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Research of the Influence of the "BETON STRONG 17" Additive on the Physical and Mechanical Characteristics of Lightweight Concrete Based on Expanded Clay

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Abstract: This article presents the results of studies of the influence of the superplasticizer "Beton Strong 17" on the physical and mechanical properties of expanded clay based on lightweight concrete. When the superplasticizer "Beton Strong 17" was added to the composition of lightweight concrete, a decrease in the water-cement ratio and an increase in strenght were found.

Key words: "Beton Strong 17", porous placeholders, cement, cement stone, water-cement ratio.

Nowadays, concrete and reinforced concrete products have become an integral part of construction. Everyone knows that concrete and reinforced concrete are very heavy, and this is the reason for the increase in volume and geometric dimensions. It is because of these factors that the demand for concrete with lightweight properties and properties with a high level of thermal conductivity is growing.

According to their extensibility, concretes are divided into compacted and simple types. These include simple concretes, in which light or heavy sand in the pores of cement mortars is filled between large composites, light concretes with large pores formed as a result of the preservation of pores from the voids between lumps without sand and additives, the resulting gas and then foams in the cement slurry. Basically, lightweight concrete with fine-grained composites and coarse-grained composites of 20-40mm in size is used in construction.

The strength of lightweight concrete depends on the ratio of water to cement, since it mainly determines the strength of the cement stone. But expanded clay composites have less concrete strength compared to cement mortar in terms of their structural properties. The introduction of expanded clay composites into the composition of lightweight concrete reduces the strength of concrete based on their quantity and density.

One of the main properties of lightweight concrete with expanded clay composites in the composition is to ensure the strength of each coarse-grained composite according to its specific concrete strength. Concrete with a given degree of strength does not lead to an obvious increase in strength even with a further increase in the strength of the mortar. In the first zone, an increase in the strength of the solution leads to an increase in the strength of concrete, and here the effect of the ratio of water to cement is observed. In the second zone, an increase in the strength of the solution does not lead to an increase in the strength of concrete. This is due to the weakness of the composite and the fragility of the thin cement framework.

Another quality of lightweight concrete is their thermal conductivity, which in turn determines the density of the structure of the partitions. As the density of the concrete increases, the thermal conductivity of the concrete increases. An increase in the number of lightweight composites in the composition, a decrease in density leads to a decrease in the thermal conductivity of concrete, in particular, the thermophysical properties are improved. But in this case, the strength of the concrete decreases. For this reason, in practice, it is required to find the most perfect ratio in finished materials. In this case, too, reducing the use of cement to a minimum level is considered one of the important qualities.

Lightweight composites, having the property of water demand to an important extent, when they get into the cement slurry, they absorb a certain amount of water in the cement slurry. This process takes place more intensively in the first 10-15 minutes of preparing the concrete solution. Here, the amount of absorbed water depends on the composition of the concrete solution: in liquid and mobile concrete, the ratio of water to cement increases, and vice versa, the ratio of water to cement is inherently low in thick concrete solutions, the amount decreases.

Expanded clay composites, in comparison with other dense composites in cement paste, have the property of absorbing more water, and for this reason affects the process of its formation. At the first stage, expanded clay composites absorb moisture and form a strong and solid connection in the layers between the cement stone and composites. At the second stage, due to water reduction, the sucked-out moisture by expanded clay composites returns and forms the required condition for hydration in the cement stone. Considering the highly uneven coating of lightweight composites, there is

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good adhesion to the cement stone and due to the easily deformable properties of the composite, there are fewer cases such as settling of the cement stone negatively affecting the composition of the cement, the formation of microcracks.

Due to the uneven coating of expanded clay crushed stone and sand, voids are formed between lumps in the solution. Along with filling these voids and introducing cement mortar between the lumps together, in order to obtain a non-layered, easily processed concrete mortar, the cement mortar is consumed 1.5-2 times more than conventional concrete.

And this by itself leads to an increase in the water demand of a concrete solution with a large amount of hollow composite.

While chemical additives have become part of modern construction. Neutralizing these problems without chemical additives is difficult. Based on the above reasons, our scientific research was aimed at studying how and to what extent the superplasticizer "Beton Strong 17" affects the physical and mechanical characteristics of lightweight concrete.

