



**RAN**  
GROUP

# Alkylation Technology

Sulfuric Acid Alkylation Unit (SAAU)

Refining

Gas Processing

Petrochemicals

Gas Chemicals

2016

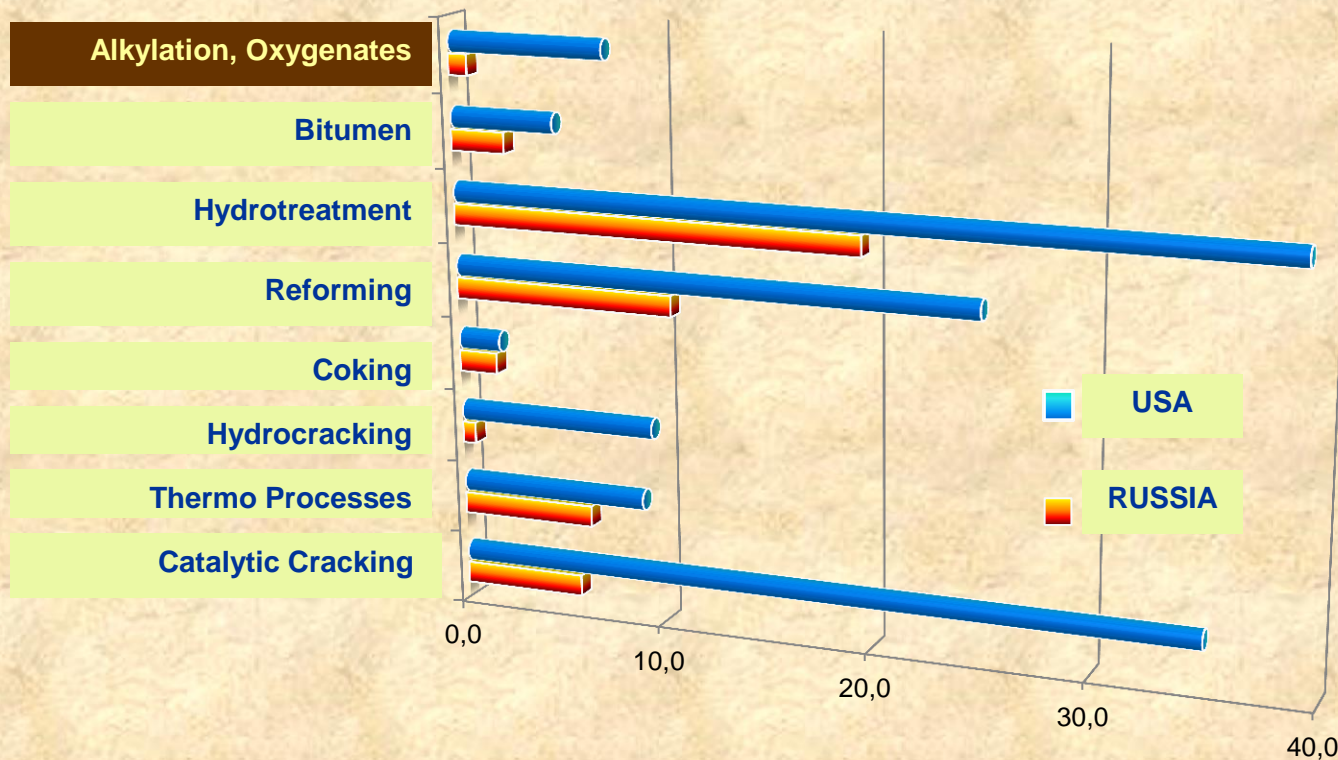
# **RUSSIAN PATENTED TECHNOLOGY**

**LIGHT OLEFINS (PROPYLENE, BUTYLENE,  
AMYLENE) TO REACT WITH ISOBUTANE  
IN THE PRESENCE OF A STRONG ACID  
CATALYST**

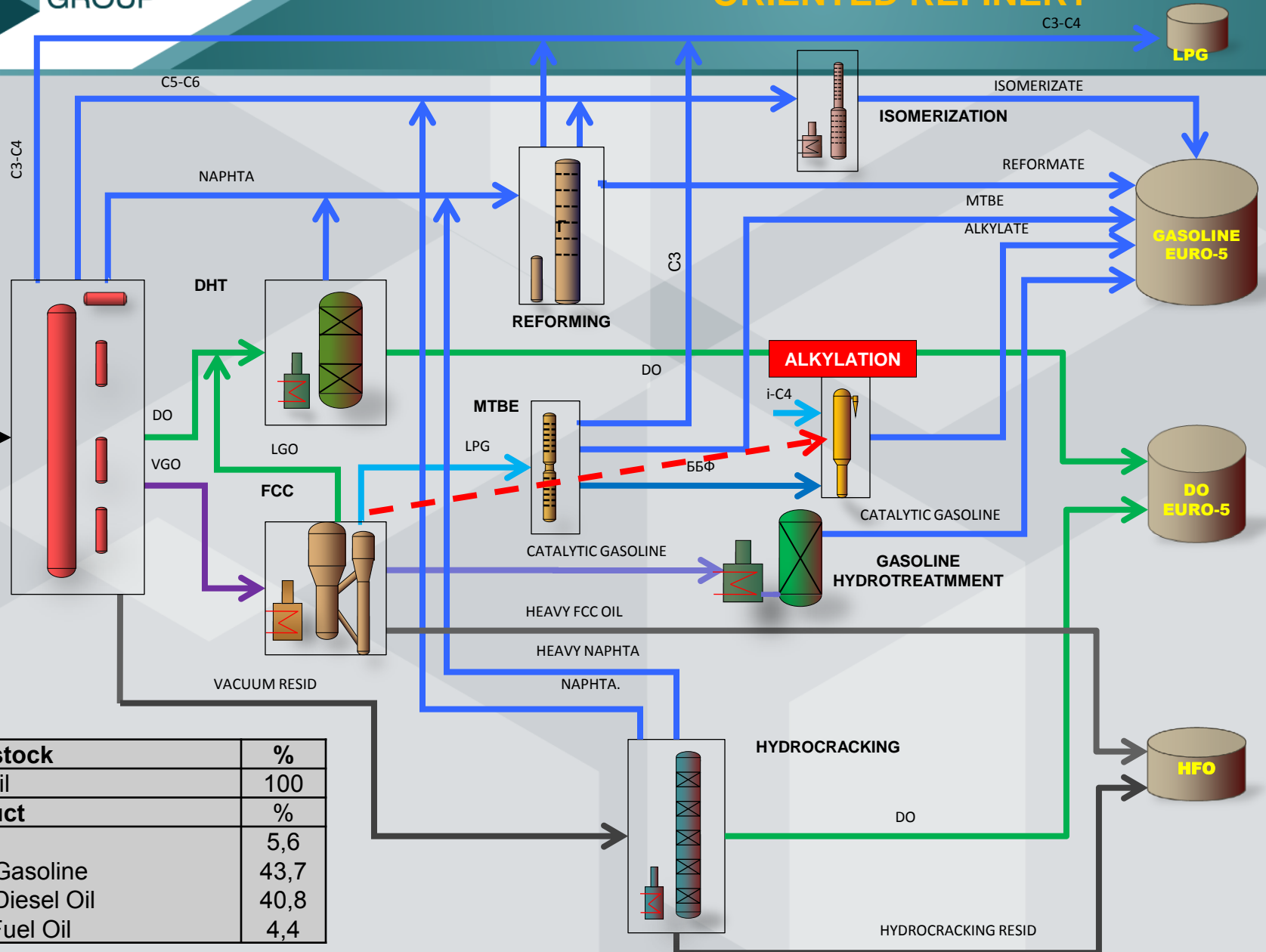
**SULFURIC ACID ALKYLATION  
TECHNOLOGY ON A BASIS OF  
REACTOR-SET INCLUDING JET  
REACTOR AND HYDROCYCLONE**

