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An innovative method for the utilization of quarry sand

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50 % waste (quarry sand) is generated during the production of ashlar. In this study, this waste material is used to produce biosandstone as new and sustainable construction material. The quarry sand used in this study is delivered by the local natural stone plant (Picard) in Krickenbach (Germany). Viewed globally, there is a high need to investigate new construction material as alternatives to concrete, because with a share of about 8.6 % of anthropogenic CO2 emissions, concrete is a major contributor to global warming. Additional, not every sand like for example sand from the desert can be used for the production of concrete because the supporting grain is missing. Microbiologically induced calcium carbonate precipitation (MICP) offers the potential of a more sustainable alternative in construction. Additional, pretrials showed that a consolidation of sand from different deserts is possible allowing desert sand to be used as an alternative building material. During MICP calcium carbonate is formed by microbiological activity and can serve as a binder between mineral particles. This calcium carbonate can be an alternative binder to conventional cement mortar used for concrete. The most commonly used mechanism for MICP is ureolysis. In this process, a cell suspension and a calcination solution (urea + calcium ions) are applied alternately in a cyclic process, whereby calcium carbonate crystals are formed by the metabolism of the cells, which bind the aggregate (e.g.: sand) together.
In this study, Sporosarcina pasteurii is used as ureolytic microorganism to consolidate the quarry sand from the local natural stone plant in Krickenbach. In a first step, the quarry sand was consolidated by MICP to check if this is possible at all. Since this was successful, a deeper understanding of the influence of particle size on consolidation was investigated. Therefore, the quarry sand was classified into four different fractions of particle sizes and consolidated using MICP. In addition, the consolidated samples were scanned by micro computed tomography. Contact points and pore space depending on various parameters during the treatment of MICP were investigated. However, this study shows what influence the grain size has on the strength of the biosandstone. Furthermore, it will be shown what influence the pore volume has on the strength of the samples and whether the strength can be optimized by an optimal composition of the different fractions of particle sizes. Finally, a demonastrator will be presented produced from quarry sand using the interlocking principle. The interlocking principle is an adaptable modular structure based on the building block principle, which is functional without mortar.

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Participation

In-Person

References

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