	0.020700566	10949419.19
11	Light residue	1453297	488.25	0.94	0.060	0.17	82.75483	403.9788	68.47098167	99508672.25	0.189336779	100148359.2
12	Slop	3743.1	-	1	-	-		-	176.57	660919.167	-	660919.167
			1000.0									
13	Total	3011722.8	2976521.5				437.0774	-	-	531779901.4		535158468
										6215493.5		6215493.5
										525564407.9	1	528942974.5
14	Loss	19177.6										
15	TOTAL	3030900.4										

Table 8 Determining the Cost Prices by the Specific Gravity and Number 1000 Method

CRUDE UNIT

Calculating base: The Heat of Combustion Method

Item no.	O i l products	Q'ty in tons	Q'ty from 1 ton	Heat of combustion (KJ/kg)	Equivalent numbers	Conditional units	Cost of conditional unit	Cost price $/t	Cost of feedstock in $	(%) for distributing prop.cost	Cost of feedstock in $
1	2	3	4	5	6	7(4x6)	8	9(6x8)	10(3x9)	11	12
1	Liquid petroleum gas	31458.2	-	46.000	-	-		176.57	5554574.374		5554574.374
2	Light gasoline	72897.1	24.49	45.000	1	24.490702	186.42223	186.42223	13589639.822	0.0258572294	13676999.843
3	Straight - run gasoline	247049.3	83.00	43.999	0.98	81.153059	186.42223	182.27537	45031002.428	0.0856812231	45320480.985
4	Gasoline C70-175 C	321898.8	108.15	43.906	0.98	105.51682	186.42223	181.8901	58550203.904	0.1114044283	58926589.674
5	Jet fuel	91450.5	30.72	43.348	0.96	29.59604	186.42223	179.57846	16422540.067	0.0312474349	16528111.183
6	Wajtspirit WS	1234.4	0.41	43.488	0.97	0.4007779	186.42223	18015844	222387.58015	0.0004231405	223817.1827
7	Petroleum for blending	22825.8	7.67	43.348	0.96	7.3870925	186.42223	179.57846	4099022.0398	0.0077992761	4125372.3079
8	Diesel fuel	1121	0.38	43.000	0.96	0.3598757	186.42223	178.1368	199691.34829	0.000379956	200975.04974
9	Light gas oil	691412.9	232.29	42.500	0.94	219.38396	186.42223	176.06544	121733915	0.2316251063	122516472.7
10	Heavy gas oil	73334.7	24.64	42.300	0.94	23.159456	186.42223	175.23689	12850945.098	0.0244517029	12933556.473
11	Light residue	1453297	488.25	42.000	0.93	455.70325	186.42223	173.99408	252865074.18	0.4811305025	254490599.1
12	Slop	3743.1	-	43.000		-		176.57	660919.167	-	660919.167
			1000.0								
13	Total	3011722.8	2976521.5						531779915		535158468
14	Loss	19177.6							6215493.5		6215493.5
15	TOTAL	3030900.4							525564421.46	1	528942974.5

Table 9. Determining the Cost Prices by Heat of Combustion Method

Applying this method we get the cost of half-finished products in a very small range 1:1.07, (see Table 9, Column 9) that exactly is the greatest disadvantage of this method.

It is interesting to say that the first two methods are in use in a great number of refineries in the world which explained by the fact that the cost is used as a calculating category for ascertaining total profit and part of the profit distributed between share holders as dividend and not as a work efficiency standard in refineries depended on function criterion realization - minimization of costs.

As far as the possibility of cost calculation in refineries is concerned, the emphasis should be placed upon elective division calculation with equivalent numbers which is the complex form of book calculation and used made of the advantages and disadvantages of afore-said methods, computing technique and interdisciplinary teams composed of personnel from and beyond oil refining industries.

Conclusion

The purpose of this Paper was a presentation of possible methods for determining the efficiency and effectiveness of crude oil processing technology, viewed from energy and technological aspects.

From energy aspect, efficiency of crude oil processing technology is analyzed by comparing the cost prices of steam, generated in refinery units, to the cost prices of steam generated in Refinery Power Plant. It can be concluded that the cost prices of steam generated in refinery units are lower about twenty times than the cost prices of steam generated in Refinery Power Plant.

From energy aspect, effectiveness of crude oil processing technology is analyzed through the money savings realized by eliminating the differences between the target standard of energy consumption and self energy consumption of each refinery unit. It can be concluded that important money savings of 9 millions dollars / annum can be realized by eliminating of causes of inefficiency, taking the typical oil refinery with the processing capacity of five millions tons per year as an example.

From technological aspect, efficiency of crude oil processing technology can be analyzed through the cost prices of half-finished products, and effectiveness through the cost prices of finished products, along with calculating the profit or loss per each oil product, separately. Emphasis is placed on the complexity of crude oil processing technology i.e. the production of coupled products, on the complexity of possible methodology for determining the cost prices of half-finished and finished products, as well as on problems and dilemmas that management of refinery has to face in the choosing the methodology for determining the cost prices of oil products.

References

(1) Ocic, O., Gehrecke, S.: Rationalization in Oil processing Industry. Technology and Energy. ZNAMEN, Belgrade, Yugoslavia, 1995.
(2) Perisic, B., Ocic, O.: Management in Function of Increasing the Process and Energy Efficiency in Petroleum Refineries, 3rd IFSAM World Conference, Proceedings, Paris, France, 1996
(3) Ocic, O., Perisic, B.: Aspects in Monitoring the Efficiency and Effectiveness of Energy Refineries, IV International EurOMA, Conference Proceedings, Barcelona, Spain, 1997.
(4) Manne, A.S.: Scheduling of Petroleum Refinery Operations, Cambridge, 1963.
(5) Masseron, J.: L'economie des hydrocarbures, Editions technip, Paris, 1969.