## Secondary Petroleum Refining Processes Share

(Primary Processes = 100%)



# TYPICAL SCHEMATIC OF FUEL ORIENTED REFINERY



Feedstock	%
Crude oil	100
Product	%
LPG	5,6
Euro-5 Gasoline	43,7
Euro-4 Diesel Oil	40,8
Heavy Fuel Oil	4,4

## BBF CONTENTS PRODUCED ON FCC UNIT capacity 120 ktpa

Component	Contents, % mass	Volume, ktpa
propylene	0,5 %	
propane	1,5 %	
n-butane	10 %	
i-butane	35 %	42,0
i-butylene	16 %	62,4
n-butene	12 %	
t-butene	14 %	
z-butene	10 %	
pentene	0,3 %	
i-pentane	0,6 %	
n-pentane	0,1 %	
Total:	100	120

**COMPARISON OF BBF PROCESSING METHODS**

	PROCESS	SELECTIVITY, %	FINAL PRODUCT, tpa
1	Oligomerization	51	62 400
2	Alkylation*	102	122 000
3	Alkylation + MTBE**	87	115 000
4	Selective oligomerization + Alkylation	87	104 400

\* - in presence of additional volume of isobutane

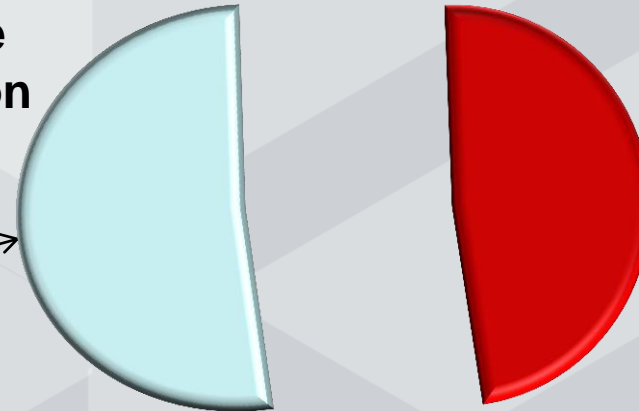
\*\* - in presence of additional volume of methanol

## OCTANE-TON PARAMETER COMPARISON TABLE

	Component	Volume, ktpa	RON	MON	(RON+MON)/2	Octane-ton, thousand per year
1.	Alkylate	85,2	95	93	94	8000
	MTBE	29,8	117	101	109	3260
		<b>115</b>				<b>11 260</b>
2.	Oligomerizate	<b>52</b>	97	85	91	<b>4 420</b>

