DOCTORAL STUDENTS

Mr. Avinash Ramsaroop

Project Title: High Speed, High Precision Manufacturing of Dry Pre-Pregs for Composite Structures

The first part of the research entails the design of a robotic end-effector that is capable of orientating and placing fibres quickly and effectively to form dry pre-pregs for a composite structure. The end-effector will consist of five mechanisms: pulling, cutting, orientating, placing and spraying.

The second part of the research is the design of a control algorithm. This algorithm will be capable of exporting a drawing of a structure from a CAD application to a FEM application. It will then instruct the FEM package to analyse the structure to determine the critical stress regions. Thereafter the algorithm will perform matrix calculations in order to establish the precise fibre orientation angles as well as the number of fibre layers that would be required to reduce the stresses in the critical regions. Subsequently a multi-directional, multi-strength composite component can be fabricated.

Instructions would be sent to a robotic arm, equipped with the fibre placement end-effector, to orientate and place the fibres according to the calculated values. Once the fibres have been placed, the formed pre-preg may then be infused by conventional techniques.

Mr. G. F. d'Alamine

Project Title: The Offshore Generation of Electrical Power Utilizing the Agulhas Current

The Agulhas Current is the third largest ocean current in the world moving approximately 70 million cubic meters of water per second at an average velocity of 1.2 meters per second. This gives an average energy potential of 50 GW that could be harnessed for use off the coast of KZN. South Africa has a total installed capacity of about 35 GW which could then (by utilizing the Agulhas Current) be significantly increased without any damage to the environment.

This research is aimed at identifying suitable sites off the coast of KZN to place generators on the sea bed so that they will be within the current irrespective of any meanders it may have. A further objective is to design a suitable generator and prime mover that would work at the depths required and at the velocities of the current encountered.

Mr. Festus Mwangi

Project Title: Development of Aluminium – Nanoclay Based Matrix Composites through Powder Metallurgy Route

The development of light metals, especially aluminium, opens up the possibility of their being used in areas where weight reduction is first priority, for instance in the aerospace and automotive industries. To date, conventional materials that have been used to reinforce aluminium include Saffil (Al2O3), SiC particles, etc. In this project, the objective is to synthesis nanoclays reinforced aluminium metal matrix composites (AMCs). Powder metallurgy is the main contemplated processing technique, supplemented by stir casting. Effect of clay content on mechanical, electrical and thermal properties will be investigated, as well as the sensitivity to alternative processing techniques. It is envisaged that novel AMC material and processing technique will be developed.

AMCs are intended to substitute monolithic materials including aluminium alloys, ferrous alloys, titanium alloys and polymer based composites in several applications. Although increasing development activities have led to system solutions using metal composite materials, the use of especially innovative systems, particularly in the area of light metals, has not been utilized. Also, AMCs substitution for monolithic materials in engineering system to be wide spread, there is a compelling need to redesign the whole system to gain additional weight and volume savings. These goals need also embrace processing, reliability and economic efficiency.

Mr. Gizachew Kebede Bedane

Project Title: Biogas Plant Upgrading

Biogas from anaerobic digestion of biological wastes is a renewable energy resource. Presence of CO2 and H2S in biogas affects the biogas plant and the gas-utilization equipment performance adversely. Reducing CO2 and H2S content will significantly improve quality of biogas. This study will deal with the removal of H2S and CO2 by introducing scrubbing techniques and to test the effectiveness of the methods that reduce the concentration of carbon dioxide and hydrogen sulphide below the detection limit and CH4 enrichment in biogas.

This project is believed make contribution in the endeavour to conserve the available Biogas to be utilised efficiently by removing CO2 and H2S thereby increasing calorific value of Biogas. In this study, a method for biogas scrubbing and CH4 enrichment will be studied by Chemical absorption and adsorption of H2S and CO2 by aqueous solutions in a packed column will be experimentally investigated.

Mrs. Vimla Paul

Project Title: Development of a New Grade Bio-Composite

The objectives in achieving this aim are as follows:

- To identify potential natural matrix for cross linking purposes. A comparative study of sugar cane, sisal and hemp fibres will be conducted. Physical and chemical attributes of the above fibres, such as fibre strength and stiffness, thermal stability, moisture absorption will be determined.

- To crosslink the selected fibre with the natural resin. The resin will be modified for better adhesion to the fibre. The interface between the fibre and the matrix is crucial in terms of composite performance. This research will develop a bio-composite with optimum performance.

- To manipulate these parameters so that optimum adhesion of the natural fibre will take place with the natural resin, hence a synthesis of a novel biopolymer.

- To utilize analytical techniques in the evaluation and characterization of mechanical properties, moisture resistance and chemical properties of the novel bio-composite.