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 kepted unsonicated (B-NS). Different control samples were prepared: Control (untreated) & H2O (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).

Table 1. Composition and code of the bioformulated cement mortar samples.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Code</th>
<th>Sand (g)</th>
<th>C (g)</th>
<th>Water (ml)</th>
<th>B1 (ml)</th>
<th>B2 (ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control (Cement mortar with water)</td>
<td>CW</td>
<td>4</td>
<td>627.13</td>
<td>530</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>B1 (Cement mortar with bioproduct)</td>
<td>CB1</td>
<td>4</td>
<td>627.13</td>
<td>0</td>
<td>530</td>
<td>0</td>
</tr>
<tr>
<td>B2 (Cement mortar with older bioproduct-3 days old)</td>
<td>CB2</td>
<td>4</td>
<td>627.13</td>
<td>0</td>
<td>0</td>
<td>530</td>
</tr>
</tbody>
</table>

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

