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The effect of the morphology of concrete surfaces on its wettability and adhesion phenomena of water particles

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Introduction

Surfaces of such heterogeneous materials (e.g. concrete) are known of being characterized by relatively high coarseness and irregularities [1]. These coarseness and irregularities in same cases, are visable using naked eye observation, but very often there is a need of deeper understanding of morphological properties of this surface. Moreover, the mechanism of the adhesion of different particles (dirt, water, etc.) into concrete may be different and affected by the surface [2]. It is known that concrete surface morphology is highly affected by the formwork used to cast the concrete surface in concreting process. However, the relation between the morphology of concrete surfaces on its wettability and adhesion phenomena of water particles is still not discovered. Because, it is still an open problem to predict the behaviour of water in contact with the concrete surface, the Authors performed experimental tests. Thus, in the first step the authors determined the surface morphological parameters of the concrete surface using 3D laser triangulation scanner, described here [3]. Secondly, in order to fully understand the phenomena of the adhesion of water particles to the concrete surface, the authors performed series of contact angle measurements using the apparatus designed by authors for this purpose. Finally, the results were deeply analyzed and compared to get an answer on the question what is the effect of the morphology of concrete surfaces on its wettability and adhesion phenomena of water particles.

Materials and Methods

1. The cement paste cubic samples (150 x 150 x 150 mm) were prepared for investigation. The cement paste were made using ordinary Portland Cement CEM I 42.5R. The views of the exemplary samples are presented in Figure 1a.
2. The samples were investigated using 3D laser triangulation scanner, presented in Figure 1b.
3. The measurements of the contact angle between the water and concrete samples were performer using apparatus designed by the authors for this purpose, presented in Figure 1c.

