

TECHNICAL INFORMATION 1432

SIPERNAT® 380 in 3D Concrete Printing

The ultimate solution for accelerated printing and curing

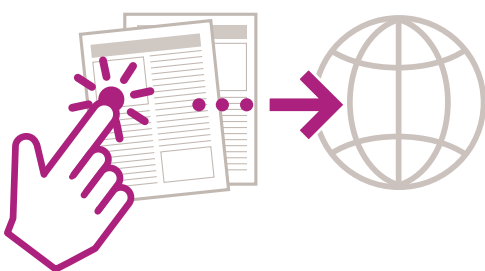


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SIPERNAT® 

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1 Introduction

3D printing of façade elements and complete buildings requires concrete formulations with special rheological properties and setting behavior. The concrete mixture needs to flow easily during pumping and printing. After printing, the printed materials need to stiffen quickly and form a stable layer. Fast curing of the printed structure speeds up the building process, making it more economically attractive.

SIPERNAT® 380 precipitated silica improves both the rheological properties and the setting behavior of concrete mixtures even at low addition amounts. This very favorable behavior of SIPERNAT® 380 is due to its fine particles which mix easily with the other components of the cement mixture for 3D printing. Addition of SIPERNAT® 380 creates a very favorable rheology, with only a minor effect on the dynamic yield stress of the formulation but high static yield stress which is tunable by adjusting the concentration of the material.

2 Key Benefits & Advantages of SIPERNAT® 380

- **EASY TO DISPERSE:** The very small particle size of SIPERNAT® 380 supports easy dispersing during the mixing process to create homogeneous mixtures.
- **ENHANCED RHEOLOGY CONTROL:** The fine particles of SIPERNAT® 380 enable precise control of rheology. Its addition leads to mixtures with favorable pumpability which stay in place after leaving the nozzle.
- **ACCELERATED CURING SPEED:** SIPERNAT® 380 significantly improves curing speed, facilitating the development of robust structures for your 3D printed constructions. No lengthy waiting times but efficient project completion.
- **SUPERIOR MECHANICAL STRENGTH:** Due to its high efficiency, already small additions of SIPERNAT® 380 vastly improve the strength of your 3D printed structures.

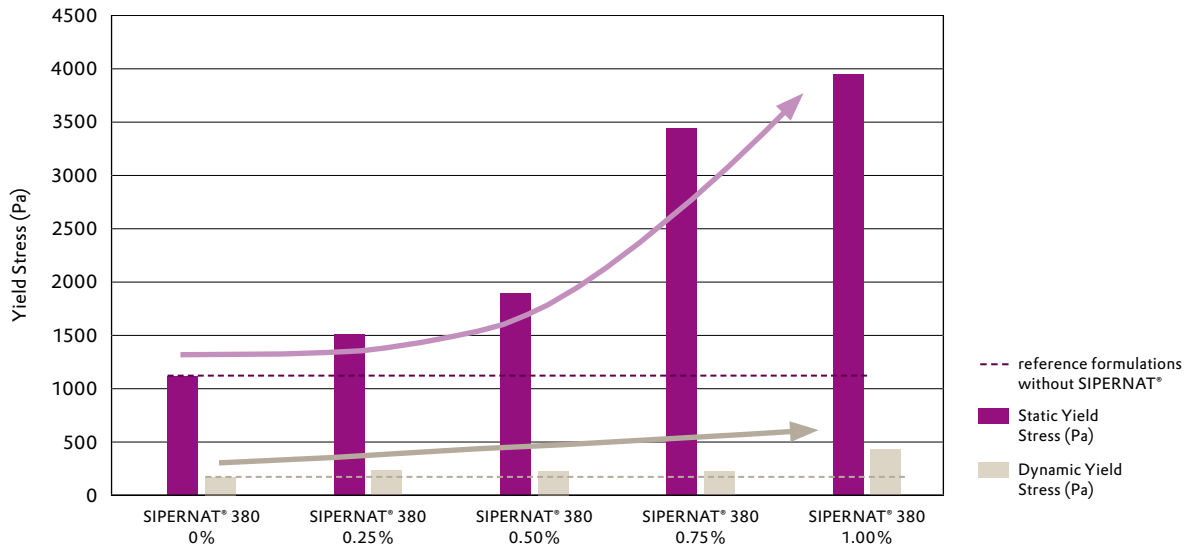
3 Case studies

As the latest addition to the precipitated silica portfolio of Evonik, SIPERNAT® 380 features ultrafine particles with amorphous, non-crystalline structure. The fine silica particles allow for an enhanced control of the rheological properties of the 3D printing concrete formulation.

Even small amounts of SIPERNAT® 380 drastically increase the static yield stress of a 3D printed concrete formulation but only feature a minor effect on the dynamic yield stress (**figure 1**).

Figure 1

Static and dynamic yield stress of a base 3D printing concrete mixture in dependence of SIPERNAT® 380 addition



While the dynamic yield stress is largely independent of the SIPERNAT® 380 concentration, increasing the concentration of the additives has a strong effect on the static yield stress. This translates into tunable strength of the printed layers without significantly compromising pumpability of the

concrete mixture. Building companies can use the modified rheology for faster printing, as SIPERNAT® 380 enables to print more layers in a shorter time while keeping the printed structure stable (**figure 2**).

Figure 2

Number of printable layers of a model 3D concrete formulation in dependence of the SIPERNAT® 380 addition

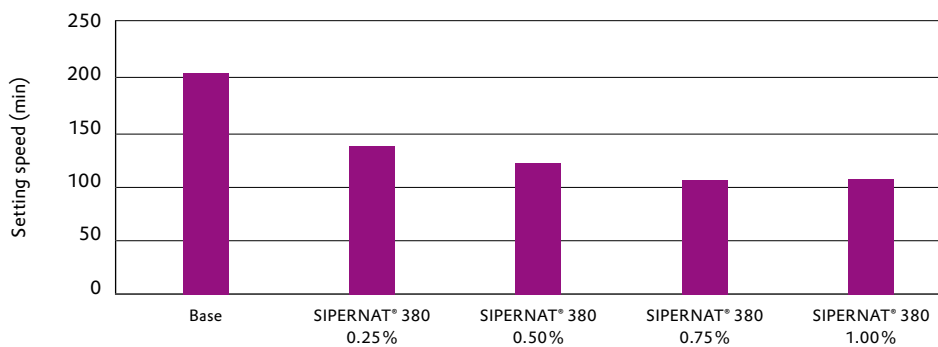


SIPERNAT® 380 can be easily incorporated into 3D printing concrete mixtures since the material easily disperses in a typical mixing process. The new precipitated silica therefore does not need any extra processing but instead is easy to incorporate into the production of the 3D concrete

formulations. In addition to the favorable effect on rheology, SIPERNAT® 380 accelerates the curing of concrete mixtures (**figure 3**). It promotes the adhesion between printed layers with a good appearance as well.

Figure 3

Setting time of a base 3D printing concrete mixture in dependence of SIPERNAT® 380 addition as measured by ASTM C191



4 Recommendations & Links

Choose SIPERNAT® 380 for unrivaled performance in 3D concrete printing.

For more information please visit our Silica webpages:



Webpage Evonik Silica



SIPERNAT® 380



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