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# CORK COMPOSITES: POTENTIAL TO BE USED AS MDF SUBSTITUTE IN FLOORING APLICATIONS

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**KEYWORDS**

Cork, water absorption, dimensional stability.

**ABSTRACT**

Cork powder is the major waste from cork processing the industries. Valorisation of this residue combining with thermoplastics may allow the creation of new cork-polymer composite (CPC) materials with interesting properties provided by cork. The impact, hardness, water absorption and acoustic properties were investigated. The objective was to create new products from cork powder with high added-value and transfer the developed technology to industrial partners.

## INTRODUCTION

Cork is the bark of an oak tree known botanically as *Quercus Suber L.* which is periodically extracted from the tree, usually every nine to twelve years. Portugal produces and transforms more than 50% of cork produced in the world (Silva, S.P. et al. 2005). The major sub-product from this industry is the cork powder (Gil, L. 1997). The low value of the cork powder combined with the moulding capacity of the thermoplastic materials could bring the use CPC to improve the current products and in new applications (Fernandes, EM. et al. 2009).

### Materials and Methods

The Cork powder with particle size of <250µm, density of 157 ± 2kg.m$^{-3}$ was compound with high density polyethylene (HDPE), with a MFI of 8g.10min$^{-1}$ and a polypropylene homopolymer (PP), with a MFI of 21g.10min$^{-1}$ using a pultrusion system at 150 – 170ºC with a output of 350kg/h. After that compression moulding at the same temperature and pressure of 1.42MPa was used to create specimens of 220×220×6mm$^3$. Standard specimens were cut, tested and compared with medium density fibreboard (MDF) in terms of dimensional stability (water absorption), morphology, Charpy impact resistance, hardness and acoustic tests conducted in a reverberation chamber.

### Results and discussion

The table 1 presents the low water absorption of both CPC (50-50wt%) compared with the MDF.

The moisture absorption is due to the presence of the lenticels from the cork (capillary absorption) and hydrogen bonding sites, or by some micro-cracks or gaps in the interface (cork-matrix) forming during the processing compounding.

Table 1: Water absorption of the tested specimens

| Specimens | After 24h (%) | After 48h (%) |
|---|---|---|
| MDF | 35.64 ± 0.74 | 49.70 ± 0.74 |
| PP/Cork | 0.44 ± 0.12 | 0.67 ± 0.15 |
| PE/Cork | 0.32 ± 0.01 | 0.49 ± 0.02 |

As expected the mechanical properties of the fibreboard (table 2) is considerably superior to the developed CPC, since the MDF is based on fibres.

Table 2: Notched Charpy impact strength and hardness of the tested specimens.

| Specimens | Impact | Hardness |
|---|---|---|
| | Strength (kJ/m$^2$) | Shore D |
| MDF | 21.38 ± 2.71 | 50.8 ± 0.6 |
| PP/Cork | 5.53 ± 0.24 | 49.5 ± 0.7 |
| PE/Cork | 6.49 ± 0.15 | 47.9 ± 1.3 |
| HDPE | 4.44 ± 0.20 | 48.9 ± 1.6 |

± Standard deviation values;

When the cork is added in 50wt% to the PE matrix the impact strength increases in mean 31% indicating that the presence of cork in the composite reinforces the energy absorption capacity. The cellular and elastic structure of cork (Silva et al. 2005) explains its ability to absorb energy. In terms of hardness the materials are similar. Since cork is a cellular material it was expect a small reduction in terms of hardness. The fracture morphology of the notched impact specimens presented in figure 1 was obtained using optical microscopy. In both cases of CPC materials shows a

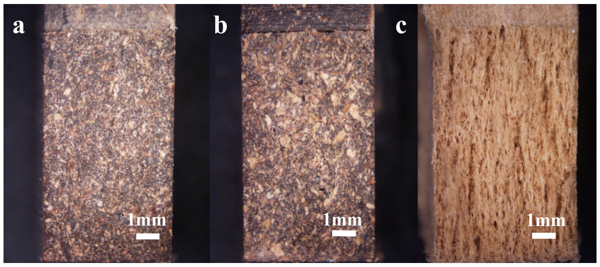


Figure 1: Fracture surfaces of the specimens after Charpy notched impact tests with a) PP/Cork (50–50wt%), b) PE/Cork (50–50wt%) and c) MDF.

good dispersion of the cork powder particles in the matrix after a two step process. The MDF illustrate the well known fibrous aspect where the fibres are stacked like rows. This fibrous morphology confirms the habitability of the water to penetrate on these structures and the higher mechanical performance.

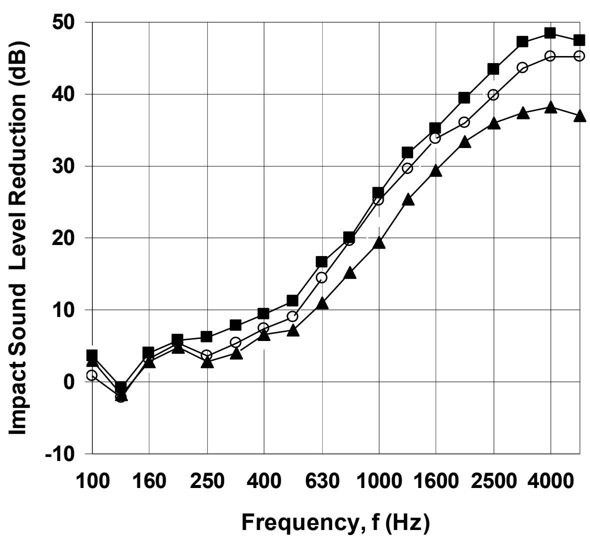


Figure 2: Impact sound reduction ΔL vs. frequency due to installation of the tested materials: (○) MDF; (▲) HDF and (■) Cork/PE (50–50 wt%). Experimental results in the 1/3 octave band frequency domain.

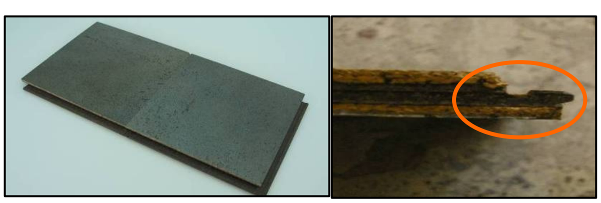

Figure 3: Cork/PE composite (50-50wt%) as core in laminated flooring solution.

As expected, figure 2 shows that the sound pressure level reduction increases as the frequency increases. In the acoustic tests it was found that the CPC showed better behaviour at high frequencies compared with the commercially materials. As show in figure 3 the developed CPC presents potential to be used as core.

## Conclusions

The following conclusions can be made base on the results presented in this work. The developed cork composites present good distribution of the cork and high dimensional stability. The reduced water absorption is a considerable advantage comparing with the MDF. The acoustic properties of CPC are similar at low frequencies and superior at high frequencies.

The mechanical performance of the cork composites is considerably inferior and the hardness very similar. The use of cork (50wt%) improved the impact resistance of the CPC. As future work, reinforcement strategies must be considered for other construction sector applications.

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