The College of Graduate Studies and the College of Engineering Cordially Invite You to a

Master Thesis Defense

Entitled

RECYCLING OF CURED CARBON FIBER/EPOXY RESIN LAMINATED COMPOSITES SCRAPS: PROCESSING AND CHARACTERIZATION

by

Khaled Mohammed Alharmoodi

Faculty Advisor

Prof. Abdel-Hamid I. Mourad, Department of Mechanical and Aerospace Engineering

College of Engineering

Date & Venue

Wednesday 14/12/2022 at 2 Pm

Room # 1043

Abstract

The concept of reinforced composites came about decades ago from the need to fabricate high strength, heat resistant, wear resistant and low-density materials. The polymer matrix composites offer a wide range of applications due to the collaborative nature of the functional fillers and polymers present. Towards the twenty-first century, the aviation industry has flourish due to flying being considered the preferred way of travel across states and countries. With such a huge demand for air transport, there is an equally parallel demand for the production of aircraft components. This study aims to reuse the waste of uncured composite prepreg scraps from the ply cutting manufacturing process in the aerospace industry, avoiding the disposal of this waste, expenses with its incineration, and resin loss. This study utilized the cut-off/waste material produced in STRATA company during the manufacturing of aircraft components. These composite sheets were manufactured through curing of a stacked layer of carbon fibers impregnated in resin and a small percentage of glass fibers. The cut-offs were reduced to powder form using a conventional face milling machine in three different sizes (90, 150, and 250µm). Four different wt% (10%, 20%, 30%, and 40%) of the recycled powder were utilized to fabricate vinyl ester composites.

The prepared composite samples were tested to evaluate the mechanical and physical properties of the composite. Results show that the maximum tensile strength and maximum flexural strength were 36.59 MPa and 74.5MPa respectively with 20wt% of rCFC for 90 µm size particles. However, the highest compression strength was obtained as 244MPa with 10wt% of rCFC for 90 µm size particles. The tensile, flexural and compression strength decreased with further addition of reinforcement. These results were supported by scanning electron microscopy. The non-uniform distribution was observed with porosity and large cavities in the composite which may resulted in decreased mechanical properties of the composite with addition of the large quantity of the reinforcement. Furthermore, thermal conductivity and DSC analysis were performed to evaluate the thermal properties of the composites. The glass transition temperature (Tg) of pure vinyl ester composite sample was 52.92°C. The Tg varied about 57±1°C for composites with different weight percentage and size of the reinforcement. The thermal conductivity increased with increase in the reinforcement as expected but the results were misleading at higher addition of the reinforcement due to the increased porosity.

Keywords: Recycled carbon fibers, Vinyl ester, polymer composites, recycling, Mechanical, physical and thermal properties.