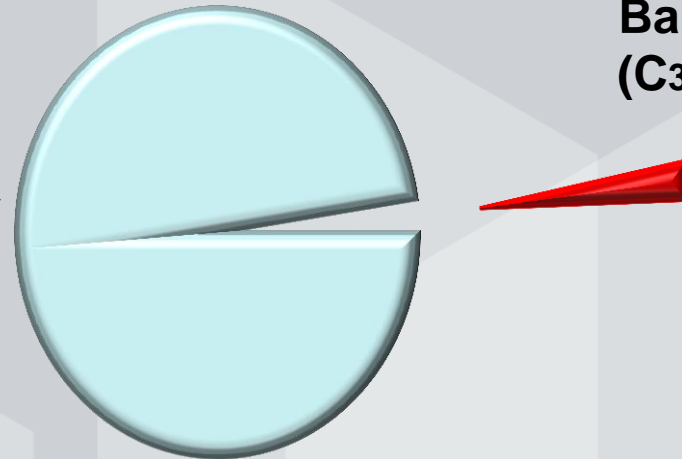
**Oligomerizate  
53 thousand ton**

Option 1



**Ballast  
(C3-C4)**

Option 2

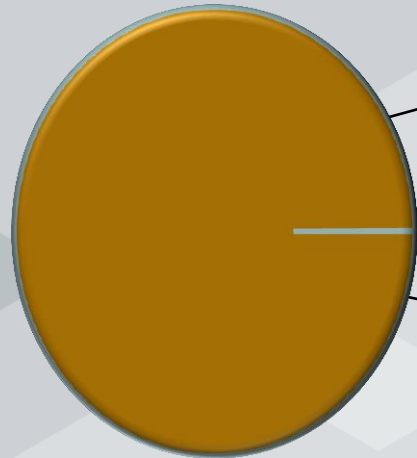


**Alkylate  
85 ktpa**

+

**MTBE  
30 ktpa**

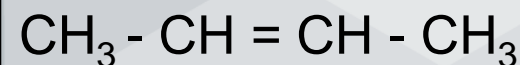
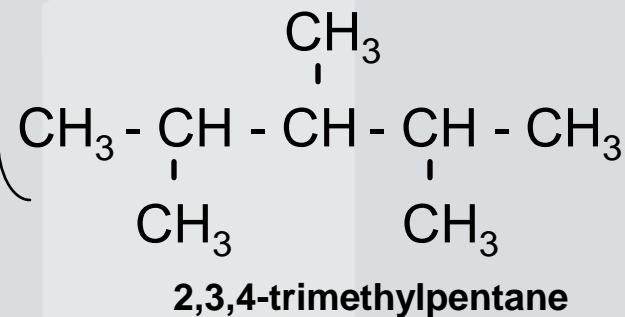
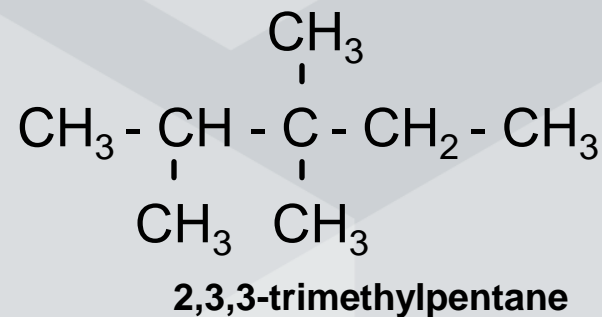
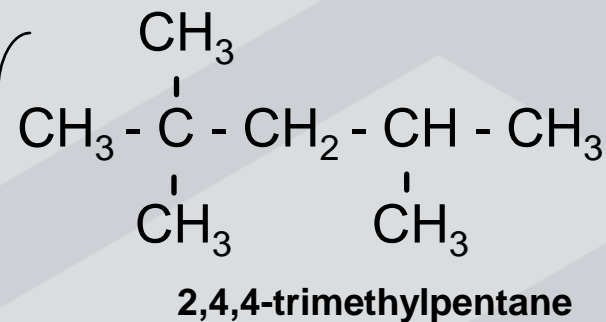
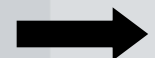
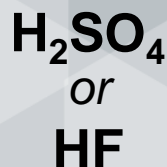
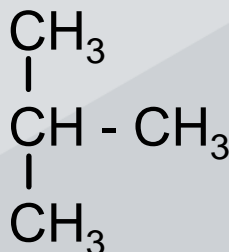
**BBF  
120 ktpa**



# ALKYLATION CHEMICAL REACTIONS SCHEME

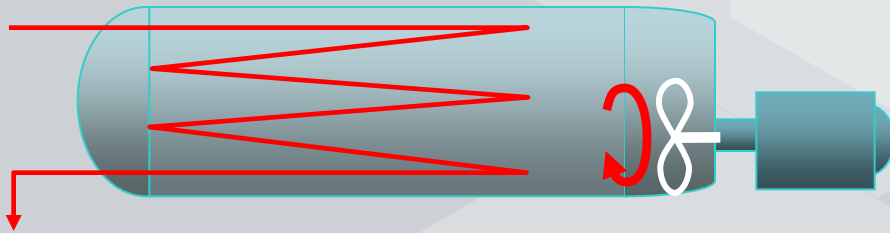
butylene

i-butane



## ALKYLATE PROPERTIES

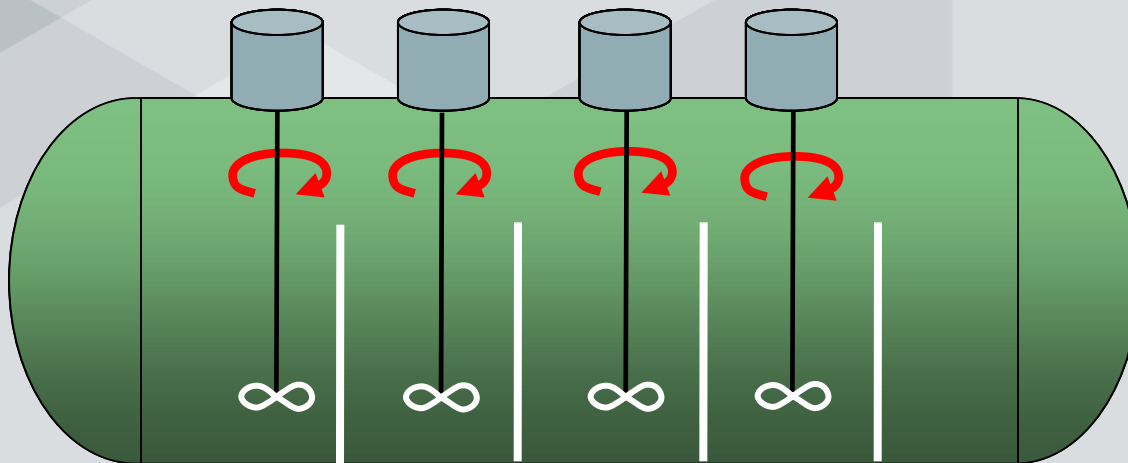
- ❑ Saturated hydrocarbons mixture contains mainly trimethylpentanes (60 to 80% mass) with low Reid vapour pressure
- ❑ Contains no aromatics, no unsaturated hydrocarbons, no sulfur, no lead, manganese and ferrum
- ❑ Motor octane number 92-94.
- ❑ Stable chemical, ideal blend for clean burning gasoline



