Joint Stock Company “GTL”

TECHNOLOGY FOR ALCOHOLS DIRECT SYNTHESIS FROM GAS

PROCESSING ALCOHOLS INTO MOTOR FUEL

EN / RU

COMPANY INITIATING PROJECT REFERENCE

Full name of the company:	Joint Stock Company “GTL”
Legal address:	125047, Gasheka Street 8-10, build. 8, Moscow
Location address:	117246, Nauchniy driveway 8, build. 1, Moscow
Main state registration number:	1027700525181
Main activity:	engineering and technical activity
Taxpayer identification number:	7706211944
Management:	Kadyrov Rafis Faizovich, President of the Company
Shareholder's capital:	519 200 000 rubles
IPO:	February 2013, Moscow Central Stock Exchange

JSC “GTL” CURRENT CAPITAL STRUCTURE

Registered capital	519 200 000 rubles
Fixed assets:	27.04 billion rubles, including:
— intangible assets	24.9 billion rubles
— research and developments results	2.14 billion rubles
Current assets:	1.64 billion rubles, including
— recurring operations	1.54 billion rubles

JSC “GTL” BRIEF REFERENCE

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) avoiding the stage of synthesis gas in the technological process. To fulfill this task the company has worked out the technology for direct synthesis of alcohols with their further processing into motor fuel.

The technology is unique due to its high profitability, possibility of refining gas containing any components with isolating end-product (high-octane petrol, diesel fuel, methanol, ethanol, helium).

JSC "GTL" has invested in R&D aimed at creating this technology 2.139 billion rubles by 2013, the project is at the stage of building industrial plant.

At the present moment JSC “GTL” in the frames of agreement with JSC “Rosneft” and “ITERA Oil-and-gas company” Ltd. has started building the plant with capacity 100 thousand tons per annum in the territory of Bratsk Gas Condensate Field (Krasnoyarsk Territory). The first stage of the project is planned to be launched in May 2014.

PROJECT BRIEF DESCRIPTION

AIM OF THE PROJECT	Creating business structure which will provide processing natural and associated gas on the base of low-tonnage automated unitized GTL plants
PRODUCTS	Low-tonnage automated unitized GTL plants. The distribution area for the products of the project is represented by oil companies
TARGETS OF THE PROJECT	• Cost efficient development of small and middle gas fields and gas-condensate fields • Processing associated gas in oil fields • Creating and developing market for low-tonnage automated unitized plants of synthetic liquid fuels • Recycling associated gas for oil production • Monetisation of gas in remote and low-pressure fields • Monetisation of remote shale gas fields • Processing gas into liquid on sea-based platforms

PROJECT STATUS

Current stage of the project (August 2013)	Planned stage of the project (February 2014)
THE STAGE OF DESIGNING	THE STAGE OF THE FIRST INDUSTRIAL LAUNCH
The technical documentation of the petrol synthesis block of the plant with capacity 100 thousand tons per annum (for the gas of Bratsk Gas Condensate Field) is prepared.	The launch of pilot plant of direct alcohols synthesis with capacity 1000 tons of methanol per year to receive 350-420 tons/year of certified gasoline 95 octane per annum.
The preparation for testing pilot plant of direct alcohols synthesis (1000 tons of methanol) is being terminated.	

TECHNOLOGICAL PROCESS BRIEF DESCRIPTION

The raw material which goes to reactor is associated oil gas or natural gas containing methane, ethane, propane, butane and other components. The process may be realized at pressure from 1.5 to 500 at.

Oxygen for reactor is received from air by the method of electromembrane separation with its further special preparation to facilitate the reaction.

