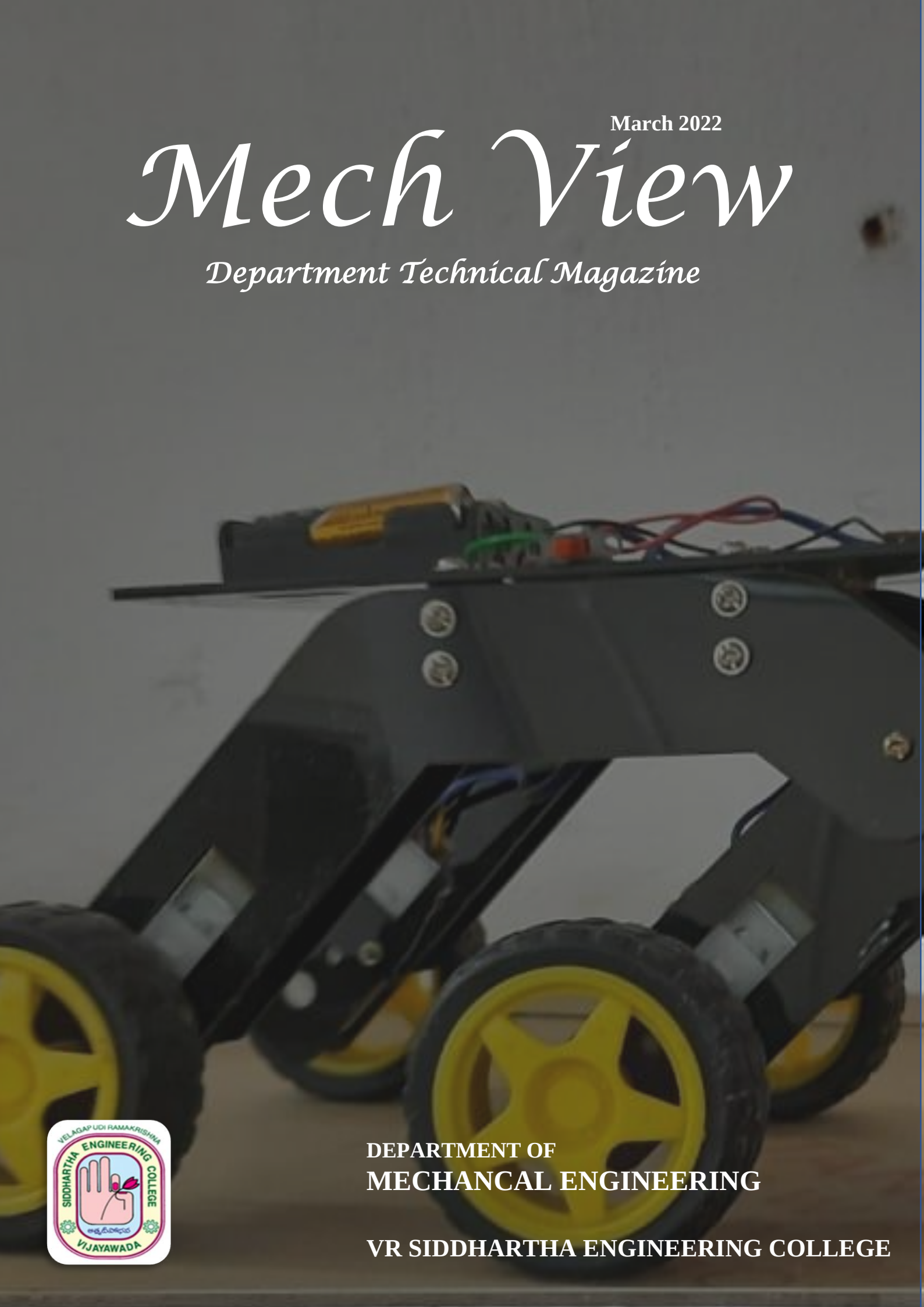
March 2022

Mech View

Department Technical Magazine



DEPARTMENT OF
MECHANCAL ENGINEERING

VR SIDDHARTHA ENGINEERING COLLEGE

INSTITUTE VISION

To nurture excellence in various fields of engineering by imparting timeless core values to the learners and to mould the institution into a centre of academic excellence and advanced research.

INSTITUTE MISSION

To impart high quality technical education in order to mould the learners into globally competitive technocrats who are professionally deft, intellectually adept and socially responsible. The institution strives to make the learners inculcate and imbibe pragmatic perception and pro-active nature so as to enable them to acquire a vision for exploration and an insight for advanced enquiry.

DEPARTMENT VISION

The Department of Mechanical Engineering endeavours to become a centre of academic excellence and research.

DEPARTMENT MISSION

Prepare graduates by providing a comprehensive knowledge and experience in a state-of-the-art mechanical engineering education to become creative, inquisitive and innovative professional in global environment.

PROGRAMME EDUCATIONAL OBJECTIVES

PEO1: Progress in professional career with a solid foundation in mathematics, science and Engineering sciences.

PEO2: Solve real time engineering problems using professional knowledge and skills resulting in significant societal development.

PEO3: Demonstrate multidisciplinary skills to analyse engineering issues in a broader perspective with ethical responsibility towards sustainable development.

PEO4: Demonstrate interpersonal skills, leadership and team building to achieve organization goals and pursue lifelong learning and higher education necessary for successful profession.

