RESULTS OF TESTING THE PILOT PLANT FOR CEMENTATION OF RADIOACTIVE WASTE

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In SIA “Radon” the compact complex for cementation of radioactive waste (Fig. 1), which is supposed to be used at centralized sites for treatment of radioactive waste, at nuclear power plants and, as a mobile complex, directly at the research-industrial centers, having small volume of radioactive waste, is developed.

The complex is designed for cementation of liquid radioactive waste (LRW) with salt content up to 1000 g/l, pulps of spent ion-exchange resins, sorbents, solid radioactive waste (SRW), previously placed in containers (barrel of 200 l), by methods of filling them with a cement mortar or impregnation with high-penetrating cement mortar.

The complex allows preparing a cement mortar with use of the additives, improving quality of cement compound (bentonite, clinoptilolite, high-water reducer, sodium silicate and etc.), with precise dosage of these materials.

The compact complex includes combined mixer, which incorporates the mixing bunker (60 l) and the electromagnetic mixer (3 l) placed under a mixing bunker. The mixing bunker is used for preliminary mixing of cement mortar with liquid radioactive waste (LRW), the final mixing, mechanical and magnetic activation, improving quality of the cement mixture is carried out in the electromagnetic mixer.

The electromagnetic mixer consists of the inductor, which includes electric winders, designed for generation of the rotary electromagnetic field, mixing chamber and separating grid (Fig. 2). Inside the mixing chamber there are ferromagnetic particles, which under the influence of electromagnetic field, generated by electric winders of inductor of the apparatus with vortical layer, make rotational-translation motions, bounce with each other and produce vortical layer.

In the mixing area, homogenisation of the mixture by the ferromagnetic particles, moving chaotically, due to their bouncing, grinding, splitting and mechanical activation

occurs. Besides, the cement mixture is in the area of electromagnetic field influence; this results into magnetic activation of the cement material mixture.

Treatment in a vortical layer results into improving the quality of the cement compound: rate of hardening and setting is increased, leaching rate of radionuclides is reduced.

Prepared cement mortar passes through a separating gird and flows out in container for SRW.

The main technical parameters of a complex for cementation of radioactive waste

capacity on a cement mortar	Up to 1,0 m^3/h
capacity on LRW (at water-cement ratio of 0,75)	Up to 0,8 m^3/h
capacity on ion-exchange resins	Up to 0,4 m^3/h
sorbent additives	bentonite, clinoptilolite
quantity of the sorbent additives (% mass. From a cement. mortar)	1-5
quantity of high-water reducer (% mass. from a cement mortar)	0,1-1
quantity of ion-exchange resins (% mass. from a cement mortar)	Up to 25
water-cement ratio	0,4-0,8
specific activity of processed waste	Up to 1 $*10^{-3}$ Ci/l
salt content of LRW	Up to 1000 g/l
mode of work	Periodic or continuous
operation life of plant	No less than 10 years
general weight	2000 kg
maximum height	4 m
the area	Up to 50 m^2

An operation of plant results into arises the secondary radwaste – water from decontamination used for washing of mixers. Compactness of the mixing device, absence of the elements of the complicated form allows to make decontamination of plant by small volume of water (30 liters). Decontamination is made at the end of the working day. The activity of secondary radwaste amount 0,001 % from activity of waste treated.

The control and the management of system are carried out in hand-operated, semi-automatic and automatic modes.

During tests of pilot plant and preparation of cement compound the samples were selected and specimens for determination its properties were prepared. Specimens from cement compound of the same structure in laboratory conditions on mechanical mixer simultaneously were prepared. Some results of measurements are represented in table 1.

Table1*.