The process of alcohols synthesis is implemented with heat liberation. The optimum temperature for this process is 200-270°C. Chemical reaction of alcohols synthesis:

1.	$2CH_4+O_2=2CH_3OH$	from $1m^3$ of methane	→	1.43 kg of methanol is produced
2.	$2C_2H_6+O_2=2C_2H_5OH$	from $1m^3$ of ethane	→	2.05 kg of ethanol are produced
3.	$2C_3H_8+O_2=2C_3H_7OH$	from $1m^3$ of propane	→	2.68 kg of propanol are produced
4.	$2C_4H10+O_2=2C_4H_9OH$	from $1m^3$ of butane	→	3.30 kg of butanol are produced

The produced alcohols are extracted from gas phase in liquid form and are directed to the block of petrol synthesis. Depending on the demand of a client, any alcohol from the mixture can be extracted as a separate product. The gas fractions which have not entered into reaction are directed to the block of extraction of helium and hydrogen. The balance of produced alcohols depends on the content of initial gas.

The synthesis of petrol is realized in isothermal reactor with stationary level of high-silicon zeolite catalyst. Service life of catalyst is three years. The flow of raw material is heated to the temperature of 300-350°C. Space velocity of feeding alcohols: 0.5-1.5 h. Alcohols conversion index during the reaction is not less than 90-95%. Output of liquid hydrocarbons: 38-45%. Maximum temperature of the reaction: 430 °C.

TECHNOLOGICAL PROCESS ADVANTAGES

1.	The synthesis of alcohols is realized without intermediate stages.
2.	The process is going at any pressure, there is no need in regulating pressure, the synthesis may be fulfilled from natural gas at high pressure and from associated gas where the pressure is not high.
3.	It does not demand compressing equipment.
4.	The process may be exercised in the field conditions of oil and gas production. It permits to implement the cost-effective development of small and middle gas fields and gas condensate fields, remote and low-pressure fields, fields of shale gas, gas at sea-based platforms, also to process associated gas directly at oil fields.