Contactor 50 cbm



Jet Reactor  
10 cbm

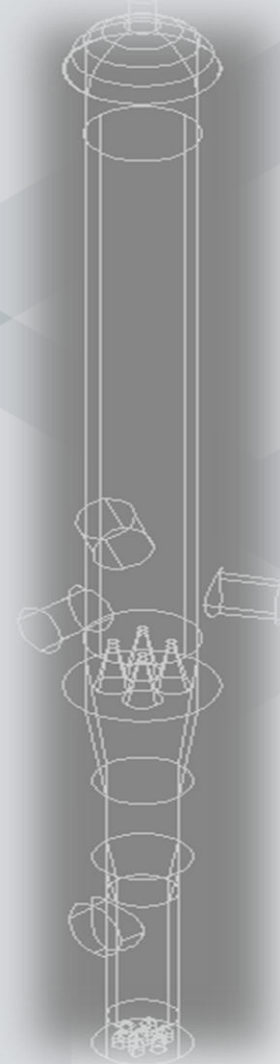


Cascade reactor 200 cbm



## KEY FEATURES

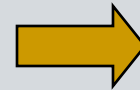
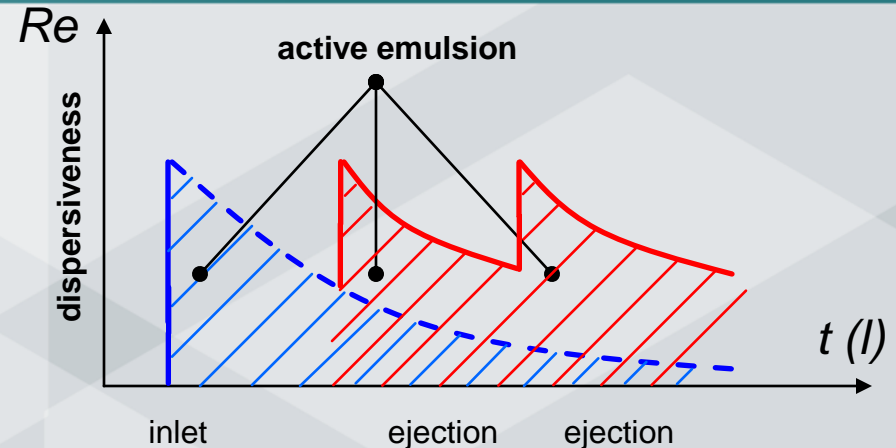
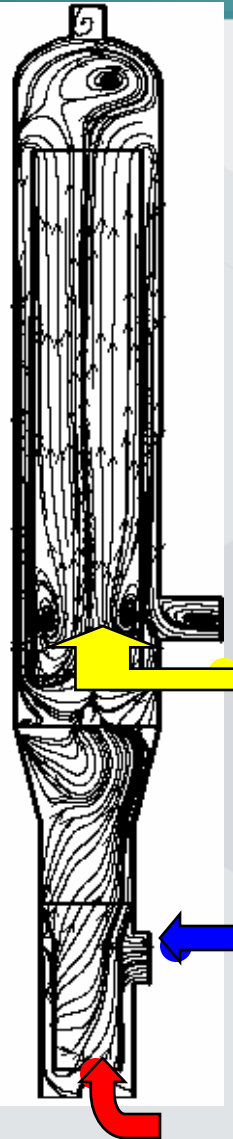
- Weight
- Volume
- Operation pressure
- Product retention period
- Olefins space velocity
- Operation temperature
- Internal olefines:isobutane ratio
- Capacity



- 10 ton
- 10 cmb
- 8 atm
- 60 sec
- 3 hr<sup>-1</sup>
- 14 °C
- 1:35
- 200 t/day

# JET REACTOR OPERATION SCHEME

- ❑ internal recirculation ratio ( $K_{EJ.} = 2$ )
- ❑ retention period max 60 sec



