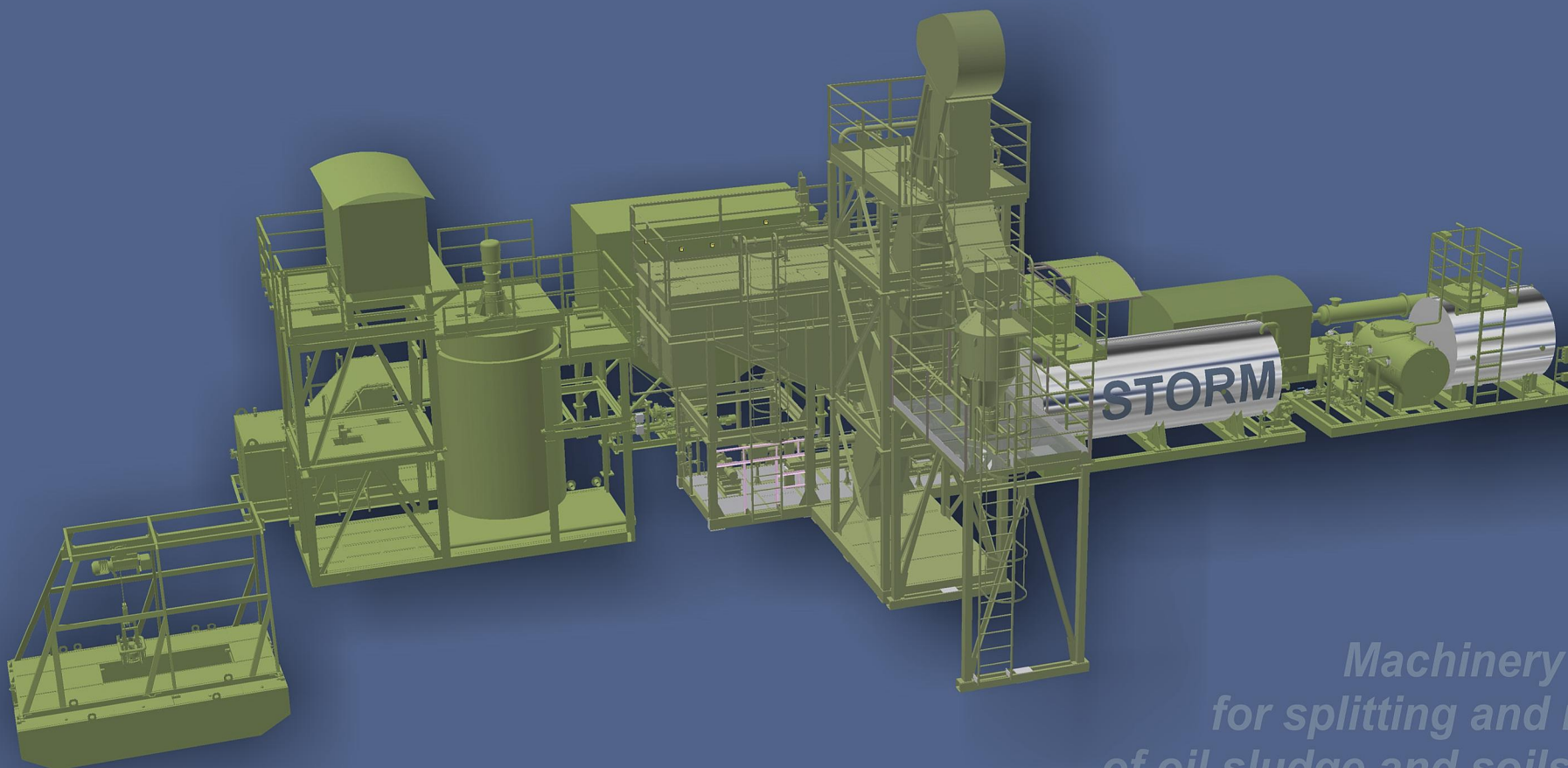




# TURBOGAS

PUBLIC JOINT STOCK COMPANY



*Machinery complex  
for splitting and recycling  
of oil sludge and soils polluted  
with oil products*



# STORM



## Machinery complex for splitting and recycling of oil sludge and soils polluted with oil products

Machinery complex for splitting and recycling of oil sludge and soils polluted with oil products provides:

- technological mobility of layer by layer recovery of the initial products, depending on its contents and characteristics by means of module structure;
- choosing of the optimal way of initial products recovery (pumps, excavators, transporters, use of washout water);
- even treatment of sludge tank taking into account sludge physical and chemical contents;
- individual technological process depending on the initial analysis of raw product samples;
- raw product recovery, splitting of wastes with further bioremediation, oil sludge recycling
- high quality of difficult sludge splitting (with pollution age of more than 15 years);
- recovery of hydrocarbons which without the additional processing can be returned to the industry;
- oil sludge recycling without new wastes creating;
- constancy of hydrocarbons recovery chemical structure;
- work with a wide range of oil-contaminated wastes (difficult oil refining sludge, fresh spills at oil recovery and its transportation).

