汽车内饰用热塑性植物纤维预浸料及构件研发

李明鹏，王戈，王翠翠，程海涛

（国际竹藤中心 北京 100102）

摘　要：为研发轻量化热塑性植物纤维汽车内饰构件，本报告首先利用响应面模型优化热塑性植物纤维预浸料的制备工艺，然后以植物纤维复合毡为控制样，探究热塑性植物纤维复合板的层积结构设计及应用特性，最后基于主机厂的关键性能指标要求，利用夹层设计研发能应用于汽车内饰构件的热塑性植物纤维复合材料。通过薄膜层积和熔融浸渍两种成型工艺可制备密度和树脂分布均匀的热塑性植物纤维预浸料，前者更为均匀；KH550 和 MAPP 可改善植物纤维-聚丙烯（PP）的界面剪切强度，二者交互作用对两种工艺制得预浸料的界面增强具有显著影响，KH550-竹纤维（BF）/MAPP-PP（KBF/MPP）预浸料较 BF/PP 预浸料拉伸强度分别提高了 32.79%（薄膜层积工艺）和 24.92%（熔融浸渍工艺）；KBF/MPP 预浸料（薄膜层积和熔融浸渍工艺）拉伸强度约是 KH550-JF/MAPP-PP（KJF/MPP）的 1.34 倍和 1.16 倍，分别占 KH550-玻璃纤维（GF）/MAPP-PP（KGF/MPP）预浸料拉伸强度的 67.13%和 67.82%，表明间歇式生产的薄膜层积工艺可为连续生产的熔融浸渍工艺提供理论依据。聚氨酯（PU）夹层结构 BF/PP 复合材料的剥离强度为 13.58(N·mm)/mm，较 PU 夹层结构 JF/PP 复合材料提高 38.15%。4 次循环试验后，PU 夹层结构植物纤维/PP 复合材料并未出现显著变形、变色现象，PU 夹层结构 BF/PP 复合材料在比弯曲性能保留率方面具有优势，其分别约为 PU 夹层结构 JF/PP 复合材料的 1.17 倍（比弯曲模量）和 1.14 倍（比弯曲强度）。BF/PP 汽车内饰构件的生产能耗和 CO2 排量最低，较聚丙烯、玻璃纤维/聚丙烯、麻纤维/聚丙烯汽车内饰构件分别降低了 10.82%和 6.65kg、44.49%和 43.94kg、16.80%和 11.07kg。（PU 夹层结构）BF/PP 汽车内饰构件的弯曲性能均能符合不同主机厂的使用要求，且其在孔隙率、尺寸稳定性、材色变化、吸湿霉变、隔热保温、吸声、气味性（80℃）、挥发性有机物和醛酮类物质方面也可满足主机厂的特定需求。

关键词：竹纤维；预浸料；复合板；夹层结构；复合材料；汽车内饰构件

、

Development of thermoplastic bamboo fiber prepregs and components for automotive interiors

Li Mingpeng　Wang Ge　Wang Cuicui　Cheng Haitao

(International Centre For Bamboo and Rattan Beijing 100102)

Abstract: To develop the lightweight thermoplastic plant fiber automotive interior components, a response surface model was used to optimize the preparation process of thermoplastic plant fiber prepreg at first in this study. Then the laminated structure design and application characteristics of thermoplastic plant fiber composite board were explored by taking plant fiber composite mat as control sample. Finally, based on the key performance index requirements of auto makers, the thermoplastic plant fiber composites which can be applied to automotive interior components are developed by sandwich design. Thermoplastic plant fiber prepreg with uniform density and resin distribution was prepared with thin film lamination and melt impregnation process. Of the two preparation methods

thin film lamination was the most uniform. KH550 and MAPP could improve the interfacial shear strength between plant fiber and PP, as well as their interaction having a significant influence on the interfacial enhancement of the prepreg prepared with the two processes. The tensile strength of the KH550-BF/ MAP-PP (KBF/MPP) prepreg was increased by 32.79% (film lamination process) and 24.92% (melt impregnation process) compared with that of BF/PP prepreg. The tensile strength of the KBF/MPP prepreg (film lamination and melt impregnation process) was ≈1.34 times and 1.16 times of KJF/MPP, which accounted for 67.13% and 67.82% of KGF/MPP prepreg, respectively. The peel strength of PU sandwich BF/PP composite was 13.58 (N·mm)/mm, which was 38.15% higher than that of JF/PP composite. No significant deformation and discoloration occurred in the PU sandwich plant fiber/PP composite after 4 cyclic test. The PU sandwich BF/PP composite had an advantage in the retention rate of specific bending properties, which was ≈1.17 times (specific bending modulus) and 1.14 times (specific bending strength) of PU sandwich structure JF/PP composite, respectively. BF/PP automotive interior components had the lowest production energy consumption and CO2 emission, which were 10.82% and 6.65 kg, 44.49% and 43.94 kg, 16.80% and 11.07 kg lower than PP, GF/PP and JF/PP automotive interior components, respectively. The bending performance of (PU sandwich structure) BF/PP automotive interior components can meet the different requirements and specific needs of care makers in porosity, dimensional stability, material color change, moisture absorption, mildew, heat insulation, sound absorption, odor (80 ℃), volatile organic compounds, and aldehydes and ketones.The properties indicated that the film lamination process (intermittent production) can provide a theoretical basis for the continuous production of melt impregnation process.

Key words：Bamboo fiber (BF); Prepreg; Composite panel; Sandwich structure; Composite; Automotive interior components