Business Plan Construction of the Plant for Processing Natural and Associated Petroleum Gas Into «PRODUCT GTL» Based on PJSC «GTL» Technology

IN THE FEDERAL REPUBLIC OF IRAQ

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1. INTRODUCTION

1.1. Introduction to Consortium of Companies

JSC "GTL" was founded in 2000 in order to realize a project of extinguishing flares and refining natural gas into high-octane engine fuels (petrol and diesel fuel). JSC "GTL" has invested in R&D aimed at creating this technology 71.3 million dollars by 2013.

JSC "GTL" scientists and specialists have developed more than 100 various innovations, which have been patented or are at the stage of registration for receiving Russian and international patents. JSC "GTL" is closely cooperating with international leading research institutes and universities.

Empire Fuel Industries Limited established in 2006 in Dubai, Moscow, Barcelona, Istanbul, Baghdad and Beirut by the association of successful companies working in the construction of oil& gas and electric power business sectors, construction of small and medium oil refineries, construction of storage tank farms, for the possibility of business increasing and large project proceeding with a uniform center of control and responsibility.

In the first stage, the company was specialized in the following technologies:

- Organizational technical preparing to startup.
- Government expertise of objects.
- Design and construction of storage tank farms.
- Construction design.
- Installation and testing work on oil chemicals, upstreaming, and preparation of gas for transportation.

Empire Fuel Industries Limited is commitment to a clear purpose, vision and set of values, which together govern decision-making at every levels in the project. Also , presence of highly experienced employees, which made the company face the challenges of work successfully and the completion of work with high quality, accuracy, and precise delivering times.

Najm Al-Shimal Oil Services Company established in 2015 as an Oilfield Services Company affiliated by Makeen Group**.** The company has developed to include a wide range of services to meet the needs of the oil & gas and petrochemical industries.

With a team of over 250 employees, we continue to expand our service offering to cater to the priorities of global firms operating in Iraq and help accelerate the development of the country's oil and gas industry. Bolstered with a broad network of international partners and an innate knowledge of the local market, we deliver innovative and impactful solutions to our clients.

Najm Al-Shimal also offers specialized oilfield equipment and services to companies operating in Iraq. As an approved supplier to leading IOCs, NOCs, and EPCs, we leverage our strong relationships with original equipment manufacturers to offer comprehensive and cost effective solutions. Our product offerings are supported with quality after sales services including spare parts.

Product Coverage:

- Casing, tubing and line pipes
- Drill bits and downhole tools
- Top drives, mud pumps, and rig equipment
- Drill pipes
- Corrosion protection products
- Flare system, flare gas recovery and burners
- Turbomachinery and Process Solutions
- Industrial hoses and hydraulic systems
- Flow, level, temperature and pressure measurement systems

1.2. GTL «Gas to Liquid» PJSC Technology Achievements

PJSC "GTL" has created a cost-effective patented technology in the form of units (plants) operating in Russia for the processing of associated petroleum and natural gas into pure hydrogen and liquid products.

We participated in Expo 2017 Astana - "Energy of the Future" and demonstrated our technologies to more than 130 countries of the world. Representatives of more than 60 countries of the world expressed a desire to use our technologies to extinguish oil and gas flares in order to reduce the emission of carbon dioxide and other combustion products into the atmosphere.

With the receipt for their own needs of cheap environmentally friendly motor fuel and their chemical compounds, including hydrogen and other chemical compounds for the needs of the local industry.

Due to financial constraints, we were today able to start implementing our environmental projects in eight countries by creating joint projects with 50/50 equity financing.

We can supply ready-made GTL installations to all countries of the world, primarily for extinguishing oil and gas flares and solving the environmental problem of CO2 emissions into the atmosphere.

The main objective of our project is a reduction of CO2 emissions into the atmosphere.

Our scientists have successfully tested the technology in a real environment. We have registered a number of patents:

- № 2199366 "**Natural Gas Homogeneous Oxidation Reactor**",
- № 2416461 "**Packet vortex packing for heat and mass transfer columns**",
- № 2426715 "**Method and installation for homogeneous oxidation of methane-containing gas**",

- № 2440189 “**Catalyst and method for producing high-octane gasoline with a low content of benzene and durol**”.

The advantages of technology

- Economic efficiency
- Absence of liquid effluents and emissions
- All stages of the technology were successfully tested
- Flexible production capacity

1.3. Corporate Values and Principles of Work

Safety

Nothing is more important than safety and we develop special GTL procedures for each project.

Innovations

It’s in our nature to start process from theory, prove it by tests and realize this challenge in the built working object.

Responsibility

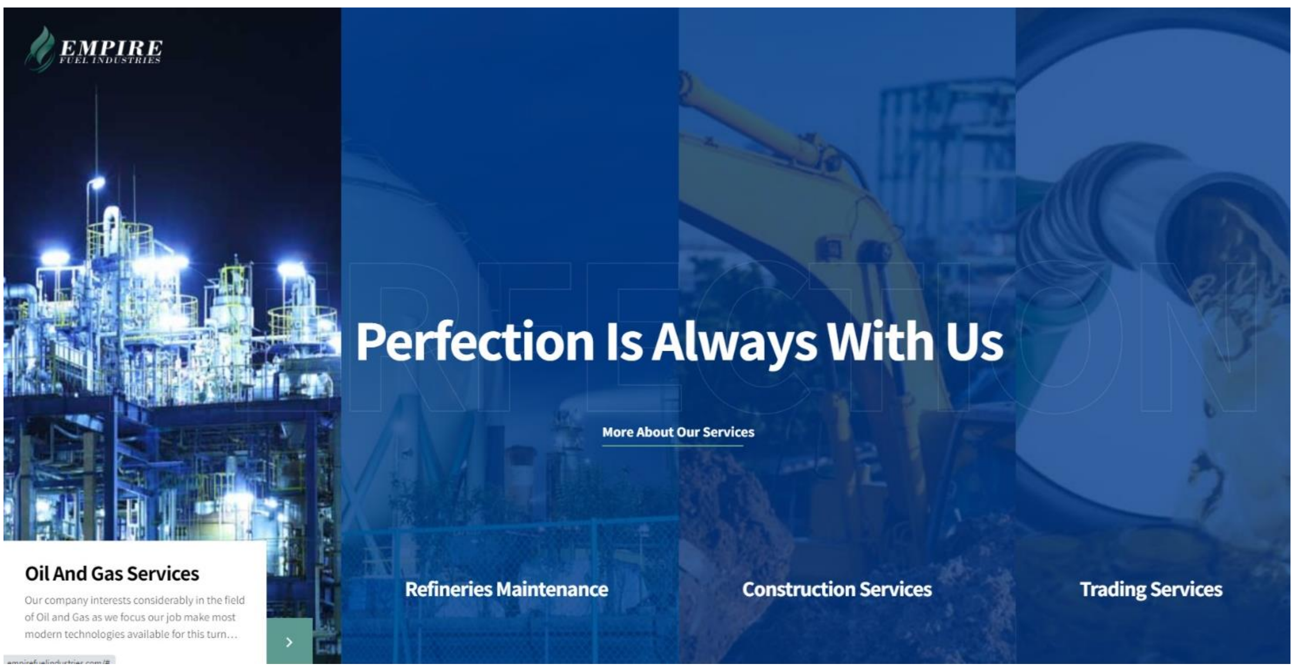
- We take time to come to the same understanding with our customers.
- We lead all projects to the built working object.
- When sceneries of project process become complicated we give a prompt response to lead the process to a stable state.

Quality

GTL production process is realized in accordance with ISO 9001, ISO 14001, OHSAS 18001.

1.4. Purpose of the Project

Development and implementation of technical and design solutions, providing the construction of a plant for processing of 60 MMSCFD of natural and associated gas, taking into account peculiarities of oil and gas field to Convert it to high-Octane Gasoline and diesel fuel using a waste-free technology with a highly profitable low-tonnage plants allows for gas processing on site and eliminates the cost of constructing a gas pipeline and also Reducing the emission of carbon dioxide and other combustion products into the atmosphere .



Intellectual Property Rights Registered in Russia

РОССИЙСКАЯ ФЕДЕРАЦИЯ

ПАТЕНТ

НА ИЗОБРЕТЕНИЕ

№ 2181622

Российским агентством по патентам и товарным знакам на основании Патентного закона Российской Федерации, введенного в действие 14 октября 1992 года, выдан настоящий патент на изобретение

УСТАНОВКА ДЛЯ ГОМОГЕННОГО ОКИСЛЕНИЯ ПРИРОДНОГО ГАЗА И СПОСОБ ГОМОГЕННОГО ОКИСЛЕНИЯ ПРИРОДНОГО ГАЗА

Патентообладатель(ли):

Закрытое акционерное общество "Метанол"

по заявке № 2001132204, дата поступления: 29.11.2001

Приоритет от 29.11.2001

Автор(ы) изобретения:

Кадыров Рафис Фаизович, Пресняков Николай Иванович

Патент действует на всей территории Российской Федерации в течение 20 лет с 29 ноября 2001 г. при условии своевременной уплаты пошлины за поддержание патента в силе

Зарегистрирован в Государственном реестре изобретений Российской Федерации

г. Москва, 27 апреля 2002 г.

Генеральный директор

А.Д. Корчагин

РОССИЙСКАЯ ФЕДЕРАЦИЯ

ПАТЕНТ

НА ИЗОБРЕТЕНИЕ

№ 2416461

ПАКЕТНАЯ ВИХРЕВАЯ НАСАДКА ДЛЯ ТЕПЛО- И МАССООБМЕННЫХ КОЛОННЫХ АППАРАТОВ

Патентообладатель(ли): *Открытое акционерное общество "Вихревые массообменные установки" (RU)*

Автор(ы): *Кадыров Рафис Фаизович (RU), Блиничев Валерьян Николаевич (RU), Чагин Олег Вячеславович (RU), Кадыров Руслан Рафисович (RU)*

Заявка № 2010105513

Приоритет изобретения 17 февраля 2010 г.

