

The Effect of Thermal Perturbation on a Polymer Material's Tensile Test via Simulation and Experimental Analysis

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Abstract— Polymers are made from pieces of monomer that can be connected into a long chain. Natural rubber is studied in this research. In this research, tensile testing was conducted to the rubber specimen in order to check the heat release from the specimen. A thermocouple device was used to measure the specimen's temperature during tensile testing. The data from the tensile test were used to generate the stress vs strain curve. Computer simulation study was also performed. The results show that the temperature reading from the thermocouple device has increased to prove that there was a heat release from the tensile test. The heat was detected after the specimen's fracture. The simulation test proved the same phenomena as the experimental test.

Index Terms—Tensile Test; Simulation Analysis; Polymer Material; Thermal Perturbation.

I. INTRODUCTION

The manufacturing industry has increased interest to use polymer for their product due to their low density, inherent high-temperature resistance and ease of fabrication. These characteristics also prefer that polymer composites have an expressive potential as materials in high-temperature structures. Nevertheless, there is normally a mutual concern around the durability of polymeric materials, partly because of their maintenance, replacement and useful life. These material deteriorations depend upon the duration and the intensity of interaction within the environment.

Energy saving is the primary reason for the trend of replacing metal parts by polymers. Generally, the density of metals is higher than the density of polymers. So that, in comparison with a certain amount of fuel, the cars with polymer parts can travel more distances than a standard car with mostly metal parts.

Nowadays, the most widely applied and the simplest measure to check material dependent property is by tensile testing. By stretching a material, the result of the experiment can be determined immediately. The results can be used by engineers and designers to predict materials and products for their project or application to the highest caliber. Tensile testing can be valued in many performance parameters.



Figure 1: 300kN AUTOGRAPH Shimadzu AG-IS MS series Universal Testing Machine

In our daily life, we use so many polymer materials. For example, clothes hanger that we use, are always placed under hot sunny day. We noticed that after a few years, the hanger will be easy to bend and fracture. It is often evident that the mechanical character of a solid polymer is altered greatly by changes of temperature as small as a few degrees [1].

Tensile test is important for designers and engineers to make sure that the material used in their work is suitable for their projects. Higher temperatures will respond badly as a result of a tensile test. If the result is bad, their projects will face problems.

The main objective of this present study is to study and analyze the effect of thermal perturbation on the mechanical strength of polymer material by tensile test. On the other hand, this research is conducted to study whether the heat release during the process will give any effect to the mechanical properties of the specimen. Skill in processing and analyzing the data and results from the test is required.

The work will be analyzed in simulation test of thermal and mechanical properties of polymer material via ANSYS software. The data will be collected and studied to compare the experimental and simulation part of the polymer material's tensile test.