IOP Conference Series: Earth and Environmental Science

The Control Waste of Communal Services

IOP Conf. Series: Earth and Environmental Science **272** (2019) 022109 doi:10.1088/1755-1315/272/2/022109

The Control Waste of Communal Services

E Rusanova[1], M Abu-Khasan[1], A Sakharova[1]

[1]Emperor Alexander I St. Petersburg State Transport University (PGUPS), Moskovskiy pr. 9, St. Petersburg, 190031, Russia

E-mail: rusanovaev@mail.ru

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.

$$\underbrace{SiO_2}_{\text{from ashes from burning of sewage sediment}} + Ca(OH)_2 + n\cdot H_2O \rightarrow \underbrace{CaO\cdot SiO_2\cdot(n+1)H_2O}_{\text{hydrosilicate}}$$

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.

Table 1. Composition of materials for obtaining autoclave ash foam concrete of medium density D500 ... D800 kg/m^3.

№	medium density, kg/m^3	Consumption of materials per 1 m^3 of ash foam concrete, kg					water/ astringent mortar mixture
		cement	lime	sand + ash from incineration of sewage sediment	water	foam forming additive	
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.

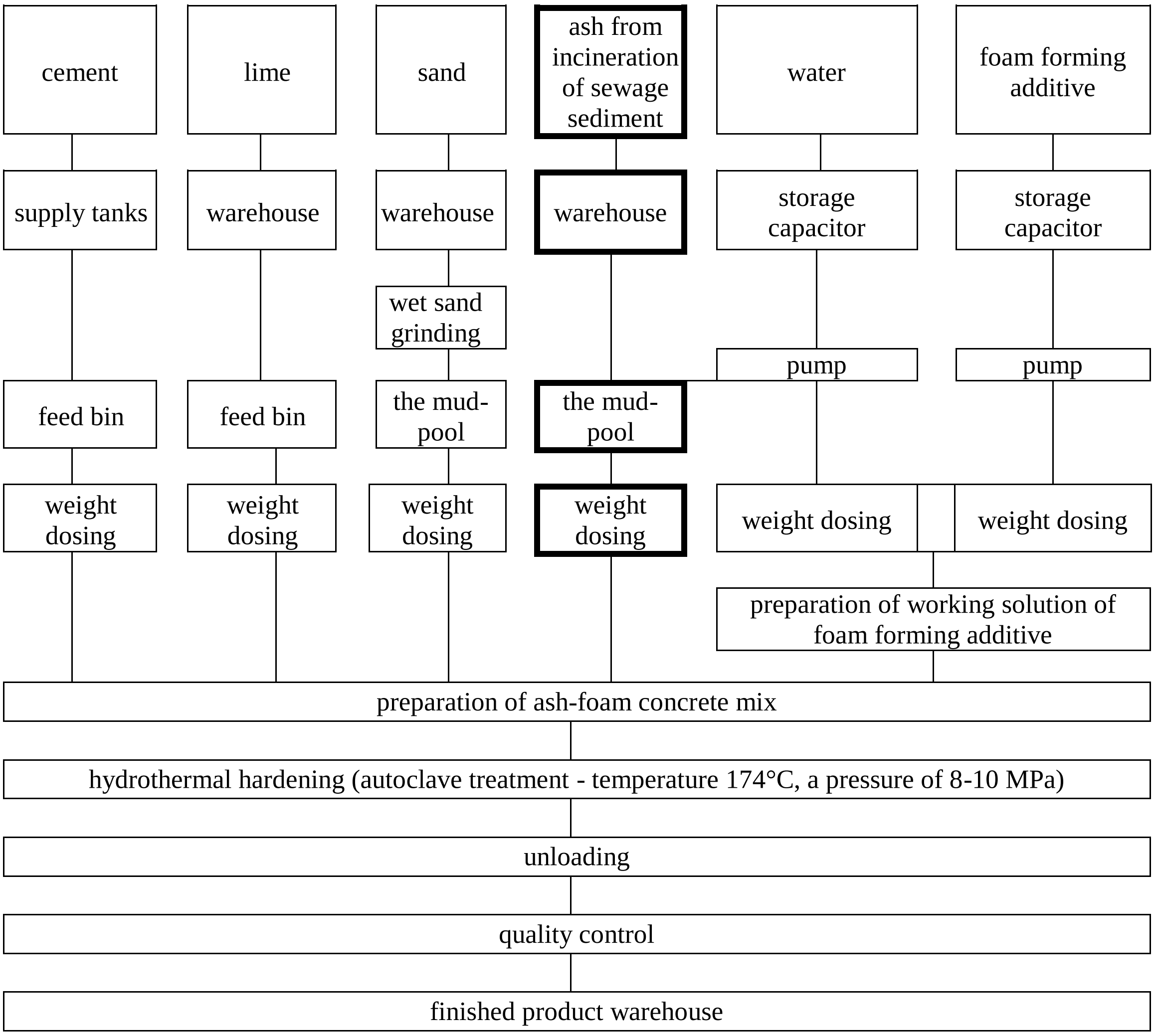

Figure 2. The scheme of production ash-foam concrete.

