

## **Conceptual design of oil palm fibre reinforced polymer hybrid composite automotive crash box using integrated approach**

### **ABSTRACT**

A hybrid conceptual design approach was introduced in this study to develop a conceptual design of oil palm polymer composite automotive crash box (ACB). A combination of theory of inventive problem solving (TRIZ), morphological charts and biomimetics was applied where the foremost requirements in terms of the material characteristics, function specifications, force identification, root cause analysis, geometry profile and design selection criteria were considered. The strategy was to use creations of nature to inspire five innovative conceptual designs of the ACB structure and the AHP method was applied to perform the pairwise analysis of selecting the best ACB conceptual design. A new conceptual design for a composite ACB was conceived bearing in mind the properties of natural fibre, unlike those of conventional materials such as steel alloys and aluminium alloys. The design with the highest ranking (26.6 %) was chosen as the final conceptual design, which was the one with a honeycomb structure for the outermost profile, reinforced with a spider web structure inside the part, supported by fibre foam structure extracted from the woodpecker sponge tissue at the centre to maximize the energy absorption capability. The new design could solve the problem of bending collapse which is a major cause of failure to absorb maximum impact energy for ACB during collision. However, the final conceptual design will still need several modifications for production and assembly purposes, which will be completed in a further study.

**Keyword:** Conceptual design; Automotive crash box; Hybrid method; Concept selection method