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ScienceDirect

Procedia Engineering 189 (2017) 616 – 621

Procedia Engineering

www.elsevier.com/locate/procedia

Transportation Geotechnics and Geoecology, TGG 2017, 17-19 May 2017, Saint Petersburg, Russia

Criteria Of Geoecoprotection In Construction

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Abstract

Questions of geoecological assessment of technology solutions in construction are considered in article. Technology solutions become geoecoprotective if they correspond to particular criteria which are defined by the author. There are four criteria such as minimization of an expense of non-renewable energy, preservation and (or) restitution of quality of the natural and technogenic environment, preservation of natural resources, and minimization of waste formation. These criteria are quantitatively expressed through the corresponding indexes. Intervals of values of indexes are calculated. Construction technologies are geoecoprotective within these values. Thus, criteria of geoecodefense are criteria which allow to estimate technology solutions in construction from the point of view of their influence on an environment.

Peer-review under responsibility of the scientific committee of the International conference on Transportation Geotechnics and Geoecology

Keywords: criteria, indexes, non-renewable energy, quality, preservation of natural resources.

1. Introduction

Structural production makes the negative impact on an environment at all stages of construction. For example there is an extraction from a surrounding medium of natural resources and introduction into a surrounding medium of pollutants, vibrations, noise, radiations, etc. The action program for the 21st century [1] was adopted at the conference of the United Nations which took place in 1992 in Rio de Janeiro. This program defines the development plan for a civilization on the near future and has several directions. The ideas of sustainable development are

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Peer-review under responsibility of the scientific committee of the International conference on Transportation Geotechnics and Geoecology
doi:10.1016/j.proeng.2017.05.098

considered by such recent trend in science as green chemistry. According to the principles of green chemistry which were formulated by P.T. Anastas and J.C. Warner [2] processes in the field of chemical synthesis have to be harmless to a surrounding medium at all production phases [2-3]. The geoecological directions such as minimization of natural resources use and a wastage production, a recycling and re-using of a wastage, an exception or minimization of pollution, monitoring of state of environment were defined. So, there are national systems of ecological building standards in world practice [4-6]. The analysis of natural sources possibilities of renewable energy, for example, of solar energy, the tidal energy and thermal energy of a subsoil of the planet which are considered in connection with fundamental physical processes is carried out by the authors [7-11]. One of possible paths of realization of the designated tasks is introduction of geoecological assessment of technologies which are used in construction. Such decision demands introduction of criteria of geoecodefense. Such criteria are minimization of an expense of non-renewable energy, preservation or (and) restitution of environment quality, preservation of non-renewable resources, and also minimization of wastage formation.

2. Justification of introduction of geoecodefense criteria and their quantitative expression

These criteria are objective for the modern civilization. Questions of energy and natural resources conservation are bound to existence and development of the modern civilization. Preservation of environment quality and minimization of wastage formation are necessary for preservation for present and future generations of people of the productive environment.

2.1. Minimization of an expense of non-renewable energy is the first criterion of geoecodefense in construction

There is a state program of energy conservation which defines measures for effective (rational) use and an economical expenditure of fuel and energy resources. Three directions of conservation of energy such as useful use (utilization) of power losses, modernization of an inventory and technologies for decrease of energy consumptions and intensive energy saving are allocated. Decrease of energy consumptions is possible also when using natural processes in structural technologies. Such processes do not demand energy consumptions from the outside. Examples of such processes which can be the basis for geoecoprotective decisions in construction are processes of interaction of structural hydrosilicate systems with solutions of various nature. If it is solutions of pollutants (for example, ions of heavy metals), then such process leads to formation of low solubility hydroxide and hydrosilicate of heavy metals. At interaction of the colloidal solution (for example, silicon dioxide) padding amounts of calcium hydrosilicate are formed [12-26]. The results of thermodynamic (on the negative value of a Gibbs function $\Delta G^0_{298,}$ kJ) calculation of such processes which showed spontaneity of their exercise are given in table 1.

Table 1. Some processes of interaction of hydrosilicate structural system with the absorbed solutions from the soil and ground waters.

Examples of natural processes	ΔG^0_{298} kJ
$2CaO{\cdot}SiO_2 + Cu^{2+}_{aq} + 2OH^-_{aq} + 1{,}17H_2O \rightarrow 2CaO{\cdot}SiO_2{\cdot}1{,}17H_2O + Cu(OH)_2$	-120,56
$5CaO{\cdot}6SiO_2{\cdot}5{,}5H_2O + Cu^{2+}_{aq} + 2OH^-_{aq} + 5H_2O \rightarrow Cu(OH)_2 + 5CaO{\cdot}6SiO_2{\cdot}10{,}5H_2O$	-120,63
$2CaO{\cdot}SiO_2 + Ni^{2+}_{aq} + 2OH^-_{aq} + 1{,}17H_2O \rightarrow 2CaO{\cdot}SiO_2{\cdot}1{,}17H_2O + Ni(OH)_2$	-108,47
$5CaO{\cdot}6SiO_2{\cdot}5{,}5H_2O + Ni^{2+}_{aq} + 2OH^-_{aq} + 5H_2O \rightarrow Ni(OH)_2 + 5CaO{\cdot}6SiO_2{\cdot}10{,}5H_2O$	-108,54
$2CaO{\cdot}SiO_2 + Fe^{3+}_{aq} + 3OH^-_{aq} + 1{,}17H_2O \rightarrow 2CaO{\cdot}SiO_2{\cdot}1{,}17H_2O + Fe(OH)_3$	-221,82
$5CaO{\cdot}6SiO_2{\cdot}5{,}5H_2O + Fe^{3+}_{aq} + 3OH^-_{aq} + 5H_2O \rightarrow Fe(OH)_3 + 5CaO{\cdot}6SiO_2{\cdot}10{,}5H_2O$	-221,90
$2CaO{\cdot}SiO_2 + Cd^{2+}_{aq} + 2OH^-_{aq} + 1{,}17H_2O \rightarrow 2CaO{\cdot}SiO_2{\cdot}1{,}17H_2O + Cd(OH)_2$	-91,35
$5CaO{\cdot}6SiO_2{\cdot}5{,}5H_2O + Cd^{2+}_{aq} + 2OH^-_{aq} + 5H_2O \rightarrow Cd(OH)_2 + 5CaO{\cdot}6SiO_2{\cdot}10{,}5H_2O$	-91,42
$2CaO{\cdot}SiO_2 + Pb^{2+}_{aq} + 2OH^-_{aq} + 1{,}17H_2O \rightarrow 2CaO{\cdot}SiO_2{\cdot}1{,}17H_2O + Pb(OH)_2$	-91,89
$5CaO{\cdot}6SiO_2{\cdot}5{,}5H_2O + Pb^{2+}_{aq} + 2OH^-_{aq} + 5H_2O \rightarrow Pb(OH)_2 + 5CaO{\cdot}6SiO_2{\cdot}10{,}5H_2O$	-91,96
$Ca(OH)_2 + 2(SiO_2{\cdot}H_2O) \rightarrow CaO{\cdot}2SiO_2{\cdot}2H_2O + H_2O$	-201,50
$2Ca(OH)_2 + SiO_2{\cdot}H_2O \rightarrow 2CaO{\cdot}SiO_2{\cdot}1{,}17H_2O + 1{,}83H_2O$	-160,10
$5Ca(OH)_2 + 6(SiO_2{\cdot}H_2O) \rightarrow 5CaO{\cdot}6SiO_2{\cdot}5{,}5H_2O + 5{,}5H_2O$	-727,96