

# THE GRANULAR SORBENTS FOR PASSIVE ENVIRONMENT PROTECTION SYSTEM DURING SEVERE ACCIDENTS WITH TOTAL LOSS OF POWER SUPPLY AT NPPs

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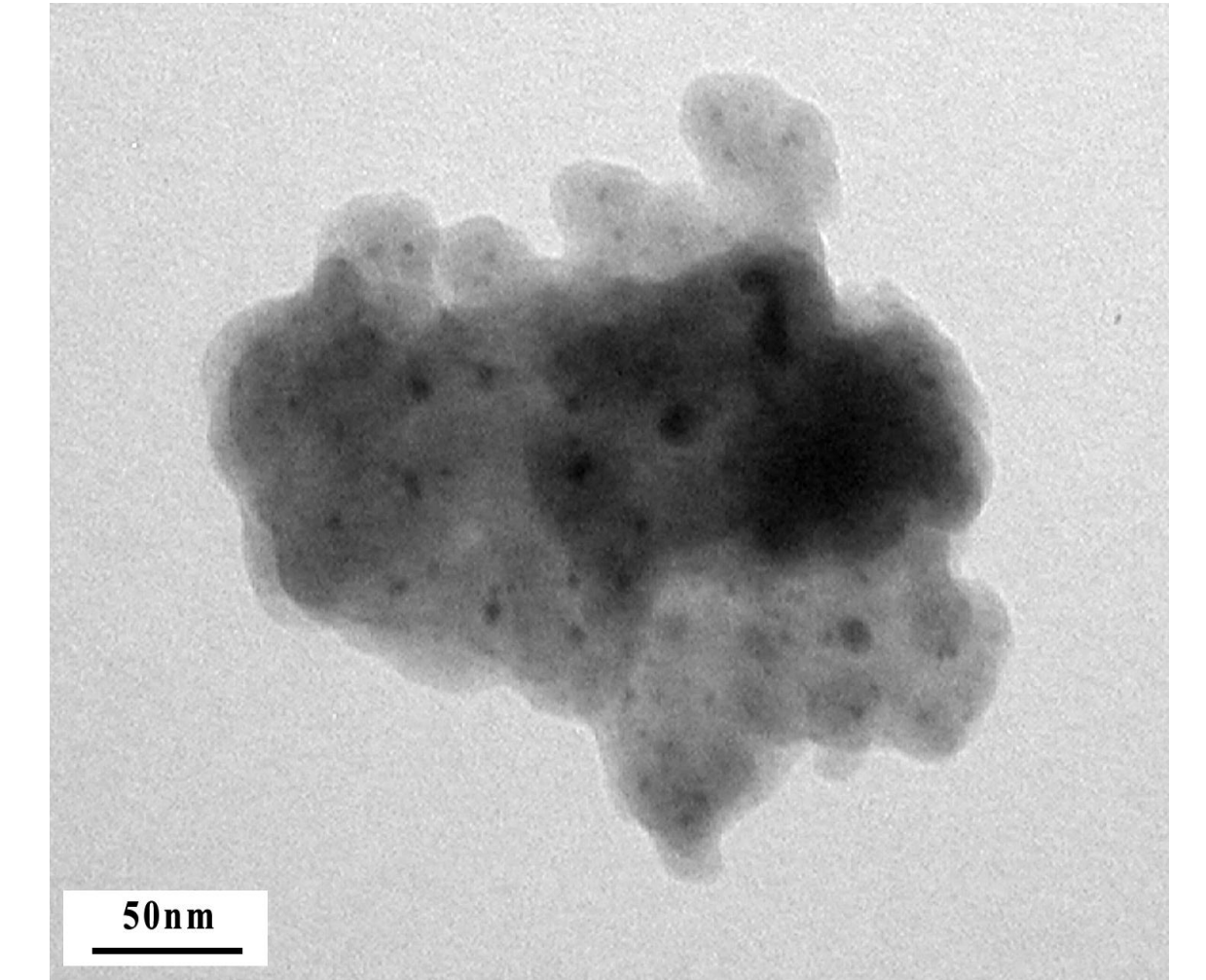
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On the basis of fundamental researches on localization of molecular and organic forms of radioactive iodine from a steam-air flow in operating conditions of passive filtering system during severe accidents the granulated sorbents "Fizkhimin"™, containing particles of Ag or Ag-Ni compounds with nanometric sizes, were selected for given filtering module. The granulated sorbent "Fizkhimin"™ represents silica impregnated by Ag or Ag-Ni and modified on technique of IPCE RAS. The sorbent is issued as several types and represents granules of dark color with the sizes of particles 0.5-6.0 mm. The studies of sorbent properties have shown, that it radiationally stable at a dose 500 MRad and does not initiate ignition of hydrogen. The given sorbents have high sorptive efficiency in relation to molecular iodine and iodide methyl. At that it is necessary to note, that they do not lose the sorptive efficiency up to temperature 300°C and up to temperature 600°C from them does not occur the desorption of radioactive iodine in a gas phase

