ҚАЗАҚСТАН РЕСПУБЛИКАСЫ БІЛІМ ЖӘНЕ ҒЫЛЫМ МИНИСТРЛІГІ
МИНИСТЕРСТВО ОБРАЗОВАНИЯ И НАУКИ РЕСПУБЛИКИ КАЗАХСТАН
MINISTRY OF EDUCATION AND SCIENCE OF THE REPUBLIC OF KAZAKHSTAN

АЛМАТЫ ТЕХНОЛОГИЯЛЫҚ УНИВЕРСИТЕТІ
АЛМАТИНСКИЙ ТЕХНОЛОГИЧЕСКИЙ УНИВЕРСИТЕТ
ALMATY TECHNOLOGICAL UNIVERSITY

ХАЛЫҚАРАЛЫҚ ТОҢАЗЫТУ АКАДЕМИЯСЫ
МЕЖДУНАРОДНАЯ АКАДЕМИЯ ХОЛОДА
INTERNATIONAL ACADEMY OF REFRIGERATION

VII ХАЛЫҚАРАЛЫҚ ҒЫЛЫМИ-ТЕХНИКАЛЫҚ КОНФЕРЕНЦИЯ «ҚАЗАҚСТАН-ТОҢАЗЫТУ 2017»

VII МЕЖДУНАРОДНАЯ НАУЧНО-ТЕХНИЧЕСКАЯ КОНФЕРЕНЦИЯ «КАЗАХСТАН-ХОЛОД 2017»

VII INTERNATIONAL SCIENTIFIC AND TECHNICAL CONFERENCE «KAZAKHSTAN-REFRIGERATION 2017»

Конференция баяндамаларының жинағы
15-16 наурыз, 2017 ж.
Сборник докладов конференции
15-16 марта 2017 г.
Proceedings of the Conference
March 15-16, 2017

Алматы, 2017

УДК 621.56/59(063)
ББК 31.392
К14

Сборник докладов подготовлен под редакцией
доктора технических наук, академика **Кулажанова Т.К.**

К14 Казахстан-Холод 2017: Сб. докл. межд.науч.-техн. конф. (15-16 марта 2017 г.) – Алматы: АТУ, 2017. – 285 с.

ISBN 978-601-263-389-4

В докладах представлены результаты теоретических и экспериментальных исследований, проведенных в Казахстане, Германии, России, Японии и Украине по следующим направлениям: холодильная техника и компрессоростроение, теплохладоснабжение, системы кондиционирования воздуха и жизнеобеспечения, экология в холодильной промышленности, холодильная и пищевая технология. Сборник рассчитан на специалистов и ученых, работающих в областях холодильной, пищевой, химической, нефтеперерабатывающей промышленностей, а также на специалистов по системам кондиционирования воздуха и жизнеобеспечения жилых, коммерческих зданий и спортивных комплексов.

УДК 621.56/59(063)
ББК 31.392

ISBN 978-601-263-389-4

UDC 62-14/-15, 62-16/-17, 62-169, 62-176, 621.5

ECONOMIC EFFICIENCY OF USE ULF EJECTOR SYSTEMS FOR THE OIL INDUSTRY

Zhikhareva N.[1], candidate of technical science., Khmelniuk M.[1], DcS (Engineering)., Bushmanov V.[1], post-graduate student., Butovslyi I.[1], post-graduate student., Kogut V.[1], candidate of technical science.
Institute of Refrigeration, crio-technologies, eco-energy, Odessa National Academy of Food Technologies, Ukraine

In the conditions of market economy, it is necessary to approach the choice of ways of reduction of losses of oil products taking into account not only the reached positive effect (in this case - reduction of emissions of hydrocarbons in the atmosphere), but also costs of production (acquisition) and operation of this means.

Considering feature of carrying out technical and economic calculations we will consider that the comparative economic efficiency of modernization of system defining for definition efficiency assessment as from the point of view of reduction of losses, and economic efficiency of means of modernization is. [1, 2, 7].

Some authors carry out technical and economic calculations at cost value of storage of one ton of oil products, and some - at cost value of storage of oil product in 1 m^3 operational tank volumes. At the same time:

$$\text{И}\quad C_н = \frac{E}{Q}, \quad C_p = \frac{E}{V} \tag{1}$$

where $C_н$, Cp – cost value of storage 1t of oil products, and oil products in 1 $м^3$ operational tank volumes respectively; E – operational costs in one year; Q – turnover of the tank in a year.