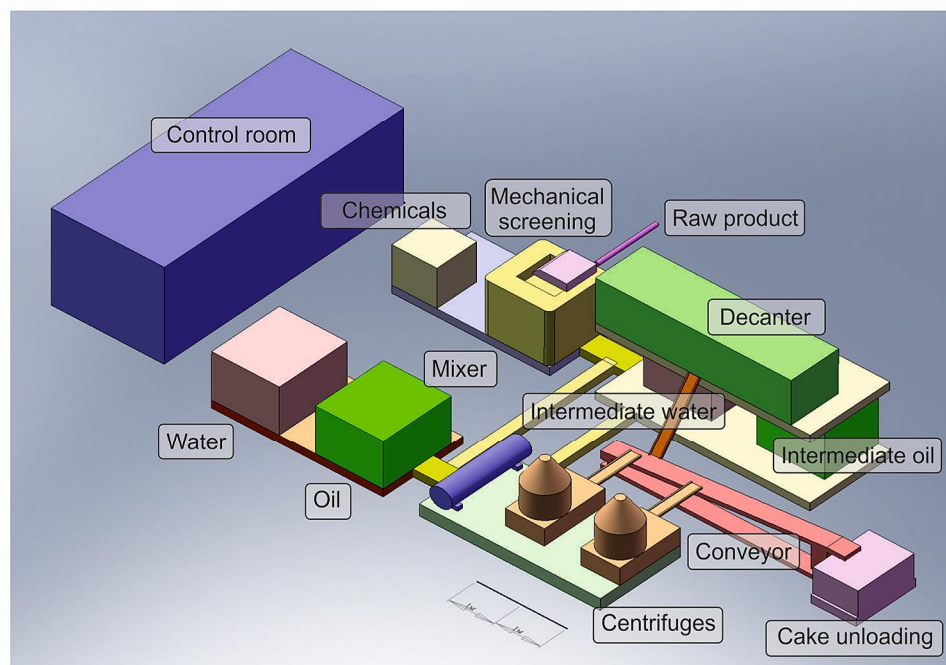




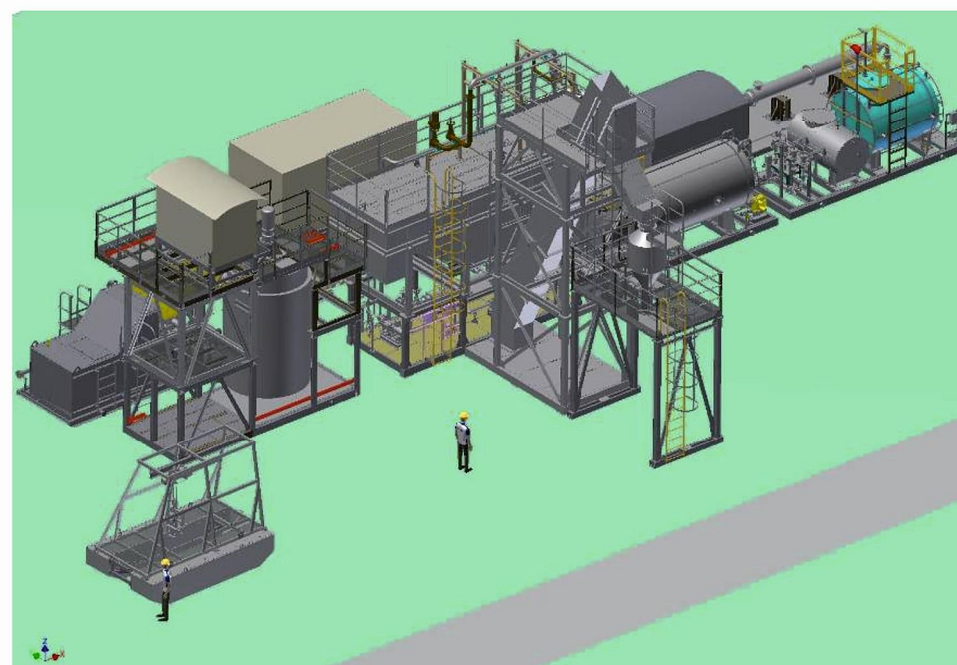
# STORM

alternate designs

Output 3 m<sup>3</sup>/hour



Output 15 m<sup>3</sup>/hour





## Scientific-technical basis of “Turbogaz” PJSC

- 38 years of experience in design and manufacturing of high-technology equipment for oil-gas and power industries
- professionally combines innovative ideas and long-term experience



- **more than 200** turbo-refrigerating expanders;
- **10** energy-saving turboexpanders;
- **212** gas compressor units;
- **20** gas turbine electric power plants with total power of more than 300 MW;
- **more than 900** sets of well equipment;
- fully equipped complex gas treatment plants at **16** gas condensate fields of Ukraine.



“Turbogaz” PJSC makes full technologically closed cycle:  
from researches and developments  
to supply and commissioning of the ready Goods.





**ТУРБОГАЗ**  
ПУБЛИЧНОЕ АКЦИОНЕРНОЕ ОБЩЕСТВО

## Man Oil Group About the company

- Man Oil Group renders services of recycling of the hydrocarbon containing wastes, formed in the process of oil recovery and processing at own equipment STORM-15 together with the bioremediation technology.

The technologies can be used as independent solutions for recycling.

