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RESEARCH PAPER

Evaluating the Products Quality of the Vacuum Distillation Unit by Using MFCA Method

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ABSTRACT

The distillation unit is one of the main units in refining companies, and it serves as the mother unit in any refinery with any degree of complexity. The optimization of this unit can increase productivity. In this study, the vacuum distillation unit of a refinery was selected as the case study. The shares of different expenses of this unit were clarified using a novel material flow cost accounting (MFCA) method, the identification of the positive and negative products, and the identification of the actual values of the products. To this end, the vacuum distillation column was simulated by replacing Ahvaz's crude oil with different types of crude oils such as Mansouri, and Maroon and also by combining these crude oils types. The results showed that the difference between the quality of Ahvaz crude oil products and Maroon and their combination was less than 2%, so it can be an appropriate alternative to the main crude oil, without changing the column operating conditions. The influence of changing the column conditions was also studied which revealed the zero effect of the variations of the quality of Mansouri's crude oil products and its blend with Ahvaz crude oil. The feed temperature was changed 20 °C while the input and bottom column pressure increased 7 and 5 mmHg, respectively. But API varied from approximately 3 to 7 in the products. Finally, two types of Mansouri's crude oil and a blend of Maroon and Ahvaz crude oil were introduced as the best alternatives to Ahvaz's crude oil.

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1. INTRODUCTION

Along with the spread of knowledge in the world and the improvement of simulation processes, various industries are seeking to make substantial changes to reduce environmental issues with the aim of attaining their goals in different processes and improving the labor-market [1]. Moreover, since it is impossible to change the conditions of many industries for performance assessment and this procedure might impose heavy expenses and damage, conducting newer studies and simulations before making changes can be a suitable solution for reducing the costs and the possible risks of the process changes [2]. In this regard, the use of optimization techniques including simulation and modeling in solving industrial problems has garnered attention since the late 1940s. Vast simulation studies have also been carried out on the petroleum distillation process in the past two decades [3]. The thermodynamic analysis of the energy and exergy of petroleum distillation systems for optimization purposes has been studied with great seriousness. As a result, a special thermodynamic model has been developed and actions have been taken to develop the operating conditions by simulating the units [4]. Attempts

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have been made using the precise, simple, and static models to simulate the distillation columns in the oil industry using these models and a given objective function [5]. Different methods have also been proposed for the optimization and enhancement of the distillation process. For instance, the optimization of operating conditions in the distillation column using the neural network method was carried out with the aid of the genetic algorithm (GA) [6]. The use of various simulation software solutions such as Aspen Plus, which help select the proper feed with the minimum energy use and high efficiency, has also been the core of the recent studies [7]. The effect of changing the input temperature and the preheat degree of petroleum before it flows into the distillation column by changing the heat exchange networks (HNE) conditions in the distillation process was also studied using the non-linear equations and variables [8]. Furthermore, the precise distillation column simulation models which require all the operating conditions including temperature, flow rate, and pressure in each stage of the distillation column to find the equilibrium relations, is extremely difficult [9]. The use of neural network simulations in the identification of the optimal conditions and the use of precise methods of changing the conditions of heat exchange networks and optimizing heating in distillation columns have also been explored [10]. Changing and replacing the controllers in the distillation column can effectively improve the efficiency and increase the precision in the control and operation of the distillation columns [11]. Considering the strict regulations recently imposed by the Environment Department on different industries such as the oil industry, environmental assessments and the identification and settlement of problems in these industries are essential [12-14]. In this regard, Material Flow Cost Accounting (MFCA) serves as a means of identifying and determining the actual value of materials, wastes, and products resulting from different processes in terms of monetary and physical units. In fact, MFCA is a different approach to cost allocation [15]. MFCA in production and industrial units unravels any nonconformity between the input and output flows and the hidden costs in all systems, which are not often included. Besides, the products are classified by their actual values [16]. The implementation of MFCA results in numerous economic and environmental achievements. In addition to the simultaneous attainment of these two goals, MFCA is highly adaptable, easy to use and flexible in the conventional management systems [17]. MFCA is also a method in which wastes are considered the value added of the products and the physical and financial values of wastes are calculated [18]. The implementation of MFCA in production industries reduces the inefficient decisions in the course of processes, thereby reducing the cost of processes and wastes [19]. The estimation of positive and negative products and the actual value of each product reflect the necessity of improving the current conditions, also offering scientific solutions. As a result, the production of negative products decreases from 41.08% to 9.23% [20]. For instance, following the implementation of MFCA in a Japanese pharmaceutical company, there was a 230 million yens decrease in the annual expenses of this company over 3 years [21]. Moreover, the implementation of MFCA in a chemical production company resulted in the annual sales of 1.111 billion yens [22]. The Material Flow Cost Accounting (MFCA) approach was applied an atmospheric distillation column in the previous study which this simulation and the effect of the variations led to acceptable results [23]. The present study, however, strived for optimizing the operating conditions (temperature and pressure) in the vacuum distillation column, which is an extension to the atmospheric distillation column. In this study, the quality of the products was analyzed by changing the feed of the vacuum distillation column through MFCA calculations and simulations. To this end, the unit and its current condition were introduced. Then this unit was simulated in ASPEN-PLUS software and the simulation precision was determined by comparing the simulation results. Afterward, crude oils in its current condition was replaced by two petroleum types in the atmospheric distillation column to explore the effects of variations in the operating conditions on the vacuum distillation column products. Finally, the MFCA calculations were carried out to increase the generation of products with the high value added.