PLANT GENERAL TECHNOLOGICAL SCHEME FOR BRATSK GAS CONDENSATE FIELD

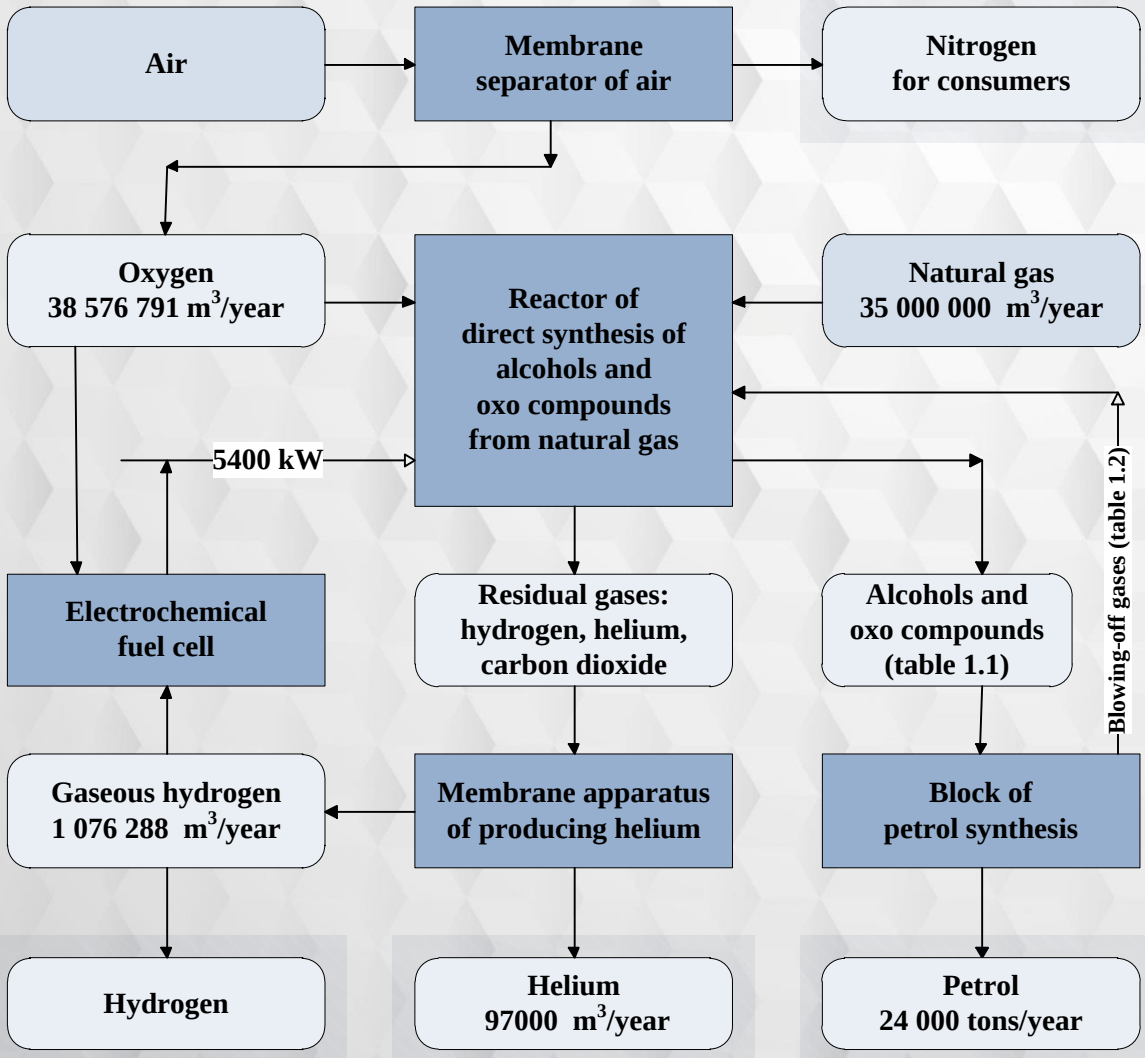


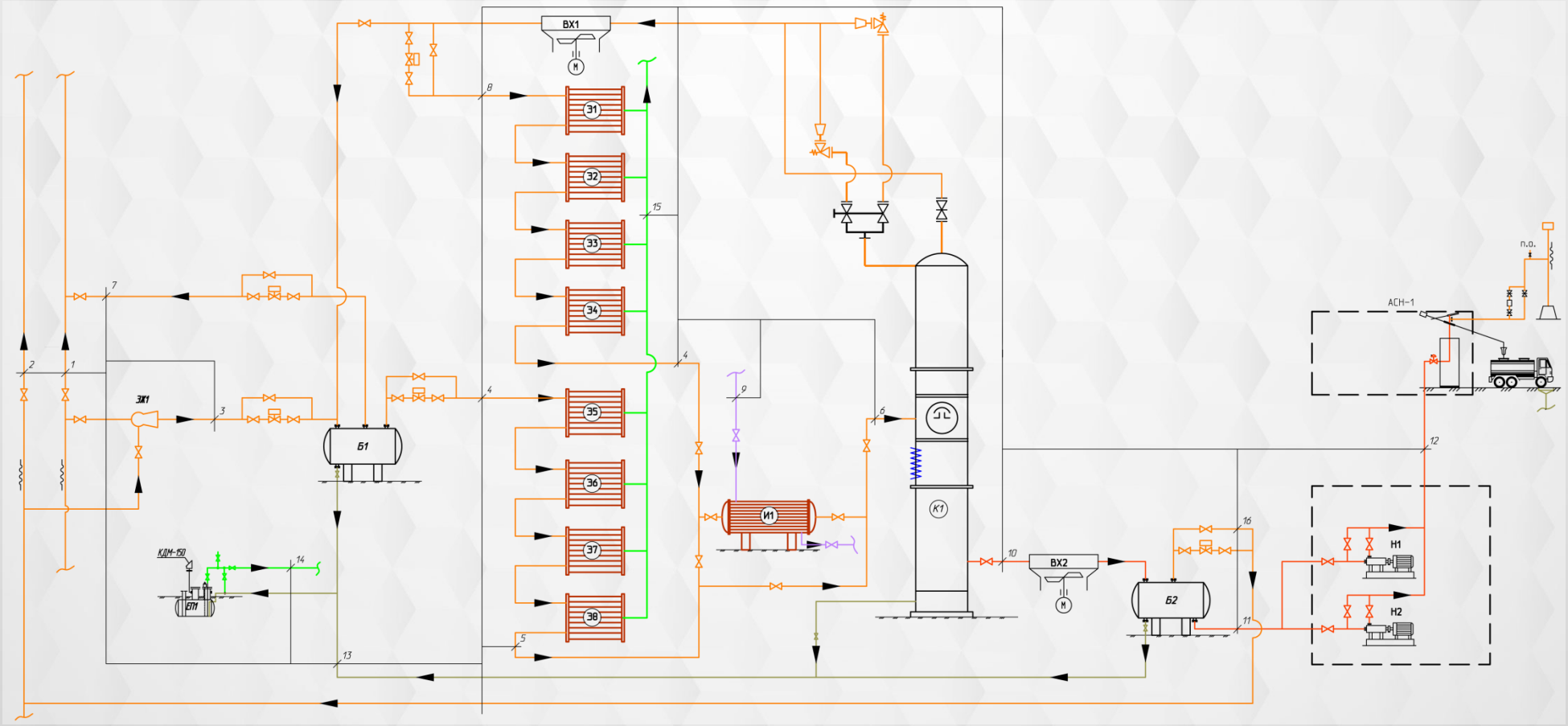
Table 1.1

Alcohols and Oxo Compounds	
Item	**tons/year**