- Recycling of oil-contaminations and soils dehydration by MOG AG technology:
- ecological safety
- industrial scale of recycling
- economical efficiency
- Individual solutions are made on the bases of own network of laboratories and unified scientific center
- Man Oil Group aspires to get the leading position at the world market of oil-contaminations and hydrocarbon recovery processing, providing the clients with the high quality of services. The main aims are CIS, Russia and the Near East markets.



**MOG AG technologies and equipment  
have been certified and licensed in Russia and Ukraine  
Applications for patents NHS (EP 11162199,1) and STORM-15 (EP 12169851,8)  
have been registered in the European Patent Office.**





## Strategic partnership of “Turbogaz” PJSC and Man Oil Group

- joint researches of efficiency of the known technologies of oil contamination recovery have been made
- the technological process for basic complex of oil sludge recycling STORM-15 by MOG AG technology has been developed
- the preliminary layout of STORM-3 complex intended for spills and small pits recycling has been developed
- the long-term contract for manufacturing of module equipment was concluded
- the project work group includes 7 PhDs, 2 members-correspondents of the Academy of Sciences.
- the first STORM-15 plant was launched at Lisichansk oil refinery, positive results have been achieved.



Strategic partnership of “Turbogaz” PJSC and Man Oil Group provides the full cycle of services with maximum efficiency: researches of storage facilities, choice and supply of the equipment, technologies adaptation, training, service maintenance.





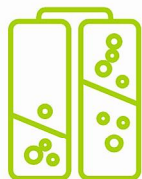
## Complex approach Unique commercial proposal



**Individual solution  
by each project**



**Non-waste technology**



**Store-15: the 3rd generation of  
equipment. Intellectual property of  
MOG AG**



**NHS: Unique composition of  
natural components.  
Intellectual property of MOG AG**



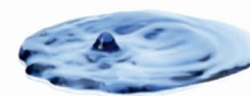
**Results guarantee**



Approach in MOG AG 100%  
satisfies high requirements of  
ecological responsibility in the  
oil industry



**Commercial  
hydrocarbon**



**Water**



**Soil**

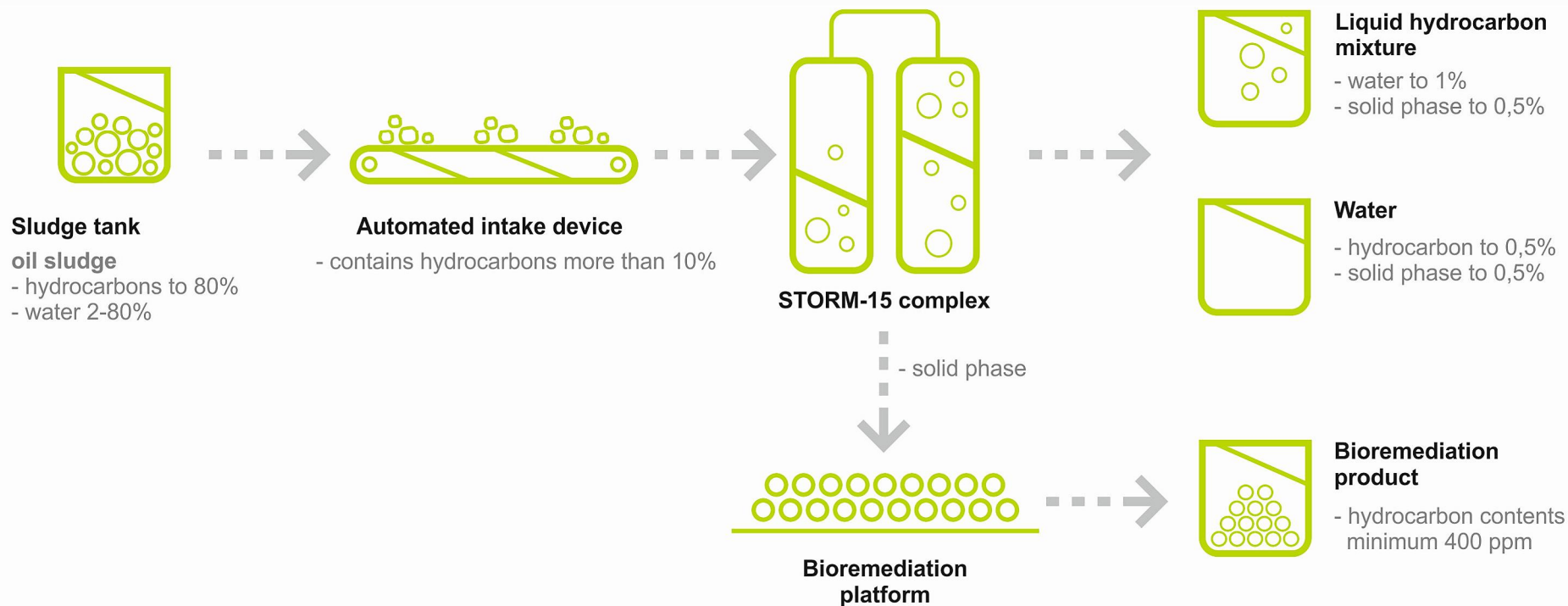


Complex approach

ТУРБОГАЗ  
ПУБЛИЧНОЕ АКЦИОНЕРНОЕ ОБЩЕСТВО

## Oil sludge splitting and wastes bioremediation

Technological diagram of complex approach to wastes recycling with further bioremediation





