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# OBTAINING THE NANOMODIFIER FOR CEMENT COMPOSITES BASED ON THE "DEALTOM" CARBON NANOTUBES

**Yu.V. Pukharenko[1], D.G. Letenko[1*], V.A. Nikitin[2], V.I. Morozov[1]**

[1]Saint Petersburg State University of Architecture and Civil Engineering,

Vtoraja Krasnoarmejskaja ul. 4, St. Petersburg, 190005, Russia

[2]Saint Petersburg State Polytechnic University, 29, Politekhnicheskaya Str., Saint Petersburg, 195251, Russia

*e-mail: dletenko@mail.ru

**Abstract.** In this paper we present the method for obtaining and the results of application of a new nanomodifier for concrete mixes plasticizers, which is the composition of the DEALTOM material with branched bulk structure and the high-reactive carbon-carbon composite by SPSUACE (Saint Petersburg State University of Architecture and Civil Engineering). As a result, we have obtained a product that has more powerful influence on rheology of concrete mix and structure of cement rock than the DEALTOM and SPSUACE nanomaterials used separately in the same concentration.

## 1. Introduction

Application of carbon nanomodifiers (CNM) for improving the properties of concrete mixes and concrete is currently one of the most rapidly developing areas of construction materials science. This is shown by a number of publications in both Russian and foreign scientific editions [1-6]. The results achieved by various authors and by us in particular allow speaking about the economic viability of using various CNM in the process of ready-mixed concrete manufacturing. However, application of CNM in construction has not become a frequent practice either in Russia or abroad. The main reasons for this are certain complication of concrete mixing process when using different CNM on the one part, and temporary instability of the additive agents modified by carbon nanoparticles and used in the production, which is noted by many authors, on the other part.

The goal of this paper was to create a technology for obtaining a reasonably priced and easily used nanomodifying additive agent based on the materials made in Russia.

There are currently two methods for injection of CNM into a concrete mixes bulk. The first one is ultrasonic dispergation of nanoparticles in liquid-saturated medium, which is usually a part of mixing water with addition of a surface-active agent (SAA) [4]. The second is collective grinding (mechanical activation) of CNM with one of the concrete mix components, for example, silica fume [3]. It is worth noting that the used methods have the following disadvantages:

1) After ultrasonic treatment in liquid-saturated medium, the suspension of carbon nanoparticles is formed, which are enclosed with the SAA molecules layer, significantly decelerating their aggregation, though not stopping it entirely. Eventually, the CNM aggregations are formed with 1-100 μm in size, which are apt to sedimentation.

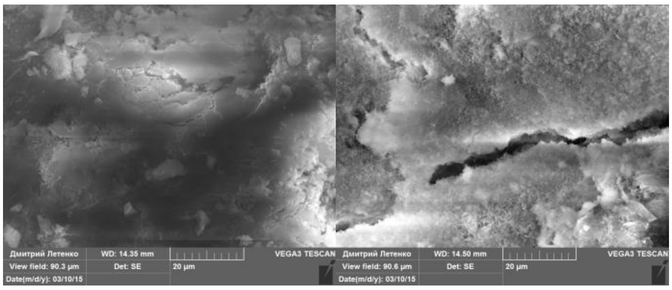
It is possible to avoid CNM floe formation with subsequent sedimentation by means of creating a bulky fractal percolation grid in the suspension, but it sets some limitation to the ratio of suspension concentration mixture, which may be inconvenient for the process of production.

2. In the process of mixing the cement with the CNM water suspension containing superplasticizing agent, the fluidity of the cement paste increases (Table 1). The quoted results were achieved at cement-water ratio W/C = 0.22 and concentration of the Schomburg Remicrete SP-10 (FM) superplasticizing agent equal to 0.6 % of the cement mass.

Table 1. Influence of Nanomodifier Form on Fluidity of the Cement Paste Defined by the Flow Tested in Shaker Apparatus.

| Nanomodifier Form | Flow, mm |
|---|---|
| Water-based cement paste (without superplasticizing agent and nanomodifier) | 148-150 |
| Cement paste with superplasticizing agent without nanomodifier | 172-175 |
| Cement paste with superplasticizing agent and the SPSUACE nanomodifier | 187-190 |
| Cement paste with superplasticizing agent and the DEALTOM nanoparticles (raw product) | 177-178 |
| Cement paste with superplasticizing agent and the new CNM | 201-204 |

3. The structure of cement rock was explored using TESCAN scanning electronic microscope (see Fig. 2).




a) b)

**Fig. 2.** Cement Rock Cleavage Face: a) without CNM modification; b) CNM modified.

Figure 2 shows that the cement rock obtained with the application of superplasticizing agent, modified by CNM, differs from the reference specimen (obtained with the application of superplasticizing agent without nanomodifier) by presence of many submicrometer dimension acicular crystals, filling micro-cracks in the material.

4. It is found that modification of concrete mix by CNM in the composition of mixing water with superplasticizing agents leads to the increase of concrete strength (Table 2).

Table 2. Influence of Nanomodifier Form on Strength of Concrete Specimens, Manufactured from Equally Fluid Concrete Mixes with Steady Flow of Cement.

| Concrete | Specified Grade of Concrete Mix and Concrete Strength | Cement-Water Ratio | Concrete Compressive Strength, MPa |
|---|---|---|---|
| Without superplasticizing agent and nanomodifier | П4<br>В 25 | 0.45 | 33.1 |
| With the application of superplasticizing agent without nanomodifier | П4<br>В 25 | 0.4 | 39.2 |
| With the application of superplasticizing agent and the SPSUACE nanomodifier | П4<br>В 25 | 0.35 | 42.1 |
| With the application of superplasticizing agent and the DEALTON nanoparticles (raw product) | П4<br>В 25 | 0.38 | 40.3 |
| With the application of superplasticizing agent and the new CNM | П4<br>В 25 | 0.33 | 43.0 |

## 3. Conclusions

In the present paper, we have suggested and tested the methods for obtaining a new nanomodifier for concrete mixes plasticizers, which allows reducing their manufacturing costs by at least 10 %, improving remoldability and increasing strength. The suggested modifier for concrete mixes is manufactured on the basis of the components made in Russia and easy to use.

## References

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