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Enhancement of Libyan Gasoline Production using HYSYS Simulation

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Abstract

The Libyan market suffers a huge deficit of gasoline. More than 70 % is imported from international market. National oil Corporation (NOC) had signed a contract with EXXON Oil, British Petroleum and Eni Company to boost crude oil production in Libya. It is planned to drill 14 wells in Gulf Sirt offshore to enhance production of natural gas and crude oil in future. In this paper, a major petroleum refinery is to be built in Sirt to utilize a portion of the suggested crude oil from proposed Gulf Sirt offshore plant with Sharara crude to eliminate the deficit of the gasoline in Libyan local market. HYSYS software is used to model a new refinery of 500,000 barrels per day to be built in Sirt in order to produce LPG, naphtha, kerosene, gas oil and fuel oil for local and international market. Downstream units are also simulated to produce the enhanced products with international specifications. The refinery will be able to produce more than 177,000 bbl/day of gasoline which will be able to satisfy local needs of gasoline in Libya. Other products include LPG, kerosene, gas oil and fuel oil will satisfy future local demands and the rest will be imported to world markets.

Keywords: Crude oil refinery, HYSYS simulation, Gulf Sirt offshore, Sharara crude, Gasoline deficit.

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الملخص:

يعاني السوق الليبي من عجز كبير في وقود السيارات حيث يتم استيراد أكثر من 70% من الأسواق العالمية. وقعت المؤسسة الوطنية للنفط عقدا مع شركة إكسون موبايل وشركة البترول البريطانية وشركة إيني لتعزيز إنتاج النفط الخام في ليبيا. ومن المخطط حفر 14 بئرا في منطقة خليج سرت البحرية لتحسين إنتاج الغاز الطبيعي والنفط الخام في المستقبل. في هذه الورقة سيتم دراسة إنشاء مصفاة تكرير نفط رئيسية في سرت مع خام الشرارة بطاقة إنتاجية قدرها 500,000 برميل في اليوم للاستفادة من جزء من النفط الخام المنتج و القضاء على العجز في وقود السيارات في السوق المحلية الليبية . يتم استخدام برنامج HYSYS لتصميم مصفاة جديدة سيتم إنشاءها في سرت من أجل انتاج غاز البترول المسال و النافثا والكيروسين وزيت الغاز وزيت الوقود للسوق المحلية والدولية. كما تتم محاكاة الوحدات النهائية لإنتاج المنتجات المحسنة بمواصفات عالمية. وستكون المصفاة قادرة على إنتاج أكثر من 177 ألف برميل يوميا من وقود السيارات وهو ما سيكون قادرا على تلبية الاحتياجات المحلية من البنزين في ليبيا. وتشمل المنتجات الأخرى غاز البترول المسال والكيروسين وزيت الغاز والوقود والتي ستلبي الطلب المحلي المستقبلي وسيتم تصدير الباقي إلى السوق العالمية.

الكلمات المفتاحية: مصفاة النفط الخام، محاكاة HYSYS، خليج سرت البحري، خام الشرارة، نقص البنزين.

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Introduction

Crude oil is a complex mixture of hydrocarbons that in most cases would contain certain impurities such as metals, element nitrogen, nitrogen oxides, hydrogen sulfide, hydrogen oxides, chlorides, elemental sulfur and mercaptans. The presence of these impurities would affect the crude oil quality. For instance, crude oil can be categorized as light, medium or heavy crude based on its density which is directly influenced by the structure and the length of the hydrocarbon chains. A medium crude oil has an API ranges from 22.3 to 31.1, while exceeding the range the crude will be considered as light, otherwise its heavy crude oil[1]. It may be also classified as sour or sweet based on sulfur content (e.g., crude oil with sulfur content below 0.5% wt. is known as sweet oil, otherwise is considered sour) and the higher the API gravity, the lower the sulfur content; or it can be also classified as paraffinic, naphthenic, or aromatic [2].

Each refinery has a unique design based on the crude oil characteristics and the well production capacity; hence, crude oil blending can be necessary for certain refineries. The distillation of light crude oil produces higher yields of high-value products such as gasoline with less energy consumption and lower transportation and storage costs compared to medium and heavy crude oil distillation [3]. Thus, crude oils blending considered a feasible alternative to obtain a new blend with desired properties to meet feed specifications of certain plants, ease transportation, and utilizing of lower grade oils by mixing a small portion with high-grade oils[4].