**Reaction mass**

**Feedstock: i-Bu, (BBF)**



**Sulfuric Acid  $H_2SO_4$**

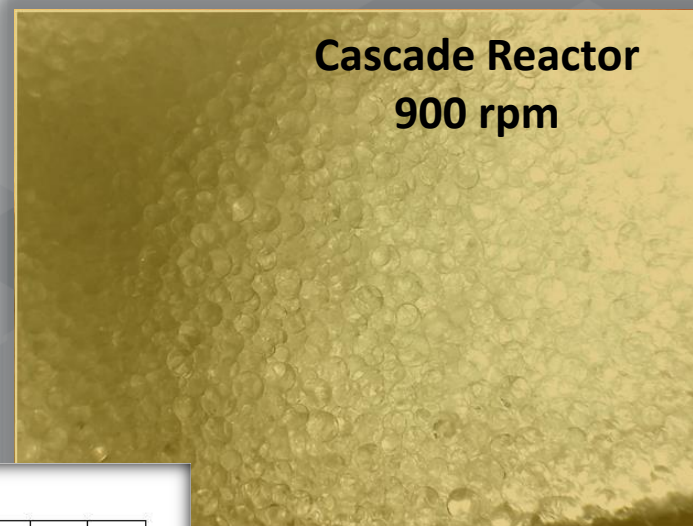
**Reactor Products**

# EMULSION DISPERSITY



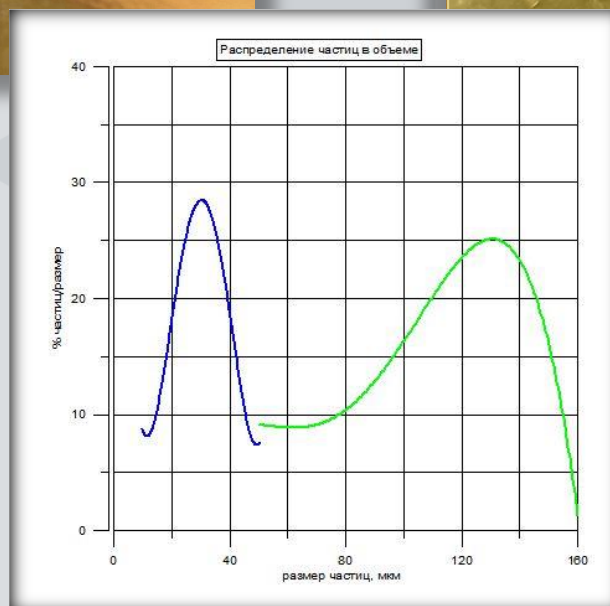
**Jet Reactor**

**35 micron**



**Cascade Reactor  
900 rpm**

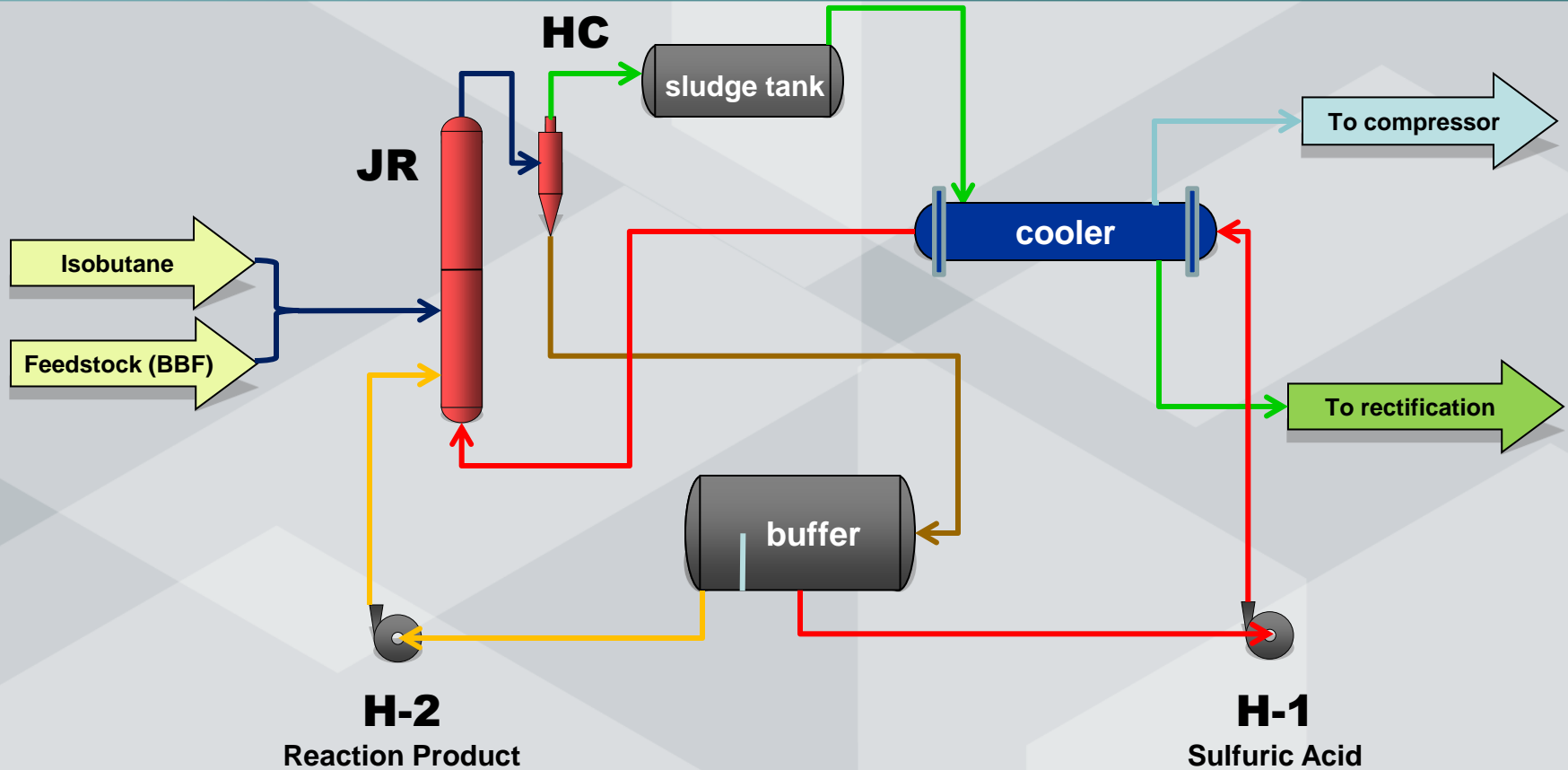
**135 micron**





- compact size
- high process flow speed
- enhanced reliability
- no mixers inside the reactor
- propylene feed operation option
- no internal tube bundle
- easy maintenance
- combined reactor-hydrocyclone operations

**YANOS Refinery / capacity 16 mtpa**  
Alkylation unit in operation since 2000



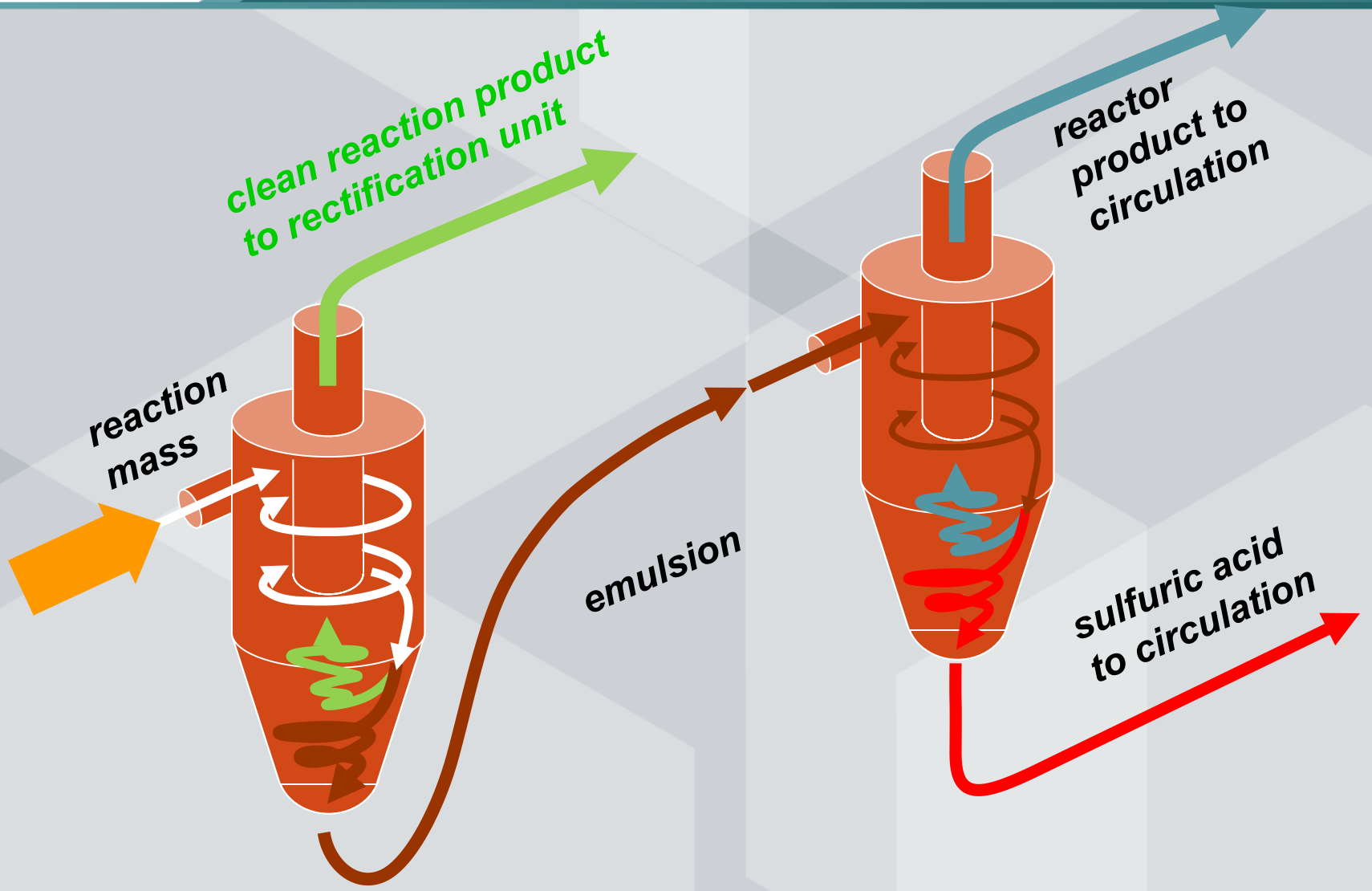
**JR** – jet reactor  
**HC** – hydrocyclone

