Development of Green Standards for Construction in Russia

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Abstract

The article considers the problems of developing green building technologies and standards for the Russian construction industry using nanotechnology products, using roofing as an example. Buildings increasingly incorporate new construction materials, these include the use of sustainable nanotechnology products, creating new conditions for improving efficiency and safety generally, thereby providing a comfortable built environment for future generations. Nanotechnology in construction performs complex tasks, providing a competitive advantage in comparison with conventional technologies for facility managers, who thereby inherit buildings constructed with high quality building materials and operating more energy-efficient engineering equipment.

Keywords: Construction; nanoindustry; green standards; green technology; system of standardization; green roof; technical committee; built environment.

1. Introduction

Existing green construction standards include general guidelines for the formation of system requirements for the assessment of buildings with green solutions. The aim of such standards is to evaluate the possibility of innovative solutions applied in construction. This requirement is a precondition for the development and improvement of indicators in the field of green technologies, as well as the replication of innovative solutions in serial (standard

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design) construction projects [1]. The main functions of the standards using system requirements for the assessment of green construction projects are:

- **constructive** - assessment is the basis of decision-making;
- **coordination** - evaluation serves as a key operational management information source to improve the efficiency of the organization;
- **control** - assessment of each aspect may vary depending on the goal: checking the relevant characteristics, evaluation of quantitative and qualitative results, achieving goals, etc.;
- **analytical** - evaluation serves as an information base for analysis;
- **communication** – the assessment procedure is a way of presenting to the enterprise the acceptance of the results of its activities, it serves as a signal for correcting behavior, providing feedback;
- **stimulation** - evaluation itself serves an important motivation tool.

2. Green standards for construction with nanotechnology products

The standards applicable for the assessment of green buildings constructed using nanotechnology products have a defined structure. Green requirements in construction projects using green nanotechnology products are divided into general requirements and requirements for the specific product. Green standards also take into account the requirements of local regulatory and legal documentation.

General green requirements contain requirements that apply to the assessment of green buildings overall. These requirements include for example:

- The provision of energy efficiency measures, reduction targets for heating and ventilation energy consumption in green buildings of 40-60%;
- Greening of the facility: the use of solutions such as green roofs, eco-parking, the proportion of green vegetated areas to the total area of the territory must be at least 20%-30%.

«Green requirements» for products are grouped into six categories:

I. Energy Efficiency;
II. Health;
III. Materials;
IV. Structure;
V. Waste;
VI. Pollution.

Each category has a set of criteria, related to a specific aspect of green construction. Green Construction here focuses on resource efficiency, the creation of a healthy environment for the end user of the building, the use of innovative materials and technologies that minimize the negative impacts on the environment and reducing waste.

The implementation of the tasks carried out on the basis requirements of normative and legal documents, according to which sets minimum indicators characterizing the evaluation criteria. Then specify recommends values for the selected indicators, taking into account excessive technical requirements for nanotechnology products.

For example, the criterion Safety cover the walls using nano-paint determined by the indicator of paint toxicity that contains following requirements:

- Formaldehyde > 0,01 mg / m³;
- Methyl methacrylate > 0.01 mg / m³;
- Styrene > 0.002 mg / m³.

In the final stage of the evaluation process, assessment methods assessing actual performance and necessary documents proving the actual use in the building of green nanotechnology products.

3. International green standards in construction – Green Roof example

Green roofs are one aspect of a green building, which also require the development, and implementation of reliable systems of standardization. Various elements of Green roofs utilize recycled and Nano technological solutions. Ramesh, T. observes in his article that universally accepted benefits of green roofs [2] are classed to ecological environment benefits (EEB), social benefits (SB) and private economic benefits (PEB). Under existing
rules, taking into account the principles of the structure of the roof green system, additional rules and guidelines for adaptation to specific countries should also be considered. These principles should include the following features: carrying capacity load, wind protection, fire protection, temperature-controlled parameters, noise protection, and technical characteristics of the roof “pie”: waterproofing material and installation of skirting, slope, drainage, etc. It is also necessary to pay attention to any existing rules and guidelines for landscape architecture - rules and guidelines for the use of soil and plants, lawn seed mix, repair and maintenance work. For high-rise buildings, depending on country-specific conditions, require different regulations regarding the safety and protection against falls from roof constructions.

In Italy, for the development and application of green roof systems the standard UNI 11235:2007 was designed - “Design Guide, device monitoring and maintenance of green roofs” (“Istruzioni per la progettazione, l'esecuzione, il controllo e la manutenzione di coperture verdi”) [3], which determines, using multi-criteria approach, planning, implementation, monitoring and maintenance of green cover, as well as promoting the use of innovative construction of the roof components.