The gulf of Sirt gas and crude oil future project is expected to be the largest project in the world in near future. National Oil Corporation (NOC) in Libya signed a contract with EXXON mobile and British Petroleum Oil companies to assess the project where 14 wells to be drilled in the Gulf of Sirt at cost 7 billion dollars in near future due to the huge depth of sea water in this location. An estimated production rate of 40 billion cubic meters of natural gas with several million barrels per day of heavy crude oil is expected. A huge pipeline will be built to transport 80% of

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the gas to Italy where the other 20% will be processed in gulf of Sirt to satisfy local demand in Libya in the near future [5].
H. O. Almansouri, used a process simulation Aspen HYSYS at steady state operation to simulate an existing oil refinery in Sarir field for re-evaluation. Sarir crude oil, used in this study, is processed in the Sarir refinery, which has a maximum capacity of 10,000 barrels per day. This study aims to simulate existing units of the refinery process and proposes adding a unit before atmospheric distillation column (ADU) called "Pre-flash column". The simulation results showed a good agreement with laboratory ASTM-D86 curves for all products except Light Naphtha, which revealed a noticeable difference. Simulation results of production rates were compared with the actual refinery data[6].
In a previous study conducted in 2023, R. R. Ikreedeegh proposed a two scenarios for developing the Sarir Oil Refinery to increase its production capacity from 10,000 BPD to 120,000 BPD by adding new units of vacuum distillation and delayed coking or fluid catalytic cracking (FCC) unit, it was found that the scenario that is technically and economically feasible and leads to increasing gasoline production to the maximum level and arrival to the best scenario oil refinery is the one that uses atmospheric distillation and FCC units [7]. This paper was conducted to cover the deficit in the production of gasoline in Libya with the help of two different types of crude oil, heavy and light. The process was carried out using HYSYS program, by mixing proportions of Sharara and Gulf Sirt offshore through a number of producing units in order to boost the gasoline production process. Figure (1) shows the consumption of gasoline in the previous years according to the U.S. Energy Information Administration through the period of 2015-2023 [8]. The main objective of this study is to produce enough gasoline in Libya to balance the deficiency of supply demand of gasoline in future.

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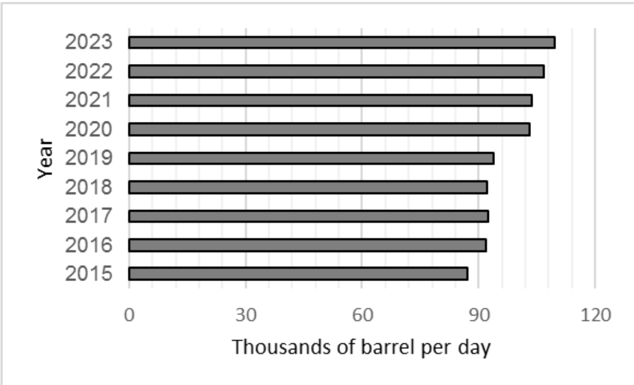

Figure 1. Consumption of gasoline in Libya (2015 – 2023)

Crude oil processing

The crude oil obtained from reservoirs undergoes several chemical processing stages before it becomes usable. Raw crude oil generally contains a complex mixture of hydrocarbons, i.e., molecules that contain hydrogen and carbon atoms, where more usable products such as gasoline, kerosene, diesel, etc. are extracted via oil refining process as shown in Figure (2).

The oil refining consists of major steps:

1. Crude distillation.
2. Conversion of intermediate streams into gasoline and diesel blend components.
3. Blending of final components, for example various grades of gasoline and diesel fuels.

In the distillation process, the crude oil is heated and various hydrocarbon chains are withdrawn from the unit based on their boiling point temperature. The components obtained as a result of this process known as cuts or fractions are naphtha, gasoline, kerosene, gas oil, lubricating oil, heavy gas, and residuals. They are categorized as light distillates (LPG, gasoline, and naphtha), medium distillates (kerosene, and diesel), and heavy distillates and residue (heavy fuel oil, lubricating oils, wax, and tar).