CH_3OH	50 975.0
C_2H_3OH	564.0
C_2H_5OH	2 758.0
C_3H_5OH	304.0
C_3H_7OH	1 813.5
i-C_4H_9OH	966.0
n-C_4H_9OH	319.0
C_4H_7OH -2-trans	54.7
C_4H_7OH -2-cis	50.4

Table 1.2

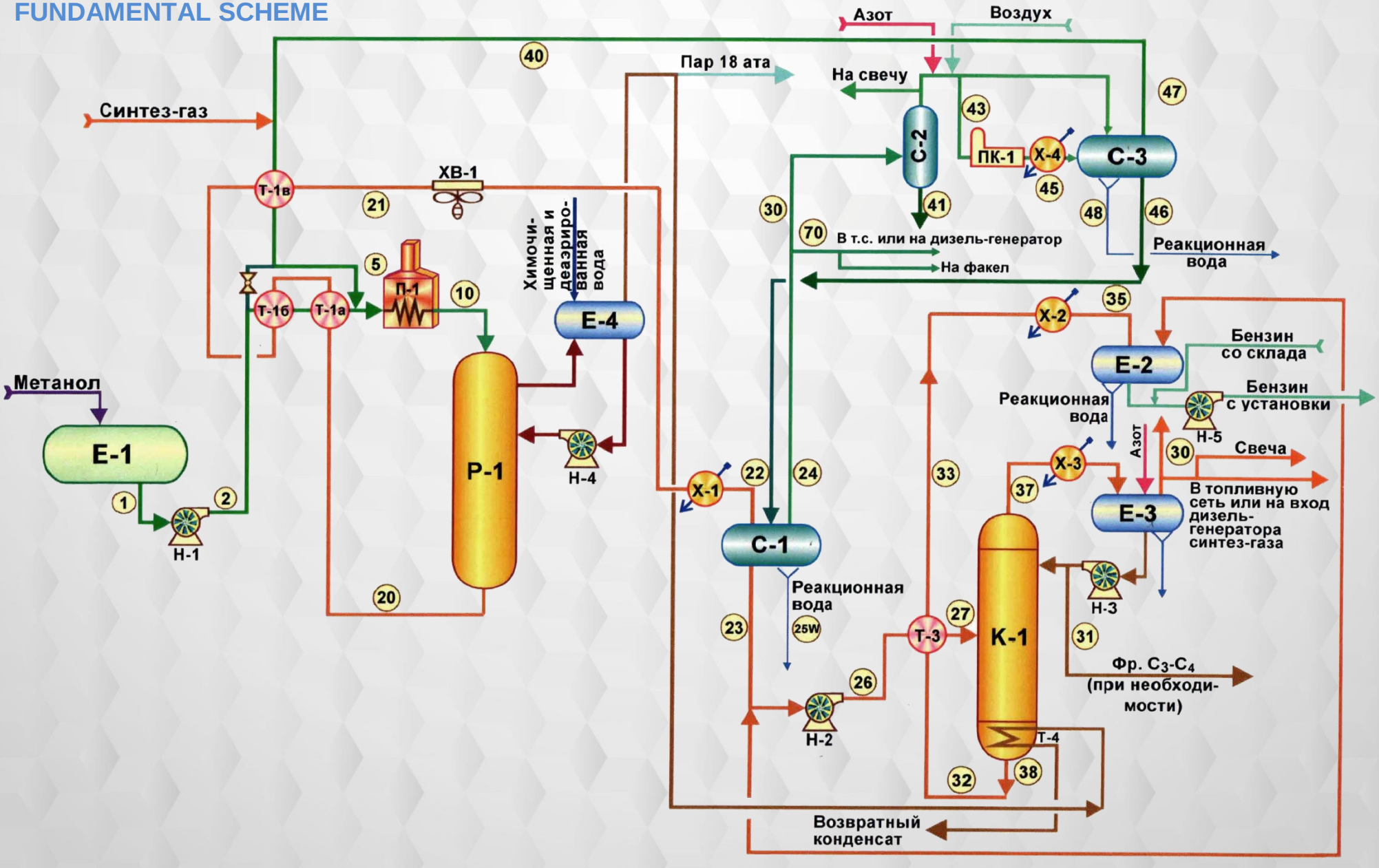
Blowing-off Gases	
Item	**tons/year**
H_2	59.9
CH_4	487.6
CO	87.3
CO_2	63.3
C_2H_4	358.8
C_2H_6	115.8
C_3H_6	220.1
C_3H_8	876.0
i-C_4H_{10}	557.4
n-C_4H_{10}	250.1
i-C_4H_8 + C_4H_8-1	541.2
C_4H_8-2-trans	42.5
C_4H_8-2-cis	39.2

