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Сборник рассчитан на специалистов и ученых, работающих в областях индустрии холода, пищевой, химической, нефтеперерабатывающей промышленности, а также гостиничном бизнесе и спортивных комплексах.

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## IT ARE SCIENTIFIC - THE TECHNOLOGICAL FUNDAMENTALS OF MAKING OF EJECTOR HEAT EXCHANGERS AND APPLICATION IN DIFFERENT SYSTEMS ARE MORE THEIR

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The cost efficiency of the industry us the heat-exchange units depended on qualitative usage of heat exchange and capital investments in these apparatus, also from a running cost.

In technical publications even more often there are a new term "an ejector heat exchanger" in which one construction introducing of the jet device are necessary. Jet devices were prime enough in a construction has worked without a direct expenditure of a mechanical energy.

In a technical publications for are more such than apparatus often used two terms: an ejector (from an armour. *ejectio* - I deletes) if it usage are intend for removal of a steam (gas) of or a fluid outside from bulk (vessel), and the working jet (flow) of are from the outside; and an injector (from an armour. *injecio* - I throws in) if a steam the bulk (gas) of or a fluid are push into bulk (vessel) of by means of a working jet out of the same bulk.

In a basis of process of work of these heat exchangers of ejector contact heat exchange between steam and a liquid are assume.

The principle of such heat exchange in the apparatus is carry out on the basis of mixing of steam and a liquid or on the contrary, sometimes there are a change of phase, and in certain cases are not present. Steam and a liquid could be one substance then the further separation it is not required. Steam and a liquid could be from various substances where after heat exchange it is necessary to spend additional separations of a mix.

For components participate in heat exchange from one substance most important phenomena in this process are a frontal resistance of drops, transpiration, friction about walls of the channel and condensation from a main stream. Though these phenomena were manifest simultaneously, nevertheless there is a predominance of each of them on the part of observing process.

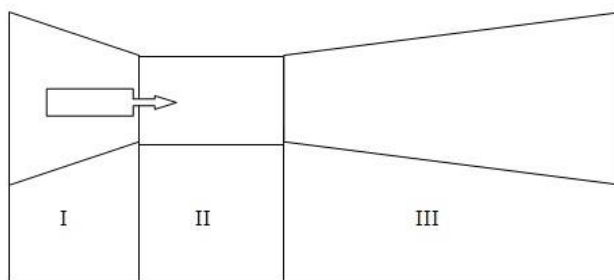


Figure 1 - Distribution of zones on length of the heat exchanger-ejector

Zone I. Accelerations of a gas stream consist of air and steams easily - boil liquids, at the expense of cotraction of the confuser (preparation for contact heat exchange).

Zone II. Active contact heat exchange between a main stream of gas and an inject liquid (instant cooling of gas).

Zone III. A retardation of a stream and condensation of a liquid from a gas mix (air of hot, and a liquid it are considerably overcool)

The estimation of each factor is necessary for qualitative analysis of process pass in the apparatus.

To the basic signs it is possible to spend classification the heat exchangers ejectors. It are conditionally possible to observe three systems in whom heat exchanger- ejector (clos, half-open and open) on the relation with a circumambient.

### Classification of application of heat exchangers-ejector in different systems

The systems us ejector heat exchangers, it are possible to classify on traffic of the basic and auxiliary streams, and high-speed characteristics in relation to a sound velocity.

Table 1 - Classification of the systems work on the basis of heat exchangers-ejector