Seven most commonly employed refinery streams (cuts) in the gasoline production are: fluidized catalytic cracking unit

(FCCU), reforming unit (REFU), isomerization unit (ISOU), alkylation unit (ALKU) etc. together with the butane's fraction (C4) and oxygenated additives such as Methyl tertiary butyl ether (MTBE) or ethanol.

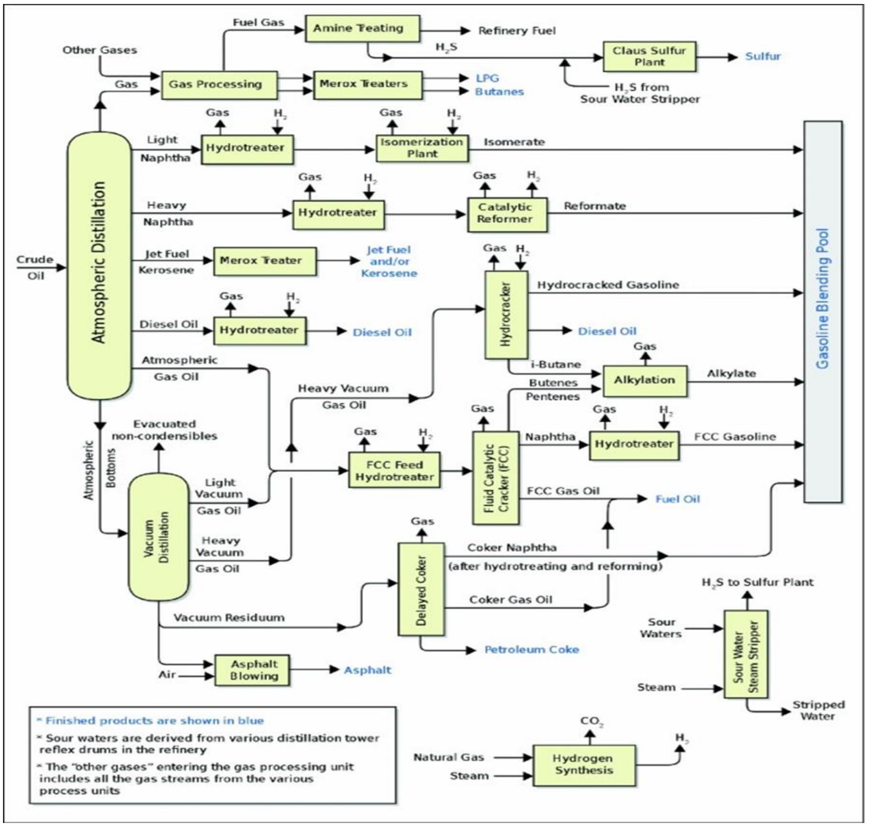

Figure 2. Process of oil refining

Atmospheric distillation unit (ADU)

The main purpose of the atmospheric distillation unit (ADU) in the refining process is separation of the lighter hydrocarbons from the heavier oils based on the difference in their boiling point. It is a long vertical column with number of trays, where each tray consists of bubble caps to allow the vapor to pass through them. This column is capable of boiling crude oil cuts to +550 C at or above atmospheric pressure (usually 101 kPa). At higher temperature, the oil will crack, which hinders the distillation process. As lighter products are boiled off at the top of the ADU, the heavier oils remain at the bottom. To increase the production of high-value petroleum products, these heavier oils are sent to a vacuum distillation column to further refine them under reduced pressure.

Vacuum distillation unit (VDU)

The distillation process is carried out under reduced pressure (pressure lower than atmospheric pressure), in order to produce additional petroleum compounds at boiling points higher than 550^{o}C without the threat of thermal cracking of the residue from the ADU, which may cause the production of less desirable products such as coke. Some VDU designed with diameters of 45 ft (14 m), where a heavy gas oil may be obtained as an overhead at temperatures about 150°C (300°F), and lubricating oil cuts may be produced at temperatures of 250°C–350°C (480°F–660°F).

