Research Results of Furniture Design Using Color Plastic

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Abstract. The article considers the experience of studying the design capabilities of colored plastic in the process of designing furniture for pool locker rooms. Colored plastic is one of the most popular materials - it is a modern, environmentally friendly, and characterized by high impact resistance, resistance to abrasion, and the action of hot and detergent materials. Furniture made of plastic is inexpensive, lightweight and easy to carry; it is stable, it is resistant to rotting processes, insects and fungi. It is not able to swell or deform under the influence of moisture. Such furniture is easy to care for. Furniture for children is often made of plastic, because it is characterized by low weight and the absence of sharp corners. Due to this, the risk of injury by contact with it is significantly reduced. These advantages have stimulated us to find ways to expand the scope of use of plastic and furniture made of it. A visit to the pool prompted us to use this material for designing furniture for locker rooms for mothers and babies, because it is plastic that is the most suitable option for this subject - spatial environment. A team of teachers and students conducted experimental work to study the possibilities of using colored plastic in furniture for pool locker rooms. The purpose of the experimental work is to design a set of colored plastic furniture for changing the pool to increase the comfortable stay of mother and baby. The development was carried out taking into account the capabilities of the material to create a convenient, safe undressing zone. The study showed that the existing furniture filling of the locker rooms of the pool for mothers with an infant is not fully equipped or does not meet the important requirements for furniture. The experimental work was carried out in three stages, at the first - a sociological study was carried out, at the second - functional ergonomic research, design features and furniture requirements and criteria for evaluating equipment for pools were determined, and on the third - a design proposal for a pool furniture set made of colored plastic was developed. Reviews of employees, managers and visitors to the pools indicate the need for this kit in modern pools in Russia.

1. Introduction

Bakelite became one of the first examples of plastics; the material appeared in 1907 and was popular with art deco masters. Later, plastic was also used in architecture, for example, in 1957; the plastic house
of the future Monsanto was built in Disneyland, in order to demonstrate the capabilities of the material. In 1961, already in Leningrad, the architect A.P. Shcherbenok and engineer L.G. Levinsky reproduced a unique small plastic mansion [21]. According to the analysis of three-year observations, from the mid-60s in Russia, they switched to the practical introduction of plastic in construction (Moscow, 4th Vyatsky Lane - a plastic five-story building was built). After the Second World War, people started to live; they did not have the opportunity to buy expensive furniture, so plastic began to be in great demand. Its popularity was ensured by an affordable price and democracy. Inexpensive and affordable plastic quickly took a special place; the plastic boom began in the second half of the twentieth century. In the 1960s, almost everything was plastic, from household appliances to furniture. To date, colored plastic is one of the most popular materials - it is a modern, environmentally friendly material. Furniture from it is inexpensive, lightweight and easy to carry, it is not afraid of corrosion, rotting processes, insects and fungi. It is not able to swell or deform under the influence of moisture. Such furniture is easy to care for. Furniture for children is often made of plastic, as it is characterized by a low weight and the absence of sharp corners. Due to this, the risk of getting injured in contact with it is significantly reduced. These advantages stimulated us to search for ways to expand the scope of application of colored plastic in furniture [17, 18]. In addition, human waste provides a great opportunity to dispose of plastic, converting it into products. In the pool we are talking about more intensive use of furniture in the locker rooms, it turns out that most of such furniture does not withstand increased loads. The use of more durable materials increases the cost of the product. A visit to the pool prompted us to use colored plastic to design a set of furniture for the locker rooms of the pool [22] for mothers and babies, because it is plastic that is the most suitable option for this subject-spatial environment.

The relevance of our work stems from the need to search for modern materials for the manufacture of furniture for swimming pools [10], which would eliminate structural and functional-ergonomic shortcomings for a comfortable and safe stay for mothers and babies. In pools, the operation of furniture has the following features: multifunctionality, aesthetics, strength and safety. These are sanitary-hygienic, aesthetic, functional-ergonomic, operational requirements stem from the functional purpose of pool furniture. In our case, the space should function as intended, hence the particular requirements for its design and materials and safety. In the design process, we took into account the following requirements [1, 2, 3, and 6]: 1) functional – ergonomic; 2) operational and technological; 3) artistic and aesthetic; 4) safety requirements (environmental friendliness). The novelty of our study is the maximum identification of the positive qualities of colored plastic - multifunctionality, environmental safety, lightness, artistic aesthetics and impact resistance and variable use for the manufacture of furniture in the designed kit.