As a result of the study, the influence of the superplasticizer "Beton Strong 17" on the characteristics of the cement paste was determined. The research results showed that when adding 0.5-2% of the Beton Strong 17 superplasticizer to the cement paste, the water-to-cement ratio decreased by 6-21% compared to conventional cement paste without additives, the beginning of hardening lasted 15-60 minutes, the end of hardening for 25-55 minutes. By adding 1% more, the highest compressive strength was achieved and the strength increased by 3.1%.

Table-1 Influence of the superplasticizer "Beton Strong 17" on the characteristics of portlad cement pozzolan.

№	Q'ty of cement, (gr)	Sand, (gr)	Water, (ml)	Ratio, (%)	Additive (%)
1	500	1500	200	0,4	0
2	500	1500	185	0,37	1

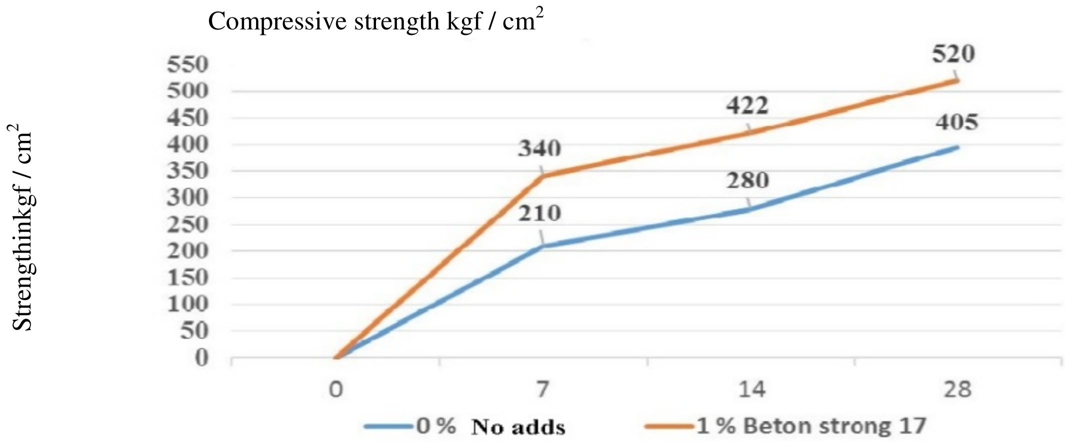

Figure-1. Influence of chemical additive Beton Strong-17to the properties of Portlandcement

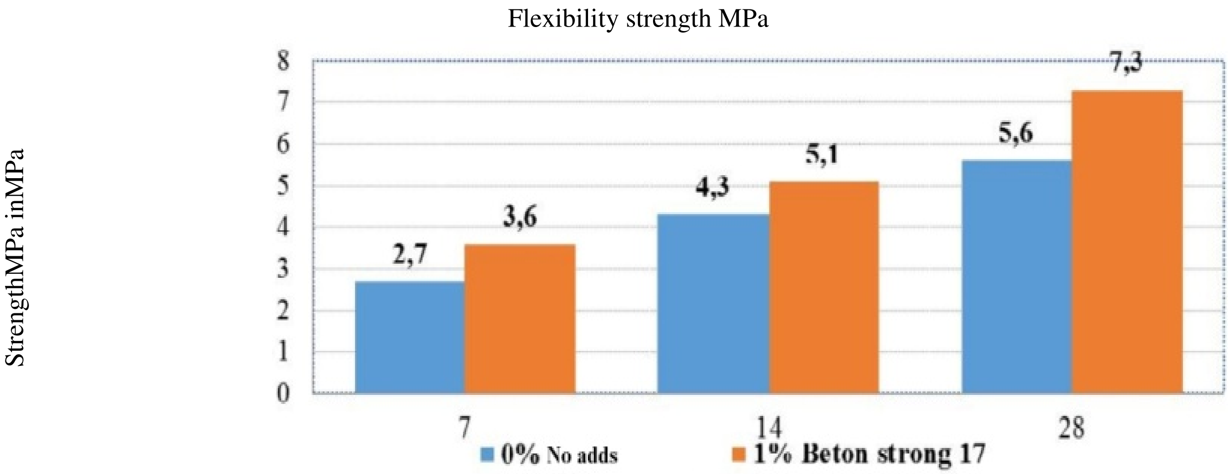

Figure-2. Influence of chemical additive Beton Strong-17to the properties of Portlandcement

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With the addition of 1%, we additionally acquire the highest degree of compressive strength and flexibility, and this amount was chosen as the most optimal option. Conducted observation of the results of the effect on the characteristics of lightweight concrete based on expanded clay for the selected optimal amount.

