ANALISIS MIKROSTRUKTUR DAN SIFAT MEKANIS *FIBERGLASS* DARI *HYBRID COMPOSITE* (*FIBERGLASS* + *FIBERCARBON*) *MATRIX EPOXY*

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ABSTRAK

Penelitian ini mengkaji material komposit berpenguat serat (*Fiber Reinforced Polymer/FRP*) yang dikenal memiliki rasio kekuatan terhadap berat tinggi, tahan korosi, dan mudah dibentuk. Fokus penelitian adalah pada komposit hibrida berbasis fiberglass (*Glass Fiber Reinforced Polymer/GFRP*) dan carbon fiber (*Carbon Fiber Reinforced Polymer/CFRP*) dengan matriks epoxy. Tujuan penelitian ini adalah menganalisis karakteristik mikrostruktur, pengaruh orientasi serat terhadap kekuatan tarik, serta perilaku patahan material. Dua konfigurasi komposit yang diuji yaitu fiberglass woven + carbon fiber woven dan fiberglass acak + carbon fiber woven. Spesimen dibuat menggunakan metode *hand lay-up* dengan dimensi sesuai standar ASTM D3039M. Pengujian dilakukan melalui uji tarik menggunakan *Universal Testing Machine (UTM)* serta analisis mikrostruktur menggunakan *Scanning Electron Microscopy (SEM)*. Hasil menunjukkan bahwa komposit fiberglass woven + carbon fiber memiliki performa mekanik lebih baik dengan nilai *Ultimate Tensile Strength (UTS)* sebesar 143,5 MPa dan modulus elastisitas 1,1 GPa, dibandingkan komposit fiberglass acak + carbon fiber yang memiliki UTS 130,4 MPa dan modulus 0,9 GPa. Analisis SEM mengungkapkan bahwa komposit woven didominasi mekanisme kegagalan *fiber breakdown*, sedangkan komposit acak didominasi oleh *fiber pull-out*, *matrix cracking*, dan delaminasi. Dengan demikian, orientasi serat woven terbukti memberikan kekuatan mekanik yang lebih optimal dan berpotensi untuk diaplikasikan pada struktur rangka *Unmanned Aerial Vehicle (UAV)*.

Kata kunci: komposit hibrida, fiberglass, carbon fiber, orientasi serat, uji tarik, SEM, UAV

EFFECT OF MICROSTRUCTURE AND MECHANICAL PROPERTIES OF FIBERGLASS FROM HYBRID COMPOSITE (FIBERGLASS + FIBERCARBON) EPOXY MATRIX

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ABSTRACK

This study investigates fiber-reinforced composite materials (Fiber Reinforced Polymer/FRP), which are known for their high strength-to-weight ratio, corrosion resistance, and ease of fabrication. The research focuses on hybrid composites based on fiberglass (Glass Fiber Reinforced Polymer/GFRP) and carbon fiber (Carbon Fiber Reinforced Polymer/CFRP) with an epoxy matrix. The objective of this study is to analyze the microstructural characteristics, the effect of fiber orientation on tensile strength, and the fracture behavior of the material. Two composite configurations were examined: fiberglass woven + carbon fiber woven and random fiberglass + carbon fiber woven. The specimens were fabricated using the hand lay-up *method with dimensions in accordance with ASTM D3039M standards. The tests conducted included tensile testing using a Universal Testing Machine (UTM) and microstructural analysis using* Scanning Electron Microscopy *(SEM). The results show that the fiberglass woven + carbon fiber composite exhibits better mechanical performance, with an Ultimate Tensile Strength (UTS) of 143.5 MPa and a modulus of elasticity of 1.1 GPa, compared to the random fiberglass + carbon fiber composite, which has a UTS of 130.4 MPa and a modulus of 0.9 GPa. SEM analysis reveals that the woven composite is dominated by* fiber breakdown *failure mechanisms, while the random composite is characterized by* fiber pull-out, matrix cracking, *and delamination. In conclusion, woven fiber orientation provides superior mechanical performance and shows strong potential for application in Unmanned Aerial Vehicle (UAV) structural frames.*

Keywords: *hybrid composite, fiberglass, carbon fiber, fiber orientation, tensile test, SEM, UAV*