## Competitive analysis Comparison of technologies efficiency

Possible technologies	Stabilization/ Encapsulation	Biological	Chemical	Incineration	Pyrolysis	Soils dehydration	Thermal desorption	Splitting	MOG
Complex technological process	—	—	—	—	—	—	—	—	+
Ecological purity of output products									+
Water	—	—	+	—	+	—	+	+	+
Cake	—	—	—	—	—	—	+	—	+
Cake after bioremediation	+	+	—	—	—	—	—	—	+
Individual solution	—	+	+	—	—	—	—	—	+
Use of high-performance products	—	+	—	—	—	—	—	+	+
High rate of productivity	—	—	—/+	—	+	—	—	+	+
Use of recovered hydrocarbons	—	—	—	—	+	—	+	+	+
Wide range of the recycled oil sludge	—	—	—	+	+	—	+	+	+
Safety, reliability	—	+	—	—	—	+	—/+	+	+
Use of autochthonous microflora	—	+	—	—	—	—	—	—	+
Safety for environment	—	+	—	—	—	—	+	+	+
Process independence from additional equipment	—	+	+	—	—	—	—	—	+
Prime cost	—	+	—	—	—	—	—	—/+	+



## Maintenance standards **STORM-15 Special Treatment Oil Recovery Machine**

guaranteed service life, months	12
operational life, hours	60000
overhaul life, hours	30000
time to regular maintenance, hours	7500



### **“Turbogaz” PJSC provides:**

- annual inter seasonal maintenance of the plant;
- experts arrival in case of emergency;
- guarantee and post guarantee servicing.





## Quality control **STORM-15 machine**



- materials purchasing
- metal constructions manufacturing
- pipelines manufacturing
- testing
- units assembly
- quality control
- acceptance testing

Production quality control  
at each stage

STORM-15 quality control system  
is certified according  
to the international  
standards ISO 9000





## Equipment for oil sludge splitting and recovery **STORM-15 complex**



- Manufacturer: “Turbogaz” PJSC (Kharkov, Ukraine). Experience of work in manufacturing of oil and gas equipment is 38 years.
- The technology is based on the physical methods of oil sludge splitting.
- The technology provides prompt response to change of input raw material contents and properties.
- 100% automated work station of the operator with the visual display.
- Automatic control system is based on Siemens elementary base and processes data of approximately 400 control sensors.
- Complex automatic control with emergencies prevention function.
- STORM-15 production quality control system is certified according to ISO 9001.



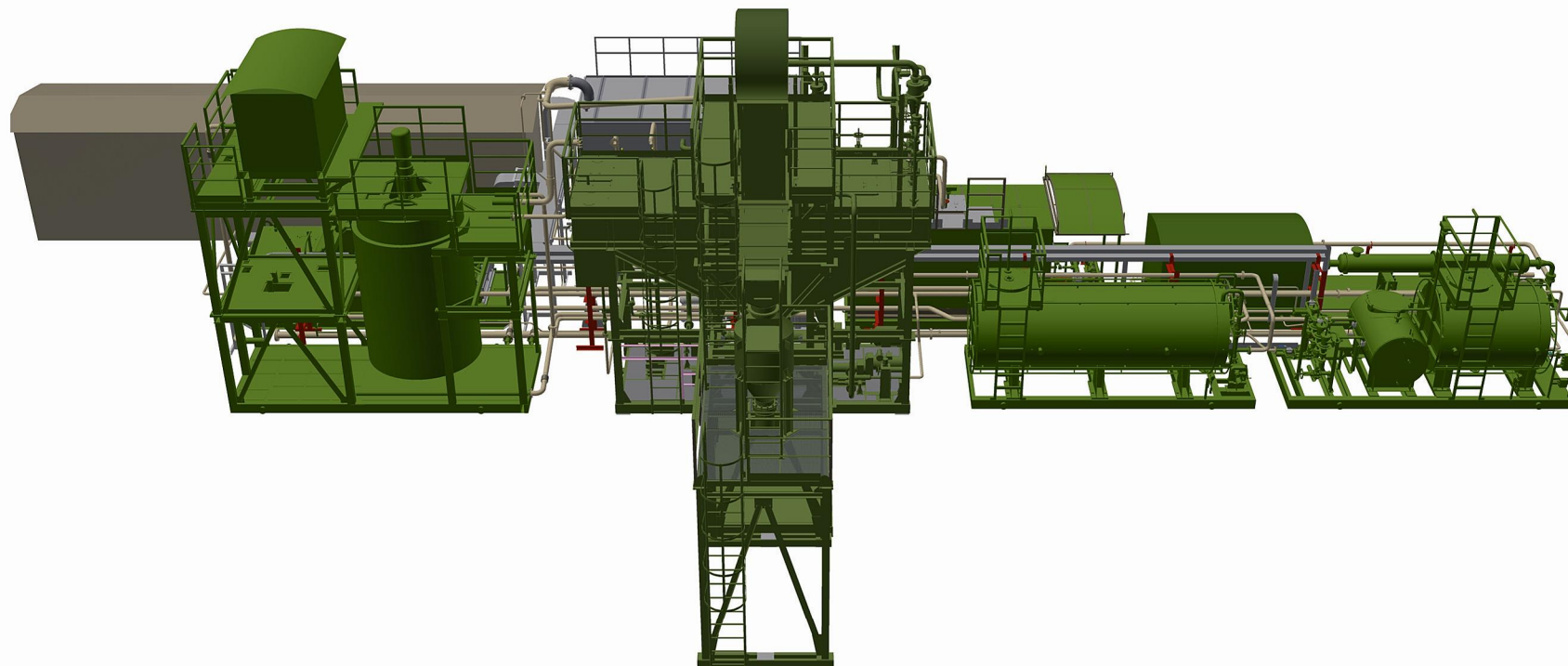
By specific projects the basic complete set of STORM-15 is supplemented by modules providing the individual solution by each project.





