

Thermal Analysis Of Car Hood Cover Using ABS Material

Vishal Ingle¹ Yugesh Kharche²

¹ ME Student, CAD/ CAM Department, Padmashri Dr. V. B. Kolte College of Engineering, Maharashtra, India

² ME Professor, CAD/ CAM Department, Padmashri Dr. V. B. Kolte College of Engineering, Maharashtra, India

ABSTRACT

In last decades automotive industries are making a lot of improvements to find reliable solution's car hood conditions. Nowadays, the use of new materials is bringing improvements for vehicle industry. This paper shows the importance of the best material used to be applied on hood cover to be rigid and us pedestrian safety. The increase in strength of car hood lead to increase the safety of Front view of car and its life period. The severity of a head injury, in case of an accident between a Human and the vehicle, depends on the rigidity of the Hood structure. The present study aim is to find static strength, pedestrian protection, and crash resistant, HIC values, forces are the main objective which the comparison is made on. All these studies will be examined by thermal analysis how the Hood Cover affected the stress after impacting load on it also this result will give us pedestrian safety. This research could contribute to improvement in both using ABS material and Pedestrian safety.

Keyword: - Car Hood Cover, ABS Material, Pedestrian safety, Head Impact Criteria.

1. INTRODUCTION

Nowadays, when a vehicle is decided to be designed and manufactured, various standards such as safety regulations should be considered. However, most of these generally accepted requirements are in whole vehicle level. At the same time, aluminum and aluminum alloy are most commonly used material instead of steel because it is light in weight. This fact can be vividly seen in the case of vehicle hood assembly which experiences different loading conditions during. Some situations in which a hood should be examined are as follows:

Hood – Thermal Sustainability of ABS Material

Hood HIC Values (results in permanent plastic deformation)

Because of recent concern about pedestrian safety, most of the hood studies have been done on same topic. For better safety performance investigator works mainly on improving the vehicle structure mechanism and to study the pedestrian injury and the injury score. And some investigator works on to investigate the vehicle front structure impact on the pedestrian's injuries, and then find the significant results to improve vehicle safety. Simultaneously, to realize the importance of vehicle lightweight design, the new material requirement becomes more important, but very few projects was done to study the thermal analysis of car hood cover using new material as well as pedestrian protection performance.

This project is carried out by doing Literature Review, to learn more about car hood cover requirements. Literature Review shows the knowledge about the materials used for manufacturing of car hood cover. The analysis will perform to learn about other researchers and their thesis. Review has made car hood made of ABS materials with consideration with Pedestrian Safety. When Literature Review is done, the researcher will be carried out analysis of material selection to compare with conventional car hood cover material like steel, aluminum the investigation was arranged to taken after obtain thermal analysis result in Lab. The comes about from this examination will likely be advance assessed.

1.1 Material

The ABS is a thermoplastic an amorphous material, it is classified as a copolymer. The ABS resin contains 60% styrene, 27% acrylonitrile, and 13% butadiene; it could be a well-known commercial polymer for its fabulous mechanical properties. It has a petrochemical origin, and it is regularly signified by a low melting point at around 105 °C. ABS material was solidified and available in 1950. However, this polymer incorporates a scattered stage of butadiene, an intermediate phase of SAN (styrene-acrylonitrile) grafted to the butadiene, and a continuous phase of SAN. The typical monomer composition in commercial ABS resin is: (20 % - 30 %) acrylonitrile, (5.0 % - 35.0 %) butadiene and (35.0 % - 75.0 %) styrene (Scheirs, 2002). Typically, ABS is utilized to make medical devices (such as

in cartilage tissue engineering), beauty products and vehicle components. In which ABS materials (e.g., intended for injection molding and extrusion) are gathered rather than rigidly classified. These groups are subdivided by class and grades. Particularly, in the case of reinforced ABS/alloys, ABS is given an assignment review within the setting of its materials properties. In general, ABS resin is well adopted by the commercial industry due to its high impact resistance, strength, toughness, thermal stability, dimensional stability and processability.

