1. **SI – Calculations for estimating the mass of the biocomposite panel and the raw material’s proportions**

For the production of 1 m² of biocomposite panel, 3.5 m² of natural fiber polymer composite is required (1 m² per skin and 1.5 m² for the omega core). The fibers are impregnated with the polymer matrix on a 60/40 ratio. Meaning that for every kg of fiber, 1.5 kg of matrix will be added. The technical textile has a grammage of 360 g/m², this results into 1.26 kg of flax fiber technical textile per m² of biocomposite panel to which 1.89 kg of matrix will be added.

The resin is 62% epoxy and 38% flame retardant agent. The resin is mixed with the hardener in an 82/12 ratio. Therefore, the 1.89 kg of matrix required for the NFPC production result from the mixture of 1.55 kg of resin (from where 0.96 kg are epoxy and 0.59 kg are the flame retardant agent) and 0.34 kg of hardener.

1. **SI – Calculations for estimating the mass of the conventional panel and the raw material’s proportions**

From the work of Vidal et al. (2018) the characteristics and raw materials’ proportions from a conventional panel used in the aviation sector were identified. In their work, the authors consider a PVC finishing for the panel. As this finishing step is not taken into consideration in the work herein presented, the mass of the PVC film was subtracted from the total mass of the reference panel. Afterwards, the percentage that each of the components represent regarding the total mass was calculated. This percentage was used as reference for determining the proportion of the raw materials used for the production of the conventional panel.

The proportion of the hardener is not specified for the reference panel. For this reason, it was considered that the same proportions as those for the biocomposite panel applied (an 82/12 resin/hardener ratio).

Results from the calculations are shown in Table 1.

**Table 1.** Proportion of the components per m² of conventional panel (inspired from Vidal et al., 2018)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Component** | **Material** | **Reference panel**  **(Vidal et al., 2018)** | | **Conventional panel** |
| *Quantity (kg)* | *%* | *Quantity (kg)* |
| Skins | Glass fiber | 0.73 | 45 | 1.16 |
| Epoxy | 0.42 | 26 | 0.55 |
| Hardener | - | - | 0.12 |
| Flame retardant | 0.07 | 4 | 0.10 |
| Core (honeycomb) | Aramid fiber | 0.41 | 25 | 0.55 |
| Phenolic resin | - | - | 0.10 |
| **TOTAL** | | **1.63** |  | **2.58** |

1. **SI – Chemical analysis of the resin and hardener used in the production of the biocomposite panel**

The objective of the chemical analysis was to identify the type and structures of epoxides and amines present in the commercial resin and hardener used in the production of the biocomposite panel, as well as their proportions and the nature and amount of additives present in the resin; specifically the flame retardant agent.

Firstly, the glass transition temperature of the resin was determined and compared to the DER 332 compound in order to corroborate the presence of DEGBA (Bisphenol A diglycidyl ether) which is a known constituent of epoxy resins. The transition temperature of the commercial resin was found to be the same as that of DER 332 (Tg= -41°C), which is a high purity DEGBA epoxy resin, thus confirming its presence in the mixture.

Furthermore, the spectrum of the resin was obtained through IR and 1H NMR spectrometry. Results were compared to literature values and corroborated the presence of DEGBA, 1,6-Bis(2,3-epoxypropoxy)hexane and oxirane, 2-phenoxymethyl, the latter being a reaction product.

Through an XRD analysis, the flame retardant agent was identified as ammonium phosphate. Additionally, a TGA analysis was carried out and results showed that the mineral charges contitute 38.4% of the resin mixture.

As done for the resin, IR and 1H NMR spectrometry led to identification of 3-aminolethyl-3,5,5-trimethylcyclohexylamine, alkylether polyamine, and methylamine as the constituents of the commercial hardener. A pH-metric dosage of amine functions proved the molarity of the primary amine functions of the commercial hardener to be 8.1 mol/L.

1. **SI – Creation of an APP production process from the production of MAP**

APP is the fire suppressant agent found in the polymeric resin used in the production of the biocomposite panel, which corresponds to 38% (w/w) of the mixture. MAP synthesis follows the same process as APP synthesis.

MAP main application is as a nitrogen fertilizer, followed by their use as fire suppressant agents. It is therefore possible to use the MAP production process as a proxy to evaluate the impacts of APP production. The Ecoinvent process for MAP synthesis is available as “Nitrogen fertiliser, as N {RER}| monoammonium phosphate production | APOS, U”. Here an effort was made to make this process consequential. First, the “APOS” processes it contains were substituted by “Conseq” processes in order to keep the consequential approach taken by this study.

However, the process considers the production of MAP by the synthesis of ammonia and phosphoric acid in 70% solution state, which corresponds to a fertilizer grade. For the production of an industrial grade MAP, phosphoric acid is used in 85% solution state. Therefore, the Ecoinvent process was modified by replacing the phosphoric acid in 70% solution state to one with an 85% solution state, as an industrial grade is required for the synthesis of APP.

As the new solution is more concentrated, the value for phosphoric acid was adjusted from 1.9096 kg to 1.5726 kg per 0.3467 kg ammonia to produce 1 kg of MAP. In order to not over or underestimate the impact of MAP production with an application as a fire suppressant agent, the validity of the adjustment was proven by the comparison of three different MAP production processes: 1) MAP production with phosphoric acid 70% solution, 2) MAP production with phosphoric acid 85% solution with adjustment of value, and 3) MAP production with phosphoric acid 85% solution without value adjustment.