2. Research Method

2.1 Process Description

Refining is primarily carried out to maximize the value added of the conversion of petroleum into the end products. Distillation is the most important separation and purification process in the oil industries, and this process will remain important in the future given the global demand for energy [3]. Oil refineries consist of different operating units including the gasoline, motor oil, bitumen, jet fuel, diesel oil, and home heating fuel units [24]. The vacuum distillation operating unit is one of the most important key operating units in oil refineries, while the other units (such as isomax, visbreaker) are designed based on the performance of this unit [3]. In the atmospheric distillation unit, petroleum is broken down into different oil products and heavy products, while the distillation of other products calls for a 400 increase in the temperature. This temperature breaks the molecules and results in the formation of coke in the furnace. The vacuum distillation column is used for this purpose to work under safe and reliable conditions. Vacuum distillation refers to the re-refining of the atmospheric bottom [4]. More than about 50% of the petroleum in the atmospheric distillation column is unrefinable and the industry has to inevitably convert these materials into the valuable products. In the distillation process, pressure directly affects the boiling point of the compounds. At low pressures, the vapor pressure decreases and the lightweight molecules easily leave the liquid, lowering the boiling point. With the creation of a vacuum in this system the boiling point is reduced to the point which cracking becomes impossible and the distillation bottom becomes separable [25].

The vacuum distillation column is used in the production of various products such as heavy fuel oil, overhead gases, heavy diesel fuel, ISOMAX feed, lube distillate 1 and lube distillate 2, and vacuum distillation bottom. The overhead gases in the vacuum distillation column are sucked by a set of ejectors and condensers at a temperature of 86 °C. The heavy fuel oil of the output liquid is conveyed at a temperature of 165 °C using pumps to a cooling tower. The ISOMAX feed of the output liquid is, first, pumped into two exchangers using a pump at the 270 °C. It partially transfers its heat to petroleum in the exchangers and then enters the cooling tower. The lube distillate 1 of the output liquid is conveyed at a temperature of 325 °C by pumps to the heat exchanger where it transfers its heat to the petroleum and cools down. Its temperature reaches 90 °C after passing through the second heat exchanger and it is conveyed to three sections, namely the L.D1, the furnace fuel system, and the tanks. The lube distillate 2 of the output liquid is pumped at a temperature of 358 °C into two heat exchangers and it is conveyed to the oil production unit after it cools down and transfers its heat to petroleum. The vacuum distillation bottom is the heaviest part of the oil compounds that flows out of the bottom of the column at a temperature of 360 °C. After the heat transfer completes, its temperature decreases to 200 °C. A part of this output is sent to the bitumen unit, while another part is sent to the tanks after entering a series of exchangers [26]. Figure (1) depicts the overall schema and the products of the vacuum distillation unit.

