

Combining the extremes: concrete admixtures for 3- D printing

Posted by [Oliver Mazanec](#) - 28 January, 2020

The building industry is being transformed by new technology: 3-D printing has the potential to revolutionize building. 3-D printing has already opened up previously unimagined possibilities in formwork production. Some pioneers have also taken a further step forward in Europe, with the printing of concrete. With long-term global expertise and experience with concrete as a construction material and its strong commitment to innovation, Masters Builders Solutions is forging ahead with this development in close cooperation with its customers and several research institutes.

The general automation of building is making rapid progress and the benefits are evident: it is faster, less costly, safer, offers more consistent quality and conserves resources. One of the key technologies in this area is 3-D printing. If you like, you could even consider traditional building techniques to be additive manufacturing processes: You add brick to brick or pour more and more concrete into the formwork until it is full. It therefore seems only logical that more and more companies in the building industry have discovered 3-D printing, as a modern approach to additive manufacturing. It also reflects the trend of automation to cope with high labour costs and the shortage of staff.

In building, 3-D printing is used in two main areas: for the manufacture of formwork and for the production of concrete elements. Concrete may face a number of different challenges. "If we are developing a concrete formulation for very thin printed formwork, the main objective is to ensure that the material is sufficiently flowable to fill the complex formwork without any gaps, at the same time as meeting the usual requirements in terms of processing time, strength, surface quality, etc.," says Oliver Mazanec, Head of Product Management Europe in the concrete admixtures business of Master Builders Solutions. "We have many years of experience with concretes that have extremely good flow properties and reach very high strength values. We have gained this experience on a number of projects including spectacular skyscrapers around the world. The requirements are very similar and the challenges mainly arise in connection with the specific details of the project. In close cooperation with our customers we are searching for the best technologies to tackle these challenges."

Conflicting requirements



In contrast, the 3-D printing of concrete elements poses fundamental challenges: First the concrete must be pumped to the nozzle. In case of the biggest available printers this is a distance of 40 meters while the diameter of the piper is only 40 mm. Such a ratio is a considerable problem for all concretes without the right rheology. In the case of the most widely used 3-D printing method, extrusion, the concrete must have proper consistency to pass through the nozzle without any problems and must then develop minimum strength to remain in shape without formwork. Sandro Moro, Construction Materials Innovation Manager Europe with Master Builders Solutions, describes the conflicting requirements: "In order to ensure workability, the concrete must be comparatively liquid but too much water would compromise its strength. In addition, the concrete must flow at one moment; the next moment, it must set so firmly that the layer will retain its shape and support the next layers after a very short time without formwork. However it must not harden to the point where the individual layers cannot bond effectively and just lie on top of each other as loose strings."

The challenge is to combine these conflicting properties and to find the "sweet spot" for each individual printing process. Both the viscosity and the yield stress play a key role," says Moro. "Cementitious materials are Bingham fluids that need a specific initial shear force in order to flow – without this force they will not change their shape. On the other hand, the flow speed depends on the plastic viscosity: controlling these two rheological parameters, the cementitious materials for 3D printing can be designed."

Admixtures create the required properties

This is where concrete admixtures come into play. They reinforce the natural properties of the concrete and add further properties which may seem contradictory at first glance.

"Some of our products are outstandingly well-suited for 3-D printing", says Dr. Oliver Mazanec. "This includes our tried and tested superplasticizers in the MasterGlenium and MasterEase series, MasterX-Seed hardening accelerator, MasterFiber fibres, MasterLife shrinkage reducing admixtures and stabilizers in the MasterMatrix series." He adds that Master Builders Solutions cooperates with research institutes such as the Technical Universities of Brunswick and Munich as well as direct with customers. These are often pioneering start-ups who are continuing the development of innovative technology for the building industry. "Innovations are one of our core business drivers," says Roland Nowicki, Vice President BASF Construction Chemicals Europe. "We consider 3-D printing as promising tool with a remarkable potential to save time and resources. Our admixtures can make a major contribution to improve this technology and further establish it at the market. "

De bouw industrie is altijd aan het zoeken naar betere en kost efficiënte oplossingen voor problemen

En nu met de opkomst van 3D printers zijn constructie maatschappijen aan het zoeken naar mogelijkheden om deze techniek te gebruiken in de bouw want dit zou dit kan zeker helpen met goedkopere productie van bouwonderdelen die dus prefab zijn en gewoon geplaatst is

Momenteel zijn er nog problemen met de spuitkop die soms verstopt raakt als het niet snel genoeg spuit maar tegelijkertijd heeft het ook nog het probleem dat het niet snel genoeg lagen kan printen waardoor het losse lagen die niet niet op elkaar zijn gekomen waardoor de spuit laat opspuitlaag de nieuwe mix de "addmixtures" zullen hopelijk beter zijn met het verbinden het is een cement plastic mix waardoor het wel buigbaar is maar niet zo sterk als cement

Maar verder veel bouw specialisten hebben zeer hoop voor deze innovatie en vinden dat sommige producenten al richting de juiste weg gaan

Mijn mening

Ik denk dat het zeer handig zal zijn als deze techniek werkelijkheid worden en ook een toepassing om snel en goedkopere huizen en voor sommige nood situatie ook snel gebouwen kan maken (snel in Air Quots) het is een techniek waar nu veel aan gedaan moet worden maar wel een toekomst heeft voor veel applicaties het zal natuurlijk tegen gehouden worden door sommige bouwvakkers maar allen innovaties die een baan automatiseren worden tegengehouden want het neemt natuurlijk banen weg en vervingt het voor minder mensen zonder de originele discipline geleerd zoals dat het waarschijnlijk nu zal worden bestuurd door een bouwvakker maar een ict'er

Terwijl ik denk dat dit niet zo snel gaat lopen het fijne detail werk zal toch niet gaan het is misschien goed voor de muren te maken en vorm het zal wel zo zijn dat het anders zal uit zien en zo ver als dat ik nu nog zie is dat het zeer geronde gebouwen zullen vormen