As cost value of storage is equal to the work of cost value of a unit of measure on quantity of such units, irrespective of a way of its calculation pay-back period (2) can be defined how:

$$T = \frac{K}{E_1 - E_2} \tag{2}$$

where K – the capital investments on modernization caused by the estimate; E1 and E2 – annual operational costs before modernization respectively.

Positive economic effect of application of ejector means of prevention of losses of oil product is reached only if expenses on prevention of losses of 1 t of oil product there is less its generalized cost.

Then define economic indicators of the compared tank equipped with means of reduction of losses from evaporation. Calculations carry out at storage of oil product of the same brand in the tank of the same capacity, as well as basic option.

Annual losses (3) gasolines from evaporation are equal to the sum of losses from small and big" breath", and calculate them behind the developed technique for each tank separately.

$$П_1 = xП_6 \tag{3}$$

where x – part of losses from the tank; capital costs:

$$К_1 = П_1 К_c + Ц_{м1} + 0{,}35Ц_1 \tag{4}$$

where K_1 – the accompanying capital investments consisting of expenses on mounting, transportation of system, uah; $Ц_{м1}$ – the cost of mounting of system of reduction of losses from evaporation (4-5% of the cost of system of reduction of losses), uah; $Ц_1$ – the cost of system of reduction of losses from evaporation, uah; K_c – the specific accompanying capital investments, UAH; they are calculated that for receiving 1 t of gasoline it is necessary to spend 5 t of crude oil.

Cost value of storage of gasoline in the reservoir equipped with system of reduction of losses (5) is calculated by a formula:

$$C_p^п = \frac{E_1}{V_{rz}} \tag{5}$$

Term of payback:

$$T_1 = \frac{K_1}{E_6 - E_1} \tag{6}$$

In market conditions as criterion of efficiency of investment projects of reduction of losses of oil (gasoline) from evaporation the size of the net discounted income of LCC calculated by a formula (7) is used:

$$LCC = \sum_{t=0}^{t_C} \frac{P_t - З_t}{(1+E)^t} \tag{7}$$

where Pt – cost assessment of results of implementation of the project in t-m to year;

3t – cost assessment of full costs of implementation of the project in t-m to year;

E – discount;

t_c – period of service of the project.

Implementation of the project in t-m to year the sum of cost of the saved gasoline is result, of reduction of a payment for environmental pollution, expenses in the adjacent fields of the industry, and also assignments for depreciation and running repair.

Full costs of implementation of the project in t-m consist to year of the capital investments of Kt, assignments made in it on running repair and costs of the consumed electric power:

$$З_t = K_t + Эл_t + Э_{тр} \cdot K_{ct} \quad (8)$$

The best hardware components of reduction of losses should provide the largest size LCC.

The size of rate of discount of E is defined by the rate of inflation, and also some other factors. Now size E is, as a rule, equal to 0,1-0,15.

If when calculating for disks of reflectors, a gas binding and pontoons it is enough to know turnover coefficient, type of the reservoir and remaining period of its service, then for calculation of capital investments and operational expenses for the ULF ejector system it is necessary to know:

- number of petrol reservoirs;
- duration of its work within a year;
- N capacity consumed by the pump;
- the price 1 kW/h the consumed electric power, and the cost of 1 kW of installed capacity.

Calculation was carried out for the installation working with tanks of the big sizes (RVS-1000, RVS-2000, RVS-3000, RVS-5000 and RVS-10000) for LLC NPIK "Zirka" in the city of Zaporizhya.

Monthly on oil depot of capacity 2 times are filled and at the single gulf of loss on the squeezed-out steam (as a result of evaporation) make about 5,000 liters of high-octane gasoline.

By the carried-out calculations, capital investments in the ULF ejector system for tank farm with the existing turn make $ (US dollars) 152 thousand. In this sum expenses on design of system, acquisition and production of the necessary non-standard equipment, and also operational costs have been considered during the installation work. Market costs of liquid nitrogen are much lower than the cost of hydrocarbons, in particular gasoline. Results of experiments have confirmed relevance of use of nitrogen and carbonic acid for cooling of a flow of mix of air with hydrocarbons in the heat exchanger the ejector, for condensation of hydrocarbons of different brands of gasolines, bioetalny and diesel fuel, and then their divisions.

