

DESIGN OF AUTOMATED HYDROCARBON PURIFICATION FACILITY MACHINE**A.A. Yurkin, V.A. Bokor, P.S. Haritonova**Scientific advisors associate professor N.V. Chukhareva, associate professor T.V. Korotchenko
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The oil industry's continued progress advances the application of resource-efficient technologies based on technical, economic, and environmental principles. The violation of the above principles generally causes the loss of irreplaceable natural resources and, as a result, environmental damage. Therefore, the international ecological standards ISO 14000 aim to persuade companies to take more responsibility for violation of these principles and regulations [1]. However, financial costs annually incurred by petroleum companies because of oil and gas transportation accidents do not decline [2]. This necessitates improvements in the existing technologies and development of new ones which would be effective in oil spill detection, elimination, and further treatment of oil sludge.

The treatment machine produced by Swedish company «Alfa Laval» has been chosen as one of the most highly positive examples [3-4] for oil sludge processing. The main characteristics of the machine are listed in table 1. All calculations were made per one month of machine operation given that it was a five-day working week and 8-hour work day. The calculations involved the current price for oil sludge treatment (1250 rub/m³).

Having considered all the advantages and limitations of «Alfa Laval» technology, the authors have made an attempt to develop a new machine within import substitution framework with due regard to the listed characteristic features (table 2).

Table 1

«Alfa Laval» machine characteristics

Company	Power	Cost	Processing capacity	Treatment methods
LLC «Alfa Laval»	45 kW	13 000 000	9 m ³ /h	Phys-Chem-Bio
Price for a block	Cost of operation (network)	Cost of operation (field)	Total profit	Payback period
N/A	34 560	N/A	1 800 000	7,5 months.

Table 2

Characteristics of the proposed machine

Company	Power	Cost	Processing capacity	Методы очистки
The proposed machine	15 kW	1 545 200	2 m ³ /h	Physical
Price for a block	Cost of operation (network)	Cost of operation (field)	Total profit	Payback period
300 000 - 450 000	11 520	47 232	400 000	4 months

Due to physical treatment methods, it has become possible to recover good quality oil from waste oil sludge, with its composition being the same. This cannot be achieved in other ways. Therefore, it can be stated that the proposed treatment machine is resource-efficient and it enables to partially reprocess waste oil sludge prior to reuse or disposal.

The authors have carried out the feasibility study in terms of short-term prospect (3 years) and long-term prospect (10 years) of the proposed machine implementation including Swedish analogue if using only physical methods of treatment (table 3).

Table 3

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

Parameters	«Alfa Laval» (1 machine)	Proposed machine (4 machines)
Processing capacity (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 processed material (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 processed material (10 years)	172 800 m ³	153 000 m ³

The most significant findings to emerge from this study are as follows:

- the proposed project is of low cost in comparison with European analogues;
- due to high mobility, small number of staff required to operate the machine and absence of consumables, it is possible to provide more cost-effective in-situ oil spill response as compared with the ex-situ methods;
- having a proper financing, the further development and serial production of the proposed machine will provide qualified specialists with new workplaces and contribute to addressing the issue concerning small local spills far from big refineries.

References

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