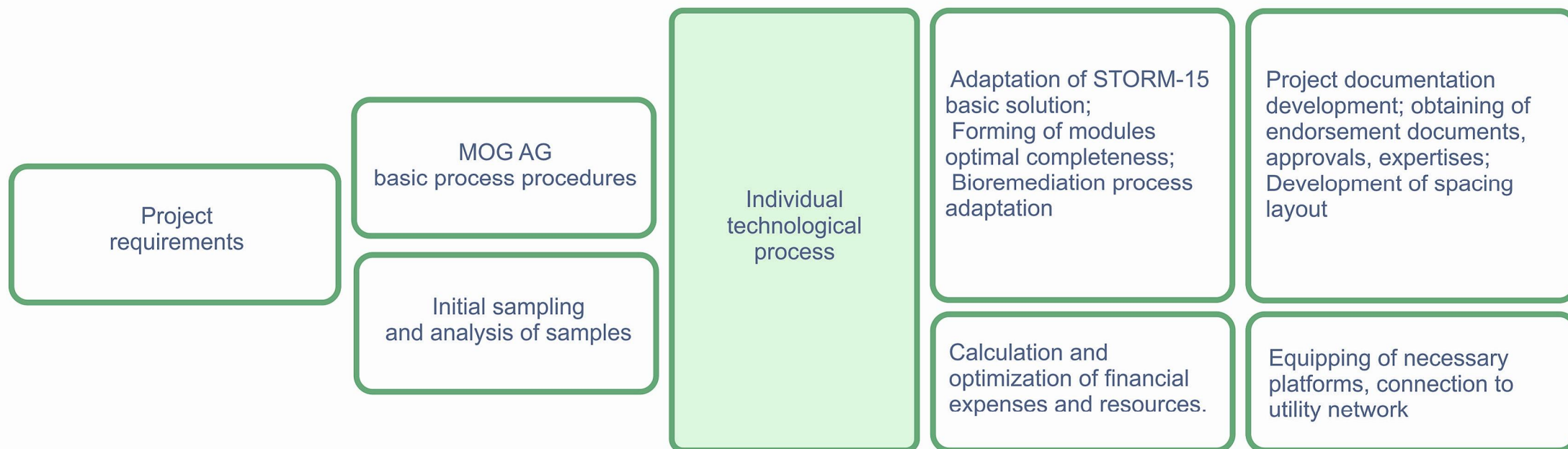
**ТУРБОГАЗ**  
ПУБЛИЧНОЕ АКЦИОНЕРНОЕ ОБЩЕСТВО

## Oil sludge splitting and recycling complex **STORM-15** cutting-edge technological complex





## Individual “turn-key” solution Production preparation plan



Development of oil sludge recycling starting with production process preparation till approval of project results with the supervision authorities



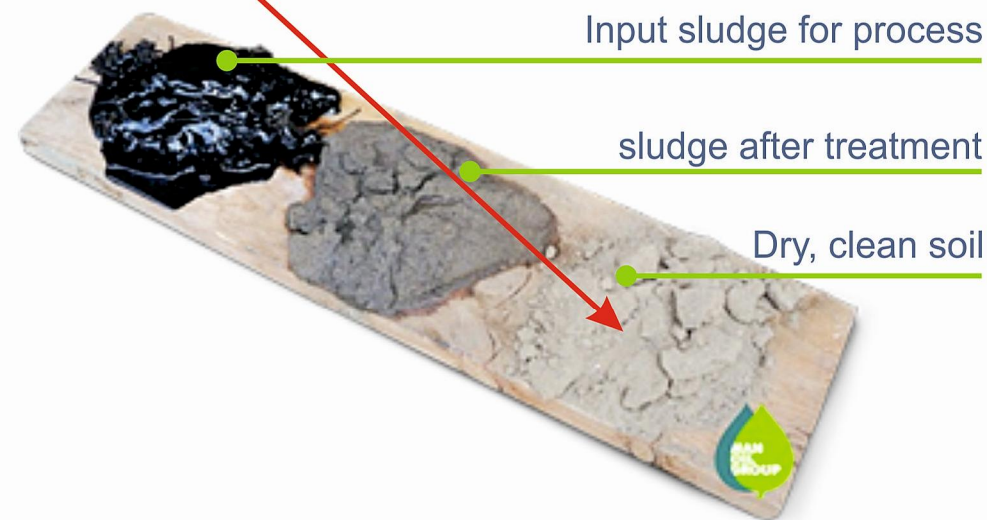
## Results of splitting Above the industrial standard