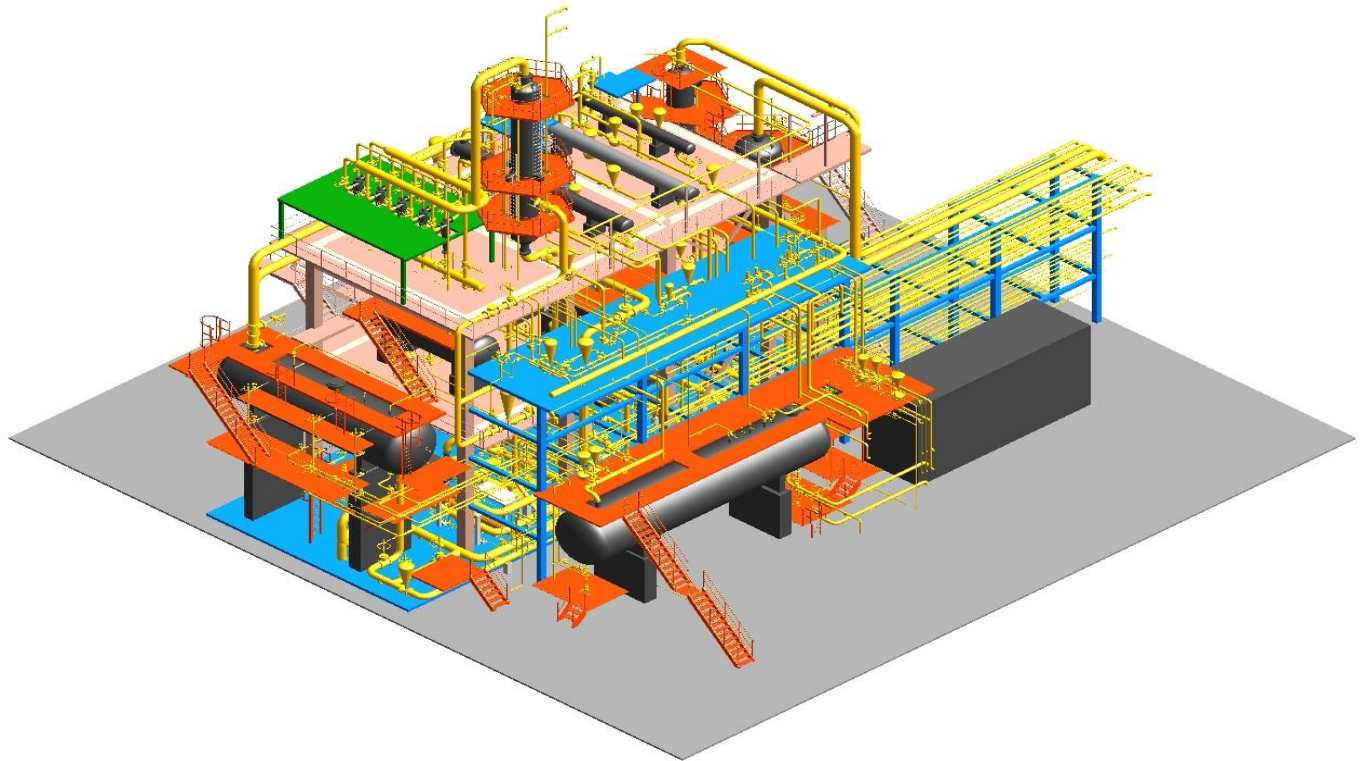


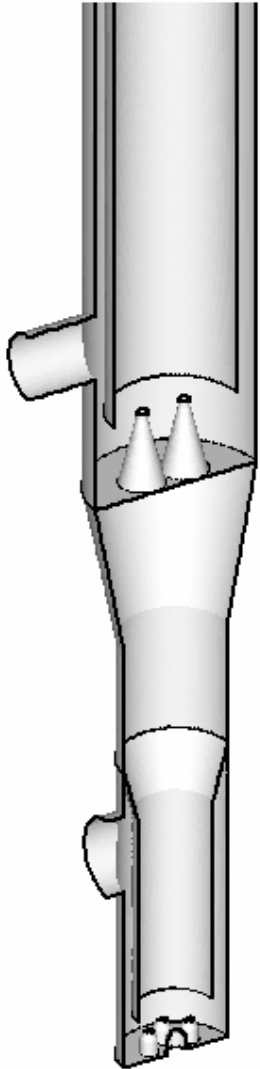
## HYDROCYCLONE DETAILS

- enhanced reliability
- regulated separation
- compact size
- separation process flow speed increase