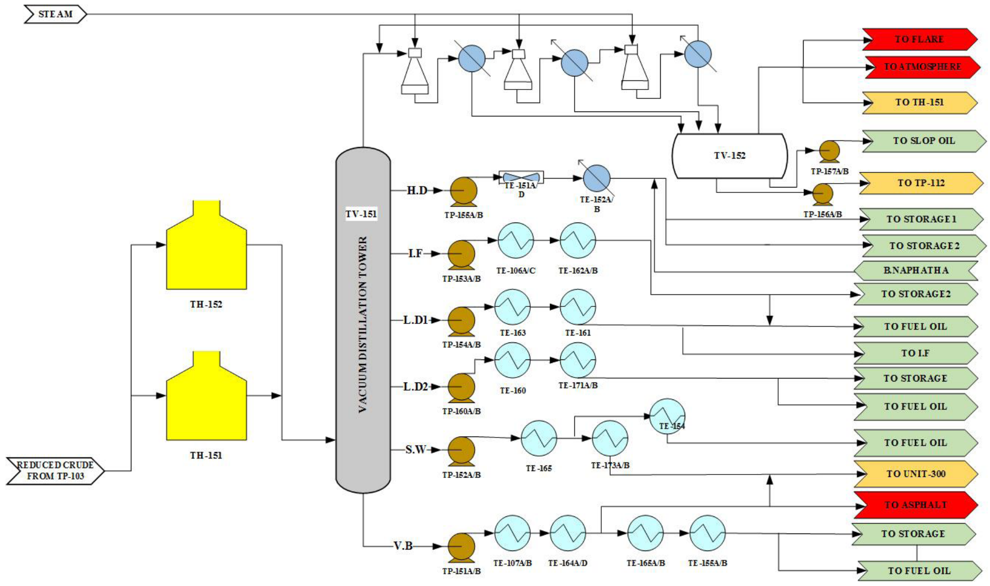

Figure (1): The overall schema of the vacuum distillation column

2.2 MFCA

Based on ISO 14051 and 14052, MFCA is applied both in monetary and physical terms and is known as a different method for allocating costs [27]. In many companies, due to the visual construction costs of losses and the calculation of actual efficiency by the deployment of MFCA, the implementation of MFCA is known as a means of coping with the fake high-efficiency report by companies [28]. The MFCA principle emphasizes on enhancing the productivity of material and energy so that all products are categorized as negative and positive products. High-value products are considered to be positive products and products that are non-marketable as negetive ones [29]. The aim of implementation of MFCA is the flow evaluation in both material and monetary and monitoring of other costs such as wastewater management, and also to identify the positive and negative products [30]. For implementing MFCA in an operational unit, it is necessary to identify the cost centers and accomplish mass and energy balance, and money to specify the number of casualties in each of these quantity centers. These centers are called as the Quantity Centers (QCs). In this study, the vacuum distillation tower was considered as a quantity center. The MFCA calculations were carried out for the quantity center (distillation tower).

2.3 Simulation

According to the results of analyzing the conditions of the atmospheric distillation column in the previous study, the costs and expenses of the atmospheric distillation unit were mainly incurred by the purchase of crude oil, while the energy and system costs were extremely insignificant as compared to the costs of crude oil [23]. Therefore, changing the current condition will not significantly change the current expenses, and thus it is necessary to resort to the purchase crisis management and crude oil replacement methods through simulation. For optimizing, the first vacuum distillation column was simulated in ASPEN-Plus (ver. 8.8) under the conventional operating conditions including the temperature and pressure of the feed stream, the reflux ratio, and the tray no.

The blend of Mansouri's crude oil with Ahvaz crude oil and the alteration of the operating conditions in the atmospheric distillation column improved the quality of the products to the desired level. In this section, the effect of replacing Ahvaz crude oil with the proposed crude oil types in the atmospheric distillation column on the products of the vacuum distillation unit is studied. The physical properties of the simulated vacuum distillation unit are also listed in Table (1).

Table 1. Physical characteristics of vacuum distillation tower

Item	Value
Total Height (m)	31.5
Total trays	44
Type of trays	Stainless Steel
Up Section Height (m)	10.4
Up Section Diameter (m)	3.7
Down Section Height (m)	18
Down Section Diameter (m)	6.9

Currently, Ahvaz's crude oil is the main feed of the refinery under study. The properties of this crude oil and the operating conditions of the vacuum distillation column are listed in Table (2). This feed is the main feed of this refinery.

Table 2. Operating Properties of Ahvaz Crude Oil

Properties of Crude Oil	Ahvaz
Flow Rate (Ton/hr)	637
Standard Density (kg/m3)	857.3
Watson Factor	12

The quality of the actual products was compared with the quality of the simulated products to ensure the accuracy of the simulation. Tabble (3) shows the results.

Table 3. Comparing the properties of the products resulting from Ahvaz crude oil and the operating conditions

Operational Situations	IT[1] (˚C)	IP[2] (Kg/cm2)	RPT3 (˚C)	RPT[3] (˚C)	TCP[4] (Kg/cm2)	BCP[5] (Kg/cm2)
	405	205	117	120	25	45
Products Characteristics	Parameters	Actual/ Software	LD 2	LD 1	IF	HD
	Mass Rate (Kg/hr)	Actual	30340	25005	87135	44960
		Software	30339	25004	87135	44959
	Std. API	Actual	20	22.3	25.9	33.8
		Software	19.12	21.41	26.43	33.73
	Std. Sp. Gr	Actual	.9341	.9198	.8993	.8562
		Software	.939	.929	.895	.8563

This unit was simulated based on the operating conditions of Ahvaz's crude oil. Hence, the software data had to be comparable to the reference information with an error in the range between 5% and 15%. Hence, first, the simulation of the vacuum distillation column was carried out using the simulation data, revealing that the resulting information was comparable to the information on the refinery processes. Therefore, simulations could be carried out to study the variations of the feed and the different parameters. The properties of different types of alternatives to Ahvaz's crude oil are shown in Table (4).