Table-2. The composition of the composite by the formation of a lump.

Lumpformationcomposition	Grain composition of the aggregate		
	Fine-grainedcomposite%	Coarsecomposite %	
	upto 5mm	5-10mm	10-20mm
I.	-	50	50
II.	15	45	40
III.	30	35	35
IV.	45	30	25

Table-3 1. Influence of the superplasticizer "Beton Strong 17" on the characteristics of lightweight concrete

Lumpformationcomposition	Composite, kg		Cement, kg	Ratio	R, MPa	Addit, %	ρ, kg/m^3
	<5mm	>5mm					
1	-	600	225	0,5	7	0	842
2	-	600	225	0,45	9,1	1	840

Compressive strength MPa

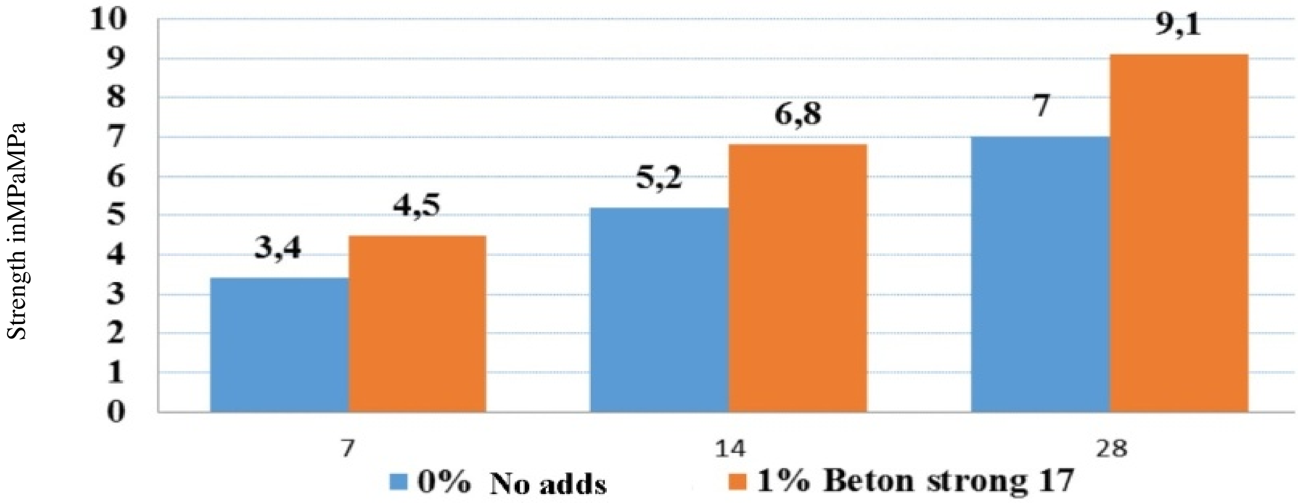

Figure-3. Influence of chemical additive Beton Strong-17to the properties of lightweight concrete

Table-4 Influence of the superplasticizer "Beton Strong 17" on the characteristics of lightweight concrete

Lumpformationcomposition	Composite, kg		Cement, kg	Ratio	R, MPa	Addit, %	ρ, kg/m^3
	<5mm	>5mm					
1	225	600	225	0,5	9,6	0	1067
2	225	600	225	0,45	12,5	1	1065
3	225	600	215	0,45	10,1	1	1054