Зарегистрировано в Государственном реестре изобретений Российской Федерации *20 апреля 2011 г.*

Срок действия патента истекает 17 февраля 2030 г.

Руководитель Федеральной службы по интеллектуальной собственности, патентам и товарным знакам

Б.П. Симонов

РОССИЙСКАЯ ФЕДЕРАЦИЯ

ПАТЕНТ

НА ИЗОБРЕТЕНИЕ

№ 2426715

СПОСОБ И УСТАНОВКА ДЛЯ ГОМОГЕННОГО ОКИСЛЕНИЯ МЕТАНОСОДЕРЖАЩЕГО ГАЗА

Патентообладатель(ли): *Открытое Акционерное Общество "GTL" (RU)*

Автор(ы): *Кадыров Рафис Фаизович (RU), Блиничев Валерьян Николаевич (RU), Чагин Олег Вячеславович (RU)*

Заявка № 2009131339

Приоритет изобретения 19 августа 2009 г.

Зарегистрировано в Государственном реестре изобретений Российской Федерации *20 августа 2011 г.*

Срок действия патента истекает 19 августа 2029 г.

Руководитель Федеральной службы по интеллектуальной собственности, патентам и товарным знакам

Б.П. Симонов

РОССИЙСКАЯ ФЕДЕРАЦИЯ

ПАТЕНТ

НА ИЗОБРЕТЕНИЕ

№ 2440189

КАТАЛИЗАТОР И СПОСОБ ПОЛУЧЕНИЯ ВЫСОКООКТАНОВЫХ БЕНЗИНОВ С НИЗКИМ СОДЕРЖАНИЕМ БЕНЗОЛА И ДУРОЛА

Патентообладатель(ли): *Открытое акционерное общество "GTL" (RU)*

Автор(ы): *см. на обороте*

Заявка № 2010128118

Приоритет изобретения 08 июля 2010 г.

Зарегистрировано в Государственном реестре изобретений Российской Федерации *20 января 2012 г.*

Срок действия патента истекает 08 июля 2030 г.

Руководитель Федеральной службы по интеллектуальной собственности, патентам и товарным знакам

Б.П. Симонов

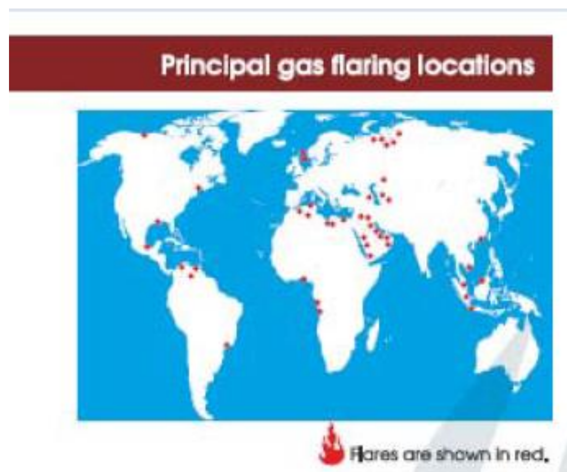
1.5. Challenge

According to the World Bank data 150 billion m^3 of associated oil gas are burned annually in the world and are discharged to the atmosphere, and it results in :

a) enormous waste of energy (the 20 billion m^3)

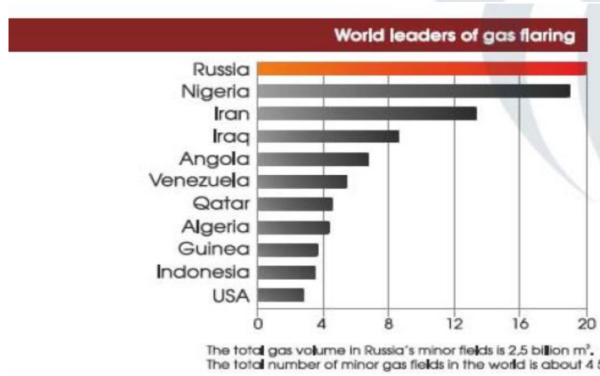
b)disaster for environment (methane and carbon dioxide are greenhouse gases) flare gas burned every year only in Russia could be used to generate more than 8.5 billion MW)

c) poisoning of surrounding areas (methane and carbon dioxide causes allergies and health problems). At the same time many countries have to import petroleum products such as diesel and gasoline.



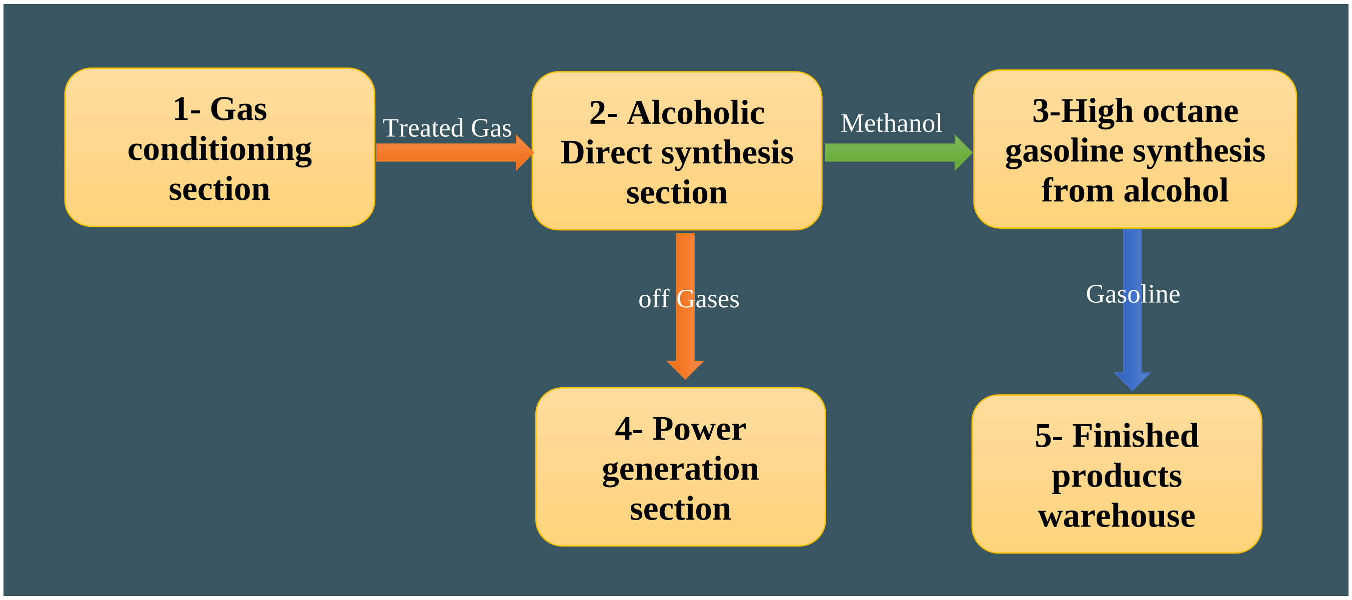
The logical solution to the problem of associated oil gas could be the usage of several GTL plants and gas turbine power plants. The installation of GTL plant in oil and gas fields permits to solve several issues, namely:

1. Production of high-quality petroleum products (motor fuel);
2. Production of cheap and environmentally friendly electric power;
3. Reductions of flare gas and environmental improvement.



1.6. Process Description:

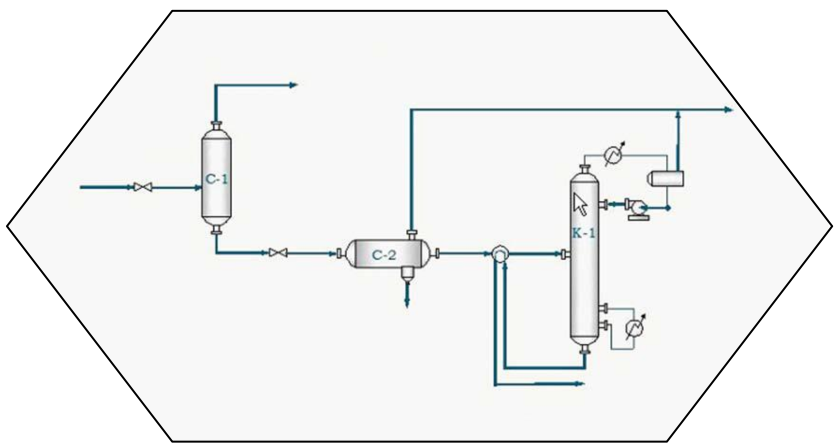
1.6.1 Gasoline Production Scenario:



1- GAS CONDITIONING SECTION

a complex of process equipment and ancillary systems, providing collection, treatment, removal of condensed moisture, mechanical impurities and processing of natural gas and gas condensate.

Below the Final test Report for Supplied Gas from Nahr bin Umer Field.



