

NATURAL MATERIALS IN THE ECODESIGN OF THE URBAN ENVIRONMENT

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Abstract: *Factors affecting the choice of materials for the creation, operation and disposal of objects and infrastructure systems of the city are considered. Basalt and carbon fiber composites were selected as materials that meet the requirements of ecodesign. The unique properties of these materials provide a wide range of products that can be made on the basis of such natural fibers. The main areas of improvement of the specified materials, improvement of properties to expand their functionality are considered. A comprehensive approach to the design of objects is proposed, taking into account all possible dangers that arise from the initial stage of their production to the last stage - disposal. The possibility of using basalt composites as components of most objects in the creation of a natural human habitat has been demonstrated. The high absorption properties of carbon fabrics have been studied. This allows creating a new approach to the issue of water and air purification.*

Key words: *urban infrastructure, power pole, basalt composite, carbon composite.*

1. INTRODUCTION

Over the past 5-7 years, the attitude of society towards the design and construction of a socialized human environment has begun to change rapidly, and there are at least three reasons for this change:

- crisis phenomena in the world economy, and above all, the crisis of infrastructure: financial, energy and resource in general, transport, communications. Moreover, against the general background of the development of infrastructure technologies, innovations in it are rapidly lagging behind the demand of society;
- strengthening of the "systemic fragility" of the infrastructure and the entire set of ensuring social reproduction (primarily in the sectors of direct support, for example, utilities, communications, transport and logistics), due to their avalanche-like complication, and also due to the asymmetric increase in threats from man-made and natural nature (including new large-scale biological threats such as the COVID pandemic);
- increasing environmental pollution and depletion, as a result, of systemic natural resources such as water, clean air, soils.

As one of the natural responses to these negative trends, a new approach to the principles of designing the human environment has emerged ECODESIGN [1].

2. MODERN ECODESIGN PROBLEMS

ECODESIGN is a key concept for a new paradigm of the arrangement of the environment and the socialization of modern man [2]. It consists, first of all, in the key attention to the protection of the environment and considers a person at the same time:

- a) as part of the ecosystem as a whole and
- b) as an object of assessment of the degree of his symbiosis with the environment of his existence.

In a simplified sense, Ecodesign is a direction in design that pays key attention to protecting the environment throughout the life cycle of a product, system, or process. Here, in the complex, all aspects of the creation, use and disposal of the product / system are taken into account.

Ecodesign, along with the obvious and already established (standardized / standardized) requirements of aesthetics, comfort and price of renovation, introduces new decision-making factors for its creation, namely:

- A measure of the consumption of the sum of all resources at the stage of design, manufacture, use and disposal, with particular emphasis on the so-called "scarce" resources (energy) and resources potentially threatening the external environment

- The very origin of materials, especially in the field of biotechnology and renewable resources. Many aspects are taken into account, starting with the protection of the environment by the manufacturer (supplier) and ending with the observance of the rights of workers in enterprises, the correct attitude to animals, etc.

- Safety in the use of the product / system, no harm to health, minimization of noise, emissions, radiation, vibration, etc. Recently, specific standards and requirements have been introduced into the understanding of safety at social facilities ANTIVANDALISM, compliance with traffic regulations, security of elements CRITICAL INFRASTRUCTURE. It is possible to expect that the multilevel safety factors will be further folded into a separate RELIABILITY AND SECURITY criterion [3].

- Ease and safety of disposal, the ability to reuse materials with minimal environmental damage

Different countries and associations have developed and adopted specific methodologies and standards that allow for a comprehensive analysis of the above aspects, for example, the Environmental Impact Analysis EIA (see below). At the same time, the very concept of Ecodesign - mentally split into two or three differently interpreted approaches in design and macro / micro design of the environment.

The first, the most primitive one is the correct consumption, processing, use of natural materials, as well as the widespread use of recycled materials.

The second is ecodesign as an introduction to today's rational and uniform world of glass and concrete of landscaping, micro-water objects, often with microfauna. This movement is typical for more or less prosperous countries of the East, poor in bioresources - South Korea, Singapore, the Middle East. In some Western countries, this takes the form of gardens and lounge facilities on rooftops without much reference to urban facilities as a single structure.

The third is an attempt to create a fashion for micro-eco-solutions as a culture of life - the creation of bio-objects on window sills, a garden on the roof, complex solutions with bio-objects, up to greenhouses inside prestigious households. In the latter case, it is no longer so much a design as a way of life.

In addition to this, the three-year period of the pandemic has given rise to a trend in the search for a biologically independent and protected environment as an element of solving the problem of biological protection (the introduction of biological protection means into households such as quartz lamps, bioprotective vestibules, etc.), as well as

means of autonomous life support.

Finally, in a number of EU directives, since about 2009, the concept of “Ecodesign” has already been working normatively in its most adequate understanding in matters of labeling goods and services for energy efficiency, the presence of hard-to-recycle waste and the possibility of their use as secondary raw materials, and others.

One of the options for assessing the factors that are key to reducing environmental impact at all stages of the life cycle can be used as an Environmental Impact Analysis (EIA) [5].