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. 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).

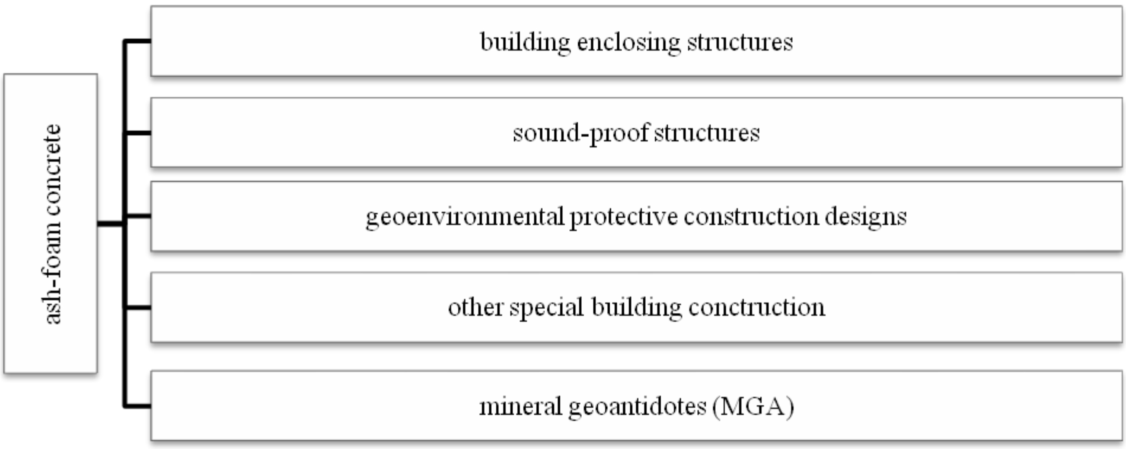

Figure 4. Possible directions of use of ash-foam concrete.

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:

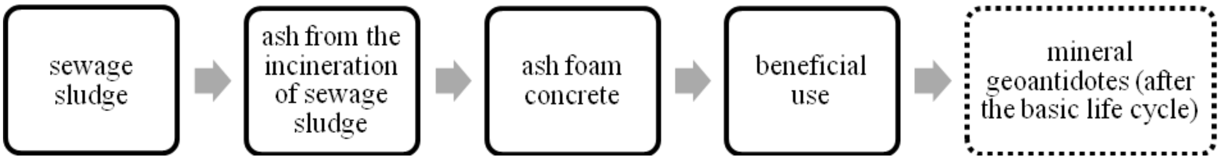

Figure 5. The possibility of effective management.

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

[1] Svatovskaya L B, Starchikov D S 2015 About the Relationship of Some Artificial Hydrosilicate Material Parameters *Natural and Technical Sciences Moscow 6 (84) pp 586-590 ISSN-1684-2026*

[2] Svatovskaya L B 2012 Some Information Signs for Classification of Nanoscale Particles *Natural and Technical Sciences Moscow* 5 (70) pp 247-248 ISSN-1684-2026

[3] Svatovskaya L B 2014 Fundamentals of Innovative Solutions in Construction Activities on the Chemical Engineering Basis, Proceedings of I International scientific practical conference *"Innovative Technologies in the Construction and Geoecology"* Sputnik+ Moscow pp 3-8

[4] Svatovskaya L B, Shershneva M V, Baidarashvily M M, Sycheva A M et al 2015 Geoecoprotective Properties of Cement and Concrete Against Heavy Metal Ions *Procedia Engineering* 117 pp 345-349

[5] Sakharova A S, Svatovskaya L B, Baidarashvili M M, Petryaev A V 2016 Sustainable Development in Transport Construction through the Use of the Geoecoprotective Technologies *Procedia Engineering* 143 pp 1401-1408

[6] Svatovskaya L B, Sycheva A M, Sychev M M, Gravit M New Geoecoprotective Properties of the Construction Materials for Underground Infrastructure Development Procedia Engineering 165 2016 pp 1771-1775

[7] Svatovskaya L B, Kabanov A A, Sychev M M 2017 Soling, Aerating and Phosphating for Soil Strengthening and Detoxication *Procedia Engineering* 189 pp 398-403