Standard technology,  
Flottweg equipment:



*for comparison*

MOG AG technology - implementation  
of advanced scientific achievements:



For the best implementation of the specific project STORM-15  
main equipment can be supplemented by special modules  
for solution of the individual tasks





## Project execution Modern solution for oil sludge recycling



Wastes complex management including oil sludge treatment and hydrocarbons recovery.  
STORM-15 plant at Lisichansk oil refinery (capital asset of TNK-BP in Ukraine)







# Lisichansk oil refinery

## Modern technology

**ТУРБОГАЗ**  
ПУБЛИЧНОЕ АКЦИОНЕРНОЕ ОБЩЕСТВО

### Comparison of characteristics of the installed equipment with STORM-15 complex

Technology	Centrifugal separation	MOG AG technology
Equipment	Flottweg-Z6E-4	STORM-15
Main separation unit	Tricanter	Bank of hydrocyclones + hydraulic dynamic separator
Stated output of pulp processing	20 tonnes	60 tonnes
Output	3,62 m <sup>3</sup> /h	15 m <sup>3</sup> /h
Duration of 10000 tonnes treatment	Approx.  5 months	Approx.  1 month
Hydrocarbons contents in cake	About 15%	5%
Cake post-treatment	N/A	Bioremediation
Hydrocarbons contents at plant output	About 15%	Maximum 0.04%
Cake		





## Technology implementation: Lisichansk oil refinery **Flexibility of STORM-15 technological process**

**Self-sufficiency and independence** from infrastructure and geographical location of oil sludge storage.

### **Mobility of intake device**

Ponton provides operative transfer of the unit on all volume of sludge tank.

### **Pulp preliminary treatment**

Oil sludge is processed by NHS composition and forms micro emulsion with fragments of hydrocarbon molecules providing weakening of hydrophobic connections and decrease of oil sludge melting temperature.



MOG AG provides smooth treatment of sludge tank taking into account physical and chemical contents of oil sludge



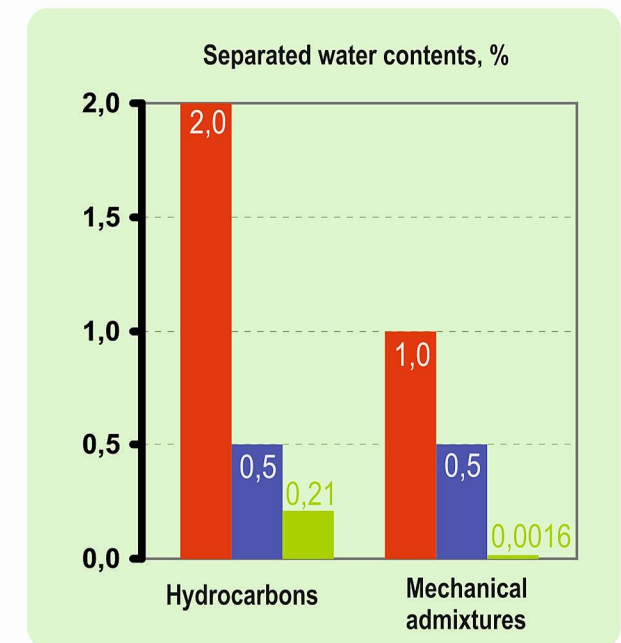
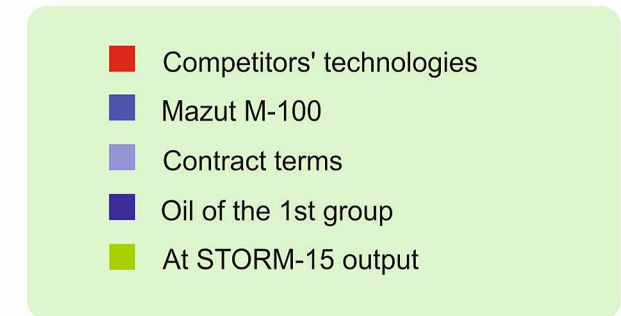
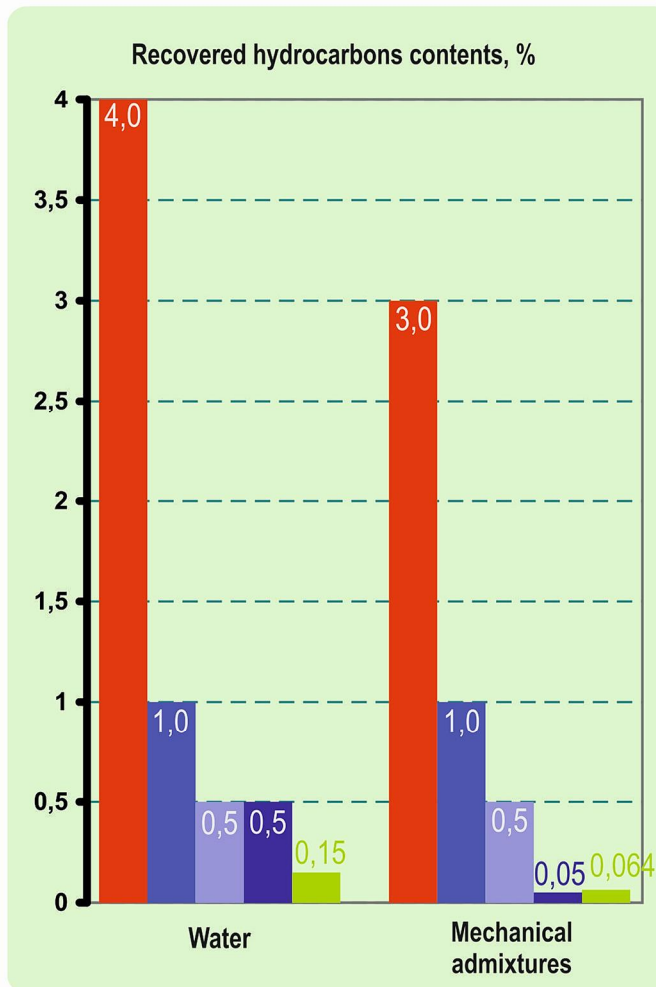
## Lisichansk oil refinery project implementation Quality, proven by practice

