

UTILIZATION OF GLASS WASTE FROM SOLAR PHOTOVOLTAIC PANELS IN THE PRODUCTION OF BINDING MATERIALS AND CONCRETE BASED ON THEM

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Photovoltaic panels are the most commonly used energy generation technology, right after hydro and wind power generation. However, as the number of installations increases, the number of solar panels that have fully exhausted their resource will continue to grow. From this point of view, solar cells will become a form of hazardous waste, since the composition of photovoltaic glasses includes compounds of heavy elements. Therefore, to prevent damage to the environment, they must be restored or disposed of properly.

The use of waste glass of solar cells of photovoltaic panels as a secondary raw material is considered due to its great advantages, which include reducing the cost of its disposal, protecting the environment and preserving the raw materials. The inclusion of photovoltaic waste (in particular, glass from photovoltaic panels) in the cement matrix can become one of the new directions of possible recycling. Therefore, the purpose of this study is to determine the possibility of using the glass of solar photovoltaic panels for partial replacement of cement, as well as an aggregate for obtaining concrete.

Partial replacement of cement with scrap glass in the composition of the binding material is possible, mainly for Portland cement, since the presence of glass in the composition of more than 70 wt. % SiO_2 allows it to be used as a pozzolanic additive similar to synthetic microsilica. It was established that the introduction of broken glass into the composition of the binding composition reduces the initial strength by 14%, but in the future the strength of the cement composition does not decrease when the composition of broken glass is introduced into its composition in the amount of 10 wt. %. When the cullet content increases, the strength does not increase as a result of the alkaline-silica reaction.

To obtain concrete samples, a composite mixture of Portland cement with 10 wt. % additives for broken glass and alumina cement. Broken glass from photovoltaic panels was used as a filler. As a result of the conducted research, it was established that waste glass from photovoltaic panels can be used as an aggregate for obtaining concrete for general construction purposes. At the same time, the use of larger fractions of glass is impractical, since its smooth surface does not allow establishing strong adhesion with cement and will lead to the appearance of cracks along the grains of the aggregate. The developed concretes are suitable for load-bearing elements of brickwork and have a strength mark of M500 (class B40). It was established that the obtained concretes have a density of 2140 and 1850 kg/m³, and therefore the density grades D2100 and D1800, respectively. That is, concrete on Portland cement composition is considered heavy, and on alumina cement – weighted. Thus, depending on the brand and class, the obtained concrete should have W10 waterproofing classes, and F200 frost resistance classes, which will allow them to be used for the manufacture of bridge structures, hydraulic structures, special reinforced concrete structures, bank vaults, subways, dams and other structures with special requirements.