	Basra Oil Company/ Research & Quality Control Dep.			
	Report Code: BOC-RC-02-WI-01/F07	Issue NO.:1	Issue date: 3/12/2017	

Final Test Report

Location: Nahr bin Umer	Report No. 125	Report date: 11.7.2021
Beneficiary : قسم انتاج حقول اللحيس وارطاوي والطوبة وبن عمر		
Beneficiary Req. NO 715	Beneficiary Date: 6.7.2021	

Composition of Natural Gas by Gas Chromatography (TCD, FID), ASTM D 1945, GPA 2286

Source of sample	Nahr bin Umer Degassing station dry Bank				
Well no.	Nr(13, 15, 23, 27, 28, 29, 30, 32)				
Formation	Zubair				
Stage No.	1st stage	2nd stage	3rd stage	4th stage	GTU
Date of sampling	7.7.2021				
Date of Analysis	7.7.2021				
Pressure (Kg/cm^2)	39	7	2	0.40	35 bar
Temperature (°C)	44.6	43.2	43	48	47.8
Sample no.	**S518**	**S519**	**S520**	**S521**	**S522**
Compound	Normalized Mole % Analysis				
Nitrogen (N_2)	0.2856	0.1325	0.2680	0.1500	0.1649
Carbon Dioxide (CO_2)	2.5301	3.2183	2.6303	1.5929	2.5205
Hydrogen Sulfide (H_2S)	0.0014	0.0040	0.0050	0.0070	0.0012
Methane	82.0449	60.8033	27.6078	11.0060	82.2763
Ethane	7.7984	15.3804	21.2908	20.1266	7.7889
Propane	3.8618	10.7058	22.5026	30.8208	3.8462
Iso Butane	0.6237	1.8707	4.5538	6.8824	0.6242
Normal Butane	1.3160	3.9794	10.0883	15.2962	1.3135
Neo Pentane	0.0086	0.0225	0.0584	0.0895	0.0087
Iso Pentane	0.3698	1.0817	2.9770	4.3042	0.3699
Normal Pentane	0.4040	1.1547	3.2569	4.5241	0.4004
Hexanes	0.3649	0.9461	2.8999	3.5639	0.3433
Heptanes	0.1545	0.3349	1.0692	1.1504	0.1190
Octanes	0.0696	0.1124	0.3346	0.2399	0.0427
Nonanes	0.0907	0.1289	0.3391	0.1813	0.0516
Decanes +	0.0760	0.1244	0.1183	0.0648	0.1287
TOTAL	100.00	100.00	100.00	100.00	100.00

Specific Gravity and Calorific Value and main Molecular weight of Gases, GPA 2172, ASTM D3588

Characteristics	Result				
Specific Gravity Air=1 at 14.696 psia and 60°F	0.7203	0.9389	1.3664	1.598	0.7176
Calculated Molecular weight ,(g /mole)	20.862	27.1936	39.5768	46.2842	20.7832
Calculated Density , (LBS/SCU.ft)	0.0548	0.0714	0.1039	0.1216	0.0546
Calculated Net Calorific Value , (B.T.U./CU.ft) (LHV)	1088.2941	1391.9345	2022.0834	2382.613	1086.7362
H_2S content , By Drager Tube , ppmv	14	40	50	70	12
Water Content ,By Drager Tube , mg/L	2	5	>40	>40	2.5
Calculated M.W of C6+	101.4886	97.8514	95.4840	92.6372	102.5104

Husain N, Ali A., Ahmed J.	Hassan A.N , Ali A.	Hassan A.N	زهير احمد خلف
Sampled by	**Tested By:**	**Reviewed by:**	**Approved by:**

2. ALCOHOLS DIRECT SYNTHESIS SECTION

Natural gas from the gas conditioning section is supplied to four parallel "gas-gas" heat exchangers. Heated gas is supplied to the tube space, heating is carried out by the heat, generated during the gas reaction in four parallel rectors of the first order, entering the tube space (housing). In the heat exchangers, the gas entering the reactor is heated to start the reaction, gas cooling after the reaction area of the reactor and the condensation of resulting product. For the start mode and turning the reactors into the operating modes for several minutes, a heat exchanger is used with a possibility of heating the additional gas, supplied thereto from the conditioning unit. (Used technologies are protected by the patent for invention no. 2181622.).

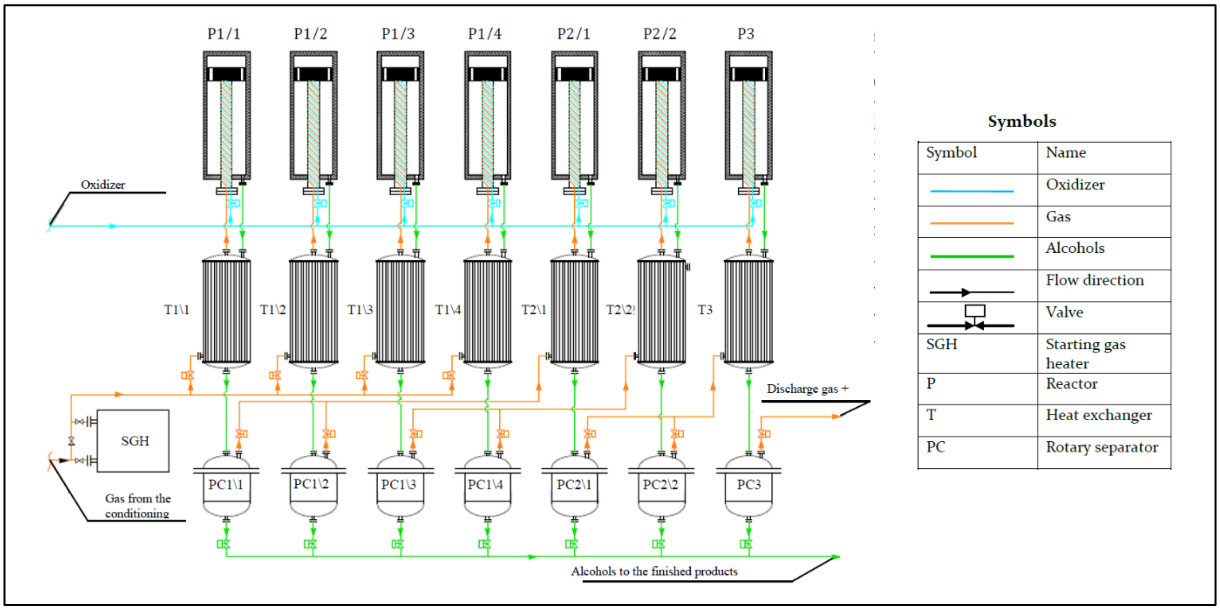
The gas, heated in the heat exchanger, then enters the reactor through the central tube, which is also the inner electrode of the reactor. Inside the tube there are two channels in the form of mutually interwoven springs, tightly contacting with the inner wall of the tube, which serve to guide the gas and the oxidant gas into the reaction zone, achieving the highest possible level of heat exchange and additional heat exchange in the reaction zone of the reactor. This allows additional control of the heat balance in the reaction zone of the reactor. (Used technologies are protected by the patent for invention no. 2199366.

The upper end of the reactor has an apparatus which creates swirling of gas and oxidant gas, entering the reaction zone , creating a maximum fast mixing of gas and oxidant gas, heated to the temperature, required to initiate the reaction. (Used technologies are protected by the patent for invention no. 2426715.

After the reaction, the mixture of obtained products and unreacted gas residue, leaving the reactor, enters the heat exchanger where it is cooled to the desired temperature by cold gas, supplied from the gas conditioning section, and then goes to the block for separating the liquid products from the residual gas. Isolated liquid products are sent to the finished products warehouse or for further processing in the following sections of the plant for conversion of natural and associated gas.

Secondary gas, obtained from two reactors of the first order, after separation from the depleted liquid product in sections of gas-liquid separation, according to the technical requirements during the designing, may be sent to the section for isolation of the formed hydrogen, as a commodity product or for further use in fuel elements in the plant power unit; if there is helium in gas composition, then to extract helium as a commodity product. (Used technologies are protected by the patent for invention no. 2513917.

Two streams of gas from the reactors are combined into a single stream and sent as cooled gas to the fifth heat exchanger to heat it before processing in the next reactor of the



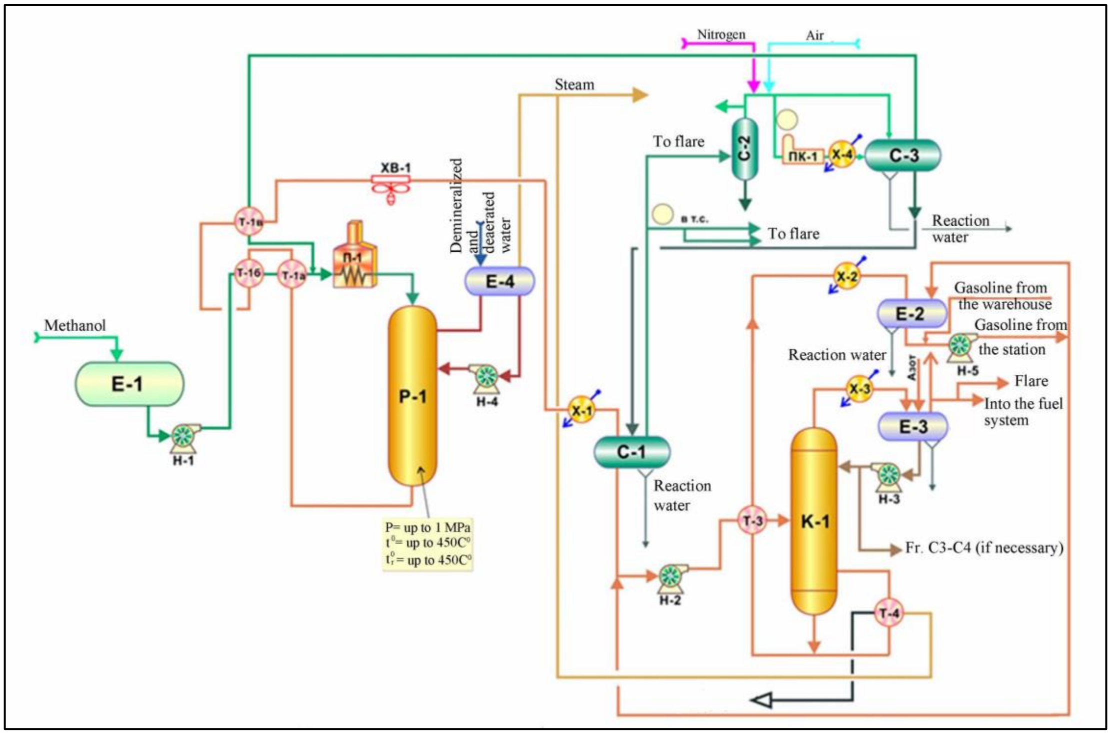
second order, if the technical design specification does not provide for the allocation of helium and hydrogen. Heating of the gas is carried out by the heat flow from this reactor. Also the gas flows are sent from the second pair of parallel reactors of the first order.