Table 4. The properties of the proposed alternatives

Type of Crude Oil	Mansouri	Maroon
St Density (kg/m3)	894	861.6
Watson Factor	-	11.98
Viscos type	Kinematic	Kinematic

3. Results and Analysis

To establish MFCA in the vacuum distillation unit, this unit was considered a data center and the mass balance calculations for a one-year period were carried out (Table 5).

1. *Input Feed Temperature*
2. *Input Feed Pressure*
3. *Return Pump Temperature*
4. *Top Column Pressure*
5. *Bottom Column Pressure*

Table 5. The mass balance calculations of the vacuum distillation column for a one-year period

Stream Name	INPUT/OUTPUT	Mass Flow(ton/yr)
REDUCED CRUDE FM CDU	INPUT	2066960
B.N. (B.G.O.)	INPUT	193935
L.D1	INPUT	34711
M.P. STEAM	INPUT	75367
Heavy Disel to Product	OUTPUT	72588
L.D2 to Tanks	OUTPUT	18510
V.B to U- 300	OUTPUT	616927
S.W to U- 300	OUTPUT	313678
Fuel to Fuel System (IF+LD1+LD2+S.W+HD)	OUTPUT	499381
Slop Oil	OUTPUT	17989
ISO FEED+LD1 to Tanks	OUTPUT	785393
V.B to Asphalt	OUTPUT	20339
Wastewater	OUTPUT	24312
S.W to H 151	OUTPUT	-
S.W to U- 100	OUTPUT	-
%UnBalance		0

To study the effect of changing the input feed of the atmospheric distillation column on the products of the vacuum distillation column in the simulation environment, the results were compared to the situation of the products obtained using Ahvaz crude oil in Table (5). In this table, Tin shows the input feed temperature, Pin denotes the input feed pressure, and T1 and T2 represent the temperatures of the return pump. Besides, P1 and P2 denote the top and bottom column pressures, respectively.

Table 6. The results of simulation under constant operating conditions

Operational Situations	IT (˚C)	IP (Kg/cm2)	RPT (˚C)	RPT (˚C)	TCP (Kg/cm2)	BCP (Kg/cm2)
	405	205	117	120	25	45
Products Characteristics	Parameters	Type of Crud	LD 2	LD 1	IF	HD
	Std. API	Ahvaz	20	22.3	25.9	33.8
		Maroon	19.8	22.1	26.0	29.7
		Ahvaz- Maroon	19.5	21.9	25.5	32.7
		Ahvaz- Mansouri	17.9	20.5	25.6	26.7
	Std. Sp. Gr	Ahvaz	0.9341	0.9198	0.8993	0.8562
		Maroon	0.935	0.921	0.898	0.877
		Ahvaz- Maroon	0.937	0.921	0.901	0.861
		Ahvaz- Mansouri	0.946	0.931	0.901	0.894
	D86-IBP	Ahvaz	429.5	398.9	228.8	266.6
		Maroon	425.04	388.32	328.22	296.45
		Ahvaz- Maroon	401.75	389.34	348.37	260.7
		Ahvaz- Mansouri	423.4	380.78	323.73	304.12
	D86- FBP	Ahvaz	569.761	562.152	522.062	442.19
		Maroon	565.75	528.73	483.72	411.76
		Ahvaz- Maroon	560.12	552.95	516.7	396.77
		Ahvaz- Mansouri	568.25	532.13	521.3	512.6

According to Table (6), the properties of the products generated by replacing the mixture of Mansouri and Ahvaz crude oils were more different than the other alternatives. Some of the differences include the API difference from approximately 3 to 7 degrees in the products, which are high considering the standards met in the study refinery. Moreover, Std. Sp. Gr of the product obtained using the blend of Ahvaz and Mansouri crude oils are extremely larger than the Std. Sp. Gr of Ahvaz crude oil. To study the effect of a change of feed more thoroughly, the difference between the calculated product parameters and the actual feed values in the current condition was calculated and the results are presented in figures (2) to (5).

