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THERMO MECHANICAL MODELLING OF POLYMERIC COMPOSITES

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ABSTRACT

To meet global industrial requirements, materials have been developed from conventional monolithic alloys to composite materials. Traditional monolithic materials cannot attain the right blend of strength, toughness, stiffness, and density with monolithic material. A composite material can be used to overcome these deficiencies and meet the increasing requirements of new-day technology. Composite materials are among the most promising materials we have in recent years. There are many structures that contain polymeric materials, including pipelines, vibration isolators, and dampers. On a smaller scale, magnetic-sensitive polymers are becoming useful in sensor and actuator applications. There are two constituents in composite material, the matrix and the filler. It is a multiphase material in which the filler phase disperses throughout the matrix.

In a polymer composite, polymers are mixed with a filler, and the resultant composite will have the properties of both types of polymers. The physical properties of the composite will be determined by the type of polymer and filler. Among the most common applications for composite materials are in aerospace, architecture, automotive, energy, marine, pipe and tank construction, sports & recreation, and transportation industries. It is the objective of new composite materials to improve mechanical properties. They are softer and less rigid when compared to the component materials. The purpose of this study is to examine the mechanical and tribological behavior of polymer reinforced composites formed by combining ABS, and Nylon Matrix materials with $BaSO_4$ and $CaSO_4$ materials as fillers.

Composites can be constructed using materials such as Nylon and ABS combined with $CaSO_4$ and $BaSO_4$. Analyses were performed to better understand how composites respond at various loads and to determine their performance..

7.1 Tensile Characteristics

- Tensile properties of Nylon/ CaSO4, Nylon/ BaSO4, ABS/ BaSO4 , and ABS/ CaSO4 composites were evaluated by (ASTM D 3039) Standards.
- Based on the tests results, it was discovered that ABS/ CaSO4 has better strength than other compositions for the same load.
- Nylon composites have a 34 % higher tensile strength than ABS composites, indicating that Nylon matrix composites are better suited for high strength applications, whereas ABS composites may be employed for lightweight applications.
- Finally, Nylon-based composites were shown to be more suitable for use in various industries, including aviation and automotive, aerospace, marine, and sports applications.

7.2 Hardness Characteristics

- The Rockwell hardness (HRc) of Nylon and ABS-based Matrix Composites was investigated, and it was discovered that Nylon/ CaSO4 has a greater hardness than the other composites.
- Nylon/ CaSO4 has a higher hardness when the filler content is lower. And it was discovered that when the filler amount of CaSO4 increased, the hardness of the material decreased.
- ABS has a lower hardness than Nylon-based composites. ABS/ BaSO4 has a greater hardness than ABS/ CaSO4, and the hardness decreases as the filler concentration increases.
- Nylon base composite has a higher hardness. It offers more significant benefits in a variety of aerospace and marine applications.

7.3 Influence of process parameters on wear behavior of composites.

- The impact of process parameters on various composite compositions is studied using process parameters such as normal load, sliding speed, and sliding distance.
- Each of the factors has a substantial impact on the composite's wear behavior.
- For ABS/ BaSO4, normal load contributes 42.39 % to wear. The contribution of speed is 37.38% while the contribution of sliding distance is 9.76 %.
- Normal load contributes 37.44 % to wear in ABS/ CaSO4 Speed contributes 8.48 %, whereas sliding distance contributes 28.2 %.
- Normal load contributes 12.05 % to wear in Nylon/ CaSO4. Speed contributes 73.4%, whereas sliding distance contributes 8.46 %.
- For Nylon/ BaSO4, speed contributes 72.45%, whereas sliding distance contributes 0.07%. and Normal load contributes 12.05 % in the wear rate.

7.4 SEM analysis of wear debris and fractograph of composites.

- SEM examination was used to examine particle clustering in the specimens and the deposit of filler matrix material in the voids of the Matrix composites.
- There is an influence on the Composite behavior when the filler material is increased. On the rare occasion that light is reflected back to the viewer, the debonding reflects light at the defect periphery, causing the faults to appear dull regions or fine spots.
- With filler materials, worn surfaces with entire plowing pathways, multiple microcracks, and scratched surfaces filled with different wear debris were found.

- As the applied force and sliding distance increased, the dimension of the platelets, flakes grew larger.

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