The produced products in the reactors of the second order, as in reactors of the first order, are isolated in sections of gas-liquid separation, and cooled gas of two streams is combined into the single stream and sent to the heat exchanger, serving the following reactor of the third order. The product obtained from the reactor after cooling in the heat exchanger is isolated in the unit of gas and liquid products separation.

Liquid products are sent to the finished products warehouse or for further processing in the following sections of the plant for conversion of natural and associated gas, and isolated gas in the composition of the discharge gas is sent to the power section of the plant, where, if it is necessary, additional associated products, including hydrogen, are possible to be produced.

3.SECTION OF HIGH-OCTANE GASOLINE SYNTHESIS FROM ALCOHOLS.

Section of high-octane gasoline synthesis from alcohols with low durene and benzene content is characterized by the fact, that the catalyst for the production of high-octane gasoline is heated in an isothermal reactor with heat pipes to a temperature of 280-320 °C. The process of contacting the raw material with a catalyst, heated in the isothermal reactor with heat pipes, is carried out at a pressure of 0.1-1 MPa, fed into the reactor of raw material with volumetric feed rate of 1-5 h -1 (for fluid) and inert gas with volumetric feed rate of 1000 -10000 h -1 after evaporation of the raw material in the preheater. Alcohols are used as raw materials. (Used technologies are protected by the patent for invention no. 2440189.)



Process Conditions

T=360-420°C; P=1.0 MPa; W (for raw materials) = 1.0-2.0 h -1

Equipment Specific Design

Tray reactor using a cold quench.

Process indicators

- Output of gasoline - 95-105% on the initial fraction C5-C11.
- Conversion of methanol - 99-100%.
- Performance ≈ 0.6 tons of gasoline/1t of catalyst per hour.

Zeolitic Catalyst

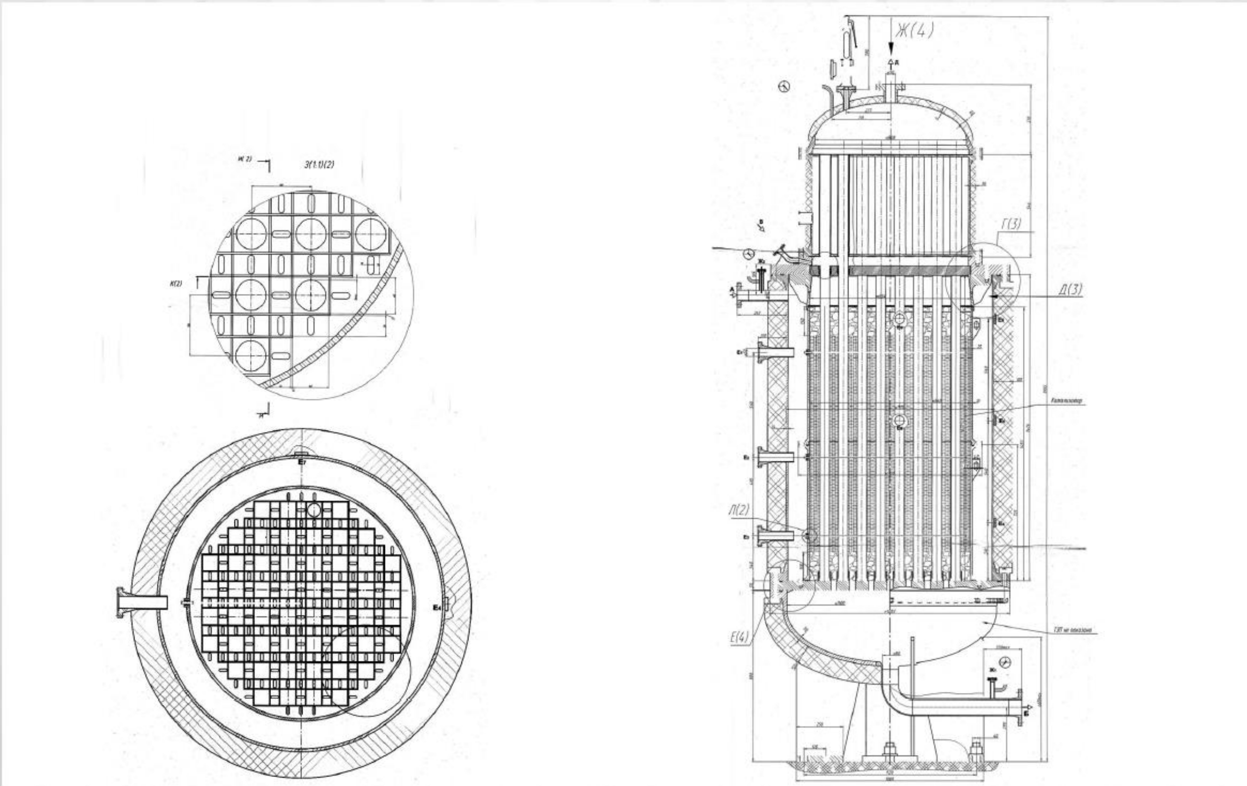
- Cycle length of at least 500 hours.
- Total lifetime of at least 2 years.

FEATURES OF THE PRODUCED GASOLINE

Gasoline with RON 92-93 with the following composition:

Components:	% by weight.
Aromatic hydrocarbons	38-40
Olefins	2-3
Naphthenes	12-15
Iso-paraffins	28-30
Paraffins	15-20

REACTOR FOR PROCESSING ALCOHOLS INTO PETROL



End Products Characteristics

High octane component of petrol	
Density at 15°C	755 kg/m^3
Molecular mass	90
Containing paraffin hydrocarbons	38-42% of mass
Containing olefin hydrocarbons	6-7% of mass
Containing naphthene hydrocarbons	9-11% of mass
Containing aromatic hydrocarbons	30-35% of mass (containing benzol: 0.05 - 0.1% of mass)
Octane number (RON), not less than	92
Octane number (MON), not less than	84
Pressure of saturated steams of petrol, mm, not more than	500
Fractional composition:	
start of distillation temperature, °C	35
10%	55
50%	120
90%	160
end of boiling temperature, °C	205

The complete component composition is mentioned in technical documentation.

CATALYST

Catalyst of receiving petrol from methanol of NKT-1 mark.

Possible supplies: "New catalystic technologies" LLC.
Design: extrudate having diameter 3-4 mm of white or yellowish colour.

Composition:	
High-silicon zeolite (% of mass)	70.0
Promoting agents (% of mass)	5.0
Bonding agent (% of mass)	25.0

Portion of weight loss during tempering at 550 °C, % mass, not more than	5.0
Degree of crystallinity of zeolite, %, not less than	100
Containing dust and granulate, % of mass, not more than	2.0
Density, in filling layer, kg/m^3	550-800 (according to producer's data 700-750)
Strength index, kg/mm of diameter	1.5
Conversion of methanol, %, not less than	95
Output of liquid hydrocarbons, % of mass of source methanol	35 ÷ 38
Temperature of reaction start, °C	350-360
Maximum temperature of reaction, °C	430
Maximum temperature of reactivation, °C	550
Process pressure, mPas	0.7÷1.0
Space velocity of feeding methanol, h^{-1}	0.8÷1.2
Cycle length of catalyst at space velocity 1 h^{-1} and degree of conversion of methanol 95%, hour	>500
Service life of catalyst, year, not less than	3

4- POWER GENERATION SECTION

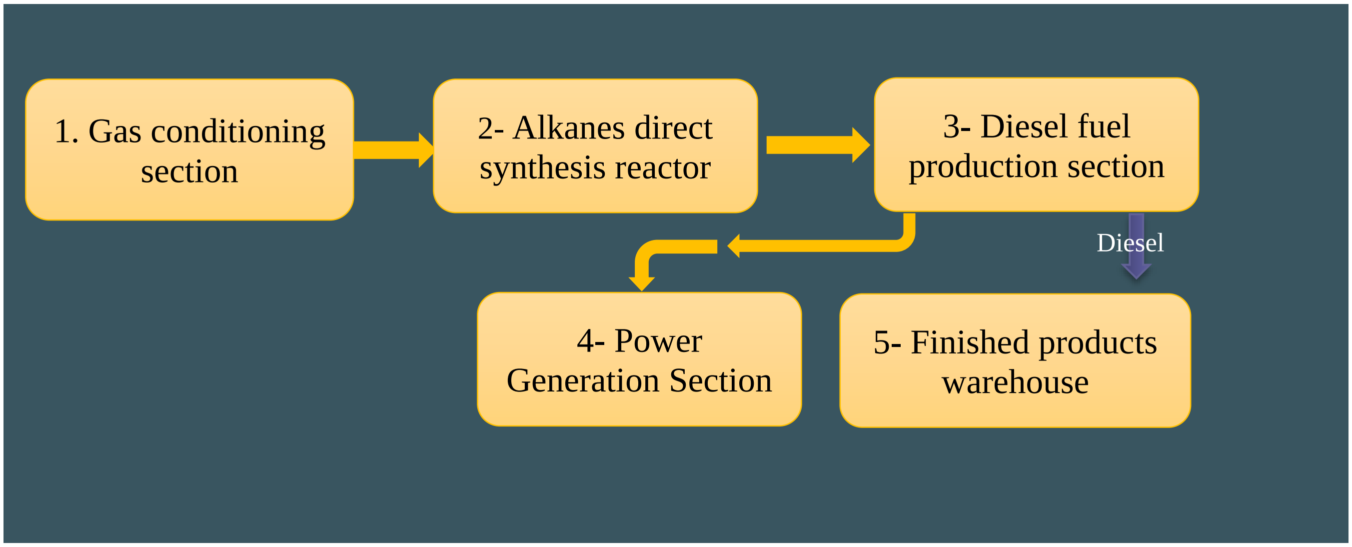
Rest of gas leaving the reactor of the third order is sent to the power block of the plant, where it is used to generate electricity and provide electricity needs of industrial, administrative and residential areas.