PROCESSING GAS INTO METHANOL
FUNDAMENTAL TECHNOLOGICAL SCHEME

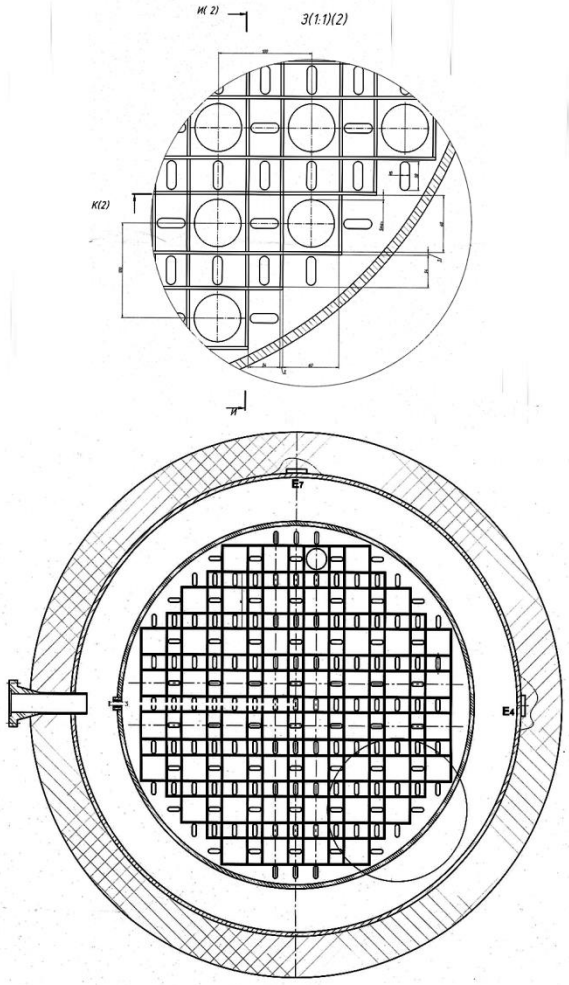


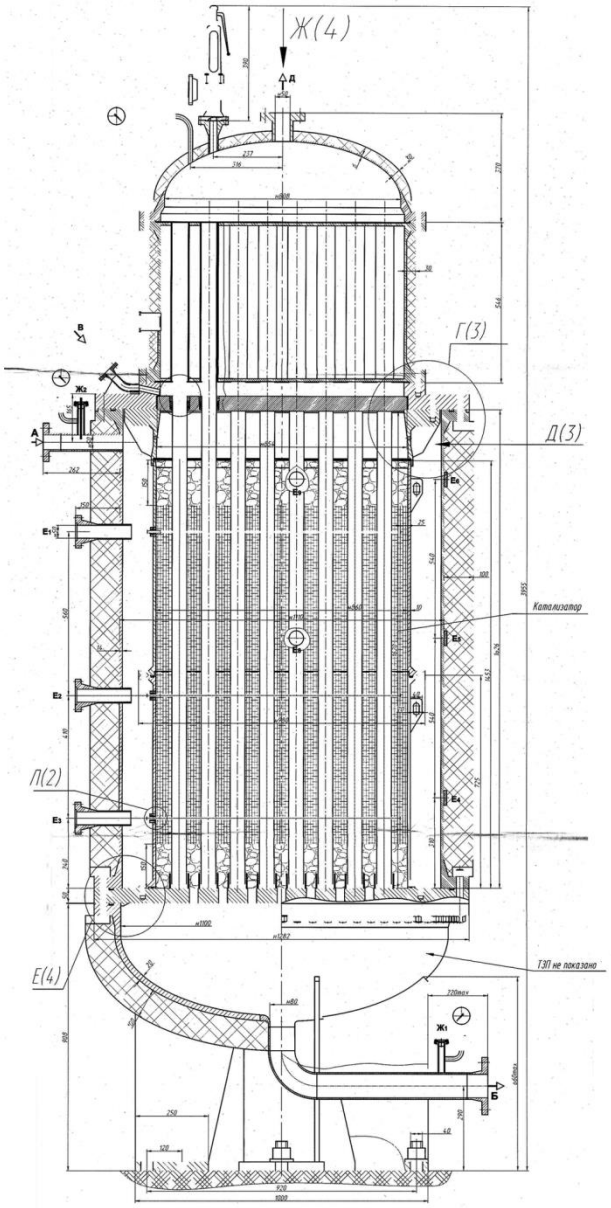
TECHNOLOGY OF RECEIVING PETROL FROM METHANOL

FUNDAMENTAL SCHEME



REACTOR FOR PROCESSING ALCOHOLS INTO PETROL





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, ^{o}C	350-360
Maximum temperature of reaction, ^{o}C	430
Maximum temperature of reactivation, ^{o}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

MATERIAL AND PRODUCT BALANCE OF PLANT

Flow name	Outlet		
	Kg per hour	Thousand t/year*	% of mass for raw materials
1	2	3	4
Taken:			
Raw materials 98% methanol, including	180	1.107	100.0
methanol	176.5	1.085	98.0
Recycle of raw methanol, including	63.5	0.39	35.27
methanol	62	0.381	34.44
Total:	**243.5**	**1.497**	**135.27**
Produced:			
Blowing-off gases, including	15	0.092	8.33
of separator	8	0.049	4.44
of column	7	0.043	3.89
High octane component of petrol	60.5	0.372	33.61
Hydro- methanolic mixture, including	168	1.033	93.33
methanol	62	0.381	34.44
Total:	**243.5**	**1.497**	**135.27**

* number of working hours is taken of 6150

The reactor produces 105 kg/h of water steam of 18 at of absolute pressure due to heat removal.
It wastes for its own needs 10 kg/h of steam (for heating cube of stabilizer).

END PRODUCTS CHARACTERISTICS

Gas	
with the minimum temperature of burning not less than	11 400 kcal/kg
molecular mass	20.9
density	0.885 kg/mn^3
containing H_2	to 32% of volume
containing C_3-C_4	to 43% of volume

The complete component composition is mentioned in technical documentation.

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.