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Compressive strength MPa

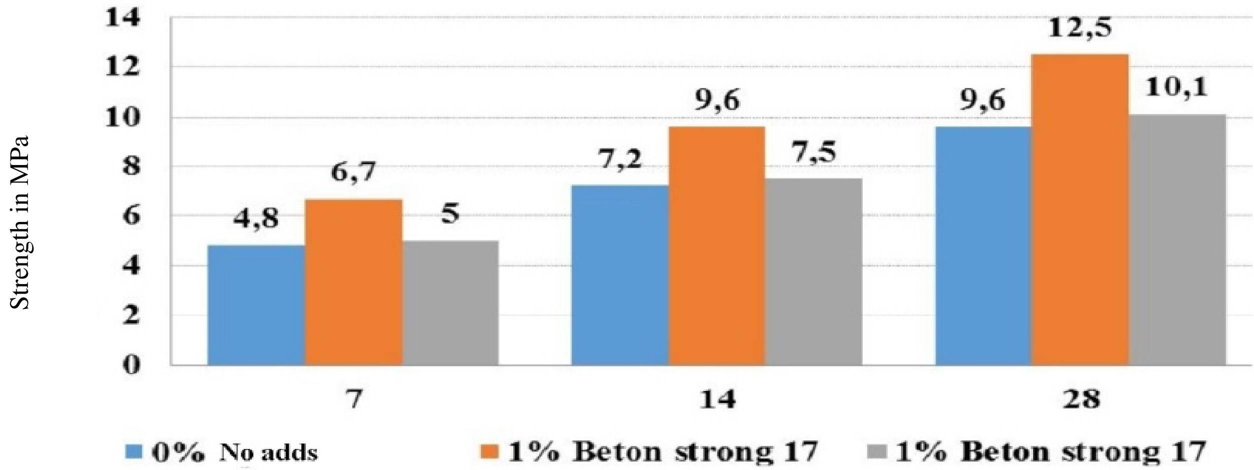
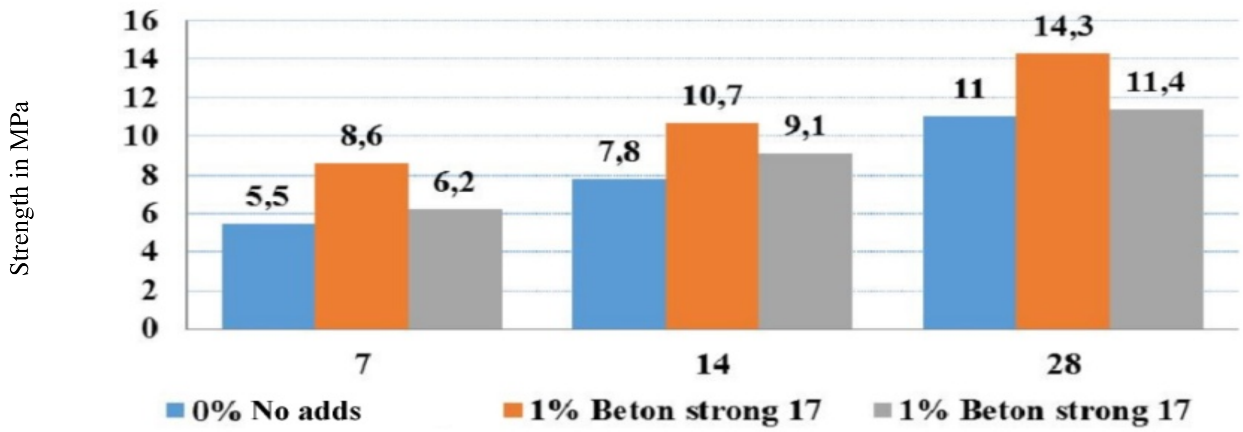


Figure-4. Influence of chemical additive Beton Strong-17to the properties of lightweight concrete

Table-5. Influence of the superplasticizer "Beton Strong 17" on the characteristics of lightweight concrete

Lumpformationcomposition	Composite, kg		Cement, kg	Ratio	R, MPa	Addit, %	ρ, kg/m^3
	<5mm	>5mm					
1	450	600	225	0,5	11	0	1292
2	450	600	225	0,45	14,3	1	1290
3	450	600	205	0,45	11,4	1	1269

Compressive strength MPa



Additivesin% quantity

Figure-5.***Influence of chemical additive Beton Strong-17to the properties of lightweight concrete***

In conclusion, we can say that an increase in strength and a decrease in the ratio of water to cement were revealed when adding superplasticizer "Beton Stron-17" even to lightweight concrete.

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