Completing of the power equipment designed to generate electricity, as well as suppliers of construction of the power generation section in each project are determined individually taking into account local conditions and needs in electricity in order to achieve maximum reliability and profitability of operating equipment.

5- FINISHED PRODUCTS WAREHOUSE

In developing the technology for storage and shipment of finished products, the "GTL" company applies Sealed system to prevent evaporation of the finished product and air pollution.

1.6.2 Diesel Production Scenario:



2- ALKANES DIRECT SYNTHESIS REACTOR

In the alkanes direct synthesis reactors. The kinetic energy of the molecules is expressed by the formula:

$$E=mv2$$

During the movement of the molecules, the collisions occur; resulting in the momenta exchange, the speed of one group of molecules increases, and the speed of the other decreases. In this case, the law of conservation of momentum is satisfied, i.e., sum of the momenta before the collision is equal to the sum before and after the collision. If we write the equation of exchange of momentum between two molecules, it becomes obvious.

$$m1v1+m2v2= m1v'1+m2v2'$$

After the collision the speeds of molecules changes, the speed of one of molecules increases, and the speed of the other decreases. As a result of these collisions in the gas, there is a separation of molecules by the velocity. Maxwell specified this separation, and it depends on the temperature. The higher the gas temperature, the greater the molecular motion at high speed.

This confirms the Boltzmann equation, which relates the temperature of the gas with a rate of gas molecules, and consequently, the kinetic energy.

$$E=3/2kT= mv2/2;$$

where

k- Boltzmann's constant;

T is the temperature of the gas.

But in this case, a certain average velocity of the gas molecules is assumed, and gas molecules undergo elastic collisions, i.e. the molecule is not deformed, and inside it the state of the electrons is not changed.

This shows that the velocity of gas molecules is dependent on temperature. The higher the gas temperature, the higher the velocity of the gas molecules. If you raise the gas temperature, then a moment occurs, when the molecules will undergo inelastic collisions, i.e., they will begin to firstly deform each other, and then destroy them. A fact that confirms the inelastic collisions is glowing of gas when heated.

The source of glowing is the excitation of the outer electrons of the gas molecules. When the electron returns from the excited state to the normal state, a quantum of light is emitted. Quantum energy: $E=h\gamma$,

Where h- Planck's constant and γ- frequency of the emitted light.

For the methane molecule, the destruction of the molecule is a hydrogen atom removal. The energy, expended in this removal, is called the binding energy. This energy must be expended to destroy this binding. After hydrogen atom removal, there are two options:

1. Two molecules without hydrogen atom (radicals) can connect and form a molecule of ethane.
2. The molecule without hydrogen atom (radical) is connected to a hydrogen atom and again becomes methane molecule. It can be assumed that these processes are equally probable. Then there are the reaction products of ethane and hydrogen.

$$2CH_4= C_2H_6+H_2$$

Practice has shown that the implementation of such reaction needs a minimum temperature of 2000 °C and high pressure, which will depend on the reaction outcome. Further, if the ethane molecules will collide, they can form molecules of butane or propane, but these processes are very unlikely.

Thus, the thermal activation of molecules with a very low probability can lead to the formation of more complex molecules than ethane. This will happen if the formed molecule is rapidly removed from the zone of transformation, i.e., cooling, Hence, in order to carry out the reaction and obtain the products, the gas molecules need to be converted into an excited state.

Barrier Discharge

The best way to do this is the gas discharge. There are many types of gas discharges, but to implement the technology of chemical reactions, the barrier discharge is most suitable.

Barrier gas discharge exists between the two electrodes, and one electrode is separated from the other by a dielectric barrier. This barrier is any material with poor electrical conductivity.

In the interelectrode space the gas molecules commit disorderly, chaotic motion, which is called Brownian motion.

When voltage is applied to the electrodes, it produces an electric field, and the electric current should appear. By increasing the voltage, at the beginning there is a polarization of the gas molecules and the dielectric barrier. Polarized molecules in an electric field will move to the electrodes and will transfer the charge, i.e. there is a weak electrical current. According to Ohm's law, the current is:

$$I=U/R;$$

Where

U - voltage in volts;

R- Electrical resistance of the polarized gas barrier.

In turn, voltage is:

$$U=Ed;$$

where

U - voltage in volts;

E- Electric field strength;

d- Distance between the electrodes.

$$E=Fq$$

Where

F- Force of the electric field, acting on a charge in the interelectrode space;

q - Charge in the interelectrode space.

Strength is a force of the electric field, and the voltage is the force multiplied by the distance, work on charge transfer between the electrodes. Work is energy, then the electric field is the energy that is transferred to the charges. Charge is an ion or electron.

With an increase in voltage, the time occurs when the electrons in the central electrode (cathode) begin to leave it and go into the interelectrode space. This process is called the electron emission.

On their leaving the electrode, it is necessary to expend energy. This energy is called the work function of the electron and is 4-5 eV.

Once entering the interelectrode space, the electron is accelerated under the action of electric field, as in the electron accelerator, the kinetic energy increases. However, it will inevitably collides the gas molecules. If its energy is greater than the binding energy between the atoms of carbon and hydrogen, it will destroy this binding.

As a result of this destruction, there will occur two radicals: hydrogen atom and methane moiety without hydrogen. If its energy is high, then it can free the electrons from the radicals. They are called secondary electrons.

Thus, in the interelectrode space by the impact of the electric field, the hydrogen ions and methane molecule residues appear. In addition, there are at least two secondary electrons, which are accelerated and in the collision can free four electrons, four - eight electrons, etc.

Avalanche process will occur as long as the electric field energy is sufficient to ionize a number of molecules in the interelectrode space.

As a result of these processes, the current is generated, which characterizes the flowing process capacity and therefore, the number of transformations undergone by the gas molecules located between the electrodes.

$P=UI$ - power of the gas discharge.

Power multiplied by time shows the energy expended in the gas discharge to the chemical conversion in the gas reactor.

$E=P\tau=UI\tau$ (kilowatt hours)

In the gas discharged line

1. Activation of the gas molecules occurs.
2. It results from the impact of the electrons on the gas molecules more efficiently than in heating.
3. The degree of activation depends on the voltage of the electric field, and so the process is controlled.

As practice has shown, the reactor temperature does not rise above 250 0C. The reaction products can optionally include a wide range of substances, and selectively at high output. Power consumption for various substances is between 0.2 and 5 kilowatt hours per kilogram of product. Dielectric barrier may play a catalytic role and determine the yield and quality of products. The process can be carried out at any pressure.

Calculation of energy Consumption

On the formation of alkanes (liquid state) of molecules of methane, ethane, propane, butane. Methane, ethane, propane and butane, constituting the main part of the natural gas and associated oil, gas, under normal conditions, are in a gaseous state. Next in the homologous series of saturated hydrocarbons (alkanes), pentane has a boiling point (condensation) 35 ℃, and it is different from gaseous alkanes by the molecule length.

In pentane, five carbon atoms are connected in the carbon chain. Hydrocarbon molecules with a chain length of 5 or more carbon atoms are liquid hydrocarbons. In order to combine the molecules of methane, ethane, propane, butane and receive hydrocarbons, molecules length of which increases to five atoms and more, some energy must be expended.

The effective way of introducing energy in gases is a gas discharge in an electric field. Gas discharge is a stream of electrons that ionize gas molecules. As a result of ionization at the reactors with a gas barrier discharge, methane loses one hydrogen atom. Two ionized methane molecules are combined into the ethane molecule, wherein hydrogen is obtained.

$$2CH_4 = C_2H_6 + H_2$$

This endothermic reaction takes place with heat absorption. ΔH = 15.54 kcal/mol - the heat result of the reaction. In this case, it is necessary to spend 15.54 kcal (kilocalories) on formation of 30 g of ethane (gram moles).

The energy of the electric field is calculated by the formula:

$$E_{out} = UIt \text{ (kW/h)}$$

where
U - voltage, volts (V)
I -current, amperes (A)
t -time of electric field impact on the gas, (h).

Activation of gas molecules in the interelectrode space of the gas discharge. The electrons are emitted from the cathode under the impact of the electric field (electron emission). The electron emission requires energy. This energy is called the "electron work function". Its level is about 3-5 eV and depends on the type of material, from which the electrode is made. Since the electrodes are made of metal, "electron work function" is ~ 4 eV.

The electrons, released from the electrodes and trapped in the electrode space, by the action of the electric field are accelerated and acquire energy capable tear hydrogen atoms in a molecule of methane, i.e. exceed the ionization energy of the gas molecules. This ionization energy is about

6000-8000 electronvolts (eV). In this case, a molecule of methane in the moment of collision with an electron can have low kinetic energy (cold gas). After separation of the hydrogen atoms, the remaining parts are combined into a molecule of ethane.

The process of activation and association of molecules can occur almost without heating the gas at room temperature, so the reaction in the gas discharge does not require to warm up the gas. But after a collision with an electron, the part of the energy is transferred to the gas molecules.

Gas molecule or formed ion begin to move faster. This increase in velocity of the gas molecules and ions is recorded by the thermometer as an increase in the gas temperature. In the process of turning the gas temperature does not rise above 250 ℃.

In order to the reverse process of ion recombination does not occur promptly, the optimum temperature is required. By adjusting the flow of energy in the gas discharge it is possible to manage the process of association of molecules into the long chain molecules.

Let's make a calculation of the energy consumption for the formation of ethane from 1000 m 3or 714.286 kg of methane. Ethane output - 669.851 kg. The formation of ethane from methane requires 0.34 x 106 kcal or 395.3 kW/h. Further, transmitting the electrical current through the gas, methane is formed from formed ethane and propane:

$$CH_4 + C_2H_6 = C_3H_8 + H_2$$

Thus H = 13.31 kcal/mole is absorbed.

