Title :
Design of an Environmental Stress Cracking (ESC) Tester using Fracture Mechanics Approach

Journal :
Journal of Mechanical Engineering, Volume 18, Issue 1, 2021, Pages 123-136

Document Type :
Journal

Authors :

Azli, M.S.M.N.,
syafiq.azli@s.unikl.edu.my
Radzi, M.F.M.,
Nazri, M.N.A.,
Saharudin, M.S.,
Inam, F.

Full Text Link:
Publisher : https://rgu-repository.worktribe.com/output/1627857/design-of-an-environmental-stress-cracking-esc-tester-using-fracture-mechanics-approach

Citation:
MOHAMAD NOR AZLI, M.S., MOHD RADZI, M.F., AHMAD NAZRI, M.N., SAHARUDIN, M.S. and INAM, F. 2021. Design of an environmental stress cracking (ESC) tester using fracture mechanics approach. Journal of mechanical engineering [online], 18(1), pages 123-136. Available from: https://jmeche.uitm.edu.my/wp-content/uploads/2021/01/8-RI-18-1-P20-50.pdf

Abstract:
In this research, an ESC tester machine was built by utilising a fracture mechanics approach. The machine consists of critical components such as an aluminium frame, 3D printed pulley and bracket, DC motor, Arduino microcontroller, and fasteners. The test was performed by securing an acrylic sample using a hook fixed to bracket on the base of the frame and integrated load cell with Arduino microcontroller board. Digital camera was used to capture images with Image J processing software to measure the transient damage area and macro-crack length development at each test condition. The results suggested that the applied load can influence the fracture toughness values. At 55N, the fracture toughness for the acrylic was 1.9 MPa.$m^{1/2}$. Increasing the load to 65N, the fracture toughness dropped by 60% to 0.7 MPa.$m^{1/2}$. The minimum fracture toughness was observed at 85N load; a 91% reduction was recorded. Maximum damage area of 89 mm^2 was recorded for sample tested at 55N while minimum damage area was at 85N load, where only 31.81 mm^2 area was calculated. It can be concluded that this newly built machine can be used to perform fracture toughness test on polymeric materials under environmental stress cracking (ESC) condition. © 2021 Faculty of Mechanical Engineering. All Rights Reserved.