

condensate purifying and returning, filling filter,  
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## **THE INDUSTRIAL WATER EXPENSES DECREASE UNDER NEW TECHNOLOGIES INTRODUCTION AT THE RAILWAY TRANSPORT ENTERPRISES**

**Summary.** The article is related to ecologization for the enterprises of railway branch. The usage of purified water from compressed air cooling elements of the depot pneumatic system is suggested.

## **УМЕНЬШЕНИЕ РАСХОДОВ СВЯЗАННЫХ С ИСПОЛЬЗОВАНИЕМ ПРОМЫШЛЕННОЙ ВОДЫ НА ПРЕДПРИЯТИЯХ ЖЕЛЕЗНОДОРОЖНОГО ТРАНСПОРТА**

**Аннотация.** В статье рассматриваются вопросы экологизации предприятий железнодорожной отрасли. Предложены схемы возврата очищенного конденсата в систему оборотного водоснабжения депо.

Water resources play an important role in providing stable social and economic development of the Russian Federation. Population health conditions, country economical formation at a considerable extent depend on presence and quality of water resources, it's complex rational usage and protection.

Water is one of the most important factors determining productive forces placing and very often means of production. The industrial water consumption increasing is connected not only with its fast growth, industrial unit production consumption increasing, but irrational usage in industrial cycles, absence of ecologically substantiated technologies of worked off industrial water as well.

The Russian Federation railway branch carries out not only mass cargo and passenger transportation, but produces different kinds of products. It is the most "clean" branch of the transport complex of the country. Still it considerably consumes water in many ways. The example structure is given at fig. 1.

Except for imposing purifying water consumption volumes for industrial needs the branch enterprises make considerable sewage water escape not always purified according to the norms. In this connection the company has worked out plan "Ecological safety providing". On the one hand its realization has allowed to carry out systematic escape decrease of non-refined water and to decrease annual water consumption by 10 %. On the other hand it has allowed formulating the following goals:

- to abolish the water escape without purifying to surface reservoirs, municipal sewerage systems;

- to decrease on 35% non-refined water escape to surface reservoirs;
- to increase industrial water turnover up to 75% [1].

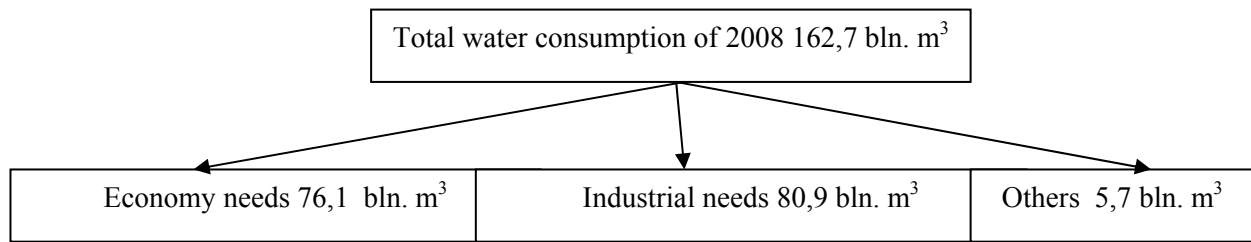


Fig. 1. Open JSC “RZD” water consumption example structure

Рис. 1. Примерная структура водопотребления ОАО «РЖД»

The last obligation of ecological programme realization by the open JSC “RZD” forces to search non-traditional delivery sources of the most valuable nature resource – water and technologies of its purification up to requirements “Industrial water”. Such works were held out at the laboratory of the RSUTC under realization of the compressed air drying project for technical service point (TSP) “Sever” of the Bataisk station. The pneumatic system length is 235,7 m. The typical processes occurring along the compressed air motion from compressor to breaks charging and approbation device is the heat exchange with the environment, accompanied by moisture condensation and its discharging on the relief.

Daily compressed air average production is 528 m<sup>3</sup>. The daily average air temperature changing during the warm period of year is from 20 to 30 °C and average moisture content changing is from 16 g/kg up to 40 g/kg. For the cold period of year the mentioned above parameters are from 3 to -10 °C and from 2g/kg to 18 g/kg.

In table 1 below the condensate volumes from compressed air under minimal and maximal expense are given depending on the environmental temperature for the average relative humidity.

In such a way it’s clear that the depot necessities of the technical water coverage can be realized by 10 - 15% by water “out of air”. The main limitation for application of the mentioned above received condensate is compressor oil. The fig. 2 shows the received water volume from atmospheric air dependence under minimal and maximal compressed air expense.