And butane is formed from two molecules of ethane:

$$2C_2H_6 = C_4H_{10} + H_2$$

H=8.33 kcal/mol

On the connection of two molecules of ethane, almost twice less energy is required then for the connection of methane molecules. Thereafter, the gaseous medium contains molecules of methane, ethane, propane, and the number of options for the formation of molecules is increasing.

If we look at how the hydrocarbon chain elongation takes place, we get a series of parallel reactions:

$$2CH_4 = C_2H_6 + H_2$$

H=15.54 kcal/mol

$$CH_4 + C_2H_6 = C_3H_8 + H_2$$

H=13.31 kcal/mol

$$CH_4 + C_3H_8 = C_4H_{10} + H_2$$

H=10 kcal/mol

$$CH_4 + C_4H_{10} = C_5H_{12} + 4H_2$$

H=15,06 kcal/mol

During the reaction of pentane formation of methane, pentane and four hydrogen molecules are obtained.

$$5CH_4 = C5H_{12} + 4H$$

Energy costs amount to H = 54.45 kcal/mol.

On obtaining of pentane in reaction (5) at one time, there would be required to expend H = 54.45 kcal/mole. If this process is carried out in stages (reactions 1-4), each step takes less energy. It does not require immediate entering large amounts of energy. In a gas discharge, the self-regulation, stepwise conversion of methane into liquid pentane occur.

This chain extension process will continue to form solid or tarry substances. To avoid this, it is required to cool the gas after some time. Thus, liquid substances, formed in the process, are condensed and converted into liquid hydrocarbons.

The process of burning of the produced hydrogen:

$$H_2 + 2O_2 = H_2O$$

H=57.79 kcal/mol

Since four moles of hydrogen are burned, it emits 231.16 kcal, i.e. 4 times more than spent. Reaction with methane indicates that, the bigger molecules are, the less energy is needed for their association. This means that in general, the system selects the path where it meet less resistance. This corresponds to the well-known principle of least action.

If we write the general formula to form a hydrocarbon chain of any length, it is evident that the result is a hydrocarbon and hydrogen in an amount of (n-1), where n - is the length of the hydrocarbon chain.

$$nCH_4 = CnH_2n+_2 + (n-1)H_2$$

Energy consumption for the formation of octane, n = 8

$$8CH_4 = C_8H_{18} + 7\ H_2$$

Heat of reaction (spent): H=93.32 kcal/mol (1 mole 114 g).

Combustion of 7 moles of hydrogen, formed during this, allocates 404.6 kcal, 4.3 times more than spent.

1 kW/h = 8,598,400 cal = 36,000,000 J.

Let's make a calculation of the energy consumption in accordance with the thermodynamic parameters for formation of octane (liquid state) from methane at 1000 m 3 or 714.286 kg. We will obtain 636.16 kg of octane. Generation of octane from 1,000 m3 of methane consumes 61 kW/h of electric energy. The longer produced hydrocarbons, the lower the unit cost.

Calculation of the chain length

The first part shows, the hydrocarbon chain elongation is possible, and energy expenditure are calculated. It is important to know what determines the length of the chain, which hydrocarbons and under what parameters hydrocarbons of the desired length can be obtained.

The general formula of hydrocarbon formation.

$$nCH_4 = CnH_{2n+2} + (n-1)H_2 ,$$

where n is a number of atoms in the hydrocarbon.

It is assumed that for the hydrocarbon chain elongation, the methane must lose one hydrogen atom and be transformed into a radical. This occurs under the influence of an electric field. When this energy is supplied from the outside - Eout. = UIt. For the calculation, it is assumed, that at cleavage the energy is consumed - the endothermic reaction, at formation the energy is released - an exothermic reaction.

The hydrogen atom release in methane and hydrocarbons with an increase in the chain length requires energy - e1 = e3 = 99 kcal/g-atom. In case of formation of connection at elongation C-C e2 = 85 kcal/g-atom and the H-H e4 = 104 kcal/g-atom energy is released, respectively, e2 and e4. The change of the total energy of the system is represented by formula (1).

For methane the total binding energy Emet is four connections

$$C\text{-}H\ Emet=4ne1.$$

For hydrocarbon the total amount of connections C-C will be (n-1), so the total binding energy will be

$$E_{C\text{-}C}=(n-1)e2.$$

Number of C-H connections in the resulting hydrocarbon amounts to (2n + 2), so the total binding energy is

$$E_{C\text{-}H}=(2n+2)e3.$$

When extending the chain, hydrogen is formed and connection H-H, the number of molecules of hydrogen connection H-H will be (n-1), and the binding energy of hydrogen atoms is equal to

$$E_{H\text{-}H}=(n-1)e4.$$

The total energy of the system is:

E total=Eout- No 4ne1+ No/n[(n-1)e2+(2n+2)e3]+ No(n-1)/n (n-1)e4+ No 3/2kT+n(Qa-Qd) (1)

After simplification we get the formula for calculating the length of the chain:

$$n= 1+ (Eout. /2e1- e2-e4)\ (2)$$

From the equation it follows that the length of the chain depends on the gas discharge electric power and the ratio of the binding energy between carbon and hydrogen atoms e2, e4.

If Eout. = 0; energy is not supplied, then n = 1. This means that the methane remained unchanged. To form octane n=8, necessary amount of the applied electric energy is calculated by the formula (2).

$$n= 8=1+ (Eout. /198-85-104)=1+ Eout. /9$$

Eout. = 63 kcal or 0.007 kW/h of electricity to obtain 114 grams of octane or 0.0614 kW/h to obtain 1 kg of octane. The greater applying electric energy, the greater the length of the carbon chain.

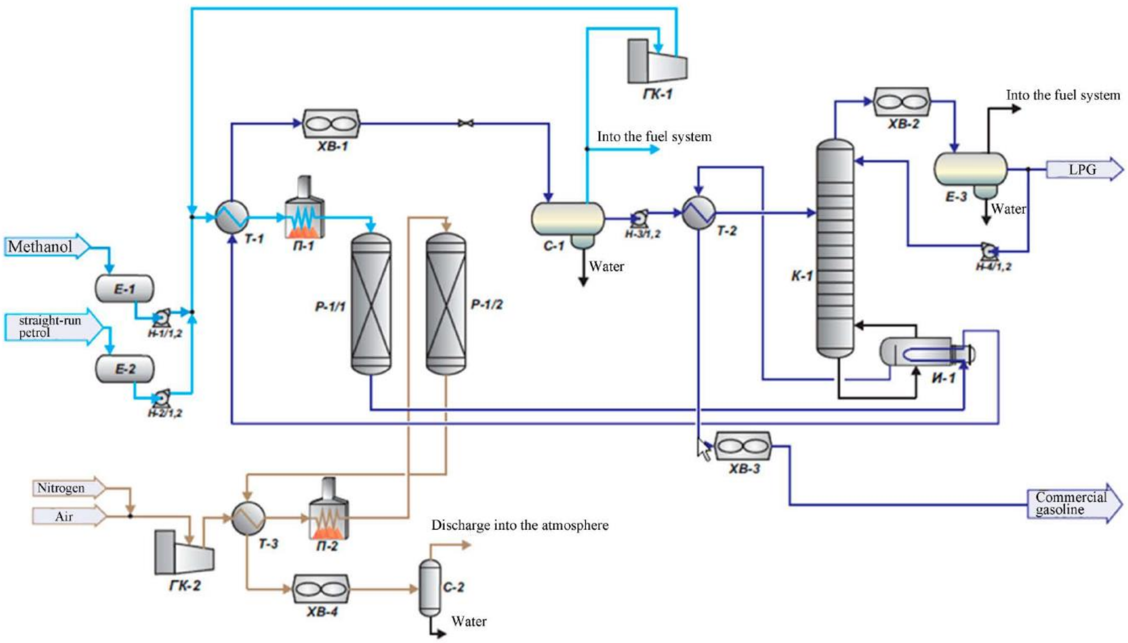
Calculation of energy consumption for formation of octane (liquid state) of from per 1000 m 3 or 714.286 kg: 636.16 kg of octane. Generation of octane from 1,000 m3 of methane consumes **39 kW/h of electric energy**. The longer produced hydrocarbons, the lower the unit cost. Use of catalyst also reduces energy costs.

3- DIESEL FUEL PRODUCTION SECTION

In the production of diesel fuel, the "GTL" company applies a widespread scheme of two-column distillation of hydrocarbon fractions. The process is carried out at temperatures of 400-450 ^{0} C and pressure of 2-2.2 MPa. Principal differences of the "GTL" Company technology consist of:

- Application of the special design of column equipment, providing maximum mass transfer at the optimum resistance of contacting media;
- Maximum automation of the process using up to 10 algorithms of automatic emergency stop of the equipment to enhance technological safety of the process;
- High energy efficiency of the process by the design of column equipment.

1.6.3 Technology of Production of High-Octane Gasoline by Co-Processing of Hydrocarbon Fractions and Oxygen-Containing Raw Material.



A new technology of production of high octane gasoline is proposed, which consists of co-processing of hydrocarbon fractions and oxygen-containing raw materials, which has obvious advantages in comparison with conventional technologies.

Reforming is the most common method of catalytic upgrading of straight-run gasoline. Catalytic reforming units are located almost in all domestic and foreign refineries. But at the same time, this process has several disadvantages, the need to increase the reformate octane number leads to a decrease in liquid yield with an increase in the proportion of undesirable gaseous products: high content of aromatic hydrocarbons in the catalytic reforming gasolines; the use of expensive platinum catalysts; narrow hydrocarbon fraction 85-180 °C is served in processing To eliminate these reforming shortcomings, there were developed the technologies of one-step upgrading of low-grade (straight-run) gasolines without usage of hydrogen and expensive platinum catalysts: BIMT type and Zeoforming (SEC "Zeosit" of the Russian Academy of Sciences, Novosibirsk). However, the disadvantage of these technologies is the low yield of gasoline compared to the process of reforming (80-85% for AI-80, 60-75% for AI-92 and only 55-60% for AI-95), the dependence of the output of gasoline with fixed octane number on the feed composition and high content of benzene in the final product (from 4 to 10%).