TNK-BP officially confirms:

- MOG AG provides fulfillment of the contract terms
- high quality of difficult oil sludge recycling (pollution age of 10-15 years)
- Hydrocarbons recovered by MOG AG technology without the additional treatment can be returned into industry

New standards for oil industry:

- Oil sludge recycling prevents forming of new wastes
- 95% of hydrocarbon component is recovered
- Chemical structure of recovered hydrocarbons is not violated
- Refinery capacity of 15 m<sup>3</sup>/h allows at one plant per season to clean the tank with volume of 75 000 m<sup>3</sup>
- STORM-15 works with a wide range of oil contaminated wastes





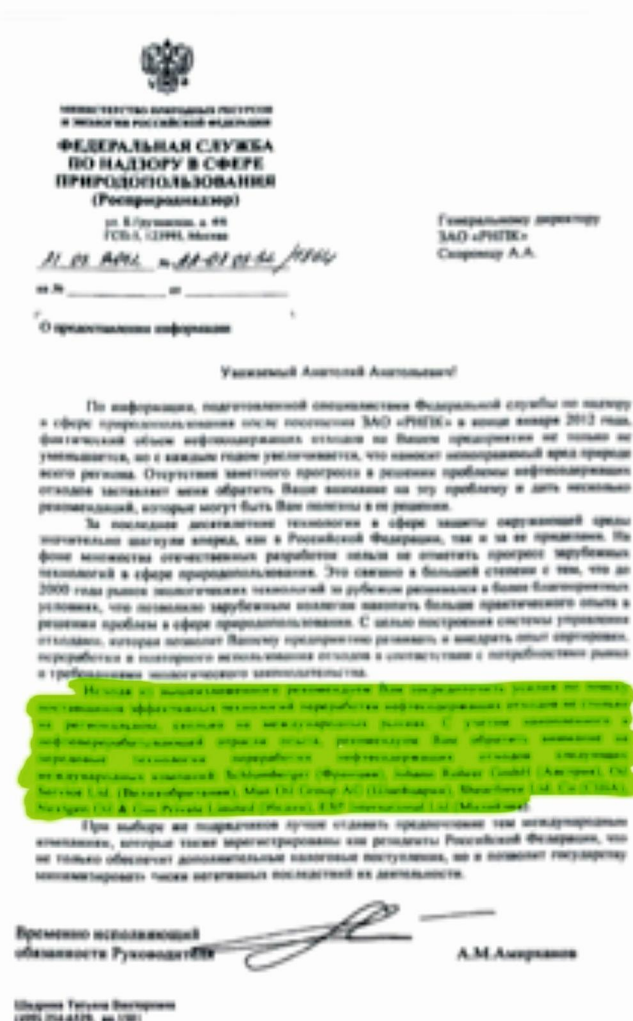


Yesterday oil sludge recycling was considered as the additional income, today to neutralize oil sludge accumulations means to liquidate the regular cause for the state to interfere in oil companies business

“Launching of STORM-15 plant and what is more important – the results of operation are one of the remarkable events in the framework of implementation of the wastes ecological management program. Man Oil Group has demonstrated that there are solutions at the works market, which successfully solve the problem of oil sludge. It is very important to invite such companies to the Russian market and create conditions for their work”



**Vladimir Kirillov**  
Director of Rosprirodnadzor





## Experts high opinion **Switzerland**

Comparison with world leading analogues confirms MOG AG technology efficiency. Independent expertise of STORM-15 was made by Swiss Federal Institute of Technology of Zurich together with the laboratory "Safety of transportation and recycling".

Professor Philipp Rudolf von Rohr personally has visited the production facilities and pointed out the high level of operating possibilities of STORM-15, reliability of equipment and quality of processing.

Swiss Federal Institute of Technology Zurich is one of the world leaders in the area of improvement of technologies for processing industry.