Water volume, l

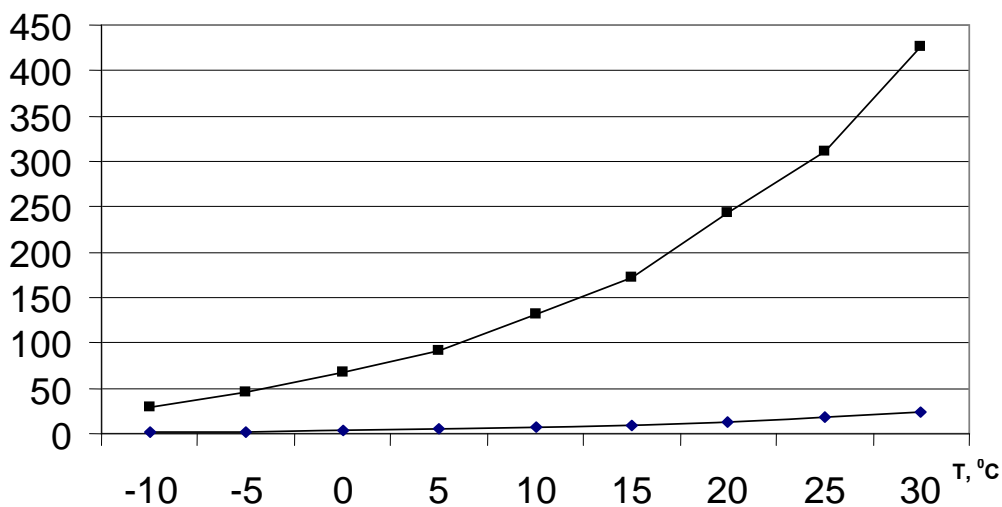


Fig. 2. The received water volume from the atmosphere air under: 1– minimal compressed air expense per day, 2–maximal compressed air expense per day

Рис. 2. Объём воды, получаемый из атмосферного воздуха при: 1–минимальной расходе сжатого воздуха в день, 2–максимальном расходе сжатого воздуха в день

Table 1

The moisture volumes received dependence on the environmental temperature under the minimal and maximal compressed air expense at depot

Environmental temperature, °C	The received from atmospheric air water volumes under minimal compressed air expense, l/day	The received from atmospheric air water volumes under maximal compressed air expense, l/day
1	2	3
-10	1,8	30
-5	2,5	45
0	3,83	68
5	5,1	92
10	7,5	132
15	9,72	172
20	13,6	243
25	18,2	311
30	24	427

The given dependences analysis shows the medium received water value volume under the minimal compressed air expense and the atmosphere air temperatures from -10 °C to 30 °C is 9.58 l/day and the medium value of the received water volume under the maximum compressed air expense is 168.88 l/day (for the same atmospheric air temperatures and relative humidities diapason). Having applied the golden section rule we receive the medium received water value during the moisture condensation – 117.91 l/day [1].

Hence, the received water volume for industrial cycle usage should be purified and directed to industrial needs. In connection with this the RSUTC scientists suggest two schemes of water collecting, purifying and returning into the system of depot water turnover:

- using filters with filling;
- non-using filters with filling.

The filling filter scheme application is connected with the waste appearance problem, its utilization and it complicates the purifying scheme by a filling regeneration element as well. However, the scheme usage gives a higher condensate purifying degree. The fig. 3 shows the condensate purifying scheme including filling filter [2].

According to the given scheme the collected condensate contains oil and mechanical inclusions. It is directed to cascade precipitators 1 consecutively connected, then sand and gravel filter 4, pump 5, a volume for purified condensate accumulation and its returning to the wagon depot water turnover system. Oil emulsion drainage is realized throughout volume 2, given on fig. 3 [3].