These problems are solved by the technology, which consists of co-processing of wide hydrocarbon fractions and oxygen-containing raw materials, which, in contrast to the reforming and "Zeoforming"/BIMT, allows to bring the output of commercial high octane gasoline to 98-100% on taking the initial hydrocarbon fraction i.b.p. -140/180 degrees. This technology does not use hydrogen and expensive catalysts containing precious metals, and gassing is minimized.

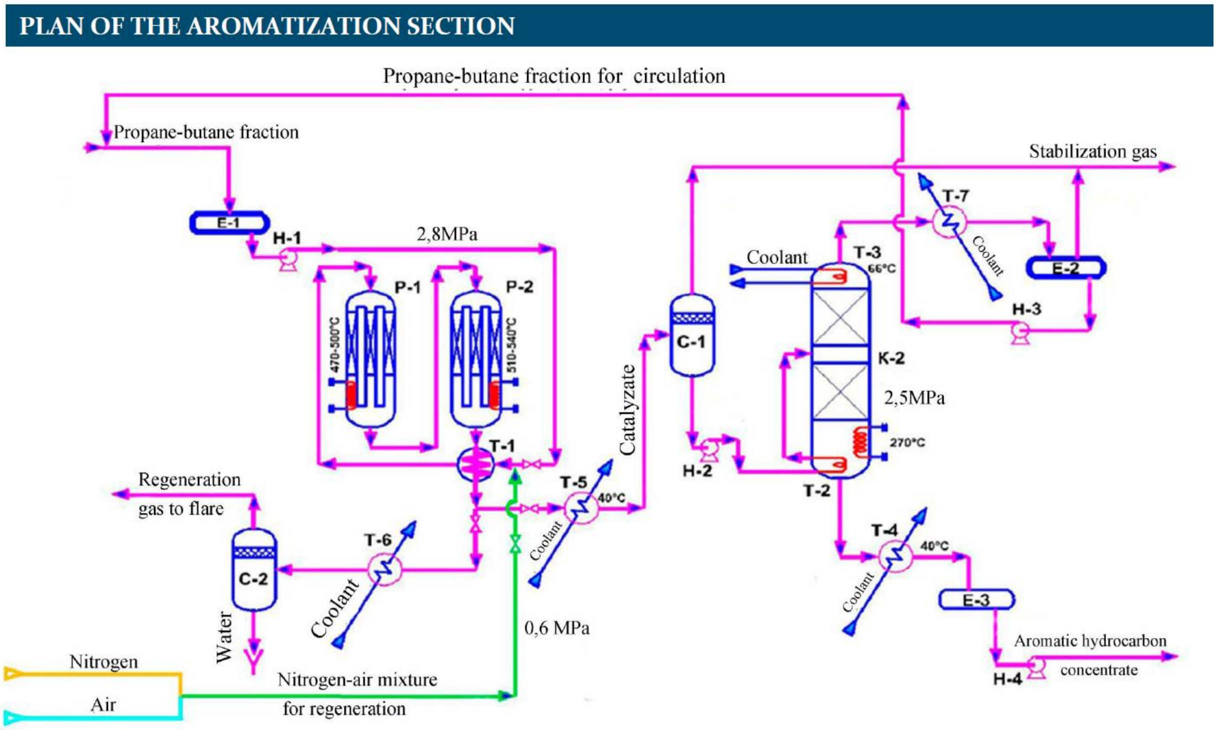
The principal difference of the proposed technology - the use of two types of raw materials. Wide hydrocarbon fractions i.b.p. -140/180 degrees undergo processing (straight-run gasoline, stable gasoline etc.) together with the oxygen-containing compounds: C1-C4 alcohols (methanol, crude methanol, ethanol, crude ethanol, propanol, butanol, alcohol production waste etc.) ethers etc.

Process conditions: temperature - 350-450 ° C, pressure - 0.5-1.5 MPa. Service cycle of the catalyst - at least 500 hours, regeneration - oxidant, with air to 550 °C, catalyst life - 2 years, catalyst - zeolite-containing.

The process was tested in experimental units, gasolines, produced by this technology, have been tested in the Test laboratory of oil products"Lukoil-Nizhegorodnefteorgsintez" and OJSC "VNII NP". As can be seen from the scheme, in order to increase the yield of the desired fraction - a component of high octane gasoline - the reforming unit is complemented with the aromatization unit of discharged gas of decontamination and stabilization, containing more than 40% of unsaturated hydrocarbons.

This technology can be applied both to produce high octane gasoline Euro-5, and for the production of short supplied in Russia aviation fuel B-92 with an additional compounding of gasoline with lead and high-octane additives (e.g. toluene).

1.6.4 Technology for Producing a Mixture of Hydrocarbons of The Aromatic Series from Propane-Butane Fraction or Associated Gas:



The most important element of the proposed facility is reactors with heat pipes. Their use provides a constant temperature throughout the length of the pipe-vaporizers and prevents overheating of the catalyst at any sites. Due to the isothermal process, the catalyst life increases by about 1.5 times compared with conventional reactors (3-4 years). Moreover, product yield is increased by 10-20%. Another important factor is the significant reduction in weight and size characteristics of the reactor-furnace equipment in comparison with the classical layout.

Potassium is used as coolant in the reactor tubes.

The first reactor is intended for converting mainly C4

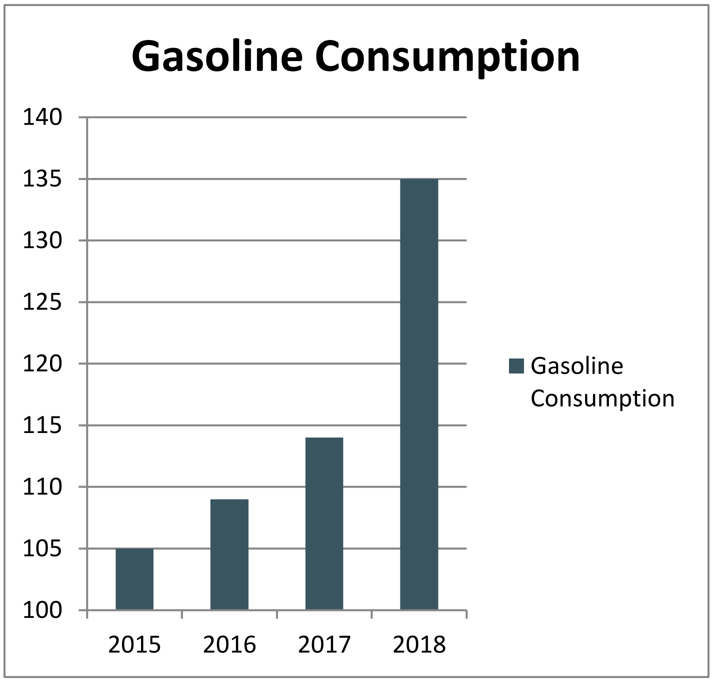
The second reactor, operating at higher temperatures, allows to involve propane into the reaction. + fractions.

Regeneration of the catalyst is carried out by the nitrogen-air mixture after 250-300 hours at a temperature of 550 ° C.

Output of the BTX fraction to the contained in the feed fraction C3+ is 55-60% by weight.

2. MARKET ANALYSIS

2.1 Iraq Market



the above figure provide data for Iraq from 2015 to 2018. The average value for Iraq during that period was 115 thousand barrels per day with a minimum of 105 thousand barrels per day in 2015 and a maximum of 135 thousand barrels per day in 2018

2.2. Global Market

Global Motor Gasoline market is projected to witness substantial growth over the forecast period. Rapid growth in disposable income of middle class especially in emerging economies of Asia Pacific is expected to fuel the demand for automobiles which in turn is projected to drive the demand for motor gasoline over the forecast period. In 2015, sales of passenger cars reached to 73.9 Mn vehicles out of which sales of passenger vehicles in China

INNOVATE

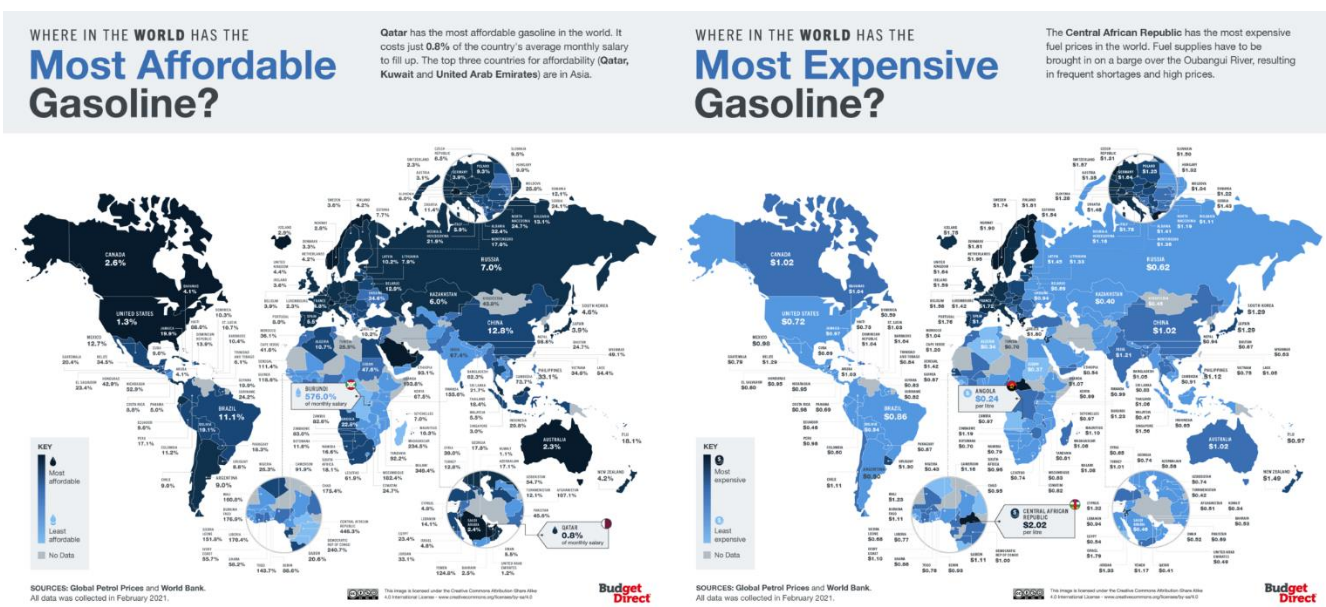
With advancements in industry 4.0 innovations, the oil & gas (O&G) industry trends are set to transform the industry in terms of efficiency, safety, and smart solutions. The oil & gas industry is exploring ways to efficiently and competitively digitize, automate, and solve complex sub-surface engineering challenges. The use of artificial intelligence (AI) algorithms, in addition to providing a competitive edge, also enables oil & gas companies to increase field or well productivity. Further, the gradual adoption of advanced robotics and data management practices invigorates scientists to develop novel practices that accelerate the processing times and reduce human labor.