Preparation	Structure of cement compound			S/C	Compressive strength, month, MPa			Leach rate Cs137 on 14 day, g/cm^2*day $*10^{-3}$
	Cement	Sealer	Ion exchange resin, %mass.		1	2	6	
Pilot plant	PC	Simulator 1	-	0,6	19	30	45	5
	PC	Simulator 2	-	0,6	13	29	41	6
	PC	LRW	-	0,6	16	24	39	6
	PC	Simulator 1	5	0,5	18	25	37	5
	PC	Simulator 1	10	0,5	13	20	32	6
	PC	Simulator 1	15	0,5	11	18	29	7
	PC	LRW	10	0,5	10	19	31	7
Mixer	PC	Simulator 1	-	0,6	17	22	27	7
	PC	Simulator 2	-	0,6	12	16	20	9
	PC	LRW	-	0,6	15	18	24	9
	PC	Simulator 1	5	0,5	16	19	25	8
	PC	Simulator 1	10	0,5	11	15	18	8
	PC	Simulator 1	15	0,5	8	11	15	9
	PC	LRW	10	0,5	10	13	17	9

*S/C – Sealer to cement ratio;
PC – Portland cement;
Simulator 1- water solution $NaNO_3$, 200 g/l;
Simulator 2- water solution NaNO3, 500 g/l;
LRW –liquid radioactive waste, salt content 100 g/l.

As the processing of a cement mortar in the electromagnetic mixer is visible from represented results of tests of pilot plant allows increasing compressive strength of cement compound in 1,5-2 times and reduces leach rate of radionuclides.