Isomerization unit

Light naphtha exits the ADU and enters the isomerization unit, where it is converted by the suitable catalyst from light straight chain paraffins with low RON (C6, C5, and C4) into branched chains with the same carbon number and high-octane values. In the presence of additional hydrogen and a catalyst, the refinery isomerizes n-paraffins into isoparaffins. In addition, naphtenes are produced when benzene is saturated. After being processed, crude oil is atmospherically distilled and used as the unit's feed. The main constituents of this mixture are C5–C9 paraffins, lighter alkyl cycloalkanes, and alkyl aromatics. Light naphtha is delivered to the isomerization unit at C5 800^{o}C. (180^{o}F). There are two reasons for this fractionation. The reformer tends to hydrocrack light hydrocarbons, which is the first factor. The second is that C6 hydrocarbons tend to create benzene in the reformer.

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Fluidized catalytic cracking unit (FCC)

For operating the FCC to convert heavy, long-chain C20–C70 gas oils and residues into lighter, shorter, naphtha-boiling-range hydrocarbons, this unit is fed by VGO from the VDU unit. Additionally, the FCC unit can be fed with the low sulfuric gas oil products to improve conversion. The FCC unit creates high octane number gasoline components. The unit is the one in the oil refinery that is most frequently used to transform heavy oils into lighter and more valuable products.

Catalytic reforming unit (CCRU)

This unit also receives fuel from VGO, which changes low-octane fuel into high-octane fuel (reformate). It generates reformate with octane values between 90 and 95. In the presence of hydrogen, catalytic reforming is carried out over hydrogenation-dehydrogenation catalysts that may be supported on alumina or silica-alumina. Depending on the catalyst, a predetermined series of reactions with structural changes in the feedstock occurs. The majority of the time, CCRU feeds are straight-run naphtha, which are saturated (i.e., not olefinic) materials. However, other low-octane byproduct naphthas, such as coker naphtha, can be processed following treatment to remove olefins and other pollutants. Another good feed is hydrocracker naphtha that has a high naphtenes content. A major chemical reaction in catalytic reforming is dehydrogenation, which results in the production of a lot of hydrogen gas. In order to provide the environment required for the chemical reactions and to prevent carbon from building up on the catalyst, the hydrogen is recycled through the reactors where the reforming occurs so extending its useful life.

Alkylation unit

Isobutane from FCC combines with olefins in the alkylation unit to create C8 isoparaffins like iso-octanes. The alkylation process uses a sulphuric or hydrofluoric acid catalyst and calls for low temperature (between 0 and 40 °C) and a high isobutane-to-olefin ratio. Alkylation is easily carried out by mixing liquefied hydrocarbon feeds with strong acid, followed by the separation of the alkylate from the catalyst. Since the alkylation produces acid-hydrocarbon compounds through an exothermic process, it necessitates extensive observation in practice. Additionally, the process must avoid olefin polymerization, consume a large amount of catalyst, and take safety concerns into account. Alkylates are then collected from the column plate for blending gasoline, together with iso-butane from the top of the column and n-butane collected as a side stream.

Delayed coking unit

The heated charge is moved to enormous soaking (or coking) drums during the semi-continuous delayed coking process, which gives the cracking reactions the time they require to complete. Although fractured residue can also be used, air residue is often the input for these machines. Lighter fractions are withdrawn as side streams after the feedstock is heated in the product fractionator. The fractionator bottoms are then heated in a furnace whose outlet temperature ranges from 480°C to 515°C (895°F to 960°F), together with a recycle stream of heavy product. One of two coking drums receives the hot feedstock, where the cracking processes proceed. Coke deposits develop on the inner surface of the drum as a result of the broken products leaving as overheads. Two drums are employed to provide continuous operation; while one is onstream, the other is being cleaned. The coke drum has a temperature range of 415°C to 450°C (780°F to 840°F) and a pressure range of 15 to 90 psi. Overhead materials are sent to the fractionator, where fractions of naphtha and heating oil are extracted.

Catalytic hydrocracking unit

Heavy feedstocks are cracked in the presence of hydrogen during the two stages of hydrocracking, which combines catalytic cracking with hydrogenation. Typically, the reaction includes a reactor portion, a gas separator, a scrubber to remove sulfur, and a product fractionator. A multi catalyst bed, either fixed or ebulliated, is present in the reactor section. Some reactors use on-stream catalyst addition and removal to maintain catalyst activity.

In this paper, coker gas oil produced from the delayed cooker unit and LCO product from FCC unit will be used as feed

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stocks to convert it into high OC gasoline. Catalytic hydrocracking, another innovation that truly belongs to the twentieth century, is regarded as the modern method for converting high-boiling petroleum fractions, such as gas oil into gasoline and other low-boiling fractions.