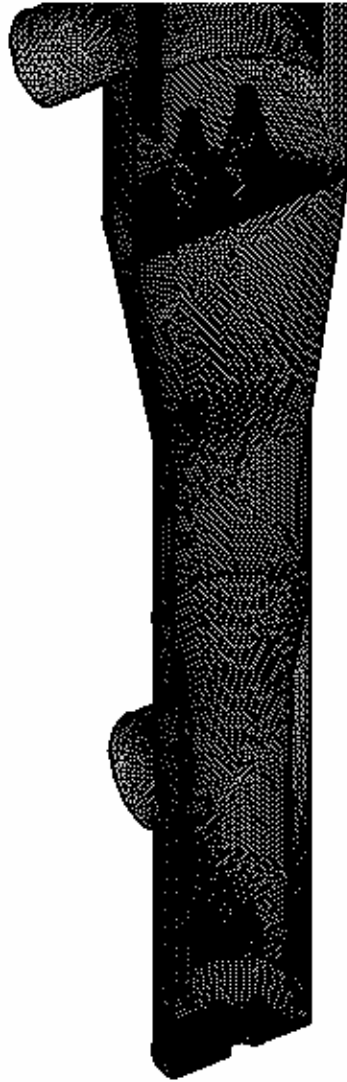
# HYDROCYCLONE OPERATION SCHEME



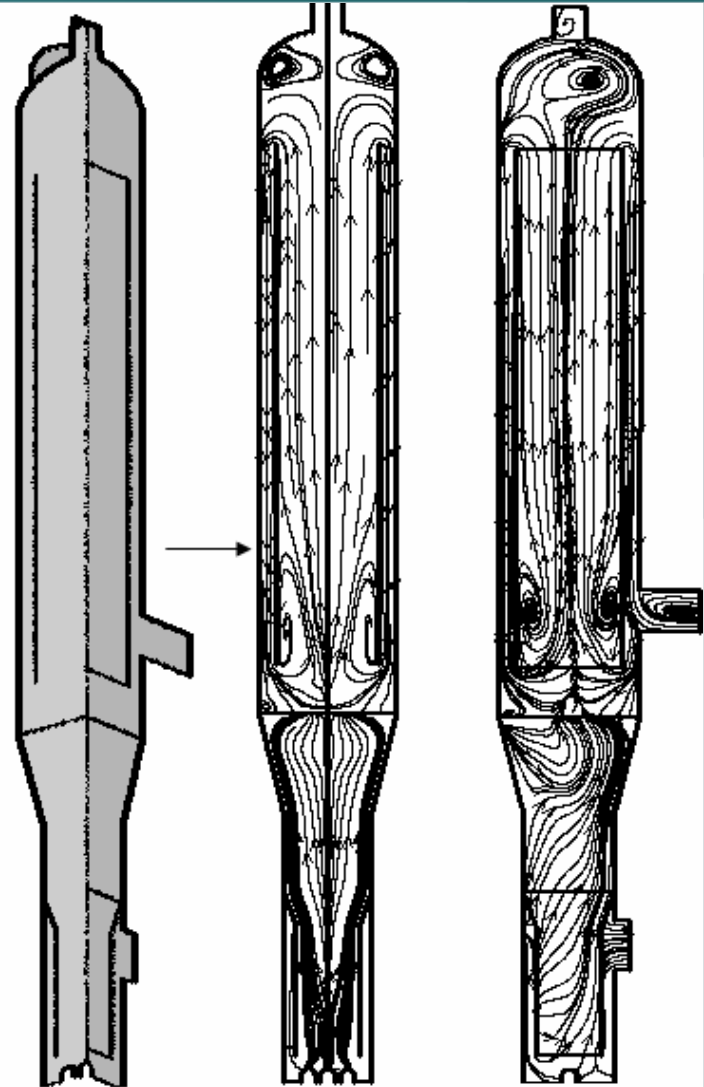




Reactor geometry



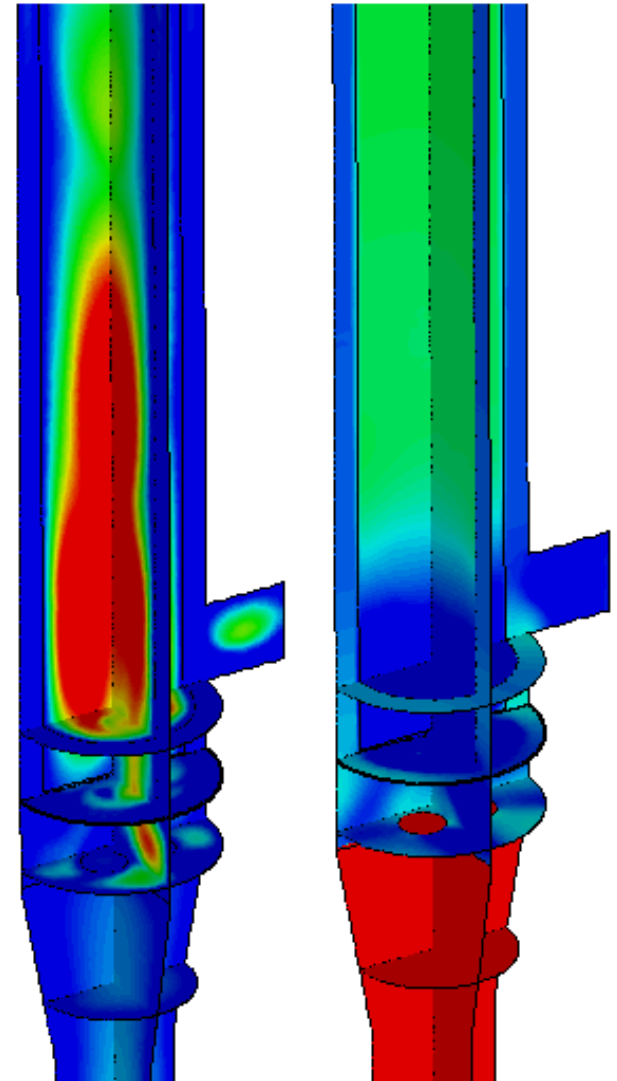
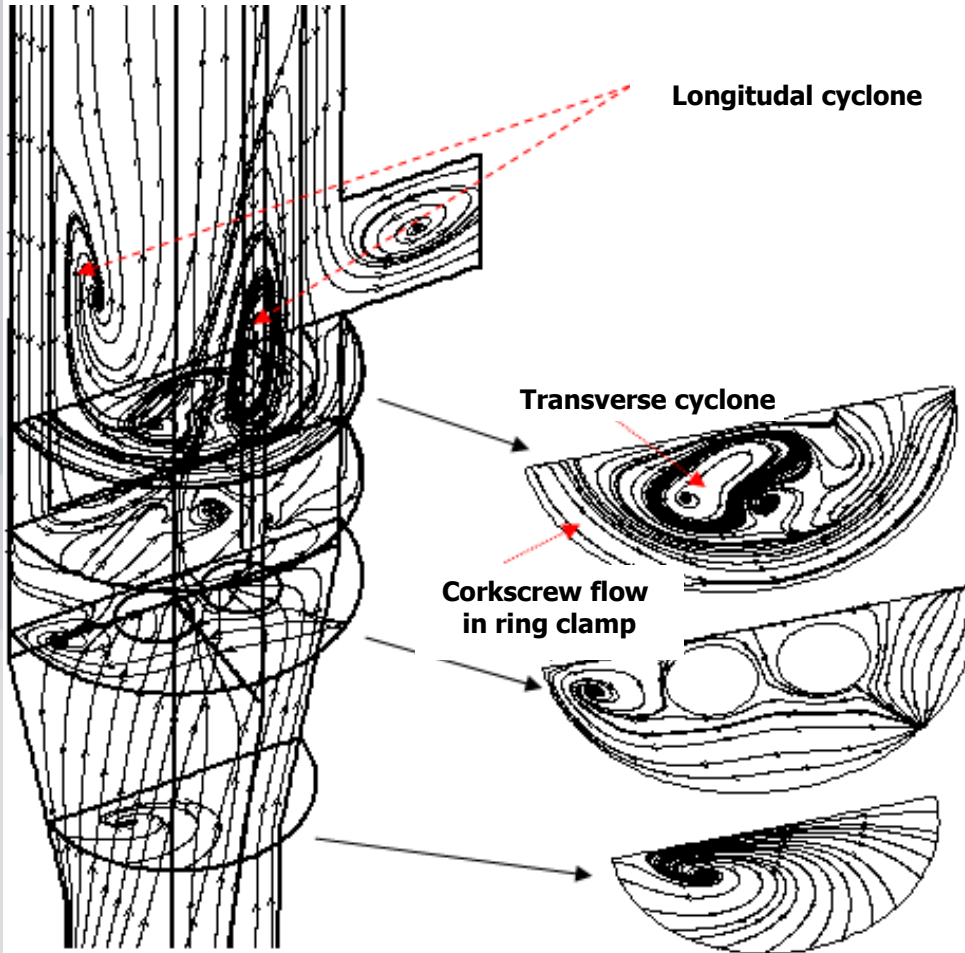
Model mesh fragment



