UDC 691.327.32

TIME-DEPENDENT BEHAVIOR OF SHRINKAGE STRAIN FOR EXPANDED CLAY AGGREGATE FIBER-REINFORCED CONCRETE

YU. G. MASKALKOVA, V. A. RZHEVUTSKAYA
Belarusian-Russian University
Mogilev, Belarus

Expanded clay aggregate concrete is a promising building material for the manufacture of load bearing building and framed structures. Using of this type of concrete reduces material consumption and thermal conductivity of building structures. The disadvantages of expanded clay aggregate concrete are the brittle failure and high value of shrinkage strain than for equal-strength normal weight concrete [1].

These negative impact factors can be reduced by reinforcement of expanded clay concrete with low-modulus fibers (for example, polypropylene).

Despite the fact that steel fibers are more common, the using of polymer fibers has some advantages. Polymer fibers have high corrosion and chemical resistance, low tendency to clumping due to the small length of the fibers, insignificant self-weight. As a result of the use of polypropylene fiber, the resistance of concrete to impact significantly increases and brittle failure is eliminated [2].

The object of this research was samples of expanded clay aggregate concrete and expanded clay aggregate fiber-reinforced concrete.

The subject of this research was free shrinkage strain of expanded clay aggregate concrete and expanded clay aggregate fiber-reinforced concrete.

The following materials with the main characteristics were used for concrete specimens manufacturing: coarse aggregate was expanded clay gravel with a particle size of 4–10 mm (G); fine aggregate was locally available natural river sand with a bulk density 1670 kg/m^3; the fineness modulus of river sand was 2.13 (S); binder was Portland cement (type I) with compressive strength 42.5 MPa (C); dispersed reinforcement was polypropylene fibers with a diameter of 50 microns and length of 12 mm. The composition of the expanded clay aggregate concrete mixture was C : S : G = 1 : 1.84 : 0.79, W/C = 0.52. The polypropylene fibers content by volume was 0.36 %.

The accumulation process of shrinkage strains was investigated for expanded clay aggregate fiber concrete and expanded clay aggregate fiber concrete (without fibers). The specimens for testing were prisms with dimensions of 150 × 150 × 600 mm. Free shrinkage strains were measured on each surface of the tested prism by dial indicators (the classic mechanical version, provides a dial display similar to a clock face with clock hands) [3]. The measurement of strains on the open surface of the prism began in 3–4 hours after the concrete mixture placing. The duration of the test was 120 days.

In Figure 1, the histogram shows a decrease of the total shrinkage strain values (in %) of the expanded clay aggregate fiber-reinforced concrete compared to the total shrinkage strains of the expanded clay aggregate concrete without fibers.

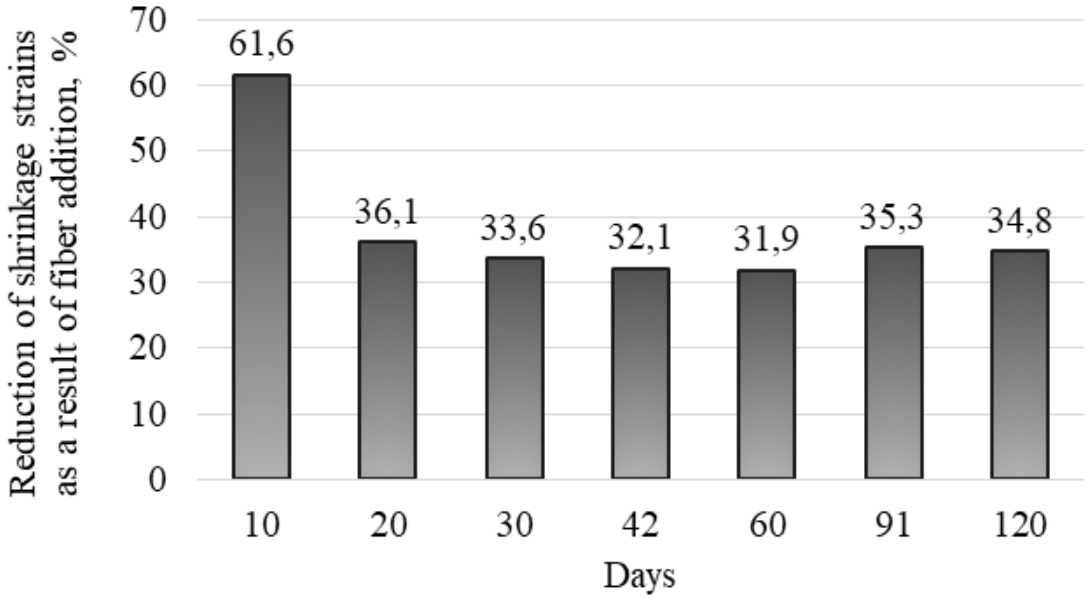

Fig. 1. Reduction of total shrinkage strains due to the addition of polypropylene fibers

As can be seen from the histogram, the shrinkage strains decrease most significantly in the first 10 days. This is due to the fact that a lightweight coarse porous aggregate (expanded clay gravel) retains water. The values of shrinkage strains decrease by an average of 34 % on the 20th day and later.

Thus, according to the experimental data obtained on the 120th day, fiber content of 0.36 % by volume reduces the total shrinkage strain of expanded clay aggregate fiber-reinforced concrete by an average of 34 % compared with strain of expanded clay aggregate concrete without fiber reinforcement.

REFERENCES

1. **Maskalkova, Yu.** Compressive Strength of Expanded Clay Fiber-Reinforced Concrete / Yu. Maskalkova, V. Rzhevutskaya // AlfaBuild. – 2021. – Iss. 19 (4).

2. **Maskalkova, Y. G.** The Effective Reinforcement Ratio of Expanded Clay Concrete by Polypropylene Fiber / Y. G. Maskalkova, V. A. Rzhevutskaya // Construction of Unique Buildings and Structures. – 2020. – Vol. 93, № 83 (8).

3. **Ржевуцкая, В. А.** Относительные деформации полной усадки керамзитобетона / В. А. Ржевуцкая, Ю. Г. Москалькова // Вестн. Полоцкого гос. ун-та. Сер. F. Строительство. Прикладные науки. – 2021. – № 16. – С. 99–105.