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# Biodegradable Polymers on Cementitious Materials

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## 1 Introduction

The replacement of synthetic admixtures by natural polymers would pave the way for more green construction. This work deals with biopolymer from biodiesel by-product to get a double effect: self-healing and surface repairing of cement-based materials.

## 2 Material and Methods

The bioproducts used as surface repairing agents were obtained by glycerol waste biomass from a microbial mixed culture (MMC) for polyhydroxyalkanoates production. Some samples were sonicated to disrupt cell walls (B-S) and other keeped unsonicated (B-NS). Different control samples were prepared: Control (untreated) & $H_2O$ (bioproduct replaced by tap water). Old mortar samples were biotreated. After 5 days the repairing effect was assessed by a water-drop absorption test (WDA). On the other hand, cement mortar samples to test the healing effect of the polymer were bioformulated (Table 1).

**Table1.** Composition and code of the bioformulated cement mortar samples.

| Sample | Code | Sand (g) | C (g) | Water (ml) | B1 (ml) | B2 (ml) |
|---|---|---|---|---|---|---|
| Control (Cement mortar with water) | CW | 4 | 627.13 | 530 | 0 | 0 |
| B1 (Cement mortar with bioproduct) | CB1 | 4 | 627.13 | 0 | 530 | 0 |
| B2 (Cement mortar with older bioproduct-3 days old) | CB2 | 4 | 627.13 | 0 | 0 | 530 |

## 3 Results and Discussion

Results of the WDA are represented in Figure 1. When cement mortar was treated with B-NS, a waterproof effect was observed, with an increase of 601% of WDA time compared with control. When B-S is applied, the effect is even greater, 912% higher than control. Chandra *et al.* (1998) used cactus extracts in mortar samples, with improvements of 83% in WA.

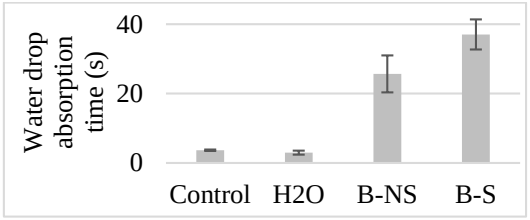


**Figure 1**. Water drop absorption time of surface treated cement mortar samples.

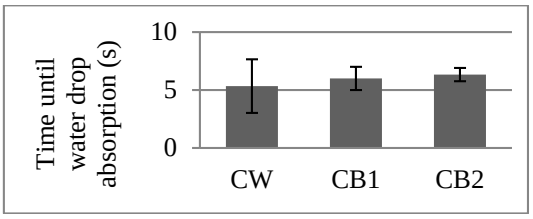


**Figure 2**. Time until water drop absorption of CW, CB1 and CB2 bioformulated samples.

Figure 2 shows the WDA results. CB1 samples show a time increase of 12,5% to absorb water than CW ones. The self-healing effect rised with age (CB2 sample), increasing the WDA time near 17%. Authors as Chandra *et al*. (1998), Chandra and Aavik (1983) and Hazarika *et al*. (2018), also used organic additives, decreasing WA capacity of the mortar samples.

# 4 Conclusions

- MMC treated specimens from glycerol bioproduct exhibited a significant permeability decrease: sonicated samples showed greater repairing effect than non-sonicated ones.
- Addition of MMC bioproduct on the formulation of cement mortars implied a positive effect on its durability and this result was greater when the bioproduct solution was older, involving a relatively short period of time (few days).

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**References**

Chandra, S. and Aavik, J. (1983). Influence of black gram (natural organic material) addition as admixture in cement mortar and concrete. *Cement and Concrete Research*, 13(3), 423-430. doi: 10.1016/0008-8846(83)90043-1

Chandra, S., Eklund, L. and Villarreal, R.R. (1998). Use of Cactus in Mortars and Concrete. *Cement and Concrete Research*, 28(1), 41-51. doi: 10.1016/S0008-8846(97)00254-8

Hazarika, A., Hazarika, I., Gogoi, M., Bora, S.S., Borah, R.R., Goutam, P. J. and Saikia, N. (2018). Use of a plant based polymeric material as a low cost chemical admixture in cement mortar and concrete preparations *Journal of Building Engineering*, 15(1), 194-202. doi: 10.1016/j.jobe.2017.11.017