1.2 Method

Thermal analysis (TA) are measuring techniques noted for recognizing the material thermal response (e.g., through heating, cooling or held isothermally); therefore, TA points to relate the temperate and the material physical properties. Measurement and investigation techniques include thermogravimetric analysis (TGA), differential scanning calorimetry (DSC), thermomechanical analysis (TMA), These are among the well-known Thermal investigation techniques. This subsection gives deep knowledge into two thermal investigation techniques, TGA and DSC.

a. Thermogravimetric analysis

Thermogravimetric investigation, TGA, is a method in which the mass of a substance is measured as a function of temperature or time, while the substance is introduced to a controlled temperature program in a particular atmosphere. Commercial thermogravimetry analyzers, are able to resist temperature programs extending. TGA is capable to recover information as the volatile content, the onset of thermal decomposition, inorganic filler content, volatility of additives, or define kinetic analysis through isothermal runs, just to name a few. Among the experimental parameters in thermogravimetric experiment are note down. TG curves are used to evaluate the mass loss from the polymer or measure the mass gain. The TGA temperature programs are chosen in connection to the research interest. For example, a low limit temperature is adequate to examine solvents, moisture evaporation or phenolic cure (100 °C–300 °C), an intermediate limit temperature is planning for most polymer decomposition (500 °C–600 °C) and high limit temperatures to decide filler content and for thermally stable polymers (650 °C–1000 °C). The derivative thermogravimetry (DTG) profile, is known to provide the maximum rate of mass loss and developed DTG peak contains information relative to a separate thermal event Ultimately, it describes the assessment of material thermal stability through the determination of the temperature at which the materials start to decompose or react and the extent of the mass change using thermogravimetry.

b. TGA- Acrylonitrile-butadiene-styrene

ABS have been broadly studied by researchers. It examined the thermal stability and performed infrared spectroscopy studies on acrylonitrile butadiene-styrene (ABS), polystyrene, polybutadiene, polyacrylonitrile (PAN), and styrene acrylonitrile (SAN) copolymer. The specimen's mass was approximately 40 mg. and it utilized a heating rate that was about 20 °C/min. ABS experimental studies, under an inert atmosphere, purged at approximately 30-50 cc/min, showed a single degradation step transition in the TG profile. Additionally, the residual analysis, measured at 600 °C, yielded approximately 4.0 %. According to the authors, two degradation step transitions were identified for pure ABS, under static air. As far as thermal stability, the first degradation step was observed through 180 °C to 480 °C. In addition, a second degradation transition was noted through 480 °C to 620 °C. In fact, the authors recognize it exists a variability in their results when compared to other works published on TGA. Therefore, these variations reported through different publication are prevalent due to the polymer matrix compounding parameters and testing parameters, including: the molecular weight, ABS component ratios, sample weight, sample volume, heating rate and cleansing gases. Ultimately, these variations define the actual degradation of ABS. These TGA examinations pointed to determine the thermal decomposition kinetics parameters on ABS. It was shown the specimen were almost completely decomposed at 500 °C. Whereas, quasi-isothermal thermogravimetric studies on ABS resin demonstrated two-stage decomposition events. This corresponded to the styrene and butadiene components. In fact, this was confirmed through FTIR analysis of decomposition gas.

c. Differential scanning calorimetry

The differential scanning calorimetry studies, originated from the pharmaceutical and polymer material industries, has been utilized in research settings, as a strategy in which the heat flow difference into a substance and a reference material is measured as a function of temperature technique in which the heat flow difference into a substance and a reference material is measured as a function of temperature. A DSC temperature programmed scan, heating, cooling or isothermally, is capable to cause some structural modifications or decomposition. More specifically, in the case of DSC, it is possible to recover information, such as the heat capacity, melting temperature, crystallization temperature, heat of fusion, heat of reaction, fast purity determination. Also, it can show the mechanical and thermal history of polymers, the kinetic evaluation of chemical reactions, or the glass transition temperature.

2. LITERATURE REVIEW

- i. **M. Mohamed et al. 2018 (Journal of Fundamental and Applied Sciences)** considered AISI 304 amalgam steel and AA5182 have nearly the same quality to resist weight indeed in spite of the fact that the densities are distinctive. As both materials are solid sufficient to stand the pressure, but aluminum is the foremost reasonable. It is since this fabric is lighter compared to steel, in this way it can diminish the weight of the car. Reenactment of the affect test on car entryway are able to be done and investigation has been done on the three diverse material that has been choosing which is AISI 304 steel combination, AA 5182 aluminum amalgam and AS4/3051-6 for composite material.