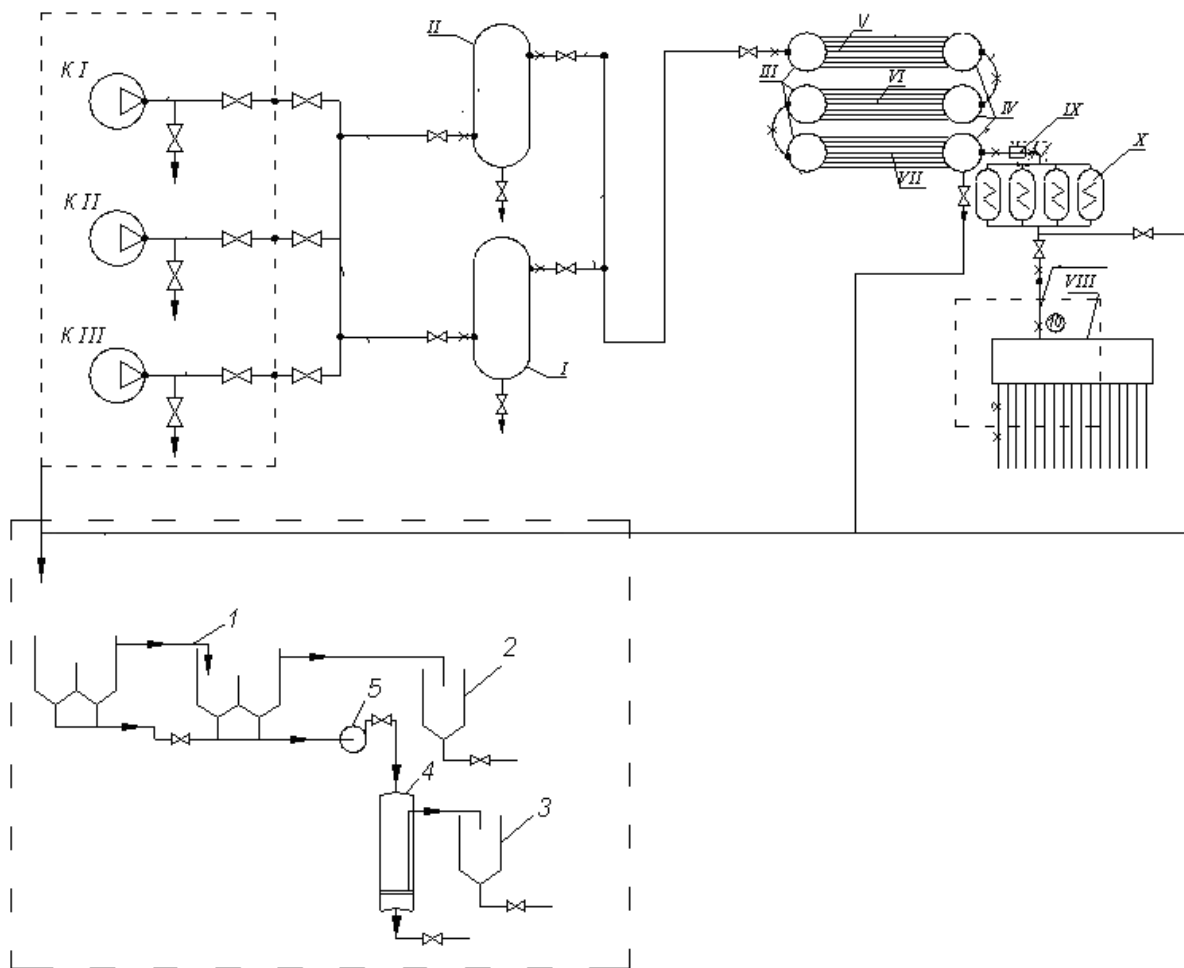


Fig. 3. The condensate purifying and returning scheme to the system of wagon depot water turnover. I, II, III, IV – Reservoir-cooler; V, VI, VII – connecting pipes; VIII – Y3OT (Breaks charging and approbation device); IX – throttle, X – jalousie separators system; K1, K2, K3 – compressors

Рис. 3. Схема очистки и возврата конденсата в систему оборотного водоснабжения вагонного депо. I, II, III, IV – Резервуар – охладитель, V, VI, VII – соединительные трубы, VIII – УЗОТ (устройство зарядки и опробования тормозов); IX – дроссель, X – система жалюзийных сепараторов, K1, K2, K3 – компрессоры

The second suggested variant of the collected condensate contains combined pneumatic and flotationing machine with unit final purifying. It can be included to the scheme in the case of higher requirements to the quality of the recycling water.

Often the purified water quality after the floating machine is quite enough for usage in the closed technological systems as oil concentration doesn't overcome 1-2 mg/l [4].

The principal sewage water purifying from oil and precipitated fractions is given at the fig. 4.

The suggested purifying scheme includes devices and apparatus for physical and mechanical water purification. The collected condensate flows itself in sloping chute to 3 sections of the sand collector (if the sewage water doesn't have suspended fraction overcoming maximum allowed concentration the apparatus can be excluded of the scheme). The precipitated suspended fractions are periodically removed out by a plunge pump 4. From the dirty water reservoir the sewage water is directed by the pump 3 to the dirt and oil collector where occurs the thin dispersion catch and particular removing oil from water. The precipitant accumulates at the bottom and periodically removes to the collector 6 under dirt and oil collector.