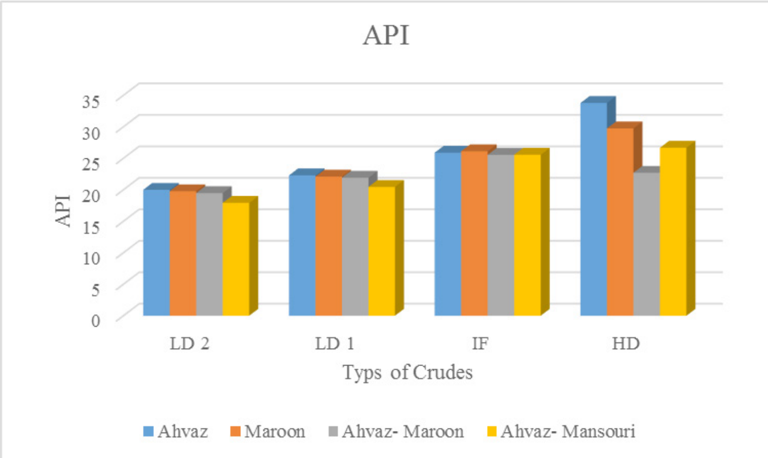

Figure (2): Comparing the API of the products resulting from different inputs

According to the diagram of the API results, there is a slight difference between the quality of the downstream products of Maroon and Ahvaz-Maroon crude oils and the quality of Ahvaz crude oil. The difference between the qualities of Maroon crude oil products and the aforesaid products is less than 2%, which can be minimized by changing the column design. The similarity between the qualities of the products of these two crude oils can be attributed to the minor difference between the properties of these two crude oil types. The API difference between these two crude oil types is also approximately 0.5 API. As regards Maroon crude oil and the mixture of Ahvaz and Maroon crude oils, the API parameter for the IF[1], LD1[2], and LD2 products shows a slight difference. However, as regards the HD[3] cut, there is a significant API difference between Ahvaz and Ahvaz-Mansouri crude oils.

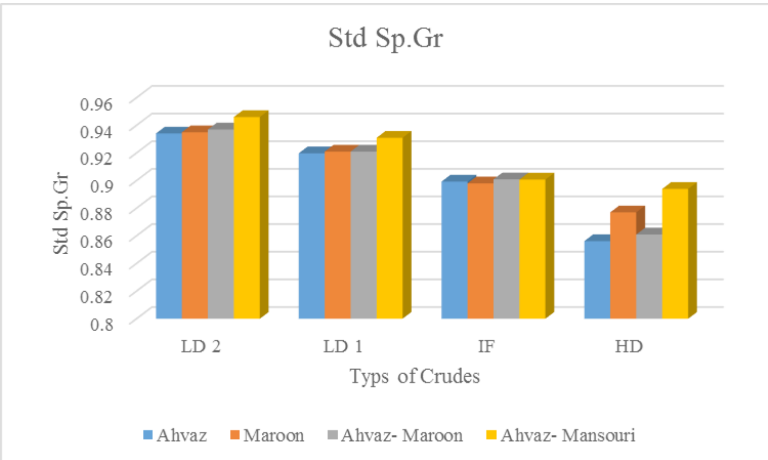

Figure (3): Comparing the Std Sp.Gr values of the products of different inputs

1. *IsoMax Feed*
2. *Lube Distillate*
3. *Heavy Diesel*

The results of the Std. Sp.Gr values of different cuts after replacing Ahvaz crude oil are presented in Figure (3). As seen, Mansouri's crude oil shows a considerable difference. However, the Std. Sp.Gr difference between the products of Maroon and Maroon-Ahvaz crude oils is approximately 0.003, which can be attributed to the similarity between the analyses of Maroon crude oil and the primary crude oil.