HYSYS process simulator of blending crude oil

HYSYS is widely used in industry for modeling and performance enhancement. A process model can be created using the program HYSYS and it can subsequently be simulated using intricate calculations (models, equations, math calculations, regressions, etc.) [9].

HYSYS use mathematical models to forecast how a process will behave in the presence of a process design and an adequate choice of thermodynamic models. The application was frequently used by engineers to replicate this in order to enhance already-existing designs and optimize brand-new ones. It is essential to describe these precise thermodynamic properties for separating non-ideal mixtures. One of the key benefits is that HYSYS already contains a data store of species and the pure/binary regressed parameters for each one.

Therefore, HYSYS software is frequently used to model any refinery equipment, including distillation columns, crackers, cokers, reformers, and FCC units. It makes use of an existing design that the user adds to or inserts using an existing template or a new flow sheet in order to mimic and enhance the performance of that design [10].

Process simulation procedure

In order to obtain crude oil that matches Libyan specifications, six basic steps are used to run the flow sheet simulation in the HYSYS simulator as shown in figure (3).

There are some important calculations involved in distillation column simulation includes: the process of combining two types of crude oil according to their temperature before entering the distillation tower, material balancing calculations.

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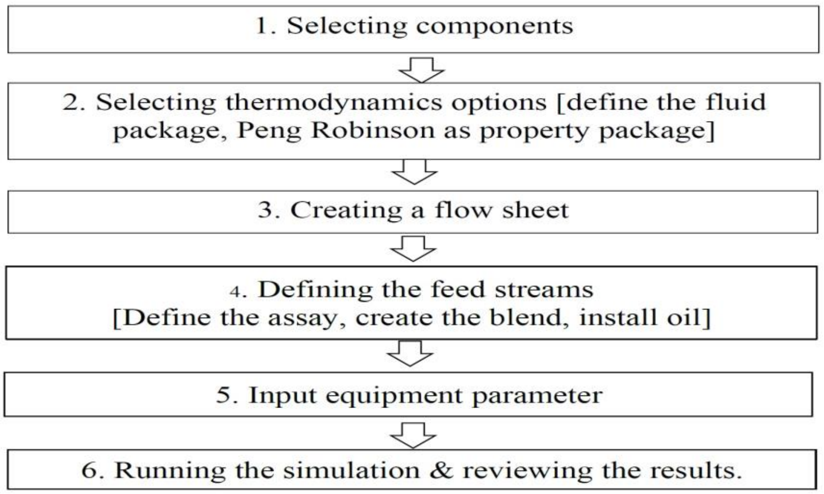

Figure 3. HYSYS simulation method

Blending crude oil

A simulated blending process is carried out for 80% Sharara oil and 20% Gulf Sirt offshore crude oil as shown in figure (4).

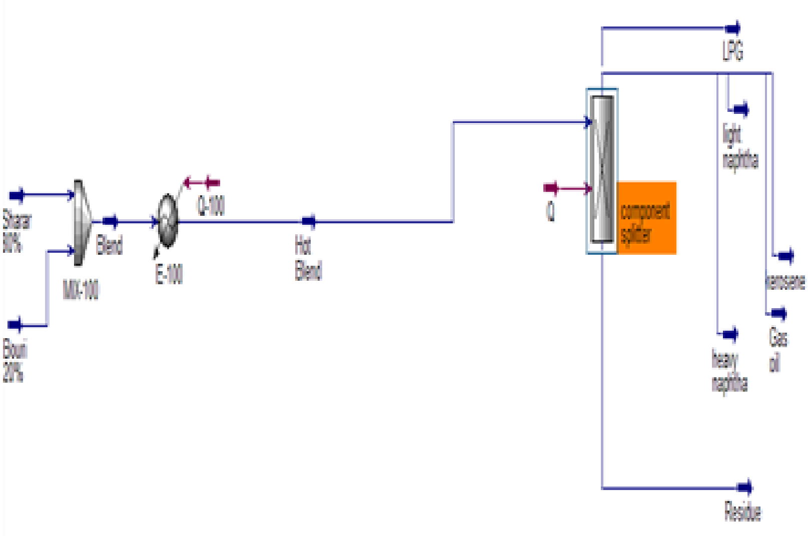

Figure 4. Flowchart of blending process for the mixed crude oil

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Table1. Specifications of blend line in the mixed crude oil from Hysys simulation.

