DESIGN OF AUTOMATED HYDROCARBON FACILITY

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ПРОЕКТИРОВАНИЕ УСТАНОВКИ ПО ПЕРЕРАБОТКЕ И УТИЛИЗАЦИИ НЕФТЕПРОДУКТОВ

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Аннотация. *Современное развитие нефтяной отрасли предполагает наличие ресурсоэффективных технологий, которые базируются на технических, экономических и экологических принципах. Нарушение технологических режимов транспортировки углеводородов может привести к невосполнимым потерям природных ресурсов и нанести существенный экологический ущерб. Поэтому международные экологические стандарты ИСО 14000 предполагают повышенные виды ответственности к предприятиям, допустившим указанные нарушения. Тем не менее, нефтяные компании ежегодно несут серьезные финансовые затраты, связанные с аварийными или чрезвычайными ситуациями при транспорте нефти и нефтепродуктов. В связи с вышеуказанным, возникает необходимость в совершенствовании существующих и разработке новых эффективных и быстрореализуемых технологий локализации и утилизации нефтяных разливов.*

The modern development of oil and gas industry requires application of resource-efficient technologies which are based on technical, economic and ecological principles. The violation of hydrocarbon transport regulations could lead to irreversible losses of natural resources and result in significant environmental damage. That is why, international ecological standards ISO 14000 aim to persuade the companies to take more responsibility for violation of these regulations [1]. However, the number of oil and gas transportation accidents does not decline, and oil and gas companies annually have serious financial losses [2]. This proves the necessity to enhance and develop new effective and easy-to-apply technologies aimed at oil spill localization, elimination and further utilization.

The volume of spilled hydrocarbons to be utilized urges to develop efficient, reasonably priced, and ecologically safe technologies based on the various physical and chemical methods of separation.

Today, there are both foreign and Russian companies which are focused on oil spill elimination and further utilization and purification of oil and oil slurries. The reviews of the research literature reveals the most widely applied technologies, which have been developed by Russian companies (LLC «Avantage», LLC «Spetzautocom», ZAO «RusEcoProject») and foreign manufacturers (LLC «Alfa Laval», AG «MOG») [3-5].

The facility produced by Swedish company «Alfa Laval» has been chosen as one of the most successful decisions in terms of technical basis and cost efficiency. The main facility's characteristics are listed in Table 1.

All calculations were made per one month of facility operation, given that it was a five-day working week and 8-hour work day. The calculations involved the current prices for purification of liquid oil slurry that is a rather low-cost material, with the price being 1250 rub/m^3.

Table 1

"Alfa Laval" facility characteristics

Company	**Capacity**	**Price**	**Processing capacity**	**Methods of purification**
LLC «Alfa Laval»	45 kVt	13 000 000	9 m^3/hour	Phys-Chem-Bio
Price for a block	**Cost of operation (network)**	**Cost of operation (field)**	**Total profit**	**Payback period**
	34 560		1 800 000	7,5 month

The advantages of Swedish project are as follows: high utilization quality of any oil products, compliance with modern environmental standards, high reliability and technical support guaranteed by the manufacturer. However, the facility discussed has some limitations: impossibility of feedstock reprocessing due to high performance and need for consumables (filter cartridges and chemical reagents).

Having considered all the advantages and limitations of "Alfa Laval" project, the authors have made an attempt to develop a new facility within import substitution framework with due regard to the listed characteristic features.

Based on the calculations which involve the costs related to the proposed facility operated from different power sources, it has been revealed that one of the most effective methods to cut utilization cost is the possibility to carry out all works stationary. Depending on the operating conditions, autonomous field work will be 3-4 times more expensive (Table 2).

Table 2

Characteristics of the proposed project

Company	**Capacity**	**Price**	**Processing capacity**	**Methods of purification**
JSC «We»	15 kVt	1 545 200	2 m^3/hour	physical
Price for a block	**Cost of operation (network)**	**Cost of operation (field)**	**Total profit**	**Payback period**
300 000	11 520	47 232	400 000	4 month

Another main feature of the proposed project is an application of physical methods of purification. Unlike biological and chemical methods, the proposed project contributes to achieving the required level of source material (feedstock), as its structure remains constant. Therefore, it can be stated that the new project is resource efficient and it makes possible to partially reprocess the source material (feedstock) for further utilization (for example, for road pavement or building materials production, etc.)

It should be noted that the change of the Russian Federation towards industry development implies application of domestic details and components because of financial benefits. As a result, the project cost at the stage of facility assembly, as well as the cost of the final product could be significantly reduced with the little changes in quality level as opposed to Swedish and British analogues.

The authors have carried out the feasibility study in terms of short-term prospect (3 years) and long-term perspective (10 years) of the proposed project implementation including Swedish analogue if using only physical methods of reprocessing. The cost of one cubic meter of the product was 500 rubles. Among other possible expenses, only energy consumption was considered. Unlike "Alfa Laval" facility, the proposed solution has

obvious advantages in terms of short-term prospect as profit significantly exceeds the cost. Long-term perspective does not evidence any significant difference in profits (Table 3).

Table 3

Profit and work volume comparison for short- and long- term perspectives

Characteristics	**Alfa Laval facility (one installation)**	**Proposed facility (four installations)**
Performance (m^3/hour)	9	8
Expenses (facility assembly and energy, 3 years)	14 244 160 rubles	6 595 520 rubles
Total profit (3 years)	25 920 000 rubles	23 040 000 rubles
Volume of reprocessed materials (3 years)	51 840 m^3	46 080 m^3
Expenses (facility assembly and the energy, 10 years)	17 147 200 rubles	7 563 200 rubles
Total profit (10 years)	86 400 000 rubles	76 800 000 rubles
Volume of reprocessed materials (10 years)	172 800 m^3	153 600 m^3

The present study demonstrates the following:

- ✓ the proposed project is of low cost in comparison with European analogues;
- ✓ due to high mobility and small number of staff required to operate the facility (up to 3 persons including an operator), it is possible to eliminate oil spills in-situ which, in its turn, contributes to significant cost reduction as compared with the ex-situ methods;
- ✓ having a proper financing, the further development and serial production of the proposed facility will provide qualified specialists with new workplaces and contribute to addressing the issue concerning small local spills far from big refineries;
- ✓ the equipment performance is enough to utilize the wastes of a small refinery.

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