Sectional controls

Flow structure in sectional controls




## FLOW STRUCTURE (lines of fluid flow is some sectional controls)

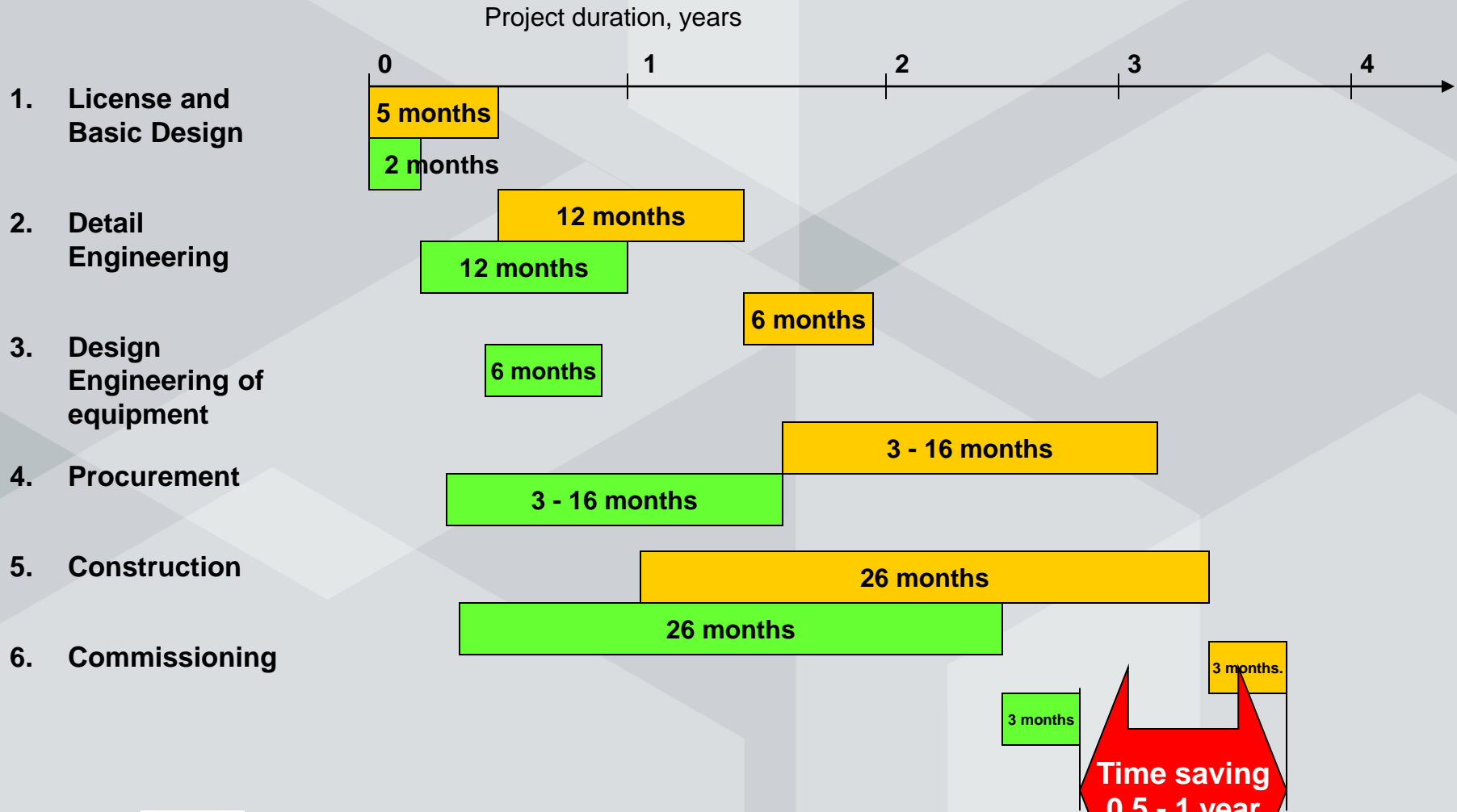


Turbulence area

Pressure area

# COMPARISON TABLE FOR TECHNICAL AND ECONOMICAL EVALUATION OF ALKYLATION TECHNOLOGIES IN THE MARKET

			
Operation temperature, °C max	<b>9</b>	<b>9</b>	<b>15</b>
Alkylate production capacity, ton per day	<b>850</b>	<b>850</b>	<b>850</b>
Octane Number	<b>96.3 RON</b>	<b>96.3 RON</b>	<b>96.3 RON</b>
Number of reactors	<b>1</b>	<b>4</b>	<b>4</b>
Number of mud tanks	<b>1</b>	<b>4</b>	<b>5</b>
<b>Energy consumption</b>			
Compressor, kW	<b>2130</b>	<b>2280</b>	<b>2200</b>
Built in mixers, kW	<b>400</b>	<b>1490</b>	-
Pumps, kW	<b>600</b>	<b>600</b>	<b>1300</b>
Total, kW	<b>3130</b>	<b>4370</b>	<b>3500</b>
Cooling water, m3/hr	<b>2700</b>	<b>2800</b>	<b>2700</b>
Steam, t/hr	<b>50</b>	<b>45</b>	<b>45</b>
Fresh Acid, ton per day	<b>69-75</b>	<b>70-75</b>	<b>70</b>



Detailed construction plan is prepared in MS Project format and can be modified according to Client's demand

- A new type of reactor for Alkylation process has been developed and implemented**
- New alkylation technology has proven design and in operation currently**
- Quality of final Alkylate product is matching with other Licensor's product characteristics**
- Our technology provides cost savings in both CAPEX and OPEX and also easier equipment access and maintainability comparing with other Licensors' units**



HEAD OFFICE  
Barklay Plaza Business Center  
6-5, Barklaya str., Moscow

### Address:

6 bld. 5, Barklaya str.,  
Moscow 121087, Russia

---

### Phone / Fax:

+7 (495) 989-12-75,  
+7 (495) 728-68-39,  
+7 (495) 678-20-58,

---

### E-mail:

[info@rangroup.ru](mailto:info@rangroup.ru)

---

[www.rangroup.ru](http://www.rangroup.ru)