Stream Name	Sharara 80%	Gulf Sirt Crude 20%	Blend	Blend Vapour Phase	Blend Liquid Phase
Vapour/ Phase Fraction	1	0	0.9074	0.9074	0.0926
Temperature (°C)	320	223	304.9	304.9	304.9
Pressure (Kpa)	344	344	344	344	344
Mole Flow (Kgmole/hr)	1.457E+04	922.7	1.557E+04	1.412E+04	1442
Mass Flow (Kg/hr)	2.025E+06	4.051E+05	2.430E+06	1.977E+06	4.537E+05
Std ideal liquid volume flow m3/hr	2602	449.8	3052	2536	516.5
Molar enthalpy (kj/Kgmole)	-1.667E+05	-6.800E+05	-1.994E+05	-1.735E+05	-4.532E+05
Molar entropy (kj/Kgmole)	5.680E+02	1436	624.7	563.60	1224
Heat flow (kj/hr)	-2.429E+09	-6.751E+08	-3.104E+09	-2.450E+09	-6.534E+08
Liquid volume flow@ Std Cond (m3/hr)			3046	2525	520.8

Table 2. Specifications of blend line and hot line for the blended crude oil Hysys simulation

Stream Name	Blend	Hot Blend	Q-100
Vapour/ Phase Fraction	0.9074	1	-
Temperature (°C)	304.9	650	-
Pressure (Kpa)	344	289	-
Mole Flow (Kgmole/hr)	1.557E+04	1.557E+04	-
Mass Flow (Kg/hr)	2.430E+06	2.430E+06	-
Std ideal liquid volume flow m3/hr	3052	3052	-
Molar enthalpy (kj/Kgmole)	-1.994E+05	-2.437E+04	-
Molar entropy (kj/Kgmole)	624.7	862.7	-
Heat flow (kj/hr)	-3.104E+09	-3.793E+08	2.724E+09

Calculations and results

The calculation process depends on the process of balancing the material, but above all, it is necessary to know the data sources used, the type of crude oil, the quality of the oil and how to deal with it. The data was taken from the crude assay for Sharara and Gulf Sirt offshore crude oil. The characteristics of the crude oil were clarified in the two tables that were taken from the crude assay for different types, where the Sharara known as light crude oil, and Gulf Sirt offshore as heavy crude oil as shown in Table (3). A blend of Sharara crude oil of 80% with Gulf Sirt offshore crude oil of 20% is used in this study. Properties of the projected Gulf Sirt offshore is represented by Bouri crude oil due to the fact that Mediterranean see crude oil have similar compositions.

Table 3. Properties of Sharara crude oil and Gulf Sirt offshore crude oil

Description	units	Method	Results for Sharara crude oil	Results for Gulf Sirt offshore crude oil
Density@15ºC,	g/ml	ASTM D-4052	0.8139	0.8976
Specific gravity@60/60ºF		Calculation	0.1846	0.8984
API gravity		Calculation	42.2	26.0
Flash point (PMCC)	ºC	ASTM D-93	-42	< -30
Reid vapor pressure	psi	ASTM D-323	7.1	2.9
Hydrogen sulphide	ppm	IP 103	1.02	< 1
Water and sediment content	Vol%.	ASTM D-4007	Traces	0.00
Sulphur content	Wt%.	ASTM D-4294	0.0733	1.664
Pour point	ºC	ASTM D-97	< -33	+ 6
Kinematic viscosity @70ºF, 100ºF	cSt cSt	ASTM D-445 ASTM D-447	1.1348 2.2886	57.212 17.193
Asphaltenes	Wt%.	IP 143	0.260	4.0
Conradson carbon	Wt%.	ASTM D-189	1.206	2.830

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residue				
Ash content	Wt%.	ASTM D-482	0.006	0.003
Characterization factor		UOP 375	11.9	11.7
Salt content (as NaCl)	Mg/l	IP 77	0.12	55
Vanadium	ppm	ASTM D-5708	0.908	21.25
Nickel	ppm	ASTM D-5708	0.541	20.71
Calcium	ppm	Dry ashing	5.301	< 0.04
Potassium	ppm	Dry ashing	0.276	9.83

Where the percentage was crude oil of Sharara 80% and crude oil of Gulf Sirt offshore 20%, new crude oil was obtained with API = 38.7.