Systems	Industrial title of the apparatus	Processes in a confusor Speedup of a main stream	Processes in the mixing chamber or evaporations	Processes in a diffuser Inhibition to initial velocity or smaller	Processes in a sprayjet
Shut systems	Termopressor - an intercooler	Speedup of a main stream (steams of ammonia)	The instantaneous heat exchange from merging and evaporation of ammonia	Inhibition of a main stream (steams of ammonia)	Shallowly dispersible raspyl (liquid ammonia)
	End coolant - a refrigerator set	Speedup of a main stream (steams of ammonia)	The instantaneous heat exchange from merging and evaporation of ammonia	Inhibition of a main stream (steams of ammonia)	Shallowly dispersible raspyl (liquid ammonia)
Semiopen systems	The thermocapacitor - a hydrocarbon	Speedup of a main stream (air mixture with steams of a hydrocarbon)	The instantaneous heat exchange from merging and evaporation of nitrogen or Carboneidioxydum and condensation of a hydrocarbon	Inhibition of a main stream (air mixture and pool hydrocarbon)	Shallowly dispersible raspyl (liquid nitrogen or Carboneidioxydum)
	Ejector - the screen of flue gases	Speedup of a main stream (air mixture with flue gases)	The instantaneous heat exchange from merging and evaporation of nitrogen or Carboneidioxydum and condensation of builders of flue gases	Inhibition of a main stream (air mixture with the condensed flue gases)	Shallowly dispersible raspyl (liquid nitrogen or Carboneidioxydum)
Open systems	Ejector - the air humidifier in a heat-treatment chamber	Speedup of the main cooled air flow	The instantaneous heat exchange from merging and an evaporation of water humidification of air	Inhibition of a main stream of a humidified air	Shallowly dispersible raspyl Cooling water
	Ejector - snow - the generator	Speedup of the main cooled air flow	The instantaneous heat exchange from merging and a solidification of water and formation of snow	Inhibition of a main stream of air and snow	Shallowly dispersible raspyl Cooling water
	Ejector - an air cooler in a band of a bench	Speedup of a main stream of air	The instantaneous heat exchange from merging and an evaporation of water	Inhibition of a main stream of air	Shallowly dispersible raspyl Cooling water
	Ejector water-cooling tower	Speedup of a main stream of air	The instantaneous heat exchange from air and refrigeration of water	Inhibition of a main stream of air and compartment of cooling water	Shallowly dispersible raspyl of water

Classification on driving of the main and auxiliary flows and speed regulation characteristics in relation to a speed of sound

It is possible to classify systems us ejectors heat interchangers on to phase change main and auxiliary flows.

Table 2 - Classification on driving of the main and auxiliary flows

Coolantsystems (heatexchange)	Flow rate in ChisloMakhaMayevskogo mixing chamber	Drivingof a mainstream	Driving of an auxiliary flow
Termopressor - anintercooler	M=0.3	Ejectorheatinterchanger (refrigeration)	sprayjet
End coolant - a refrigerator set	M=0.3	Ejectorheatinterchanger (refrigeration)	sprayjet
The thermocapacitor - a hydrocarbon	M=0.3	Ejectorheatinterchanger (condensation)	sprayjet
Ejector - the screen of flue gases	M=0.3	Ejectorheatinterchanger (condensation)	sprayjet
Ejector - the air humidifier in a heat-treatment chamber	M = (0.1-0.3)	Ejector heat interchanger (refrigeration and humidification)	sprayjet
Ejector - snow - thegenerator	M = (0.1-0.3)	Ejector heat interchanger (refrigeration and snegoobrazovaniye)	sprayjet
Ejector - an air cooler in a band of a bench	M = (0.1-0.3)	Ejectorheatinterchanger (refrigeration)	sprayjet
Ejectorwater-coolingtower	M = lessthan 0.1	Sprayjet (refrigeration)	Ejectorheatinterchanger

Classification on to phase change in ejectore heat interchangere main and auxiliary flows.

In engineering calculations the dependences gain as a result of experimental data and blind carrying over on various aspects of apparatuses, did not lead to optimum maintenance and hid reserves of the g device. An important problem in calculations is correctly to define traffic of the main and auxiliary stream.

The design procedure of the ejector-heat exchanger was bas on the equations of thermal balance. Important parameters for calculation of the ejector-heat exchanger are the volume maintenance of steams of substance in a mix, ambient temperature and working substance (the chill hydrocarbons; carbonic acid; inert gas nitrogen, aspect of a liquid).

