The Control Waste of Communal Services

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Abstract. The article deals with municipal waste-sewage sludge. This is the technology of the full cycle of sewage sludge utilization with the production of useful products is proposed. The technology includes the use of ash from the incineration of sewage sludge in the production of building cellular materials in the form of ash-concrete blocks and the use of blocks for construction.

1. Introduction

Public utilities, industry and transport complex are the largest sources of environmental pollution, including various types of waste. Therefore, one of the most important environmental problems is to solve the problem of waste disposal generated in the municipal economy. One of the solutions to this problem is the development and implementation of low-waste and waste-free production, as well as the development of technologies for recycling existing waste. It is necessary for this reason:

- development of new and improvement of existing technological processes to create low-waste and waste-free production;
- the use of existing waste in industries;
- find ways to recycle waste that is not currently being used for any reason.

2. Materials and methods

Unfortunately, the number of existing technologies for recycling and recycling municipal waste is less than the waste itself. Accordingly, currently a large amount of waste is not recycled. Today, there are some types of municipal waste, the proposals for disposal of which are currently insufficient, for example, sewage sludge and sediment of natural waters.

Since 1996, in St. Petersburg, there is a technology that allows the most efficient recycling of sewage sludge by combustion in furnaces with a fluidized bed Pyrofluid. Ash is obtained by incineration wastewater sludge dewatered on the centrifuges (which is a mixture of sediment of primary sediments and excess compacted activated sludge) in furnaces with a fluidized bed at a temperature of 850 ° C. Currently, there are already three such industrial plants, which allows to reduce the amount of precipitation by more than 10 times. But along with the obvious advantages – reducing the number of vehicles involved, reducing the area of new landfills, and, accordingly, reducing emissions and improving the environmental situation – there are new problems associated with the utilization of the resulting ash from the incineration of sewage sludge. Despite the rather rich international experience in combustion of sewage sludge, final disposal technology is not. In most countries, it is simply buried, storing in landfills, abandoned mines and galleries. This may lead to new
problems in the future, such as air and water pollution (including groundwater) due to the fine-grained ash (the particle size is about 10-100 µm).

One of the main ways to use evils, including ash from the incineration of sewage sludge, is to add them to the material as an element of raw materials in the production, for example, cellular foam concretes. With a sufficient specific surface of the ash it is not necessary to grind, and one of the most labor-intensive limits of production-grinding, the cost of which is up to 10% of the total cost of production, is reduced. The most effective method of hardening was recognized as the autoclave technology (temperature 174°C, a pressure of 8-10 MPa). In this case, cement, sand, ashes from burning of sewage sediment, construction lime Ca(OH)$_2$ is used in certain ratios with certain flow parameters. In this case, in an autoclave the reaction is realized. This reaction is a carrier of strength and provides the main exploitative properties of the stone formed.

$$\text{SiO}_2 + \text{Ca(OH)}_2 + n \cdot \text{H}_2\text{O} \rightarrow \text{CaO} \cdot \text{SiO}_2 \cdot (n+1)\text{H}_2\text{O}$$

### 3. Results

The composition of ash-foam concrete is presented in table 1. Experimental batches of ash-foam concrete are shown in figure 1. The scheme of production, including the ash supply line, is shown in figure 2.

| № | medium density, kg/m$^3$ | cement | lime | sand + ash from incineration of sewage sediment | water | foam forming additive | water/ astringent mortar mixture |
|---|-------------------------|--------|------|-----------------------------------------------|-------|------------------------|---------------------------------|
| 1 | 500                     | 170    | 70   | 160 sand + 0 ash (0%) 120 sand + 40 ash (25%) 80 sand + 80 ash (50%) 160 ash (100%) | 96    | 2,56                   | 0,40                            |
| 2 | 600                     | 190    | 80   | 230 sand + 0 ash (0%) 172 sand + 58 ash (25%) 115 sand +115 ash (50%) 230 ash (100%) | 105   | 2,42                   | 0,39                            |
| 3 | 800                     | 210    | 80   | 410 sand + 0 ash (0%) 308 sand + 102 ash (25%) 205 sand + 205 ash (50%) 410 ash (100%) | 110   | 2,15                   | 0,38                            |
**Figure 1.** Experimental batches of ash-foam concrete.

- **test № 1** – replacement in ash-foam concrete D500 of 25% of natural sand for ashes from burning of sewage sediment;
- **test № 2** – replacement in ash-foam concrete D500 of 50% of natural sand for ashes from burning of sewage sediment;
- **test № 3** – replacement in ash-foam concrete D500 of 100% of natural sand for ashes from burning of sewage sediment.

**Figure 2.** The scheme of production ash-foam concrete.
The ash-foam concrete construction in the form of walls of an industrial building was carried out (figure 3) from different type of ash-foam concrete was executed.

![Figure 3](image-url)  
**Figure 3.** The use of ash-foam concrete in the construction of industrial buildings.

4. **Discussion**

The studies on the properties of ash-foam concrete it were conducted more for 12 years, from 2005 to 2018. Researches was conducted on a metallographic microscope of Altami MET 6C with increase 5X. Holes in the material become smaller, when ash content percentage is large. Herewith other studies have shown noise protection properties become better and thermal conductivity become better too. Ash-foam concrete is stable in long time and ashes from burning of sewage sediment is not released into the environment. Ash from sewage sludge incineration is securely tied into ash-foam concrete. The data given in the article allow to claim that the obtained ash-foam concrete can be used as various structures (figure 4).

![Figure 4](image-url)  
**Figure 4.** Possible directions of use of ash-foam concrete.
After the basic life cycle of the products of destruction of ash-foam concrete can serve as mineral geoantidotes (MGA), as they have the capacity to neutralize heavy metal ions.

The studies show the possibility of effective management of municipal waste-sewage sludge in sequence:

![Diagram of waste management sequence]

**Figure 5.** The possibility of effective management.

5. **Conclusions**

The quality of this new technology is composed, as a result, as the sum of the following components: recycling of sewage sludge, recycling of the resulting ash, the creation of a useful product that is applicable on an industrial scale.

6. **References**

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