## Laser-induced breakdown spectroscopy as a sorting tool for high quality recycled wood chips in industrial environment

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Particleboard (PB) is produced using 50% to 75% recycled wood, with the possibility of reaching 100% recycled content, while Medium Density Fiberboard (MDF) is mostly made with virgin wood [1]. The presence of physical and chemical contaminants in wood waste may compromise its incorporation in recycling facilities. While physical contaminants as nails, joints, glass, textiles, etc., are easier to detect, chemical contaminants are more challenging and need good quality analytical techniques for detection and identification.

This work aims to develop an innovative industrial-scale sorting tool to produce high quality recycled wood chips from used MDF and other non-hazardous wood waste, minimizing the risk of incorporation of contaminated chips/fibers into PB or MDF production. Taking advantage of its undeniable speed, portability, low capital and maintenance costs associated, Laser-induced breakdown spectroscopy (LIBS) was chosen as the best technique to perform this task.

A LIBS system with a Q-Switch Nd:YAG laser (1064 nm), operating at 20 Hz with pulses of 8 ns duration and ~51 mJ was used. Acquisition range was between 180 and 926 nm. Wood samples from different processing states were placed in a sample holder and analysed by LIBS, obtaining an elemental distribution map with a step size of 1 cm. To help reduce the number of spots analysed, and consequently the time of analysis, a SLIC algorithm was applied to create super-pixels based on the color and spatial distances, creating delimitations similar with the sample shapes better defining the areas to be analysed. Preliminary results shown that Titanium (Ti) and Lead (Pb) were present in the samples under study, particularly in the wood painted areas. Results were displayed using a combination of photogrammetry with spectral imaging techniques [2]. LIBS showed to be a powerful technique to detect heavy elements in the wood waste, identifying contaminated wood pieces that must be discarded instead of being used for particleboard fabrication.

Figure 1.

![A. LIBS generated map for the distribution of Pb (405.85 nm) in an agglomerate of wood waste. B. Superpixels obtained applying the SLIC algorithm to a photograph of the sample. C. Superpixels filled with the average intensity of LIBS for each cluster. D. Interactive 3D model of the wood sample overlaid with the spatial distribution of Lead.]

[1] Hossain, Md Uzzal, and Chi Sun Poon. "Comparative LCA of wood waste management strategies generated from building construction activities." Journal of Cleaner Production 177 (2018): 387-397.

[2] Lopes, Tomás, et al. "Interactive three-dimensional chemical element maps with laser-induced breakdown spectroscopy and photogrammetry." Spectrochimica Acta Part B: Atomic Spectroscopy 203 (2023): 106649.

Figure 1. https://drive.inesctec.pt/s/sf93YmHny4JW8bw

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