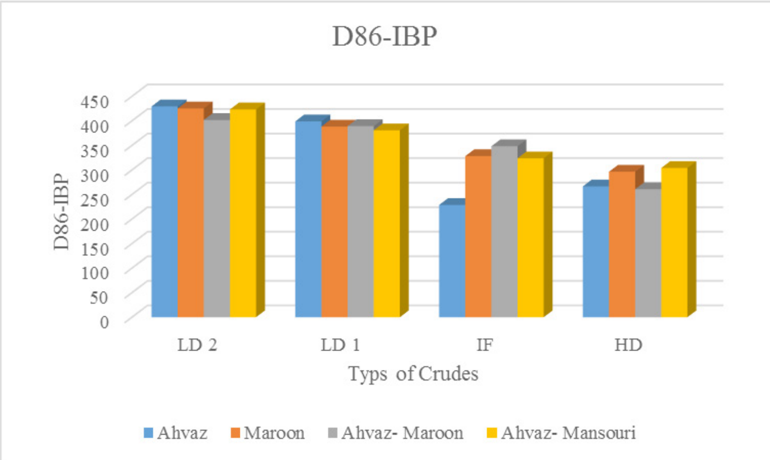

Figure (4): Comparing D86-IBP of the products of different inputs

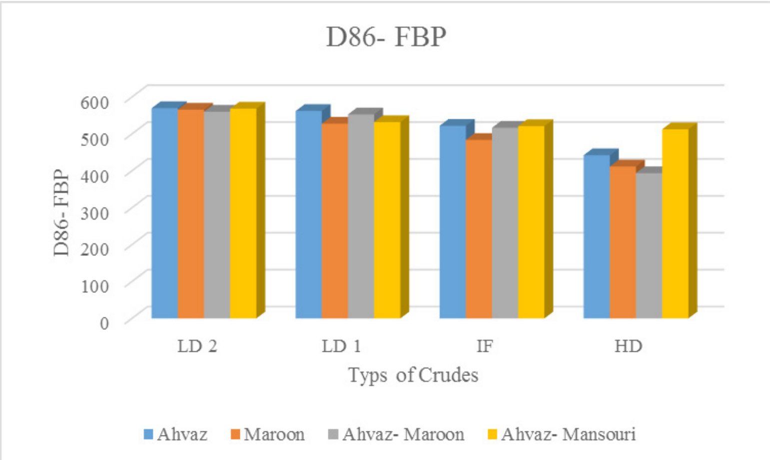

Figure (5): Comparing D86-FBP of the products of different inputs

Results of the comparison of the initial and final boiling points of the main products of the vacuum column are illustrated in figures (4) and (5). The results reveal that the blend of Maroon crude oil and Ahvaz crude oil causes an extremely small change in the quality of the intermediate products and downstream products of this column as compared to Maroon crude oil products. However, the quality of the HD cut increased unlike the other three products. The quality of the products obtained using Ahvaz-Mansouri crude oil is also significantly different from the desired quality, which calls for the modification of the column operating conditions. It is also worth mentioning that the IF cut is in a better condition than the other three products of this unit. Hence, it is tried to improve the quality of the products by altering the operating conditions to meet the desired standards.

The comparison of the results of the simulation under the unchanged operating conditions reveals that the products obtained by replacing Ahvaz feed with Maroon feed and the blend of Ahvaz and Maroon crude oils caused a slight difference in the product characteristics. The effect of changing the operating condition of the mixed Ahvaz-Mansouri feed is studied next. Table (7) presents the results of changing the feed and the operating conditions.

Table 7. The effect of changing the operating conditions in the vacuum distillation column using Ahvaz and Mansouri crude oils

Operational Situations	IT (˚C)	IP (Kg/cm2)	RPT (˚C)	RPT (˚C)	TCP (Kg/cm2)	BCP (Kg/cm2)
Operation Condition	405	205	117	120	25	45
Ahvaz- Mansouri						
Changed	425	212	175	130	30	50

To improve the quality of the products of Mansouri's crude oil and the blend of Mansouri and Ahvaz crudes, the operating temperature and pressure were changed to study the quality of the products with regard to MFCA. The input feed temperature was changed to 425 while the input pressure increased from 205mmHg to 212mmHg. There was an approximately 5mmHg increase in the overhead and bottom column pressure with an increase in the input pressure. The quality of the products altered after making these changes to the vacuum distillation column operating conditions. The simulation results of changing the properties of the products obtained by replacing Ahvaz crude oil with the mixture of Ahvaz and Mansouri crude oils are presented in figures (6) and (9).

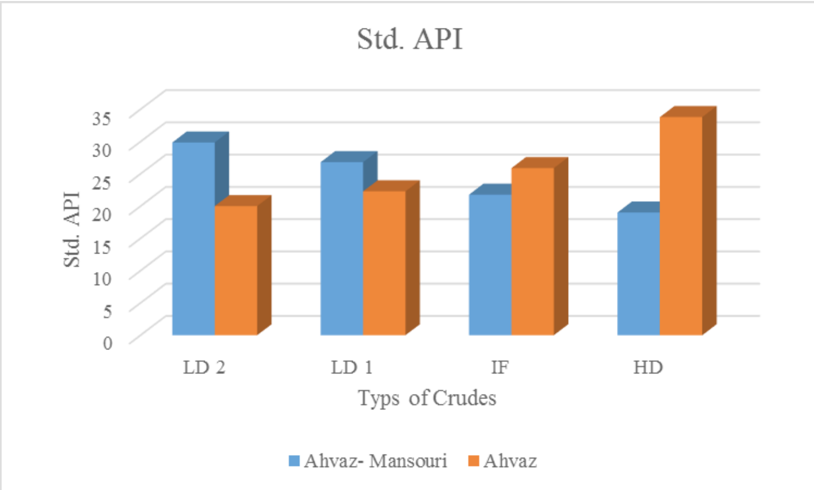

Figure (6): Comparing the APIs of the products of Ahvaz crude oil and Ahvaz-Mansouri crude oil

The comparison of the API values of the distillates resulting from Ahvaz and Mansouri's crudes under changed operating conditions suggests that the quality of the products was different from the quality of the products of Ahvaz crude.