		
Steel alloy	Aluminium alloy	Carbon fiber composite
Name: AISI 304	Name: AA 5182	Name: AS4/ 3051
Model type: Linear Elastic Isotropic	Model type: Linear Elastic Isotropic	Model type: Linear Elastic Isotropic
Poisson's ratio: 0.29 N/A	Poisson's ratio: 0.33 N/A Elastic	Poisson's ratio: 0.27 N/A
Elastic modulus: 1.9e+011 N/m ²	Elastic modulus: 8e+10 N/m ²	Elastic modulus 3337062529.8983 N/m ²
Shear modulus: 7.5e+010 N/m ²	Shear modulus: 150000000 N/m ²	Shear modulus: 48263301.052248 N/m ²
Yield strength: 2.06807e+008 N/m ²	Yield strength: 3.95e+008 N/m ²	
Tensile strength: 5.17017e+008 N/m ²	Tensile strength: 4.2e+008 N/m ²	Tensile strength: 45505398.134977 N/m ²

Table -1 Comparison properties of 3 materials

- ii. **M. Mohamed et al. 01 February 2018 (Journal of Fundamental and Applied Sciences)** Comparison Carbon fiber Fortified plastic, Aluminum Amalgam and combination Steel for Car Hood application for Affect Test. It reenacts the affect test for car hood utilizing Solid works recreation computer program. 3 Diverse materials of car hood (Al 6061 T6, Steel AISI 1045 & CFRP Sandwich composite) were inspected by 4 distinctive strength (870 N, 1370 N, 1870 N & 2370 N) that affecting the car hood. Additionally, the reenactment result gives CFRP- Sandwich composite has higher esteem of most extreme relocation compared to Steel AISI 1045 and Al 6061T6. From this result CFRP-Sandwich and Steel AISI 1045 nearly have same esteem of push. Subsequently, bother materials have tall surrender quality execution compared to Al 6061-T6.
- iii. **M Osanloub et al. 2003 (J Crash 2003 Vol. 8 No. 4 pp. 367–374 Woodhead Publishing)** The display points at comparing two diverse plans (steel and aluminum) from inactive quality, person on foot assurance, and crash focuses of see. Torsion and twisting qualities, HIC values, vitality assimilation capacities and pivot strength are the most comes about parameters which the comparison is made on. In show disdain toward of a 40 % weight decrease in hood get together it is competent to carry more torsion and bowing minutes some time recently any plastic misshaping takes out. HIC appears the contrasts are so small in most cases that it can be effectively ignored. An unused arrangement such as geometrical optimization ought to be examined to decrease the level of head damage at these focuses.
- iv. **Jing Huang et al. 2018 (The Open Mechanical Engineering Journal, 2014, 8, 872-878)** Right now to utilize of modern material is bringing advancement in vehicle industry for the lightweight portion reason. The plan of motor hood is exceptionally critical by see point of sea as well as effectively accessible fabric in arrange to progress execution

of the unused fabric motor hood, the spiral hardening rib structure and trapezium sandwich structure motor hood were proposed in this paper. The reenactment comes about to show that more uniform unbending nature and way better vitality retaining capacity, which would successfully decrease the motor hood head wounds. To realize the vehicle lightweight plan, the unused fabric was utilized to supplant the carbon steel for the vehicle body.

