

Application of nanodisperse silica for increasing the strength of cement samples

© Vadim V. Potapov,¹ Evgeniy S. Shitikov,² Semen A. Tatarinov,³
Vasily N. Portyagin,³ Valeriy N. Zelenkov,⁴ and Anatoliy A. Lapin^{5,6,*†}

¹ Scientific-research geological-technological center of Far Eastern branch of RAS. Severo-vostochnoye shosse, 30. Petropavlovsk-Kamchatskiy, 68303. Kamchatka region. Russia.

Phone/fax: +7 (41552) 9-26-39. E-mail: vadim_p@inbox.ru

² Public corporation scientific-research institute for construction of traffic facilities. Kolskaya St., 1. Moscow, 129329. Russia. Phone/Fax: +7 (495) 189-72-53. E-mail: esh_45@mail.ru

³ Vitus Bering Kamchatka state university. Scientific-education center ЭТехнопаркЭ. Pogranichnaya St., 4. Petropavlovsk-Kamchatskiy, 683032. Kamchatka region. Russia. Phone/fax: +7 (41552) 42-6922.

E-mail: kgpu@kamgu.ru

⁴ Department of Physical-chemical biology and innovations. Russian academy of natural sciences. Moscow. Russia. E-mail: zelenkov@mai.cnt.ru

⁵ Technological laboratory of A.E. Arbuzov institute of organic and physical chemistry at KazSC of RAS. Ak. Arbuzov St., 81. Kazan, 420088. Republic of Tatarstan. Russia.

Phone: +7 (843) 272-73-34. E-mail: lapin@iopc.ru

⁶ Department of water bioresources and aquaculture. Kasan state power engineering university. Krasnoselskaya St., 51. Kazan, 420066. Russia.

*Supervising author; †Corresponding author

Keywords: nanodisperse silica, hydrothermal solution, nanopowders of silica, cement, nanoadditive, compression strength, strength acquiring rate.

Abstract

From natural hydrothermal solutions there have been obtained samples of sols and silica powders by the technological scheme: membrane concentration of silica sols; cryoaggregation of sols in liquid nitrogen; vacuum-sublimation drying of cryoaggregates and accumulation of nanopowders. Experiments on studying powders and sols as additives to cements (system of the type: cement-sand-water) are carried out. Silica sols had the content: SiO₂ from 3-62.5% of weights; the sizes of particles 10-100 nm; nanopowders of silica – specific surface area 100-400 m²/g; average diameter of pores – 2.7-10 nm. Sols and powders were introduced into the system cement – sand – water in the amount from 0.00001 to 0.2 wt.% of cement. Nanopowders were introduced into the water phase intended for preparation of cement solution, achieved uniform distribution of the powder of particles in the volume of water and combined water with the mixture of cement and sand. Characteristics of firm samples measured at different ages from 3 to 28 days. Influence of nanoadditives on density, strength acquiring rate, terminal compression strength of cement samples depending on mass percent of nanoadditives is established.