Table 4. Blended crude oil specifications

Type	Temperature (^{0}C)	Wt%	Accumulative%
Condensate, Gas and LPG	-	1.624	1.624
Light naphtha	C5 – 70	4.676	6.3
Heavy naphtha	70 – 175	21.932	28.232
Kerosene	175 – 235	12.246	40.246
Gas oil	235 – 350	22.428	62.906
Vacuum gas oil	350 – 550	26.3	89.206
Vacuum residue	550+	10.794	100

In this study, the crude oil is introduced at a temperature between 223 to 320 ^oC in an amount of 2.025×10^6 kg / h for Sharara oil and 4.051×10^5 kg / h for Gulf Sirt offshore crude oil to be mixed in the mix to produce a crude blend at a temperature of 304.9^{o}C. The mixture is heated in a heater to be fed into the distillation tower at a temperature of 650°C, the distillation tower separates the harvests according to the temperatures as shown in Table (5).

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Table.5. Results simulated for mixed crude oil around atmospheric distillation

Product	Temperature (^{0}C)	Pressure (Kpa)	Temp. cut point (^{0}C)	Amount calculation Ton/year
LPG	50	100	-	360,161
Light naphtha	70	100	C5-70	1,037,016
Heavy naphtha	175	100	70-175	4,863,952
kerosene	235	100	175-235	2,715,847
Gas oil	350	100	235-350	4,973,952
Residue	550	100	350+	8,226,492

The crude oil was used as the feed for atmospheric distillation unit, which produces different primary products to be used in several other units to increase the production of gasoline. Tables (6, 7, 8, 9, 10, 11, 12) shows the results of gasoline produced for vacuum distillation unit, FCC unit, catalytic reformate, delayed coker, isomerization unit, alkylation unit, catalytic hydrocracking unit respectively.

Table.6. Results around vacuum distillation unit

Feed	T (^{0}C)	Wt%	Product (ton/year)
Residue (fuel oil)	350+	37.094	8,226,492
Product	T (^{0}C)	Wt%	Product (ton/year)
Vacuum gas oil	350 -550	26.3	5,832,661
Vacuum residue	550+	10.794	2,393,831

Table.7. Results simulated for mixed crude oil around FCC unit

feed	Wt%	BPD	API	Ton/year
Vacuum gas oil	13.15	55,518	24.62	3,754,465
Product	Vol%	BPD	API	Ton/year
Coke	4.2 Wt%	-	-	122,486
C2 and lighter	4.6 Wt%	-	-	134,152
C3=	7.01	3,892	-	117,686
C3	2.10	1,166	-	34,378
C4=	9.26	5,141	-	178,945

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i-C4	6.58	3,653	-	119,315
n-C4	2.44	1,355	-	45,818
C5+	60.18	33,411	58	1,449,712
TCGO	(25)	13,880	15.2	775,987
LCGO	(19)	10,548	19.4	573,419
HCGO	6	3,332	3.43	202,567

Table.8. Results simulated for mixed crude oil around catalytic reformate

Feed	**Vol%.**	**BPD**	**API**	**Ton/year**
V.C.O wt%.	13.15	55,518	24.62	2,916,331
Product	Vol%.	BPD	API	Ton/year
H_2	3.2	-	-	93,321
C1+C2 wt%.	2.4	-	-	69,993
C3 wt%.	3.45	-	-	100,612
i-C4	2.739	1,521	119.8	53,690
n-C4	3.861	2,144	110.6	79,159
C5+ reformate	80.9	44,914	14.1	2,519,557

Table.9. Results simulated for mixed crude oil around delayed coker

Feed	**Vol%.**	**Wt%.**	**BPD**	**API**	**Ton/year**
Vacuum residue	-	10.794	18,670	10.41	1,079,401
Product	Vol%.	Wt%.	BPD	API	Ton/year
Coker gas	-	8.0203	-	-	86,570
Coke gasoline	15.49	11.8148	2,892	54.4	127,528
Coker gas oil	84.89	77.72	15,849	23.5	838,911
Coke	-	2.448	-	-	26,424