The practical significance lies in revealing the diversity of the use of colored plastic in the furniture equipment of locker rooms for the pool, especially in areas for mothers and babies. When designing furniture for mass production, we took into account the rather low cost and quick reproduction of this furniture using printing on a 3-D printer. Thus, the hypothesis of our study is the following assumption - in the process of designing pool furniture, it is necessary to look for materials that are not only affordable, but also provide multifunctionality, variability, aesthetics, safety, durability and environmental friendliness. The purpose of the experimental work is to design a set of furniture taking into account the possibilities of colored plastic, which meets the complex of modern requirements for environmentally friendly furniture. In order to solve this goal and test the hypothesis, a set of methods was used to identify the design features of colored plastic furniture for the pool.

2. Materials and methods of research
Our work was based on sociological and functional-ergonomic studies, which were applied and allowed us to obtain reliable evidence about the possibilities of using colored plastic for designing furniture for health facilities. The study involved teachers and students of the Design Department of Nosov Magnitogorsk State Technical University. They designed prototypes of pool furniture sets. The heads and visitors of the pools of Magnitogorsk took part in the evaluation of the prototypes.
The experimental work was carried out in three stages: at the first stage, a sociological study was conducted that showed the relevance of the identified research problem (Figure 1). 76% of respondents said that plastic is best suited for the manufacture of pool locker furniture, since plastic furniture is resistant to corrosion, rotting, insects and fungi. The second place is occupied by metal - 21%, and, least of all, wood and MDF (3% of the number of respondents).

![Figure 1. Sociological research.](image)

At the second stage, a functional ergonomic study was carried out, design features and furniture requirements were determined. At the third stage, a design proposal for a set of colored plastic furniture for the pool was developed. Empirical experience formed the basis for the design of furniture for the pool locker room and the manufacture of prototypes. In the work we used the following methods of scientific research, Table 1:

| Table 1. Stages and methods of scientific research. |
|--------------------------------------------------|
| 1. Theoretical                                   | 2. Sociological                                  | 3. Empirical (practical)                        |
| − analysis (functional, comparative,            | − conversation;                                  | − observation;                                  |
|     system, ergonomic)                           | − survey;                                       | − linear experiment;                            |
| − hypothesis                                    | − questioning;                                  | − study of design experience;                   |
|     construction;                               | − content analysis (statistical methods);        | − diagnostic procedures;                       |
| − classification by essential features          | − measurement                                   | − design and graphic modeling;                 |

Prototypes helped to identify the quality of the material used, to determine its functional and constructive value. Students and teachers continued to design other colored plastic furniture (objects) that were safe for use in health facilities.

3. Discussion
To date, in theory and practice, the main approaches to the use of environmental materials [4] in furniture are defined. However, such furniture is developed in small batches, individually by piece, or has a conceptual and exhibition character (art objects). Designers and designers need to have comparative characteristics for the right choice of materials and the calculation of the economic feasibility of serial production of environmental products. Today, in the context of globalization of ecology, the search for optimal resources for production, the secondary use of waste material, and ensuring the longevity of the
service of designed objects and products is becoming relevant. The inclusion of these conditions in the subject matter of a comfortable and safe socio-technical environment is an important issue for the state as a whole [6, 7, and 8].

4. Literary review

Pools belong to indoor sports facilities. In Russia, specialized pools for young children appeared at the turn of the 20th - 21st centuries, since the pool is always an economically expensive construction. Most of them were built universal, i.e. intended for all age groups. However, today there is a need to heal the smallest children by swimming. For them, sometimes they build separate pools or allocate separate time in universal pools. Both that and others demand specialized subject filling, including for a locker room. The design and formation of the subject-spatial environment of interiors of buildings and structures is carried out in accordance with the requirements in which, according to the state standard 25500-82, plastic is a very practical material [23, 24, 25]. The organization of the spatial domain is considered in the works of V.T. Shimko, S.A. Khasiev, N.N. Kim, N.A. Morgun, E.V. Sobolev. The theoretical aspects of developing a residential and public environment, taking into account social, ergonomic, constructive, bionic characteristics, are laid down in the works of A. Grushin [6], Zmeula S.G., Molchanova V.M., Novikova E.B. Furniture design is described in A.A. Bartashevich [5], V.D. Bogush, N.S. Zhdanova [7], V.F. Runge [14], Plotnikova M.M., Kosheleva N.A. [13] et al. A few works are devoted to the organization of the interiors of children's institutions. The works of Zhdanova, N. S., Zhdanov, A. A., Lymareva, J. V. [4] are of particular interest, the authors suggest the possibility of using non-traditional materials. A review of the literature showed that the declared direction in the design of colored plastic furniture is relevant and extends the existing experience in design, defining new varied solutions for the use of recycled materials and the fight for the environment.