At the heart of constructive calculation of the ejector-heat exchanger definition of diameters of the apparatus, lengths of zones and angles of inclinations of the confuser and the diffusor lay. Optimum angles of inclinations of elements of ejector experimentally:

The confuser – 45C°; the Diffusor - 10÷12 C°;

Diameter of the chamber of transpiration-Dchamber = D<sub>e</sub>/2;

where D<sub>ej</sub>-diameter of ejector (paid off dependences on speed of a stream of 20-25 km/s and productivity. For maintenance of speed of a stream M=0.1-0.3 in the chamber of transpiration.

Depth of the room of transpiration - L = 2÷4D<sub>chamber</sub>

Optimum size for good mixing of streams and instant heat exchange.

Length of the diffusor - L = 7÷9 D<sub>chamber</sub>

Optimum size for a retardation of a stream and fall

The injector could be any design, provide necessary productivity and support speed of a plume 50 - 100M/with.

Table 3 - Classification of flows by change of phase

Coolantsystems (heatexchange)	Phasechangemainstream	Phasechangeauxiliaryflow
Termopressor - anintercooler	Withoutphasechange	Fluidsteam
End coolant - a refrigerator set	Withoutphasechange	Fluidsteam
The thermocapacitor - a hydrocarbon	Steamfluid	Fluidsteam
Ejector - the screen of flue gases	Par-zhidkost-tverdoyevshchestvo	Fluidsteam

Ejector - the air humidifier in a heat-treatment chamber	Without phase change	Without phase change
Ejector - snow - the generator	Fluid - solid matter	Without phase change
Ejector - an air cooler in a band of a bench	Without phase change	Fluid steam
Ejector water-cooling tower	Without phase change	Without phase change

Classification on transiting in ejector exchanger main and auxiliary flows

For problem solving of projection of ejectors of heat interchangers indispensably:

- formalization of the task and algorithm elaboration of control by calorific effectiveness of a heat interchanger of an ejector;
- development of phonological and mathematical models of a heat interchanger of an ejector also are more their identification with plants controls;
- assaying of calorific effectiveness of heat interchangers of an ejector, development and implementation of optimal alternatives.

There is still in some systems an application of an ejector of a heat interchanger, but in these classification devices in whom the author of a paper accepting involvements in development was display.

Table 4 - Classification of streams by transiting to ejector heat exchanger

Coolant systems (heat exchange)	Driving of a mainstream	Driving of an auxiliary flow
Thermopressor - an intercooler	Ejector heat interchanger (refrigeration)	sprayjet
End coolant - a refrigerator set	Ejector heat interchanger (refrigeration)	sprayjet
The thermocapacitor - a hydrocarbon	Ejector heat interchanger (condensation)	sprayjet
Ejector - the screen of flue gases	Ejector heat interchanger (condensation)	sprayjet
Ejector - the air humidifier in a heat-treatment chamber	Ejector heat interchanger (refrigeration and humidification)	sprayjet
Ejector - snow - the generator	Ejector heat interchanger (refrigeration and snegoobrazovaniye)	sprayjet
Ejector - an air cooler in a band of a bench	Ejector heat interchanger (refrigeration)	sprayjet
Ejector water-cooling tower	Sprayjet (refrigeration)	Ejector heat interchanger

Ejectors in the capacity of jet devices had wide application in various industries - chemical, ecological, and also in refrigerating industry. Heat exchangers ejectors possessed a simple construction and high reliability. Ejectors worked without escapes, interferences, done not need inspection and possessed in this connection high manufacturing security.

Usage of an ejector of a heat exchanger are capable to solve the task of the industry on remainance of a hydrocarbon at storage, and specially in transit of oil products, and as at a flood from a capacity in a capacity. The ejector a heat interchanger by means of mixture of oblate cooled air and finely divided water droplets surfaced half carcasses. Padding concern called formation of finely divided ice at interplay of mixture of a compressed air and water droplets when escaping a diffuser - an ejector of a heat exchanger, with air of the low temperature, circulate in a cold storage room. Receivable finely divided crystal ice could find the application in a broad spectrum of tasks. The heat interchanger ejector could be applying to a refrigeration of meat stock heaps.