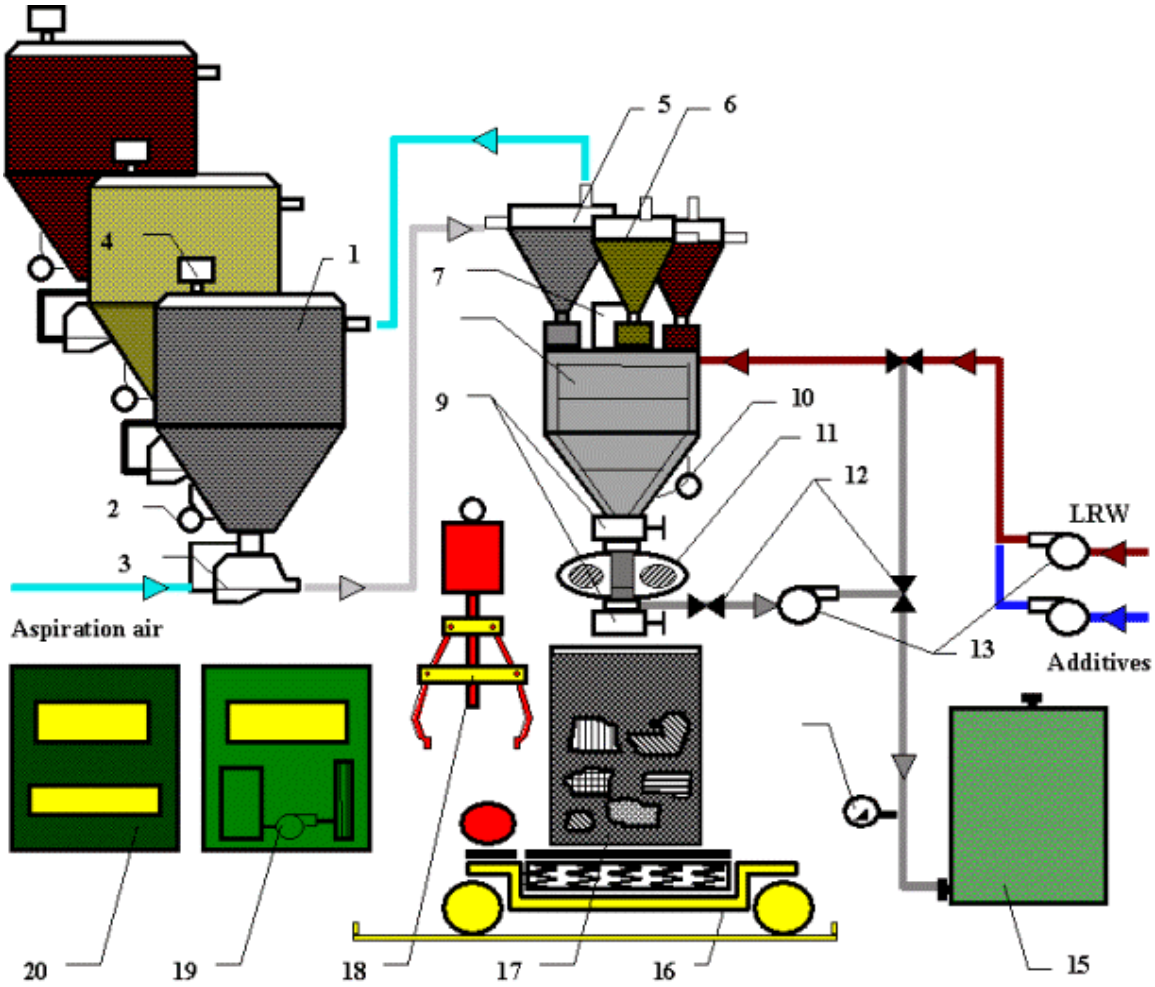

Fig 1. Pilot plant for cementation of radioactive waste

1-bunker for storage of dry materials;
2-vibrator;
3-jet pump;
4-air valve;
5-cement supply bunker with doser
6-additives supply bunkers with dosers
7-gear for mixer
8-mixing bunker
9-hose locks
10-vibrator
11-electromagnetic mixer
12-electromagnetic bolts
13-metering pumps
14-manometer
15-container with granulated sorbent
16-self-propelled small cart with vibro-platform
17-container for SRW
18-crane-grab
19-electromagnetic mixer power supply unit
20-control panel

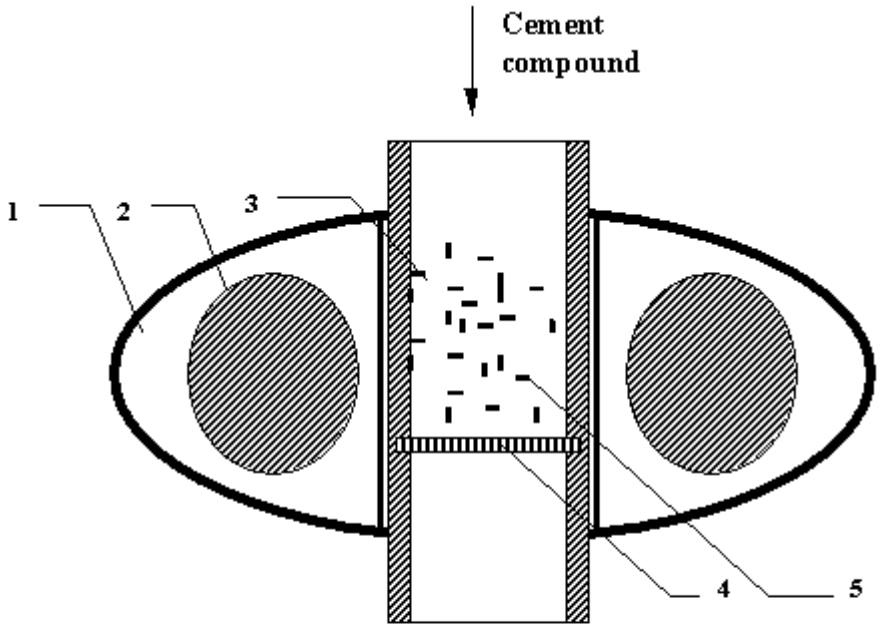

Fig 2. Electromagnetic mixer

1. inductor ;
2. windings of inductor;
3. mixing chamber;
4. ferromagnetic particles;
5. dividing lattice.