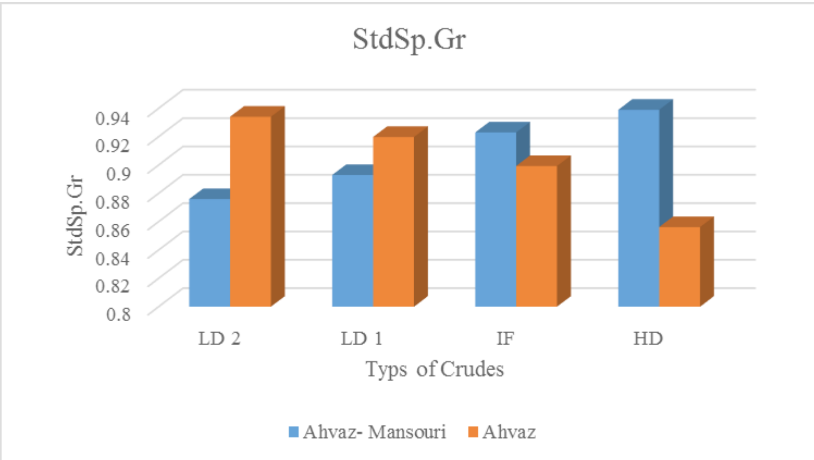

Figure (7): Comparing the Std Sp.Gr values of the products of Ahvaz crude and Ahvaz-Mansouri crude oil

The Std. Sp.Gr of some of the products was higher and lower than the products of Ahvaz crude oil, and distillates with these SG values cannot be refined considering the standards achieved in the study refinery.

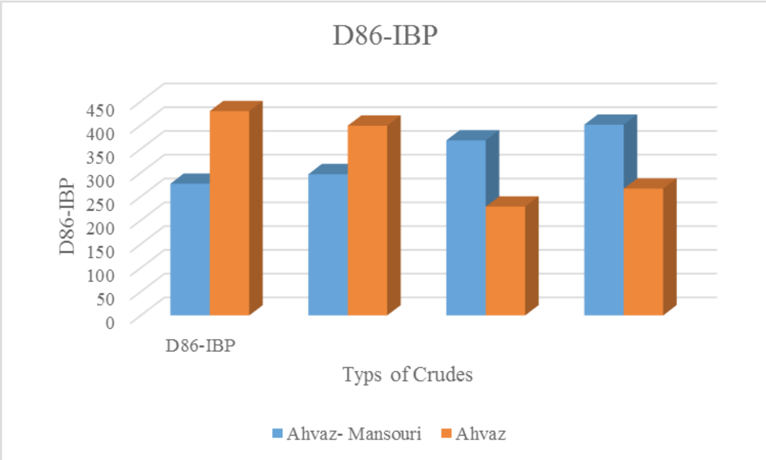

Figure (8): Comparing the D86-IBP values of the products of Ahvaz and Ahvaz-Mansouri crudes

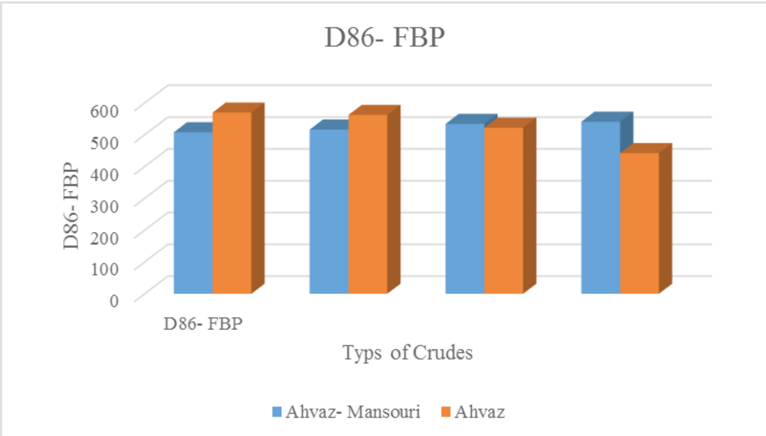

Figure (9): Comparing the D86-FBP of the products of Ahvaz crude oil and Ahvaz-Mansouri crude oil

