# ABSTRACT

Photocatalytic building mixtures fit perfectly with the concept of sustainable construction. Namely, the photocatalytic building materials show the self-cleaning properties and the ability to de-pollute air. Particles of photocatalysts are incorporated into the building material mass or immobilized onto the building material surface. Up to now, the cement and concrete materials have been intensively studied as a building matrix for the photocatalytic action. The scientific concentration on the cement mortars, concrete blocks or building stones resulted from their outdoor intended use. The base form of $TiO_2$ can be activated only by ultraviolet irradiation, which is contained in the sunlight. However, the new synthesized modified photocatalysts can be also activated by commonly available visible irradiation, which is present in the interior of the rooms. It seems that the studies of the photocatalytic building materials dedicated to the interior of buildings is highly justified. The research issue is poorly recognized in the scientific literature.

In this PhD thesis, gypsum materials enriched with the photocatalytic particles based on the titanium dioxide were presented. The aim of this work was to obtain the modified gypsum materials with the purifying and self-cleaning properties and the good technical parameters simultaneously. It was applied the commercial photocatalyst and numerous photocatalysts modified with a nitrogen and carbon, differing in the physicochemical properties. The influence of these photocatalysts on the parameters of gypsum binder as well as gypsum mixtures was analyzed in detail. The doses of the photocatalysts were differentiated and the additional components, such as a superplasticizer and a glass fiber, were incorporated into the gypsum matrix.

In this dissertation the obtained mixtures were characterized in detail towards the following technical parameters: consistency, setting time, flexural and compressive strength, adhesion, shrinkage as well as the photocatalytic properties were taken into account: the removal of nitrogen oxides from the air and the self-cleaning abilities during degradation of model dyes from the mortars surfaces. The mechanical and functional features of the modified gypsum materials were determined by the physicochemical parameters of the applied photocatalysts. It refers to the fresh mortars, the mortars during curing and the hardened mortars.

The conducted research can be divided into three stages. The first stage involved many initial analyses using the small scale samples. As a building matrix was applied the gypsum

binder. The type of binder, the type and dose of photocatalyst, and the irradiation source were differentiated. In the second stage the studies were carried out according to the normal standards. In this part of research the gypsum plaster was enriched with the selected photocatalysts. During the third stage the special attention was paid to find the additional components of mixtures in order to improve technical parameters of photocatalytic gypsum plasters, especially the strength characteristic.

It appeared that the type of the $TiO_2$ crystalline phase and the size of $TiO_2$ crystallites can influence on the mechanical and functional parameters of gypsum materials. The water demand of gypsum mortars depends a lot on the external surface area of photocatalysts, not on the total surface area of them. The presence of a photocatalyst in gypsum matrix involves the thickening of consistency, the shortening of setting time and the decrease of strength characteristic of the gypsum materials. However, using the modified TiO2 the influence occurs to a much lesser extent in comparison to the commercial photocatalyst P25. Moreover, the modified photocatalyst allows achieving a high photocatalytic effectiveness under the UV irradiation and visible light. It was found that the presence of photocatalytic particles in gypsum matrix has the positive effect on the limited shrinkage of the hardening mortars. The gypsum mortars containing the photocatalysts show the required adhesion to the different surfaces: the concrete base, the ceramic brick, the sand-lime block and the gypsum plasterboard. The detachments are cohesive and take place in the substrate or in the mortar material. The most promising properties of the final gypsum product was recognized for the gypsum mortar with combined effect of three additives: the modified photocatalyst, the superplasticizer, as a water-reducing agent, and the glass fiber, showing the reinforcement function and having the synergistic effect with photocatalyst particles towards intensification of the photocatalytic action.

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