APPLICATION OF pH-SENSITIVE HYDROGELS FOR CONCRETE APPLICATIONS

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The biggest problem in concrete applications includes occurring cracks due to its relatively low tensile strength. These cracks can generate an entrance for harmful particles which are dissolved in fluids and gases and/or fluids as such and by that become a danger for the durability of concrete [1]. The cost of a healing treatment after cracking is very high. Instead, inserting a polymer during the mixing procedure enables the creation of a self-healing material. Using a hydrogel will help heal cracks as soon as they occur, without the use of any external factors. Fresh cement slurry has a pH value of 12.8, but when a crack turns up, the pH decreases to 9 or 10 or even lower according to the environment of the application.

In the present work, a crosslinked copolymer of acrylic acid and acrylamide is synthesised as hydrogel by using N,N'-methylene bisacrylamide as crosslinker, APS (ammonium persulphate) as initiator and TEMED (tetramethylethylenediamine) as accelerator. The polymerization was performed at 45°C under an inert nitrogen atmosphere.

By varying the molar fraction of both monomers and the crosslinker, an interesting variation in swelling degree was observed. By measuring swelling values at pH values ranging from 1 to 13, a pH-dependent swelling curve [2] can be created. In this work, a copolymer with 50 mol% acrylic acid, 50 mol% acrylamide and 2 and 10 mol% crosslinker (50/50/2 and 50/50/10) was tested (Figure 1). To realize the measurements, a hydrogel sample (0.2 g) was incubated for 24 hours in a 100 ml solution with a varying pH. Then, the swollen material together with the solution was filtered by using a funnel. As can be seen from Figure 1, the swelling at low pH values is low. At pH 11-13, a higher swelling was observed to a max of around 50 times its own weight at pH 12 (Figure 2).

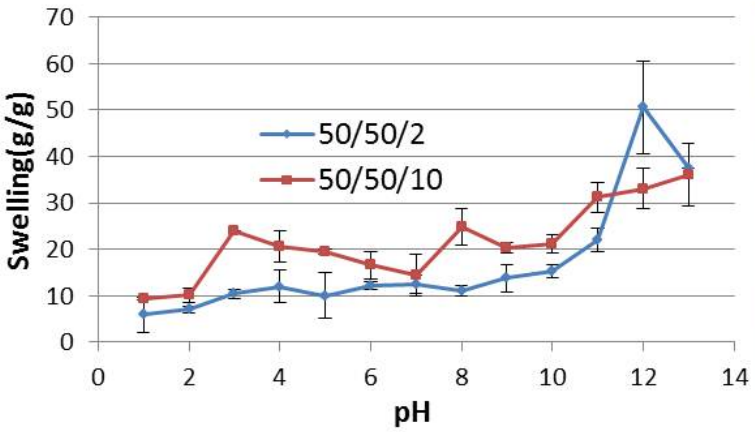

Figure 1: pH dependent swelling of the super absorbing polymer.

Figure 2: Swelling of the 50/50/2 sample at pH 12 (~50 times its weight)

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References

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