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The Modern Structure For Storm Sewage Purification Of Roads

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Abstract

A new type of local sewage treatment plant for storm sewage control from road pavement is considered in the article. Storm sewage chemical composition is presented. It shows that concentrations of some pollutants significantly exceed maximum allowable concentration, from 2 to 19 times. It is proposed to use local sewage treatment plant to solve this geoecological problem. This structure consists of geoecoprotective materials, gabions and geosynthetics. There are figures and schemes of proposed structure.

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Keywords: sewage treatment plant, storm sewage, road, gabion, geoecoprotective materials.

1. Introduction

The consumption of natural resources during the transport construction leads to their depletion and pollution of geosphere shells of the Earth such as atmosphere, hydrosphere and lithosphere.

The most sensitive components of the natural environment during the road construction and service are [1]:

- surface runoff
- population and fauna living on roadside territories
- atmospheric air

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In our opinion the surface runoff flowing from the polluted road bed has the greatest impact on the natural environment.

Contamination of storm and snow melt sewage water by oil products, suspended solids, heavy metals may reach environmentally dangerous levels [2]. Therefore the pollution assessment and the choice of methods of sewage purification should be carried out during the design of highway [3].

According to the above, the aim of this work was to develop a new type of local treatment plant to purify runoff from the road surface of highways. The main purpose of this structure is the reduction of concentration of heavy metals and oil products in storm sewage. This structure consists of gabions, gabion filler and geosynthetics. The use of geoecoprotective materials as the main gabions filler is offered. Geoecoprotective materials are materials which consist of technogenic or artificial origin substances. Their composition is similar to the composition of the Earth's crust («earth» - «geo»), and they can be used to protect the Earth's geosphere shells (atmosphere, hydrosphere, lithosphere, and others.) from pollution.

The main objectives of the work is the study of geoenvironmental protective properties of various types of fillers of gabions against heavy metals and oil products and development of the method of laying them in the in the construction of gabion local treatment plant.

Studies have shown [1] that surface runoff from roads contribute to pollution of main components of the environment.

A mixture of pollutants are contained in their composition. Heavy metals are the most dangerous of them [4].

The results of experimental measurements of storm water runoff pollution by heavy metals ions (HMI) done on the highways of St. Petersburg are presented in Table 1.

Table 1. Measurements results of storm water pollution by heavy metals ions.

Study number	Measuring point	Concentration of heavy metal ions, mg / l			
		Pb	Zn	Cu	Cd
1	Sinopskaya embankment	0,35	7,96	0,51	0,0001
2	Sinopskaya embankment	0,14	1,97	0,35	0,0001
3	Smolninskaya embankment	0,56	2,12	0,85	0,0032
4	Pulkovo highway	0,024	0,12	0,023	0,0016
5	Primorskoe highway, Gorskaya station	0,005	0,43	0,043	0,016
Maximum allowable concentration for drinking water		0,03	1,0	1,0	0,001

The given data show that the concentrations of heavy metals (except cadmium) exceed maximum allowable concentration for drinking water. It follows therefore, that storm water runoff from roads should be purified according to the current legislation of Russian Federation.

2. Determination of the Cement Clinker Geoecoprotective Properties

Geoecoprotective materials is solid difficultly soluble technogenic, artificial or natural substances, in dispersion form. They have the composition corresponding to natural composition of the crust (calcium and magnesium silicates and hydrosilicates). They can pollutants decontaminate, for example HMI, by forming of difficultly soluble substances. It is self-reaction ($\Delta G^0_{298} < 0$). Such materials have geoecoprotective properties [5, 6].

Artificial mineral substance such as clinker and some construction wastes [7, 8] can be considered as geoecoprotective materials for of storm sewage treatment from heavy metal ions. Research of this kind for the past 20 years of the department Engineering Chemistry and Natural Science, led by Professor L.B. Svatovskaya [9, 10]. Department scientists have identified geoecoprotective properties of materials such as non-autoclaved foam concrete, granulated blast-furnace slag, phosphogypsum, rubble containing shungite etc [11].