

An Investigation on the Impact of Nanotechnology on Concrete Pump Pressures

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Abstract

- This investigation elucidates the influences of nanotechnologies, specifically nano silica and graphene, on the dynamics of concrete pump pressures.
- An experimental array of nano-infused concrete batches were cyclically propelled through a recycling system, monitoring pressure variances sequentially.
- Concurrently, the fresh characteristics of the concrete were sampled and assessed at regular intervals from the mixer truck to the delivery nozzle.
- The pursuit of this study is to discern and quantify the correlation between the pumping pressure and alterations in the concrete's rheological properties.
- Integrating empirical findings from extensive field experiments, a comprehensive cost-benefit and service-life projection was formulated, demonstrating the enhanced efficiency and lifespan attributed to the application of nanotechnologies in concrete pumping practices.

Nanotechnology and Lubrication

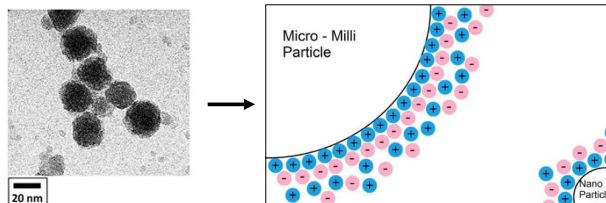
1. Concrete Paste Layer

- Cognizant of Aggregate Shape and Content
- Homogeneity in the Mix
- More water ≠ Pumpable Concrete
- Impact of the Lubrication Layer on Concrete Pressures



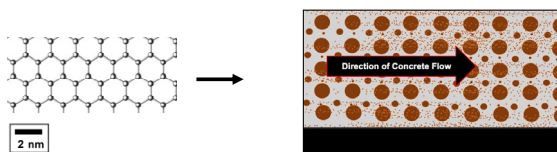
2. E5 Nano Silica

- Free Silica Surface Area Pozzolanic Reaction
- Accelerated Cement Dissolution
- Heterogeneous Nucleation
- Impact on the Lubrication Layer



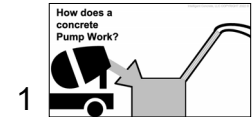
3. NanoCrete – Graphene-Jelly

- Free Silica Surface Area Pozzolanic Reaction
- Accelerated Cement Dissolution
- Heterogeneous Nucleation
- Impact on the Lubrication Layer

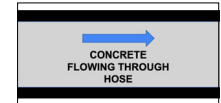


Concrete Pump Mechanics

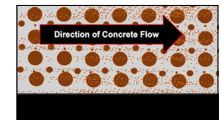
1. For Concrete to Flow through the pipe, there needs to be a certain amount of paste, THIS IS NOT CONCRETE



2. Imagine a Concrete Slug being pushed through concrete pumping system



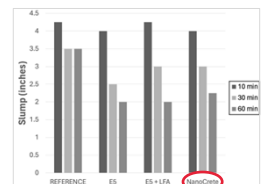
3. There needs to be enough paste to lubricate the slug as it moves down the hose as well as leave paste for the next slug.



Results

1. Concrete Slump Over Time

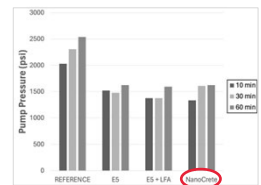
- Enhanced Viscosity:** Nanoparticles such as Nano Silica and Graphene effectively increase the viscosity of the cementitious paste, enabling smoother lubrication.
- Even Distribution:** Nanoparticles create a more uniform lubrication layer, reducing the risk of blockages in the concrete pumping system.



NanoCrete reduced the slump between 6.25% to 35.7%

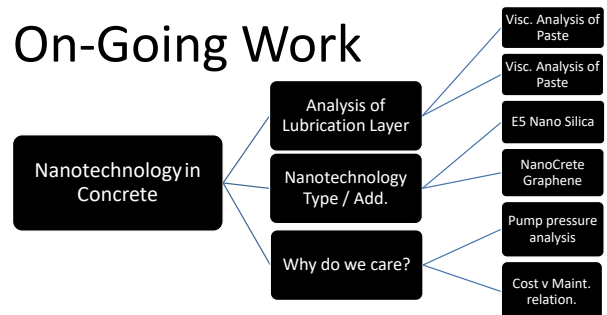
2. Concrete Pump Pressure

- Pressure Reduction:** The improved viscosity induced by nanoparticles reduces the required pump pressures during concrete pumping operations.
- Maintained Flow Rate:** Despite the reduced pressures, the use of nanoparticles maintains the mass flow rate of concrete, ensuring efficient delivery.
- Efficient Pumping:** Nanoparticle lubrication allows for more efficient pumping, saving energy and potentially extending the lifespan of pumping equipment.



NanoCrete decreased pump pressures between 30-36%

On-Going Work



Acknowledgements

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