[8] Svatovskaya L B, Shershneva M V, Savelyeva M Yu 2017 Geoecoprotective Technologies of Storage of Used Wooden Sleepers, Procedia Engineering 189 pp 605-609

[9] Svatovskaya L B, Yurov O V, Kabanov A A 2017 Geoecoprotective Technology of Transport Construction using Silica Sol Absorbtion Method *Procedia Engineering* 189 pp 454-458

[10] Svatovskaya L B, Shershneva M V, Bobrovnik A B 2017 Geoprotective Properties of Binders for Transport Systems, Procedia Engineering 189 pp 440-445

[11] Svatovskaya L B, Sycheva A M, Solvoyova V Y, Maslennikova L L, Sychev M M 2016 Obtaining Foam Concrete Applying Stabilized Foam, *Indian Journal of Science and Technology* 9 (42) 104304

[12] Svatovskaya L B, Sycheva A M, Solvoyova V Y, Maslennikova L L, Sychev M M 2016 Absorptive Properties of Hydrate Silicate Building Materials and Products for Quality and Geoprotection Improvement *Indian Journal of Science and Technology* 9 (42) 104232

[13] Svatovskaya L B 2016 Geochemistry of lithosphere protection, *Natural and Technical Sciences* Moscow 9 (84) pp 49-52 ISSN-1684-2026

[14] Boikova T I, Solovyov D V, Solvoyova V Y 2017 Concrete for Road Pavements *Procedia Engineering* 189 pp 800-804
[15] Boikova T I, Solovyov D V, Solvoyova V Y 2017 Effective Repair and Refurbishment Compound for the Strengthening of Road Concrete Pavements *Procedia Engineering* 189 pp 650-653
[16] Kondratov V V, Solvoyova V Y, Stepanova I V 2017 The Development of a High Performance Material for a Ballast Layer of a Railway Track *Procedia Engineering* 189 pp 823-828
[17] Myakin S V, Korsakov V G, Panova T I, Sosnov E A, Fomchenkova YuC, Sychov M M, Shilova O A 2011 Effect of the Modification of Barium Titanate on the Permittivity of Its Composites with Cyanoethyl Ester of Polyvinyl Alcohol *Glass Physics and Chemistry* 37(6) pp 624-628
[18] Korsakov G, Alekseev S A, Sychov M M, Tsvetkova M N, Komarov E V, Lee B, Myakin S V and Vasil'eva V 2007 Estimation of the Permittivity of Polymeric Composite Dielectrics from the Surface Characteristics of the Filler Using a Thermodynamic Model Russian *Journal of Applied Chemistry* 80 (11) pp 1931-1935
[19] Sychov M M, Mjakin S V, Nakanishi Y, Korsakov V G, Vasiljeva I V, Bakhmetjev V V, Soiovjeva O V, Komarov E V 2005 Study of active surface centers in electroluminescent ZnS:Cu *Cl phosphors. Appl. Surf. Sc*. 244(1-4) pp 461-464
[20] Sychov M M, Zakharova N V, Mjakin S V 2013 Effect of milling on the surface functionality of BaTi03 - CaSn03 ceramics *Ceramics International* 39 pp 6821-6826
[21] Bakhmet'ev V V, Sychev M M, Korsakov V G 2010 A model of active acid-base surface sites for zinc sulfide electroluminescent phosphors *Russian Journal of Applied Chemistry* 83 JSyl 1 pp 1903-1910
[22] Rusanova E V 2005 Technologies for utilization of some industrial and transport waste and their integrated assessment Thesis for the degree of candidate of technical sciences (Saint-Petersburg, Russia)
[23] Svatovskaya L B, Abu-Khasan M, Rusanova E V et al 2005 New technologies for waste management (Saint-Petersburg Russia)
[24] Abu-Khasan M et al 2008 New geo-protective technology for the elimination of oil spills in transport Natural and technical sciences 4 (36) pp 259-265
[25] Rusanova E V, Abu-Khasan M et al 2017 Geo-absorbing anti-noise screen for transport infrastructure In the collection: Professional education, science and innovation In the XXI century collected works of the XI St. Petersburg Congress pp 243-244
[26] Sychova A, Sychov M, Rusanova E. 2017 A method of obtaining geonoiseprotective foam concrete for use on railway transport Procedia Engineering pp 681-687
[27] Abu-Hasan M, Rusanova E V 2017 Physico-chemical studies of durability of autoclaved ash-foam concrete as geoenvironmental protective material for construction of transport objects Natural and technical Sciences 3 (105) pp 58-65`