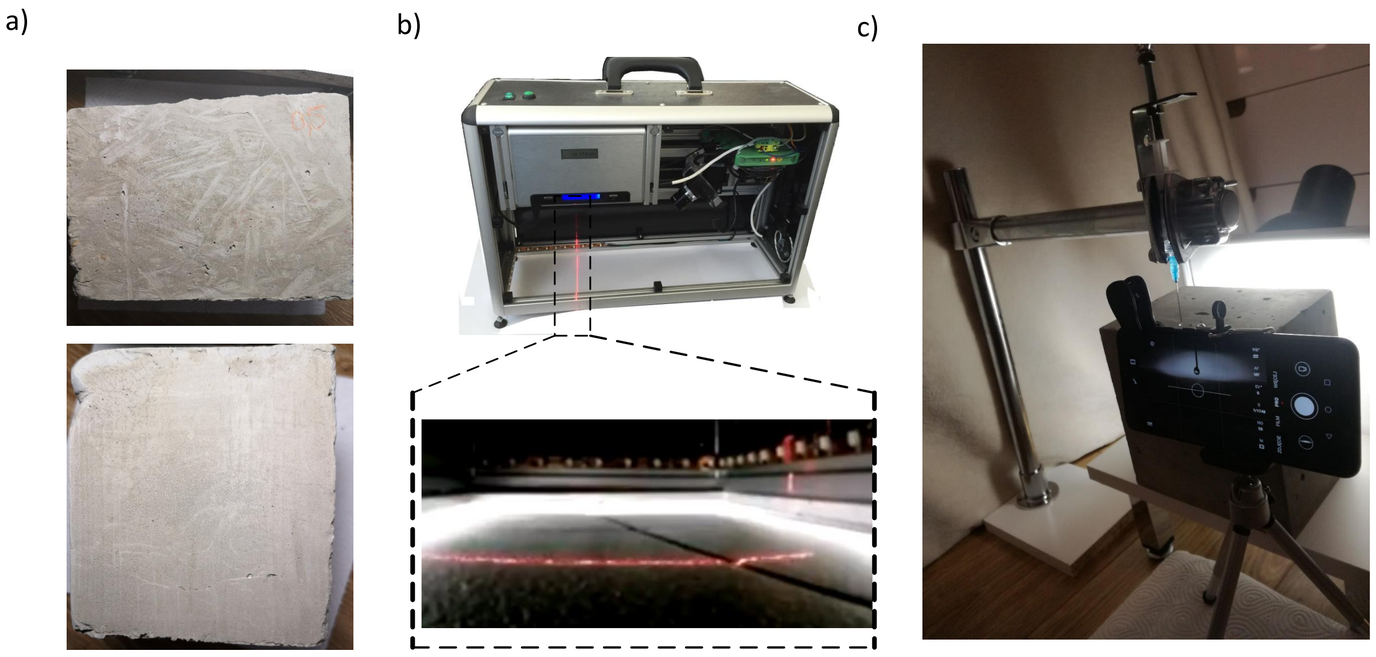

Figure 1. The view of: a) the investigated samples, b) 3D laser triangulation scanner, c) contact angle investigation stand

Results and their brief analysis

The results in the form of the values and the views of the drops in contact with the concrete surface, from the side and from the above, are presented in figure 2.

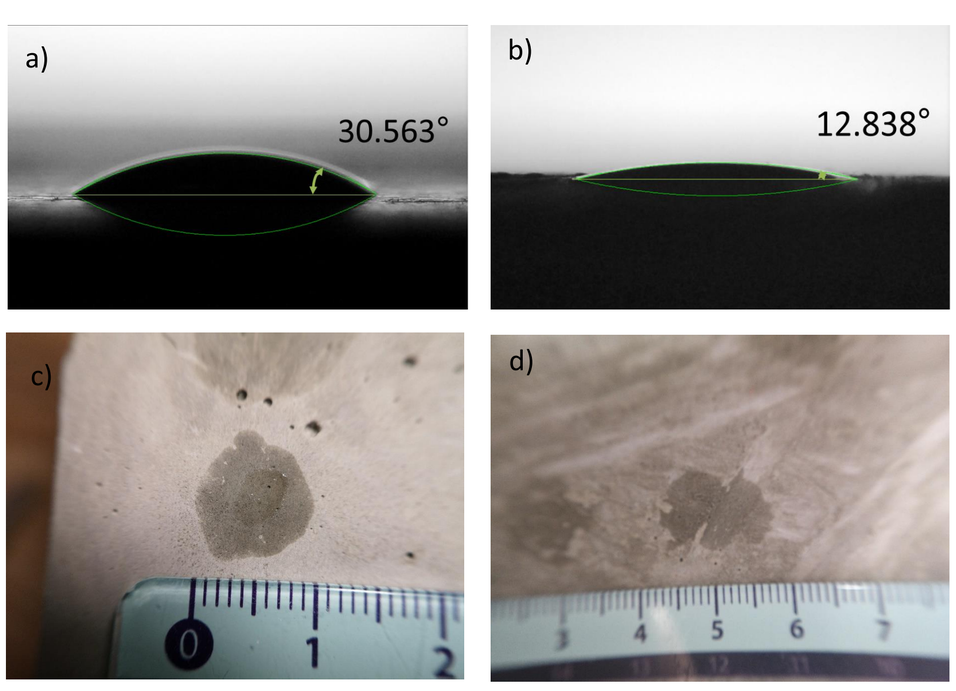

Figure 2. The view of: a, c) the drop in contact with the surface made using plastic formwork, b, d) the drop in contact with the surface made using plastic formwork,

Analysing exemplary results presented in figure 2a and 2b, it can be seen that surface made using plastic formwork is characterized with higher value of the contact angle than surface prepared using OSB formwork. For deeper understanding this results, analysing figures 2c and 2d it can be seen that drop falling on to the more rough surface, very often also containing open pores and microcracs, splashes more easily and it might be the reason why the value of the contact angle is low. Wereas, if we take surface made using plastic formwork as an example the drop has less possibility to spread and penetrate into the subsurface layer of the sample.

Conclusion

During the laboratory tests performed by the authors, the measurments of the contact angle between the water drop and the concrete surface have been carried out. It was concluded that due to the fact that lower values of the contact angle were obtained for surface made using OSB formwork, this type of surface might be characterized with the higher hydrophilia (the higher adhesion of the water to the surface from the surrounding environment).

References

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