The API and Std. Sp. Gr problems exist as well as the boiling points. Therefore, the vacuum distillation column structure for Mansouri's crude oil or a mixture of Mansouri's crude oil must be changed. The simulation results showed that the replacement of Ahvaz crude oil with the feed resulting from Ahvaz-Maroon crude oil and Maroon crude oil resulted in products with characteristics similar to the characteristics of the products of Ahvaz crude oil. Besides, there is no need to change the operating conditions. Due to the significant differences between the API and Std. Sp. Gr parameters in the blend of Ahvaz and Mansouri crude oils, the operating conditions in the vacuum distillation column have to be changed (e.g. changing the input feed temperature from 405 to 425, increasing the input temperature from 205mmHg to 212mmHg, and changing the return pump temperatures). However, these changes failed to significantly improve the quality of the products. One of the reasons for the lack of change in the operating conditions in this column is the improper location of the output platform but it is currently impossible to move the platform. Hence, Maroon feed and the blend of Maroon and Ahvaz crude oils were selected as the optimal alternatives for the atmospheric distillation column from the three selected crude oil types to manage the crisis of replacing the feed in the study refinery. The quality of the products of these two alternatives is extremely similar to the quality of the current condition products. Therefore, they are suitable alternatives for Ahvaz crude. The MFCA calculations in the previous paper [23] also indicate that the replacement of these two different feed types under critical conditions can effectively alleviate the crisis.

4. Conclusion

The results presented in the previous study indicated that the costs of the atmospheric distillation unit in the study refinery are mainly incurred by the purchase of crude oil, while the energy and system costs are extremely insignificant compared to the costs of crude oil. Therefore, changing the current conditions in the refinery does not significantly affect the ongoing expenses, and it is still necessary to manage the crisis of crude oil replacement and purchase. The attainment of this goal calls for the analysis of the use of the proposed alternatives. Three different crude oil types and mixtures were selected based on the simulation of the atmospheric distillation column. The vacuum distillation column was simulated to ensure that changing the feed does not affect the quality of the products. It was indicated that replacing the current feed with Maroon crude oil and a blend of Maroon and Ahvaz crude oils leads to the results similar to Ahvaz crude. However, the crude oil resulting from the blend of Ahvaz and Mansouri crude oil resulted in the products with highly different qualities. Since the operating conditions (including the input temperature and pressure in the vacuum distillation column under actual conditions) could not improve Ahvaz-Mansouri's crude oil products, these changes were made in the simulation environment and their effects were analyzed. The results of this analysis reflected the zero effect of changing the operating conditions on the improvement in the quality of products. In sum, Maroon crude oil and the blend of Maroon and Ahvaz crude oils are recommended as the best alternatives to Ahvaz crude. However, the selection of these alternatives does not significantly change the current expenses due to the extremely slight differences between the prices of these two crude oil types.

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مقاله تحقیقاتی

بررسی کیفیت محصولات خروجی از برج تقطیر خلا با بهره‌گیری از روش هزینه یابی جریان مواد (MFCA)

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چکیده

واحد تقطیر یکی از اصلی‌ترین واحدهای شرکت‌های پالایش می‌باشد و هر پالایشگاهی با هر درجه پیچیدگی از این واحد به عنوان یک واحد مادر بهره می‌برد. بهینه‌سازی عملیاتی این واحد جهت تولید هر چه بیشتر محصولات با ارزش افزوده بالا می‌تواند عاملی جهت رسیدن به افزایش بهرهوری باشد. در این مطالعه واحد تقطیر خلاء یک واحد پالایشی به عنوان یک مورد مطالعاتی انتخاب شده و با انجام روش نوین هزینه یابی جریان مواد، تعیین محصولات مثبت و منفی و ارزش گذاری واقعی آن‌ها، سهم هزینه های مختلف موجود در واحد شفاف سازی شده است. به این منظور با شبیه‌سازی برج تقطیر خلاء در حالت جایگزینی نفت خام اهواز با انواع نفت خام مختلف از جمله منصوری، دزفول و مارون، و حالت ادغام انواع آن‌ها نتایج مختلف بدست آمد. بدون تغییر شرایط عملیاتی برج (مانند دما و فشار) نتایج نشان میدهند که کیفیت محصولات ناشی از ترکیب نفت خام مارون و اهواز ۲ درصد نسبت به نفت خام اصلی تفاوت دارند. تاثیر تغییر شرایط برج مورد بررسی قرار گرفت که، حاکی از عدم تاثیر تغییر کیفیت محصولات ناشی از نفت خام منصوری و ادغام آن با اهواز را نشان می‌دهد دمای خوراک ۲۰ درجه سانتیگراد، فشار ورودی و پایین ستون به ترتیب ۷ و ۵ میلی متر جیوه افزایش یافت، ولی اختلاف درجه API از حدود ۳ الی ۷ در محصولات می‌باشد. نفت خام دزفول نیز شرایط مشابهی با نفت خام منصوری دارد. در نهایت دو نوع نفت خام مارون و ادغام مارون و اهواز به عنوان بهترین گزینه‌های انتخابی برای جایگزینی نفت خام اهواز پیشنهاد می‌شود.

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