When conducting pilot studies tasks of the analysis of influence of various factors on the end result, namely temperature and an expense of a gas phase, temperature of a fluid phase, separation pressure, pipeline length after the ejector were also set.

At increase in temperature of oil products, as well as in all other cases, direct dependence of size of extent of catching on the influencing factor is not observed. It is connected first of all with the fact that extent of catching is influenced by not one specific parameter, but all parameters in a complex.

At pressure increment of separation, temperature in gas space of the reservoir and reduction of temperature of working fluid (nitrogen) extent of catching in EULF increases.

By the stated above technique calculation of extent of catching of steam-gas mix with nitrogen is made under conditions of conducting pilot studies. By results of this calculation comparison of theoretically received extent of catching and extent of catching received as a result of experiments was carried out. The final result is provided in table 1.

Table 1 - Comparison of extent of catching

Number of an experiment	1	2	3	4	5
Extent of catching actual	0,98	0,575	0,931	1,000	0,968
Extent of catching rated	0,836	0,739	0,935	0,912	0,896
Number of an experiment	6	7	8	9	10
Extent of catching actual	0,765	0,121	0,559	0,947	0,784
Extent of catching rated	0,488	0,263	0,536	0,870	0,560
Number of an experiment	11	12	13	14	15
Extent of catching actual	0,314	0,434	0,876	0,690	0,257
Extent of catching rated	0,310	0,09	0,787	0,590	0,244
Number of an experiment	16	17	18	19	
Extent of catching actual	0,838	0,842	0,383	0,740	
Extent of catching rated	0,342	0,810	0,193	0,678	

In the conditions of oil depots, as a rule, use of the ULF ejector systems is more preferable, than other hardware components of reduction of losses. Comparison of experimental data with the carried-out theoretical calculations shows that the absolute error by the most problem experiences does not exceed 12.8%.

The ULF ejector system is intended for reduction of losses of gasoline, both at big, and at small "breath".

Use of systems with the ejector heat exchanger for catching of the easily boiling vapors of hydrocarbons on oil depots will allow to protect effectively a circumambient from pollution by evaporation of vapors of oil products.

Efficiency of use of the ULF ejector system out of competition, especially at connection to the ULF ejector system of several big reservoirs with gasoline, from 5 and more. Reduction of rate of discount to 0,1 and residual service life of reservoirs up to 5-10 years on oil depots by all means leads to expansion of a scope of the ULF ejector systems.

Process of a mass transfer of hydrocarbons of a gas phase in liquid takes not enough time, and at design of ejector system of catching of light fractions there is an opportunity to refuse big installations and to cut down expenses on a construction.

Use of these systems on oil depots is more preferable and it is economically reasonable, than other circuit solutions of reduction of losses. This circuit decision has indisputable advantages: compactness, a possibility of transportation to different reservoirs (mobility) that leads to essential economy of capital investments at a stage of its implementation and operation due to power saving. Also because of minimization of need for human work and increase in reliability of system, use of the majority of means of reduction of losses of gasoline from evaporation becomes economically inexpedient.

REFERENCES

1. Methodical recommendations about efficiency evaluation of investment projects and their selection for financing. - M.: NPKVC "TerInvest", 1994. – 87p.

2. Modeling of technology of trade preparation of oil / N. V. Usheva, A. Kravcov, O. Mojzes, E. Kuzmenko // College's news - 2005. - Vol. 308, № 4 - p. 127-130.

3. Kogut V., Khmelniuk M. Questions of safety during the transporting and storage oil products / Book of abstracts VII International scie-technical conference "Foreign problems of refrigeration technics and technology", Odessa, 2011p. c.102.

4. Arenbrister V. Technical-economic analysis of losses of oil. - M.: Chemistry. -160p.

5. Patent of Ukraine No. 92555 for the useful model "Installation for condensation of hydrocarbons in a flow».

6. Patent of Ukraine No. 92548 for the useful model "Way of Steam Condensation of Hydrocarbons".

7. Korshak A. A. Forecasting of extent of catching of vapors of gasoline when using ejector system of catching of light fractions//Transport and storage of oil and oil products: Books of scientific researches. Ufa. 2014. Vol.12, №4. p. 61-70.

8. Standard calculations at design and operation of oil depots and oil pipelines / Tugunov P., Ufa: LCC "DesignPoligraphService", 2008.- 658 p.