

MODIFICATION OF CONCRETE TO IMPROVE ADHESION PROPERTIES

Vinnitsia National Technical University

Abstract

The article examines the main types of modifiers used to improve the adhesion properties of concrete, namely polymer, chemical, mineral additives and dispersed reinforcement. The key factors leading to poor bond strength between concrete layers or with reinforcement, in particular high porosity, shrinkage cracking and weak interfacial transition zone, are analyzed. The influence of each modification type on the adhesion mechanisms and the durability of the contact zone is determined.

Keywords: adhesion, concrete modification, polymer additives, mineral additives, bond strength, pull-off test, interfacial transition zone.

Concrete is used everywhere today - it is strong, lasts a long time and is suitable for various tasks. But the main problem often arises at the microscale if the material does not adhere well to the reinforcement or other layers, the entire structure becomes unreliable. Cracks appear, delamination occurs, and strength decreases. Therefore, the question of how to increase the adhesion of concrete is now very relevant.

Polymer additives

The underlying mechanism is based on: they create additional bonds inside the concrete and make the contact zone denser. Most often, latex, acrylic or epoxy are used. After hardening, these polymers form a thin film that closes micropores and cracks. Due to this, moisture penetrates less. Such additives are very popular in building mixtures, adhesives and waterproofing.

Chemical additives

They work on the principle of compaction: they improve the interaction between all components of concrete. The most famous are plasticizers and superplasticizers. Thanks to them, you can reduce the amount of water in the mixture, but at the same time it remains mobile. The result is a dense stone with a small number of pores, which means that the adhesion becomes better.

Accelerators and retarders of hardening are also used. Accelerators help to gain strength faster - this saves when repairing or when working in the cold. And retarders allow you to work with the mixture longer and improve adhesion between layers when concrete is laid in stages.

Mineral additives

These include microsilica, fly ash, blast furnace slag and metakaolin. All of them are very small, so they perfectly fill the voids between the cement particles. As a result, the structure becomes denser, and adhesion increases. Microsilica works especially well. It reacts with the products of cement hydration and creates strong additional compounds. Due to this, the contact zone becomes much stronger, and the risk of microcracks is reduced. In addition, such additives increase the frost resistance, water resistance and overall durability of concrete. Even in difficult conditions, it retains its adhesive properties longer.

Dispersed reinforcement

In this method, small fibers are added to the concrete - metal, polypropylene, basalt or glass. They are evenly distributed throughout the mass and do not allow cracks to develop. This is very important for maintaining strong adhesion between the layers of concrete and with the reinforcement. Fiber concrete withstands impacts and deformations much better, and its adhesive properties remain stable for many years. Such material is often used for industrial floors, roads, tunnels and repair work - wherever structures are subjected to serious loads.

Experimental methods for assessing concrete bond strength

So how do you actually check if concrete sticks better after adding those modifiers? The most common way is the pull-off test - you glue a metal disc to the surface, pull it straight up, and see how much force it takes to rip it off. That tells you the tensile bond strength between two concrete layers or between concrete and a repair layer. Then there's the slant shear test: you cast two concrete pieces with a slanted contact line (about 30 degrees), press them together until they break, and measure the shear strength.

For reinforcement bars, the push-out test works well - you embed a short bar in concrete and push it out, recording how the bond slips. And if you want to really understand what's happening at the microscopic level, you can do SEM-EDS to look at the contact zone between old and new concrete, or try a splitting test on a composite cylinder. All these methods together give you a full picture of how well the concrete holds together and where it actually fails.

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Rizun Mykola – student of group 1B-24b, Faculty of Construction and Civil Engineering, Vinnytsia National Technical University, Vinnytsia, e-mail: rizunkola77@gmail.com

Androshchuk Kateryna Mykolaivna – Lecture, Chair of Foreign Languages, Vinnytsia National Technical University, Vinnytsia, e-mail: katja11landros4uk@gmail.com