Table.10. Results simulated for mixed crude oil around isomerization unit

Feed	**Wt%**	**BPD**	**API**	**Ton/year**
Light naphtha	4.676	27,300	84.39	1,037,016
Product	**Wt%.**	**BPD**	**API**	**Ton/year**
C1	11.41	-	-	8,322
C2	16.35	-	-	9,552
C3	24	-	-	8,882
n-C4	15.67	-	-	80,365
i-C4	11.12	-	-	115,318
C5+	**78.55**	**22,391**	**94.25**	**814,577**

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Table 11. Results simulated for mixed crude oil around alkylation unit

	Propylene			Butylene		
Feed	**M_{wt}**	**Wt%.**	**BPD**	**M_{wt}**	**Wt%.**	**BPD**
Olefin	42	100	3,892	56	100	5,141
i-C4	58	171.3	6,227	58	112.56	6,169
Total			∑10,119			∑11,310
Product		Wt%	BPD		Wt%.	BPD
C2		-	-		-	-
C3		29.05	1,160		-	-
n-C4		-	-		12.40	653
n-C5		8.53	279		7.08	350
Alkylate bottom		18.18	490		15.02	612
Alkylate			8,190			9,695

Table 12. Results simulated for mixed crude oil around Catalytic hydrocracking unit

Feed	**Wt%.**	**BPD**	**API**	**Ton/year**
Coker GO	-	15,849	23.5	838,911
FCC LCO	-	10,548	19.4	573,419
combined	-	∑26,397	21.8	-
H2	-	-	-	-
Product	**Wt%.**	**BPD**	**API**	**Ton/year**
C3 and lighter	2.575	-	-	36,369
i-C4	-	1,742	-	56,896
n-C4	-	673	-	22,756
C5-180oF	**-**	**4,619**	**223**	**107,002**
Naphtha 180ºF-400ºF	-	11,615	126	370.598
400ºF-520ºF	-	22,633	90	837,270

Discussion of simulation results

The total amount that suggested of 500,000 barrels per day of new crude oil entering the atmospheric distillation unit of two different types of Libyan crude oil has been proposed to increase the amount of gasoline production, the results were as follows:

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Table 13. Results of gasoline by BPD from different units

Description	Gasoline
Catalytic reforming	33,411
Catalytic reformate	44,914
Delayed coker	2,892
Isomerization	22,391
Alkylation	17,885
Catalytic hydrocracking	4,619
Gasoline pool	∑126,112
Enhanced gasoline	177,675

The suggested Gulf-Sirt complex refinery is complex project. It consists of atmospheric distillation column, vacuum distillation unit, fluid catalytic cracking unit, catalytic reforming unit, alkylation unit and catalytic hydrocracking unit. The main objective of this refinery is to produce the maximum amount of gasoline where a huge deficit of gasoline production has to be eliminated. Isomerization and alkylation unit are needed to improve the quality of the produced gasoline, and to minimize the addition of MTBE (Methyl tertiary butyl ether) in the gasoline pool. The catalytic reforming unit is essential where most of the gasoline are produced from it.

Table (13) summarizes the results of production of gasoline obtained from the crude oil by using several different units. It was found that produces of 177,675 bbl/day have been achieved and according to the total consumption of gasoline in Libya, it is a good production compared to previous years.

Conclusion

Libya has a bright future in crude oil production. Processing of a mixture of Sahara crude oil and Gulf Sirt crude oil will be able to produce enough petroleum refinery products to satisfy the local market needs and export the extra production of kerosine, gas oil and fuel oil. The main objective of this study is to assess technical parameters to install a new refinery in Libya at Sirt. A blend of on shore crude oil with projected offshore crude oil from proposed Gulf-Sirt crude oil with a capacity of 500,000 barrel per day. The refinery consists of atmospheric distillation, vacuum distillation,

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Alkylation and Catalytic hydrocracking. Methyl tertiary butyl ether is added to the gasoline pool to adjust the octane number due to Libyan specification of 92. HYSYS simulation have been used to simulate the units where a production of 177,000 barrel per day of gasoline can be produced per day. This production with Azzawia refinery will satisfy the local markets from gasoline for many years to come.

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