In addition to objective (measurable factors) such as

- Price per unit of power or other specific parameter of a typical system,
- The level of costs for the production of goods or services (Carbon equivalent),
- Warranty period for the product, system, etc.

The EIA evaluation scheme also includes objectified expert indicators (for example, in a wall scale or statistically processed expert opinion):

- Desires - consumer preferences (expert assessment)
- Legal requirements (eg tenders), market component (competition)
- Data on the product and its production process and the nature of the primary raw materials (assessment)

For clarity, you can build a vector diagram in comparable coordinates and define the optimum as an area.

3. BASALT AND CARBON COMPOSITES AS COMPONENTS OF ECODESIGN

Setting the task for the use of materials is based on the setting of the task of compliance with the Ecodesign approach. Requirements are:

1. Simplicity and availability of primary raw materials, avoiding metal in general and rare metals in particular (composites based on Basalt and Carbon with the simplest organic fillers).
2. Regulated (set during production) properties and consumer qualities
3. Sufficiently long (or better regulated) life span correlated with innovation/renovation cycles.
4. Ecological cleanliness (biological neutrality) and ease of disposal.
5. Easily technologically achieved aesthetic effect.
6. Relative cheapness.

In principle, all these requirements are met by materials made of composites based on reinforcement with basalt or carbon fabrics, the so-called. basalt concrete, casting, extrusion, stamping from a mixture of org. Filler + reinforcing additive from basalt or carbon particles, profiles and scales in proportions of 15% or more.

Further examples of implementation (types of products):

- pillar (pipe, structural element),
- road markers and bumpers,
- instrument boxes and body parts of the control infrastructure in the public utilities,
- basalt rebar and road grids,
- soil reinforcement systems and artificial soil for greenhouses and flower beds.

The rapid development of the production of composites based on basalt fiber made it possible to create various components of a comfortable human existence in the urban environment (Figure1).

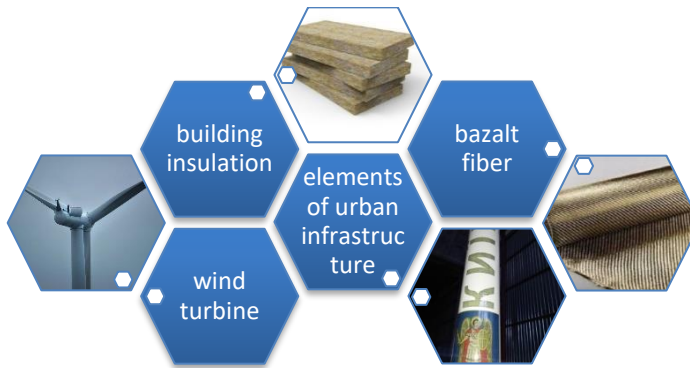


Figure 1: Basalt composite products

Thus, basalt fabrics became an alternative to metal reinforcing structures in construction [5]. Insulators based on basalt wool allow you to retain heat in homes without causing a negative impact on the environment. Replacing metal structures for street lighting with poles made of basalt composite not only extends their service life several times, but also significantly improves the aesthetic composition of the city. The energy crisis in Ukraine demonstrated the need for autonomous power supply for local areas and requires the creation of renewable energy generators. Such structures can also use elements made of basalt materials. In order to prove the advantages of basalt materials over metal in meeting the requirements of eco-design, a comparative analysis of poles for lighting city streets was carried out (Figure 2).

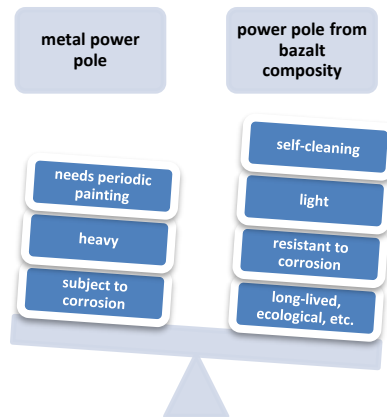


Figure 2: Comparison of the properties of a metal pillar and a pillar made of basalt material.

Another variant of the natural material that has unique properties is carbon fiber. This fiber has excellent structural characteristics and adsorption properties [6]. It can effectively adsorb various inorganic and organic compounds and promote regeneration. The main problem that arises when working with such a fiber is a weak

bond between the fibers. In order to increase the strength of weaving, it is proposed to cover it by nanomaterials, which, on the one hand, will not affect the adsorption properties, and on the other hand, it will preserve the integrity of the material.

4. CONCLUSIONS

Basalt and carbon fiber composites were selected as materials to improve urbanistic areas and satisfy the requirements of ecodesign.

It was substantiated that most metal objects of urban infrastructure can be made of basalt composites. Also wind electric stations could include such components.

Due to excellent structural characteristics and adsorption properties of carbon fiber it can effectively adsorb various inorganic and organic compounds and promote regeneration. To solve the problem of weak bonds between the fibers and to increase the strength of weaving it was proposed to cover it by nanomaterials.

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