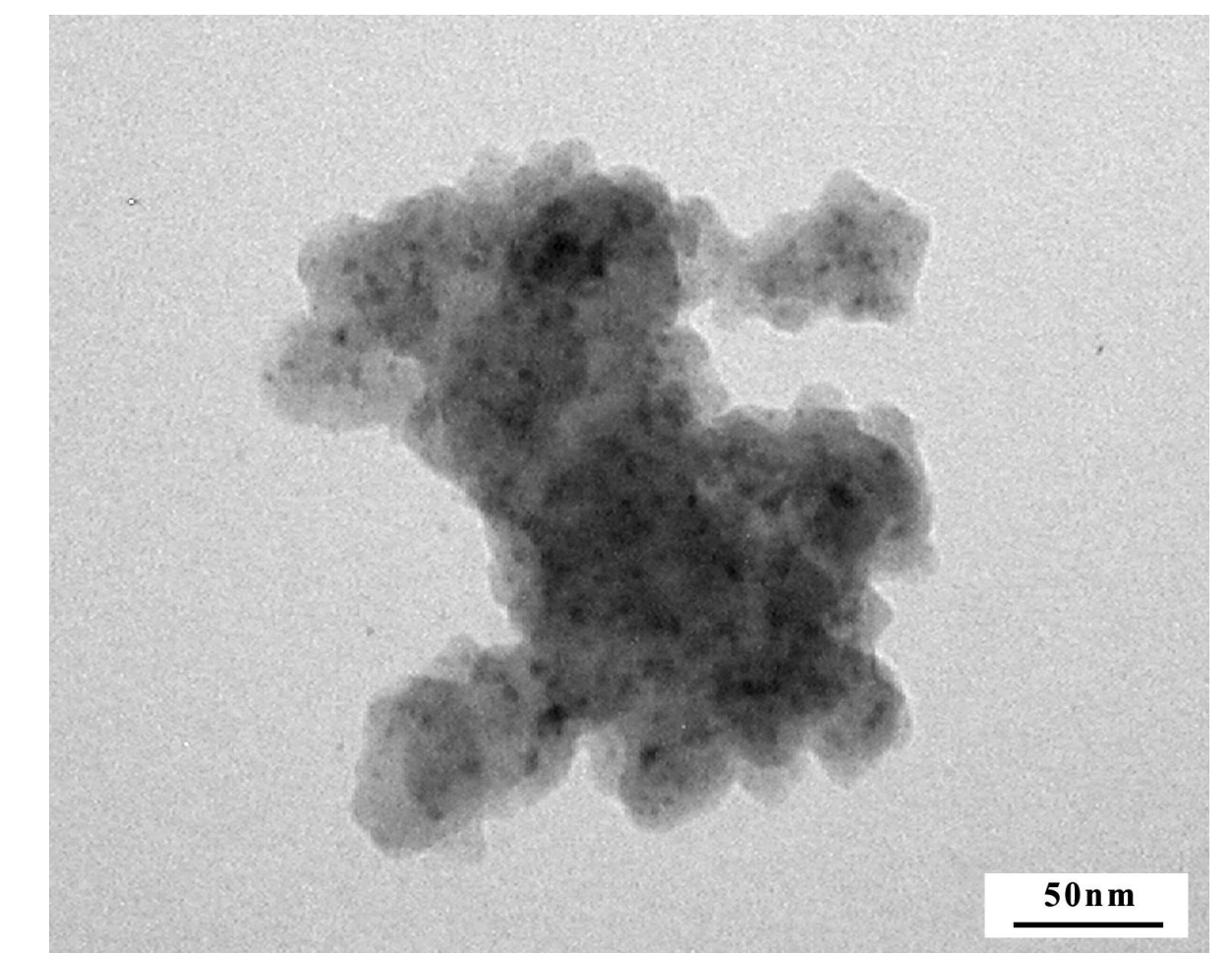
## Main properties of the granular sorbent "Fizkhimin"™