**Professor Philipp Rudolf von Rohr**  
Director of the Swiss Federal Institute  
of Technology (Zurich, Switzerland)



### Technical Expertise on a Separation Unit for Oil, Water and Solids "STORM 15"



for

Man Oil Group  
Seestrasse 5  
6300 Zug

by

Prof. Dr. sc. techn. ETH Philipp Rudolf von Rohr


April/May 2012

Division: Verfahrenstechnik 01, 4101 Madsen, Switzerland  
Office: ETH Zurich, HG-11.1, Sonneggstrasse 3, 8007 Zurich, Switzerland  
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## Experts high opinion Azerbaijan

For 35 days under the influence of NHS the number of microorganisms in soil increased 3 times that caused almost 4 times decrease of hydrocarbons



**АКТ**

**Изменение численности микроорганизмов в образцах нефтяного шлама**

Исследованы физико-химические и микробиологические характеристики шлама:

Иа - проба шлама 09.06.10 с площадки А  
 Иб - проба шлама 09.06.10 с площадки В  
 Иа - проба шлама 13.07.10 с площадки А  
 Иб - проба шлама 13.07.10 с площадки В

На площадках А и В, загрязненных работниками MOG AG на территории полигона компании "ЕКОВ" (г. Баку), проводили опытный процесс биоремедиации нефтяного шлама, полученного с НПЗ им. Гейдара Алиева (образцы шлама отобраны с завода, в течение часа после деактивации АНБ Ланка).

Биологический анализ проводили с образцами шлама в воздушно-жидкой среде, инкубировали в сутках и проследили через 30 и 40 дней.

Содержание нефтепродуктов в шламах определяли весовым методом после экстракции углеводородов из шлама с помощью гексана или дихлорметана в аппарате Соклет с последующей этановой экстракцией, дистиляцией и взвешиванием углеводородов [1].

Вязкость определяли весовым методом по методу [2].

Общую численность микроорганизмов определяли методом предельных разведений с высевом соответствующего разведения (0,25 мл) на агаризованные среды: м-со-петтоуевый агар (МПА) для бактерий и сусло-агар (СА) для грибов и дрожжей [3].

Для определения углеводородокисляющих бактерий была использована минеральная среда состава (г/л):  $K_2HPO_4$  - 0,5;  $K_2PO_4$  - 0,5;  $MgSO_4$  - 0,5;  $FeCl_2$  - 0,01;  $NaCl$  - 0,1;  $CaCl_2$  - 0,1;  $NaNO_3$  - 2,5; агар-агар 20,0.

В качестве единственного источника углерода вносил 1 % (по весу) нефти, выделенной из загрязненных почв.

Чашки Петри выдерживали в термостате при температуре  $28 \pm 2^\circ C$ : бактерии 24 часа, грибы 4-5 суток; углеводородокисляющие - 5 суток, при температуре  $32 \pm 2^\circ C$

Проба	Вязкость, Па·с	pH	Содержание нефти, %	Общее количество микроорганизмов, на 1 г абсолютной сухой почвы		Общее количество углеводородокисляющих бактерий	грибы	дрожжи
				общее	углеводородокисляющие			
Иа	16	6,5	12,2	$36 \cdot 10^6$	$4 \cdot 10^6$	$5 \cdot 10^6$	$40 \cdot 10^6$	
Иб	15	6,7	12,9	$17 \cdot 10^6$	$7 \cdot 10^6$	$21 \cdot 10^6$	$62 \cdot 10^6$	
Иа	3	6,2	3,1	$96 \cdot 10^6$	$15 \cdot 10^6$	$60 \cdot 10^6$	$48 \cdot 10^6$	
Иб	5	6,4	3,9	$49 \cdot 10^6$	$19 \cdot 10^6$	$39 \cdot 10^6$	$82 \cdot 10^6$	


Оценки, что за 35 суток под воздействием препарата NHS "Natural Hydrocarbon Solution" - собственной разработки компании MOG AG почва микроорганизмами и пробой углеводородов, почва в три раза, что повлияло на снижение веса на нефть и углеводородов образцы шлама в 4 раза.


Как следствие на загрязненных почвах микроорганизмы, выделяющие углеводороды, представляли различные виды бактерий. Дрожжи и грибовые микроорганизмы, выделяющие углеводороды, также присутствовали. Таким образом, почва, загрязненная нефтью, подверглась воздействию нефтепродуктов. В исследуемых образцах почва имеет большое количество углеводородокисляющих микроорганизмов, использующих нефтепродукты в качестве источника питания. Использование в опытных процессах MOG AG биологического ПАВ NHS собственной разработки позволило значительно повысить эффективность естественных процессов биоремедиации без внесения на загрязненные участки бактериальных препаратов на основе чужеродных штаммов.

Полученные результаты опытного применения уникальной технологии активации автохтонной культуры углеводородокисляющих микроорганизмов компании MOG AG позволяют рекомендовать ее для эффективной рекультивации (биоремедиации) загрязненных УВ нефть почв на всей площади Апшеронского полуострова.

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Руководитель лаборатории М.К. профессор  П.Ш. Мансумзаде

С.д.с. лаборатория, к.б.н.  Д.М. Курбанов

The obtained results of the trial use of MOG AG unique technology of activation of the autochthonous culture of hydrocarbon oxidizing microorganisms let us recommending it for the effective recultivation (bioremediation) of polluted oil hydrocarbons of soils in the whole area of the Apsheron peninsula.



**prof. M.M. Movsumzade**  
deputy director of Additions Chemistry of the The Azerbaijan National Academy of Sciences





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