Application of systems with the screen on the basis of an ejector of a heat exchanger allowed leading scrubbing action of flue gases, almost completely to save a flow of flue gases, from pollutants of bunch of carcinogenic agents. Such necessity originated in view of passage to low-quality combustibles, and high percent of ejections at the moment of unstable states of operation of boiler plants.

In the modern industry it is necessary to bolster comfortable air temperature on a work place. There were many various methods of keeping up of air temperature (a positive-pressure ventilation, conditioning and refrigeration). However all these methods were feebly effective on work places with a heat. It is necessary to apply zonal refrigeration of air of a band in which one the worker is. In the core the directional air flow, blast a work place.

The solution of this problem is possible with application of installation with an ejector - a heat interchanger. Refrigeration of air are carried out at the expense of injection of finely divided water droplets in the distill air flow in an ejector - a heat exchanger.

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### СТАБИЛИЗАЦИЯ ЗЕМЛЯНОГО ПОЛОТНА ЦЕНТРАЛЬНОГО УЧАСТКА БАМ С ПОМОЩЬЮ СОЛНЦЕОСАДКОЗАЩИТНЫХ НАВЕСОВ

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Центральный участок БАМ Наледный – Хани обслуживается Новочарской дистанцией пути Восточно-Сибирской железной дороги. Пересекает с запада на восток Чарскую котловину и хребты Кодар (тоннелем длиной 1,98 км) и Удокан. Повсеместно развиты многолетнемерзлые породы (ММП), нередко содержащие сегрегационный, инъекционный, погребенный и полигонально-жильный лед. Талики приурочены к руслам рек и днищам глубоких озер, а также местам разгрузки подземных вод глубокой циркуляции.

Эксплуатационная (экспл.) длина ж.д. пути составляет 217,886 км, земляного полотна – 210,352 км. По данным на 01.01.2016 г. на участке имеется 140 мест с конструктивными дефектами протяженностью 4,77 км (2,27% от экспл. длины участка) и 142 мест с деформациями земляного полотна (ДЗП) протяженностью 57,38 км (27,28% от экспл. длины участка).

Конструктивные дефекты земляного полотна с нарушениями крутизны откосов 7 мест - 0,27 км (5,66% от дефектов), ширины по верху 133 мест - 4,50 км (94,34% от дефектов). Для восстановления очертаний земляного полотна требуемый объем досыпки скального грунта – 28667 м<sup>3</sup>, в т.ч. в местах с нарушениями, крутизны откосов 1650 м<sup>3</sup> (5,76% от дефектов), ширины по верху 27017 м<sup>3</sup> (94,24% от дефектов). Дефекты с нарушениями ширины по верху развиты в выемках 12 шт - 0,364 км (8,09% от зауженных обочин) и на насыпях 121 шт – 4,136 км (91,91% от зауженных обочин). Всего с дефектами и деформациями 282 места протяженностью 62,15 км (29,55% от экспл. длины участка), в т.ч. осадки 123 места - 46,66 км (22,18% от экспл. длины участка, 75,08% от дефектов и деформаций, 81,32% от деформаций земляного полотна).

За период с 2005 по 2015 гг. количество больных мест увеличилось в 1,42 раза, суммарная протяженность – в 2,11 раза. Деформативность земляного полотна возросла в основном вследствие деградации многолетнемерзлых пород в его основании. Так, если на 1.01.2005 г. было 80 таких мест общей протяженностью 16,14 км, то на 01.01.2016 г. насчитывалось уже 123 места общей протяженностью 46,66 км (81,32% от всего количества ДЗП). За 11 лет количество таких больных мест земляного полотна увеличилось в 1,54 раза, а их протяженность – в 2,89 раз.

Установленная скорость движения поездов в пределах Новочарской дистанции пути ВСЖД – 60-100 км/час. Однако на участках деформаций земляного полотна с осадками пути скорость движения часто ограничивается до 40 км/час иногда до 25 км/час, что требует применения дополнительных компенсационных мероприятий для обеспечения безопасности движения поездов с установленными скоростями, затраты на которые с каждым годом возрастают. Для обеспечения