Parameter	Value
Colour	grey
Form	granular
Particle size, mm	0,25 ÷ 6,0
Metal concentration in the sorbent, wt.%	3 ÷ 10
Heat capacity, J·kg <sup>-1</sup> ·K <sup>-1</sup>	≥ 795,5
Heat conductivity, W·m <sup>-1</sup> ·K <sup>-1</sup>	≥ 1,4
P, kg/m <sup>3</sup>	550 ± 100
Unconfined space, %	60 ÷ 80
Specific surface, m <sup>2</sup> /g	310 ± 20
Average pore radius, Å	55 ± 10
Total pore volume, cm <sup>3</sup> /g	1.4 ± 0,2
Sorptive capacity, g per 1 kg of sorbent	CH <sub>3</sub> I 6 ÷ 25 I <sub>2</sub> 15 ÷ 60
Sorptive efficiency*, %	CH <sub>3</sub> <sup>131</sup> I ≥ 99,0 <sup>131</sup> I <sub>2</sub> ≥ 99,9
Decontamination factor (DF)	CH <sub>3</sub> <sup>131</sup> I ≥ 10 <sup>3</sup> <sup>131</sup> I <sub>2</sub> ≥ 10 <sup>3</sup>

Notes: P is the amount of sorbent per 1 cm<sup>3</sup> ("dry density"); \* Sorptive efficiency was determined under follow conditions: T<sub>steam-air flow</sub> = 35 ± 280°C; U<sub>gas flow</sub> = 2 ÷ 60 cm/s; steam content in gas flow - 3 ÷ 80 vol.%; τ ("gas flow - sorbent") = 0,3 ÷ 6,0 s; T<sub>sorbent</sub> = 35 ± 280°C; m<sub>sorbent</sub> = 50 ± 100 g; h<sub>column</sub> = 20 ± 50 cm; S<sub>column</sub> = 4,5 ± 7,0 cm<sup>2</sup>; m(CH<sub>3</sub>I) = 5 ± 200 mg; m(I<sub>2</sub>) = 5 ± 200 mg



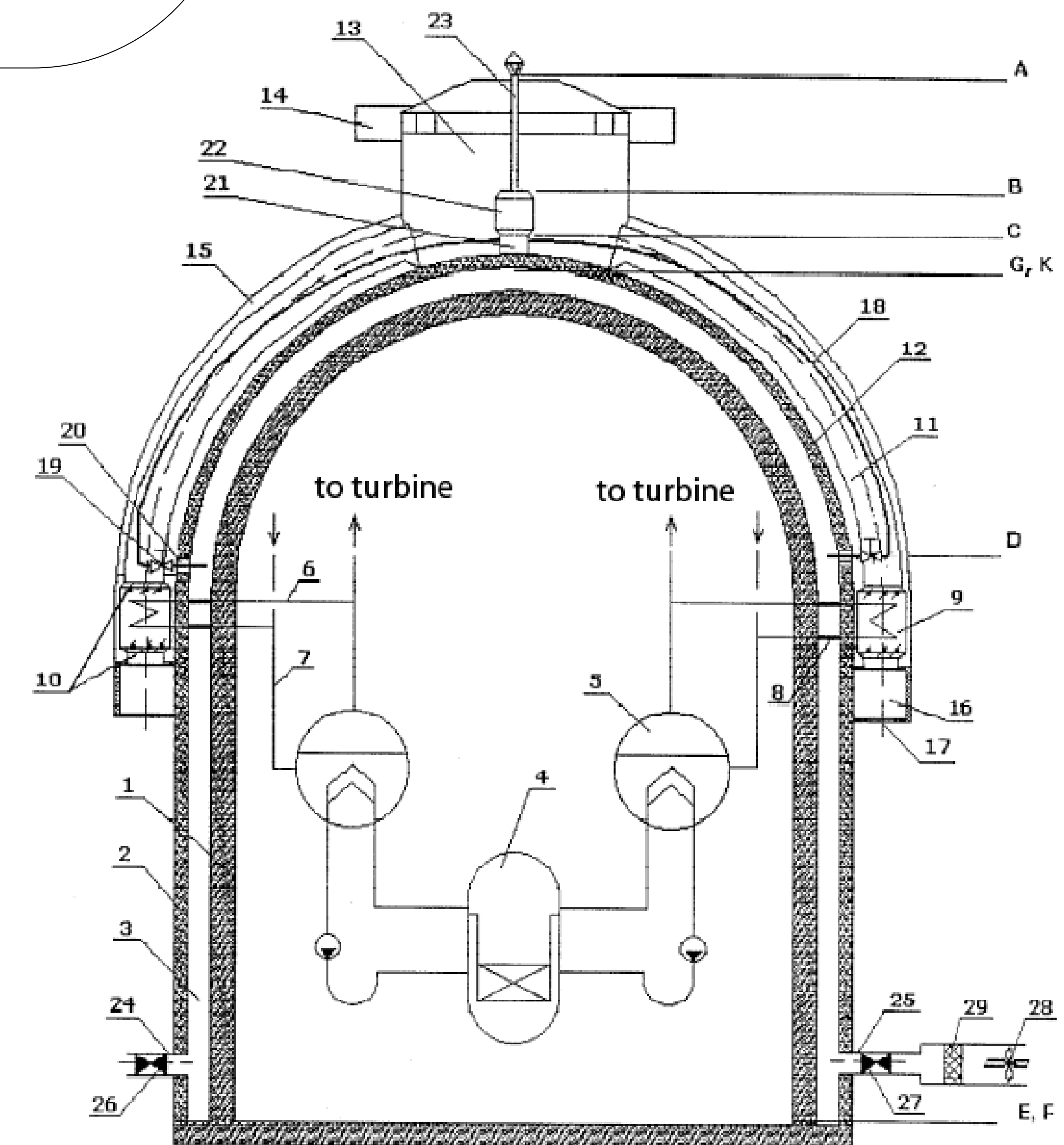
The sorbent "Fizkhimin"™ based on Ag nanometric compounds (electronic microscope EM-301 "Philips")