5. Results

Modern sports facilities in our country include: training facilities for education and training, demonstrations for competitions in the presence of spectators, general physical training and outdoor activities, indoor gyms, indoor pools, all kinds of open planar platforms and facilities [19, 20]. The functional purpose imposes additional requirements on the design and materials [11, 12] of the subject filling of pools.

The team of teachers and students of Nosov Magnitogorsk State Technical University conducted experimental work on the study and development in practice of furniture made of colored plastic. At the beginning, at the first stage, a sociological study was conducted, the consumer was studied. Further, the criteria for evaluating the equipment were determined, Table 2.

| №  | Criterion                                                                 | Availability |
|----|---------------------------------------------------------------------------|--------------|
| 1  | Technological indicators (accuracy and purity of the product, the ability to disassemble it, the interchangeability of parts, the degree of standardization, normalization and unification, type and category of finish) | +            |
| 2  | Consumer properties (functional, ergonomic, social, aesthetic and environmental indicators) | +            |
| 3  | Design features of the solution (mobility, combinativity and modularity, collapsibility and universality of the design) | +            |
| 4  | Convenience and safety of use (hygiene and sanitary standards)            | +            |
| 5  | Forming (the form is objectively dependent on the function, design, material properties, manufacturing technology) | +            |
| 6  | Technical and economic indicators (material and labor costs)              | +            |
| 7  | The role of the latest technologies in the creation of products (ensuring their quality) | +            |
indicators)
8 Overall dimensions (functional dimensions of equipment) +
9 Color in the artistic design of equipment (psychological impact of color) +
10 Composition (tectonics and spatial and spatial structure of the product, layout +
principle, proportionality, scale, compositional balance, symmetry and asymmetry,
static and dynamic, coloristic and tonal unity, which ensure harmonious integrity of
the form)

Special and regulatory literature on plastic furniture was studied; its properties and design features were clarified. Already at this stage, the team determined the number of products of prototypes of furniture. The shape and design and functional features of the furniture were determined, Figures 2-3.

![Figure 2](image1.png)
![Figure 3](image2.png)

**Figure 2.** Sample of a cabinet. **Figure 3.** Samples of benches.

Based on the results of the third empirical stage, recommendations were formulated for the subsequent design of pool equipment: 1. It is necessary to develop specific types of multifunctional equipment for pool locker rooms, in accordance with specific social groups. 2. It is necessary to develop a set of furniture corresponding to the functional purpose of the room and type of activity. 3 The color scheme of the interior positively affecting the psychological atmosphere and the comfortable stay of visitors to the people who are in it. 4. When developing, use environmentally friendly materials. The implementation of these recommendations allowed us to formulate more rationally the conceptual foundations of the artistic-shaped solution and the implementation of the locker room pool. Summarizing at the third stage of the study all the results obtained, we came to the conclusion that it is necessary to design a multifunctional [9] furniture set, which is presented in Figure 4.

![Figure 4](image3.png)

**Figure 4.** Option set of furniture made of colored plastic.
Universal, practical, lightweight and fun plastic in all respects the aesthetics of the 60s and 70s, but after a decade it somewhat lost its popularity. There were many accusations addressed to this material: it is not environmentally friendly, it is poisonous when burning, it does not look too presentable, it does not let air in, and in the global sense it also clogs the planet. All these objective shortcomings of the material have intensified the scientists who undertook to improve it. Now plastic is recognized as safe, able to "breathe" and even participate in recycling. In our study, the principle of environmental friendliness is used - ensuring the longevity of the service of designed objects and products. Testing of this material in the manufacture of furniture for swimming pools has led to the conclusion that it is one of the undisputed leaders in the production of varied, multifunctional and safe furniture, which has a high artistic-figurative expressiveness. This research work does not exhaust the fullness of the problem, showing the need for its further development and implementation in the organization of the subject-spatial environment of public interiors [15, 16, and 26] and the urban environment.

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