- v. **Hovorun T. P et al. 4 December 2017 Volume 4, Issue 2 (2017) (JES SUMDU)** The car industry has no of materials to manufactures cars, like iron, aluminum, steel, glass, elastic, petroleum items, copper and others. These materials have advance incredible properties over the decades, getting to be more advanced, superior built, and more secure. They have changed to modern car manufacturing developed over a long time, they are utilized in inventive ways. Car manufacturers are continually working to make the lightest cars possible to extents speed and control. Investigate and improvement into lightweight materials is fundamental for bringing down their cost, expanding their capacity to the re-use, empowering their ideas into vehicles, and maximizing their fuel economy. Light weighting without misfortune of quality and speed properties is the show, and long-standing time, of the car manufacturing industry. It brings inventive materials to the cutting edge of plan.
- vi. **Muhammad Harris et al. 11December 2019 (MDPI)** Acrylonitrile butadiene styrene (ABS) is the most seasoned fabric that appears solidness to warm maturing due to hydrogen deliberation of the butadiene monomer lead copolymer. A novel mix of ABS, PP and polyethylene join malefic anhydride (PE-g-MAH) is displayed for FFF. It has destitute warm maturing soundness at high temperature. This requires solid ABS as best thermo-mechanical steady fabric. The mix of ABS with PP in nearness of compatibilizer can support for long time for warm maturing.
- vii. **Vulavapoodi Narayana et al. August 2016 (International journal & magazine of engineering Technology, Management & Research)** The planning of car cap and analyzing it within the ANSYS has effectively done. The FRP (fiber strengthened plastics) materials has fabulous mechanical properties in designing field increment its applications all through designing perspective. The application of the aero industry due its light weight and good quality to stand up to the strengths and its sensible fetched to be utilized.
- viii. **Paul Bere et al. 2017 (MATEC Web of Conferences 112)** The composite material utilized to fabricate of the hood have noteworthy weight lessening. This encompasses a considerable commitment of mass diminishment of the vehicle and increments the independence of the car. The FE examinations of the mechanical structure of the vehicle hood shows that the plan of the composite fabric satisfy the prerequisites of the standard inactive tests.
- ix. **Ramesh C. K. et al. September 2012 (SASTECH Journal Volume 11, Issue 2, Sep 2012)** The head affect examination on the show hood of the car was done to ponder the reaction of the grown-up head shape at two diverse areas. Auxiliary and modular examination for the same display hood get together was done to watch the neighborhood and worldwide solidness Head affect investigation with altered Hood was reenacted, and the HIC values are found to be 760 & 948 at two areas which are inside the target esteem. Hence, are inside the unused plan of the hood is person on foot neighbor, significantly keeping up the generally worldwide solidness of the hood.
- x. **Rahul Karani, Dr. Ashish Mazumdar August 2020 (IRJET volume: 07 Issue: 08 | Aug 2020)** The objective of the examination was to guarantee that the unused plan of cap performs palatably beneath an assortment of stacking conditions. With this objective, the comes about are included to affect loads, inactive stacking and vibration. Amid the investigation, it has been watched that the plan is competent of all the stacking conditions with palatable execution. The misshaping was well inside limits for the stack cases. In this way, it can be concluded that the proposed plan of the cap meets the different security and quality parameters set forward by the different testing and guidelines organizations.
- xi. **Mahesh J, Prashanth A S August 2016 (IARJSET Vol. 3, Issue 8, August 2016)** It is evident that the hood plan meets the necessities for all DVP load cases. Moreover, to watch, there's a scope for plan optimization to diminish the weight of the hood get together. Beneath this light plan, emphases are to be carried out to decrease the weight of the hood get together.

3. PROBLEM STATEMENT

Generally, still a steel component is heavy, and they are costly to manufacture also. It is very costly and especially front side of vehicle is important to make lower fuel utilization and less emission. For this I need to think on car hood system. Hood or bonnets are manufactured using Steel. This led to major impact of heavy material due to which critical injury will happen with pedestrian after meeting an accident.

4. OBJECTIVE

In an automobile industry, many requests are affecting the car hood cover such as safety, durability and maintainability. Now-a-days several numbers of modifications, re-modification, newly designed

components or structure or machine elements are being done. At this condition these components may be affected by material related problems which lead to impact of major accident of vehicle. Hence, it also leads to increase the head injury of pedestrians. The scope of this thesis to explore the possibilities by introducing ABS material for manufacturing of car hood cover with Pedestrian safety. I like to introduce & investigate ABS material as a comparison option for steel & aluminum hood. Thus, car hood must be analyzed for better operating condition and there are several ways for testing the results. Some tests are as below:

- Thermal Analysis
- HIC

5. SCOPE

- Lightweight hood
- Available in different colors
- Decrease major injury of pedestrians which was high at the time of Steel, aluminum car hood used.
- No Harm, easily handle.

6. METHODOLOGY

- 1) Identify the problem of Steel & Aluminum car hood.
- 2) Make the objective on which you like to work.
- 3) Make Car hood design diagram.
- 4) Modeling car hood design in CATIA software & make its IGS file.
- 5) Insert IGS file in ANSYS software and apply meshing on it.
- 6) Apply thermal analysis on design to record the deformation result.
- 7) Compare the result for the conclusion.

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