



**Sudan University of Science and Technology**  
**College of Postgraduate Studies**



# Viscoelasticity - plastic behavior of fiber-reinforced polymer composites

A thesis Submitted in Partial Fulfillment of the Requirements for the degree of  
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# الآية

بسم الله الرحمن الرحيم

الَّذِينَ آمَنُوا إِذَا قِيلَ لَكُمْ تَفَسَّحُوا فِي الْأَمْ جَالِسٍ فَافْسَدُوا يَفْحَهُ اللَّهُ لَكُمْ  
بِيلَ انشُرُوا فَاَنْشُرُوا وَيَرْفَعُ اللَّهُ الَّذِينَ آمَنُوا مِنْكُمْ وَالَّذِينَ أُتُوا لِعَالَمٍ  
دَرَ جَاتٍ وَاللَّهُ بِمَا تَعْمَلُونَ خَبِيرٌ (11)

صدق الله العظيم

سورة المجادلة، الآية (11)

# *Dedication*

*Dedicated first to my husband Ahmed, who*

*is help, encourage and inspire me,*

*Then*

*To my parents with all our love*

*To my brothers*

*My husband*

*my sisters*

*&my teachers who help us...*

*To my colleagues....*

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# ABSTRACT

Fiber Reinforced Polymer (FRP) composites widely use in different fields such as, aerospace industries; automotive, water tank; marines; and building, etc.

The current studies give a brief account of analysis of static and impact on glass fiber reinforcement composites comprising composite faces from glass fiber/polyester.

Chopped strand mat E-glass layers were fabricated by using hand lay-up process. Lamination was conducted at room temperature with 65% glass fibers and 35% polyester resin volume fraction. The target thickness of each laminate is 3mm later; the composite panels were subjected to static and impact loading using Product Computerized Universal Testing Machine. The load-displacement and the load-time curves have been obtained to characterize the failure mechanisms in the glass fiber reinforcement composites.

Fiberglass/polyester composites provide improvements in strength, stiffness and toughness. They also have corrosion resistance, compared with water tank made of high density polyethylene.

Results were presented in different charts designed to help plastics engineers for an industrial manufacturing process of known material functions.

## المستخلص

المواد المركبة المصنعة من ألياف الزجاج والبوليمر مستخدم على نطاق واسع في عدة مجالات مثل الفضاء، السيارات، خزانات المياه، الاستخدامات العسكرية، المباني وغيرها.

هذه الدراسة أجريت لتحليل الخصائص الإستاتيكية والديناميكية للمواد المركبة المصنعة من ألياف الزجاج وراتنج البولستر.

ألياف الزجاج المصنوعة بطريقة عشوائية تم تحويلها إلى مواد مركبة باستخدام تقنية وضع الطبقات يدوياً (Hand lay-up) في درجة حرارة الغرفة. الحجم النسبي للزجاج 65% والبولستر 35%، سمك العينة

المصنعة 3 ملم العينة المصنعة تم اختيارها إستاتيكيًا وديناميكيًا باستخدام Product Computerized

Universal Testing Machine الإستطالة، القوة والزمن لوصف الفشل الميكانيكي للمادة المركبة. من

تحليل النتائج وجد أن المادة المركبة المصنعة من ألياف الزجاج لها متانة عالية وصلابة وصلادة عالية، وايضاً لها مقاومة عالية للتآكل مقارنة بالخزانات البلاستيكية المصنعة من البولي اثلين.

تم عرض النتائج في مخططات لمساعدة مهندسي البلاستيك لتحديد العملية الصناعية وفقاً لخصائص

المادة.

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