# CONDITIONING SOLID RADIOACTIVE WASTE BY USING HIGH-PENETRATING CEMENT MORTAR.

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The incorporation of low and intermediate level radioactive waste (RW) into a cement matrix is the basic way of its conditioning. Alongside with new methods developed for RW treatment the cementation method remains the most simple and inexpensive method allowing to obtain a solidified product of high quality.

In Moscow SIA "Radon" the industrial method of combined conditioning solid radioactive waste (SRW) and liquid radioactive waste (LRW) in cement-concrete monolith is used [1]. The long-term use this method at SIA "Radon" allows achieving safety waste storage in industrial scale and high economic efficiency.

There is a variety of SRW, which can be subject to conditioning by a cementation method. First of all they include grained sorbents, ash from furnaces for RW incineration, device and mechanisms, fragments of building materials.

As a rule the SRW cementation process is carried out by two methods depending on the type of RW:

- SRW is fed into container and then a cement mortar is poured under simultaneous vibration of the container.

- SRW and cement mortar components is mixed in a mixer and then prepared cement compound is fed into container for hardening.

Each of these methods has the essential disadvantages. By using the pouring method, one fails to achieve a homogeneous monolith, as the spaces between the SRW fragments form the air hollows, where the ordinary cement mortar does not penetrate, besides under vibration some light waste fragments rise to the surface of cement mixture. Application of the second method requires additional technological operations with SRW (batching, mixing). A type of mixer, precise batching, uniformity of SRW is of great importance too. As a rule the mixing method does not allow to obtain a final product with high SRW content.

In Moscow SIA "Radon" the works on cementation of a SRW by a method of impregnation by high-penetrating cement mortars will be carried out. The cement mortar is prepared on the basis of high-penetrating cement and can contain sodium silicate, hardener, high-water reducer and some other additives.

Some methods of impregnation nowadays are tested [2]:

1. The large-size SRW (fragment's size more then 40 mm) in container is poured by the cement mortar, which under the influence of gravity impregnate the whole of waste volume.
2. The cement mortar pump through SRW (fragment's size not less then ~ 5 mm) under pressure up to 1 MPa.
3. The container with SRW (fragment's size not less then ~ 5 mm) is vacuumized, then the cement mortar is fed into container.

It was shown that, the cementation of a SRW by a method of impregnation by high-penetrating cement mortars allows to obtain a cement compound of required quality with a high SRW content.

On the trial tests basis the simplest method from technological point of view is chosen for further development. The idea of this method is the following: a SRW is fed in the container, and then a cement mortar is pumped through a SRW under the pressure of 0,1-1 MPa.

The experiments on determination some technological parameters of this method on real waste and equipment nowadays are carried out. Thus, for example, the cementation of real ion-exchange resin, grained selective sorbents and ashes from the furnace of burning of a SRW was carried out. The impregnation of SRW is realized in plastic containers (V = 40 l) and metallic drums (V = 200 l) (Fig 1-3). The productivity of cementation process is 0,5-1,5 $m^3$/h on final product. Upon termination of cementation process the samples of cement compound were selected and specimens for determination of compressive strength and leach rate of radionuclides were prepared. Some results of researches are represented in table 1. The leach rate of radionuclides from cement compound corresponded to leach rate from specimens, prepared by a traditional method. During experimental works was conditioned about 2 $m^3$ SRW.

Table 1.

| Kind of SRW | Size of particles, mm | Compressive strength on 28 day, MPa | Content of SRW, % of masses | Modification of volume in n of time * |
|---|---|---|---|---|
| Ion-exchange resin | 1-3 | 5-7 | 40-50 | Was not changed |
| Selective sorbent | 0,5-2 | 6-7 | 40-50 | Was not changed |
| Ash | 0,5-5 | 6-9 | 40-60 | Was not changed |

*- In a comparison with bulk volume of SRW.

In a result of works was shown that, the developed method of cementation SRW by a method of impregnation by high-penetrating cement mortars allows to receive cement compound of required quality (compressive strength not less than 5 MPa [3]) with a high SRW content. This method has a number of advantages on a comparison with traditional methods, namely:

- The volume of a final product does not increase in comparison with initial bulk SRW volume, while traditional cementation results in increase of volume by the factor of 2,5-3;

- Technological process does not require such operations with SRW as batching, mixing, and vibration;

- Batching, mixing, vibrating equipment is not required;

- Realization of this method will not result in generation of secondary waste, which arises during decontamination of mixer when traditional cementation of grained sorbents is used;

- The uniformity of SRW on the size, form, densities does not have influence on the process.

Application of the method of SRW impregnation by high-penetrating cement mortar will allow to simplify a process of its conditioning essentially.

Fig. 1. Filter - patron with a ferrocyanide type sorbent, treated by high penetrating cement mortar, with a cement compound sample taken out.

Fig. 2. The cut barrel with a cement compound sample, prepared by a method of impregnation with high penetrating cement mortar on the base of nonradioactive ash.

Fig. 4. The container with radioactive ashes from plant "Torch", treated by a method of impregnation with high penetrating cement mortar.

**REFERENCES**

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