The sorbent "Fizkhimin"™ based on Ag-Ni nanometric compounds (electronic microscope EM-301 "Philips")

## Technical parameters of effective work of the sorbents "Fizkhimin"™

Parameter	Value
Temperature of the filtered medium, °C	35 ÷ 145
Relative humidity of a filtered steam-air stream, %	1,5 ÷ 95
Linear speed of a stream of the filtered medium, cm/s	1,6 ÷ 16,3
Concentration of volatile radioactive iodine compounds, g/m <sup>3</sup>	0,0003 ÷ 2,8
Quantity of radioactive iodine compounds on 1 m <sup>2</sup> of filter cross-section, g	0,11 ÷ 400
Temperature of effective sorbent work, °C	30 ÷ 300
Temperature of the radioactive iodine desorption beginning, °C	600
Pressure difference on the 250-mm layer of the sorbent at temperature 20°C and linear speed of dry air flow 1,6 cm/s, Pa	6 ÷ 9



Scheme of the active and passive filtering system of intercontainment space

1 - inter shell, 2 - outer shell, 3 - intercontainment space, 4 - reactor, 5 - steam generator, 6 - steam pipeline, 7 - pipeline, 8 - pipeline protection, 9 - heat exchanger, 10 - upper and lower gates, 11 - air draft tube, 12 - outer surface of outer shell, 13 - air collector, 14 - deflector, 15 - domed lid, 16 - inlet header, 17 - air intake, 18 - PFS draft tube, 19 - safety valve, 20 - tunneling, 21 - PFS draft tube collector, 22 - sorptive modul, 23 - stack, 24 - inlet pipe, 25 - outlet pipe, 26, 27 - valves, 28 - ventilator, 29 - filter

## Sorption of the CH<sub>3</sub><sup>131</sup>I on the granulated sorbent "Fizkhimin"™ based on Ag nanometric compounds from a steam-air mixture

Type of sorbent	The size of particles, mm	h*, cm	T <sub>sorb</sub> , °C	T <sub>gas</sub> , °C	RH, %	υ, cm/s	τ, sec	A degree of absorption on a sorbent, %
IPC-2	0.25 - 2.0	5.0	145	145	57.3	22.0	0.4	99.9994
"-"	"-"	20.0	145	145	21.0	61.0	0.3	99.9998
IPC-1	3.0 - 6.0	45.0	35	35	95.0	5.0	8.8	99.8600
"-"	"-"	37.5	110	110	16.9	8.0	4.7	99.9995
"-"	"-"	22.5	180	180	16.3	9.0	2.4	99.9995

Notes: h - height of a layer of a sorbent in a column, T<sub>sorb</sub> - temperature of a sorbent; T<sub>gas</sub> - temperature of a steam-air stream; υ - linear speed of a steam-air stream in a column; τ - time of contact "a sorbent - a steam-air flow" (for all layer of a sorbent); RH - relative humidity of a steam-air mixture