STAY FOCUSED

and Japan was 21.15 Mn vehicles and 4.22 Mn vehicles respectively. Followed by it, U.S. stood at second position with annual sales of 7.57 Mn vehicles annually. Robust growth in sales of passenger vehicles is projected to fuel the demand for the motor gasoline over the forecast period. However, growing use of alternatives such as LPG, Diesel and CNG as fuels coupled with increasing initiatives of government to promote use renewable fuels is anticipated to restrain the demand for global motor gasoline market during the forecast period (2016-2024).

By geography, North America was the largest region in global motor gasoline market in 2015. The growth in the region is fueled by increasing sales of automobiles in the regions especially in U.S. Followed by it, Asia Pacific is anticipated to be the second largest and fastest growing region in global motor gasoline market. China, Japan and India is anticipated to drive the demand for the motor gasoline in the region over the forecast period (2016-2024).

Considering the competition, the global motor gasoline market is expected to witness a significant rise in investment in capacity expansion for the production and supply of gasoline to cater the increasing demand for motor gasoline. Further, market has witnessed strategic mergers and collaborations among motor gasoline regional and global players. Such growth strategies are focused on increasing their market penetration in key consuming economies.



2.3. Overall Market Strategy

By considering difference between the recommended approved Gasoline combinations of different markets both Iraq and other countries, we need to develop a strategic production plan. The plan should be mainly based on two types of markets,

A. Local Product as per DPR regulations

Develop a Local Supply chain along with the Local Off takers or Distributors and Terminal operators by executing SPAs. The major benefits will be:

- Easy and Fast delivery of the products.
- Fast Cash flow
- Good pricing for the Local Buyers as they can save the Logistics, Handling and Insurance costs.

B. Export Product as per global business requirement.

The major benefits will be:

- Good cash flow in both Naira and Dollar which help to balance the currency Inflations.
- Global business reach
- Good business penetration for other divisions to provide multiple services for traders or related shipping companies.

2.4. Pricing Strategy

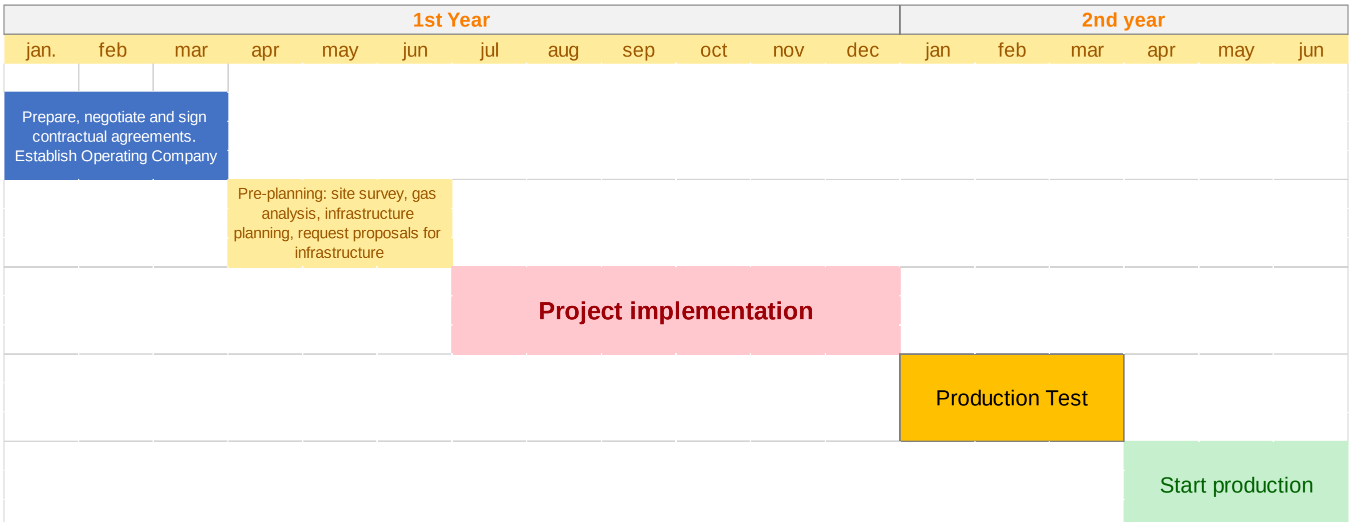
Several factors affect a convenience pricing : brand, location, the gasoline grade. The following best practices can support those essential elements and strengthen your pricing strategies to achieve maximum profitability:

1. Sales the gasoline in Specific Brand with high quality to keep its competitiveness
2. the pricing of gasoline inside of Iraq -10% of global price.

3. Project Plan

3.1 Proposed Project Schedule

The processes for planning, engineering and installation of the GTL-Plant will take in total a time of 12-18 months after project start, see the schedule below.



3.2 Finance Summary:

- Total Project Costs for delivery and installation of technology, infrastructural works, project management, insurance, guarantee, etc. is estimated at US $ 300 million.

- The aim of this investment project is building of plant for refining natural gas into 300,000 tons of Gasoline RON 5, EURO 5 per annum on the basis of the technology developed by Russian company “GTL”.
- The volume of necessary gas depends on gas content and is about 60 MMscfd per day.
- The initiator of the project is “GTL” company – the manufacturer and supplier of equipment.

The following groups of companies participate in realization of the project as joint investment:

Company 1 (Company “GTL”, Investor 1) – Company 1 is a developer of the technology of receiving liquid hydrocarbons from natural gas or associated oil gas with the use of direct synthesis of high octane compounds of motor fuel and alcohols, realizes the building of the plant and provides to Company 3 the license on building plants for refining gas on the territory of this country on the base of the patented technology.

Company 2 (EMPIRE FUEL INDUSTERIES CONSORTIUM) is an owner of gas deposit or natural gas, provides an area for building the plant for refining natural gas into petrol and is a supplier of natural gas.

Company 3 (NAJM AL-SHIMAL) is a joint venture with share participation of Company 1 (50%) and Company 2 (50%), the owner of the plant and the license for building such plants in future, refines natural gas into petrol and sells end product to customers.

The plant GTL is produced and installed during 12 months on the account of Company 1 (Investor 1) and Company 2 (**EMPIRE FUEL INDUSTERIES CONSORTIUM**). This period includes project works, production, installation and putting into operation of plant.

Further, in accordance with the agreement between the parties, joint enterprise will buy gas from partner company at a fix price and process it into liquid hydrocarbons and 300 000 MT of petrol/motor fuel, than will sell it by retail or by wholesale at actual international market prices. For the account of received revenues we cover the expenses of JSC “GTL”, than according to the agreement, in case credit resources are be needed, the joint enterprise is ready to provide guarantees to cover the credit. These are the same conditions of agreement with “Rosneft”.

It is important for us how much the prime cost of producing one ton of petrol at GTL plant will be not taking into consideration for any government taxes. The prime cost is between US $50 and 100 per MT. Other positions may vary: the price for gas, operating costs, expenses and the rest is the joint enterprise’s profit.

3.3 Pre-Project Planning

The pre-planning will take approximately 2-3 months. During this time we will complete the Feasibility Study and can adjust the final investment costs for the project. Main targets of this phase are:

- Analysis of the gas available at the selected location.
- Preparation for plant of direct alcohols synthesis.
- Detailed technical planning of the GTL Plant based on the gas analysis with precise assessment of the expected gas consumption per MT motor fuel inclusive efficiency factor, maintenance costs, etc.
- Technical planning of the Power Generator with precise gas consumption per KWh, efficiency factor, etc.
- Technical planning of the infrastructure works.
- Collecting of final proposals with fixed prices from the respective sub-contractors and suppliers and transport expenses.
- Preparing of a detailed project plan.

<u>Technical Section:</u>

1- Raw Material quality and Quantity required for one bbl. or ton of products.
2- Products and by products specification.
3- Utility consumption & quality including steam, water, fuel, compressed air and catalyst.
4- Aria and plot plan (preliminary).
5- Process description (with preliminary process block diagram & efficiency of each unit).
6- Waste material quality and quantity.
7- Personnel requirement for operation.
8- Raw material and product estimated cost.
9- Guarantee period, terms and conditions.

Commercial Section:

1- Technology cost (know-how or license).
2- Basic design cost.
3- Detail design cost.
4- Procurement costs including main equipment list and price.
5- Construction estimated cost.
6- Supervision on construction.
7- Commissioning and startup cost.
8- Supervision on commissioning and start up.
9- Training cost.
10- Laboratory equipment cost.
11- Catalyst consumption, cost and period.

The procedure of executing the turnkey completion of the Project will be mutually agreed between the parties.

GTL
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