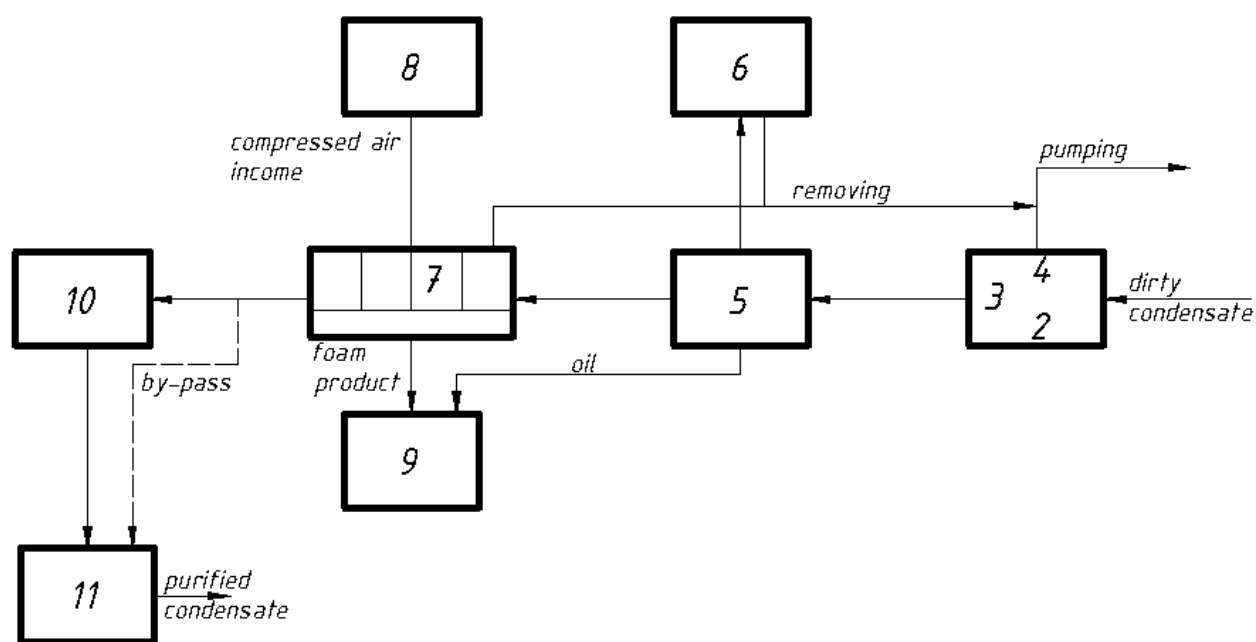


Fig. 4. The sewage water purification from oil and oil products principal scheme: 1 – sand collector, 2 – dirty water reservoir, 3 – drain pump, 4 – precipitation pump, 5 – oil collector, 6 – drain collector, 7 – pneumatic floating machine, 8 – compressor, 9 – foam product collector, 10 – post filter, 11 – clean water reservoir

Рис. 4. Принципиальная схема очистки сточных вод от масла: 1 – песчаный коллектор, 2 – резервуар грязной воды, 3 – дренажный насос, 4 – погружной насос, 5 – маслосборник, 6 – дренажный сборник, 7 – пневматическая флотомашина, 8 – компрессор, 9 – пеносорбник, 10 – постфильтр, 11 – резервуар чистой воды

The pre-cleaned water flows to pneumatic floating machine. At the floating machine chambers perforated rubber aerators are installed. The compressed air flows through them. The foam product goes to chute and then to foam product collector 9 located under the floating machine. The same way waste products caught in oil snare are removed to foam collector. The purified sewage water in the case of final cleaning necessity can be directed to non-headed coal filter for deeper purification from oil and weighed substances. Before the filter a water pace filtering regulating valve is installed. Out of the final cleaning filter water goes to reservoir for clean water 11. According to the necessity it goes further to industrial needs.

In such a way the suggested technology of mechanical compressed air drying with the usage of throttle effect thanks to utilization and purifying condensate allows:

- to rise the coefficient of depot ecology by usage decreasing of such an important natural resource as water ( $41,26 \text{ m}^3$ );
- to shorten irrational usage of water resources;
- to decrease financial expenses of enterprise on 1238000 roubles per year;
- to decrease volumes of water utilization for industrial needs.

## References

1. Риполь-Сарагоси Л.Ф.: *Осушка сжатого воздуха в пневмомагистралях УЗОТ ПТО вагонных депо*, Вестник РГУПС, №1 (29), 2008, с.18-22.
2. Балон Л.В., Шатихина Т.А., Щавинский И.Ю.: *Загрязнение окружающей природной среды при работе вагонного депо*. РГУПС, Ростов-на-Дону, 2005.

3. Жабо В.В.: *Очистка технологических и сточных вод от нефтепродуктов*. Промышленная экология, №3 (8), 2005, с. 40-42.
4. Цховребов Э.С.: *Охрана окружающей среды на железнодорожном транспорте*. Космосинформ, Москва, 2006.

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