The layers forming the green coating are regulated by UNI 11235: 2007 as follows:

- structural layer supporting the load;
- waterproof layer protects the roof from water penetration, usually made of bitumen or PVC membrane;
- the root barrier layer which protects the insulation from the roots of the plants, often in combination with the previous layer by treatment;
- membrane, providing protection against mechanical damage;
- drainage layer, drain excess water from the roof;
- water-retaining layer that collects rain water for dry periods;
- fabric filter, which protects the drainage layer;
- nutrient medium usually lightweight soil comprising peat, pumice, and natural fibers;
- topsoil.

Globally cities are contributing to standard development. For example, the Toronto “Green roof design” Standard (TGRCS) is the first municipal standard in North America, laying down minimum requirements for the design and construction of green roofs. TGRCS establishes requirements of urban development and at the same time meets the requirements of the Ontario Building Code, Ontario Building Code (OBC).

A feature of the standard is to have recommendations - “best practice”, which replaces the prescriptive requirements. The document also identifies the provisions of the Ontario Building Code, which are used in the design and construction of green as well as “traditional” roofs. It is recommended that the developer of investment and construction projects pay close attention in the selection of their roofing suppliers. Green roof systems vary in purpose and degree of difficulty, so appropriate studies by pre-project teams should be conducted. These studies should include a review of the assessment of the complexity of the configuration, the destination and the dimensional characteristics of coatings green roofs, provided by the supplier, analysis of previous projects implemented.

According to the Toronto Standard “Construction of green roofs” (TGRCS) components in the structure roofing pie (Figure 1) are:

- vegetation.
- topsoil.
- water-retaining layer.

This layer serves to retain water and to provide moisture protection for the growing plants. Usually made of recycled polypropylene, it may also serve as a root barrier layer.

- Drainage board - Drainage layer.

The function of the drainage layer is to remove excess water from the roof in rain and, in some cases, serves as a water reservoir for the roof during dry periods.

- fabric filter, an insulation layer;
membrane, providing protection from mechanical damage and prevents the penetration of roots.

Mainly, the membrane is designed to protect the waterproofing material in the roots from penetrating the membrane seams and soil microbes harmful effects acting on the impermeable membrane. It is typically made of thermoplastic sheets, such as PVC, TPO or PE. As used growth retardant aluminum or metal foils in combination with synthetic fibers.

- waterproofing membrane.

The membrane provides a resistance to hydrostatic pressure and provides protection against ingress of water. Section 4.1 TGRCS Standard.

- reinforced concrete base.

Thermal characteristics of the green roof are usually evaluated by simulation or estimation using respective parameters that are collected experimentally or from databases. W. Berardi in their studies, Toronto, Canada, examined the effect of green roof over the outside of the modified micro-climate and evaluate the benefits of extensive green roofs, using a virtual model of the building’s energy. The results show that the use of green roof modernization resulted in a reduction of energy costs for the construction of 3% [4], as well as greatly improved comfort indoors under green roof. These results once again confirm the benefits of green roof systems as a tool for reducing the UHI effect and mitigation in the urban environment.

4. Establishment of the Technical committee for Green standards in construction

In the Russia Federation green technologies have been actively used in the construction of international level facilities of the Winter Olympics in Sochi at 2014 and then for the FIFA World Cup 2018 Stadia across Russia [5]. Since more then fifty industrial, offices and commercial buildings were certified to international green standards such as BREEAM, LEED and DGNB [6, 7]. The President of the Russian Federation has declared 2017 to be The Year of Ecology.

Currently a Technical Committee (TC) is being established - "Green" technologies for the build environment and "green" innovative products", led by the Federal State Educational Institution Higher Education «Moscow State University of Civil Engineering (National Research University)». This TC aims to implement the Federal Law of the Russian Federation on June 29, 2015 № 162-FZ "On Standardization in the Russian Federation", for the improvement and development of standardization in the advanced "green" technologies, materials and products.
aimed at improving the quality of the environment of life. The TC engages with stakeholders to ensure that findings are inclusive.

The creation of this TC opens up new directions of research in science and technology, provides an improvement of known results and normative-technical documentation in the field of construction, output and transport services as well as "green" technologies. It encompasses the Life Cycle Analysis (LCA) approach - looking at production activities from cradle to grave, seeking to maximize durability, benefits to users and the environment whilst measuring environmental and economic costs.

5. Conclusion

In today’s world an undeniable trend over the last decades is the increasing attention is paid to environmental issues to counter or adapt to climate change. Green and energy-saving technologies and resources are becoming more and more popular with the development and promotion involved in almost all large-scale and multinational corporations.

This transition process is carried out in construction on the principle of best available technologies, which are environmentally friendly and more effective. Nanotechnologies have a strong potential for the creation of innovative products for construction projects and the use of new market opportunities, including in the field of environmental management and environmental protection.

Green standards are regarded as the modern key to the development green technologies of built environments.

At the current stage, the development of new standards for green construction are required to adapt to local conditions, as well as an improved scientific and legal framework for a comprehensive solution of environmental safety problems in urban development activities.

References