MECH VIEW

Department Technical Magazine

March 2022

Mech view is a student run magazine publishes the ideas and projects of the final and third year students. The objective of the magazine is to provide a platform for senior students to publish their projects and an avenue for the juniors to brainstorm the ideas. Currently, the publication frequency of the magazine is one issue per year.

Student Articles

Student Article

ENHANCING THE PERFORMANCE OF A SOLAR PANEL USING FLAT PLATE REFLECTORS

N. Bhanu Teja*, R. Gireeswar*, Md. Musharraf*, O A Mohammed Anas*, S. N V Syam Surya*, Dr. V. L Krishnan #
* - 4th Year B Tech Student, # - Guide

The article presents an overview of the work carried out to enhance performance of a Solar panel using flat plate reflectors. It discusses the methodology, work executed, results and conclusion.

Introduction

Solar energy is a renewable source of energy which is available freely in nature and also in abundance in the Indian Sub-Continent. One way to harvest the solar energy is to use Solar Photovoltaic panels. Reflectors can be used to increase the amount of solar radiation that the solar panels are exposed with, thus increasing the production of Photovoltaic based electric power. The Reflectors are available in different shapes and sizes, as shown in the figure below. It reflects the radiated solar heat which otherwise gets lost to the environment. The reflector plates can be designed to have same size or larger than the solar panels so that all reflected light falls onto the surface of the solar panel.

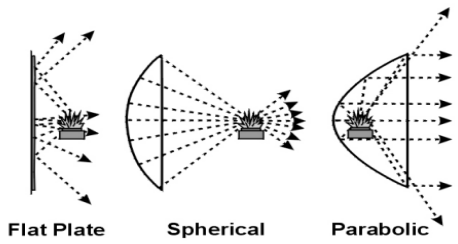


Fig.1: Types of Reflectors

Advantages:

- Simple design.
- Affordable.

Description of the Experiment

The approach adopted to investigate the influence of reflectors on the PV based electric power generation by a solar panel efficiency has been carried out as detailed below. Three sets of experiments have been executed.

First set of experiments concerns with recording the stock performance of solar panel without any reflectors (please refer Figure 2). The first set of experiment yields the baseline performance. Second set of experiments relates to the reflectors being arranged adjacent to the longitudinal edge of the solar panel on either side of the solar panel. In the third set of experiments, the reflectors used with the solar panel are aligned with the transverse edges of the panel. Performance of the solar panel has been recorded for different configurations of the reflector plates at various angles i.e., 120, 135, 150 degrees. The optimal reflector angle is chosen based on the performance parameters at each time frame. The reflector angle at which the performance of the solar panel is maximum is taken as optimal

reflector angle.

Fig.2: Experimental setup (32cms*12cms.)

The results obtained for the three sets of experiment are presented in figure 3 and also graphically presented in figure 4.

Results and Discussion

Time	Power output without Reflectors(W)	Power output with Reflectors 1 (W)	Power output with Reflectors 2 (W)	Shaded(W)
9:00 AM	2.11	2.46	2.42	0.78
10:00 AM	2.348	2.98	2.92	0.84
11:00 AM	3.487	4.562	4.58	0.96
12:00 PM	4.327	5.767	5.822	1.12
1:00 PM	3.92	5.24	5.31	1.09
2:00 PM	1.064	1.521	1.478	0.535
3:00 PM	1.182	1.68	1.672	0.62
4:00 PM	2.92	3.812	3.962	0.92
5:00 PM	2.46	3.168	3.122	0.86

Fig. 3: Comparison of performance

Fig. 4: Graphical Representation of Performance

The results of the experiment for improving efficiency of solar panel using flat plate reflectors has been found to be highly encouraging. It has been noted that the use of Flat plate reflectors has led to the improvement in solar panel efficiency. The efficiency has increased by 35%, compared to normal case i.e., without the use of solar reflectors. Output power from solar panel without using any reflectors was 4.3 watts at peak and from solar panel with reflective plates it's about 5.7 watts which means instead of purchasing new solar panel one can obtain 33% percent more power from the same solar panel using the reflectors. Even though the efficiency of solar panel has increased significantly, it can be further improved using cooling techniques.

CONCLUSION

It has been noted from literature and also validated through experiments that at peak solar incidence, temperature of the solar cells increases and in turn, panel power generation efficiency decreases. The results obtained are presented in figure 3. It is based on experimental data (readings and graph) obtained from three different sets of experiments. To address the abovementioned response of solar panel, cooling of solar cells need to be implemented. Also, the experiment has been carried out without adopting maximum power point tracking technique (MPPT). Hence, further improvement in solar power generation can be expected by combining the strategy of using solar reflectors along with the cooling arrangement, under MPPT tracking.

Student Article

Energy Efficient Cooking pot

S. Mounica*, B. Anusha*, I. Raj Kumar*, D. Koteswara Rao*, Dr. S R More#

Guide/ Mentor; * – 4th Year B Tech student

The article presents an overview of energy efficient cooking pot. It discusses the concept, its applications, and fabrication testing in brief

Introduction

This research is intended for designing and creating energy-efficient cookware for LPG stoves by using extended surfaces known as "FINS". By the techniques, cookware can include a cookware base having a cooking surface and heat surface. The heating surface can have a pattern of fins forming heat exchange channels.

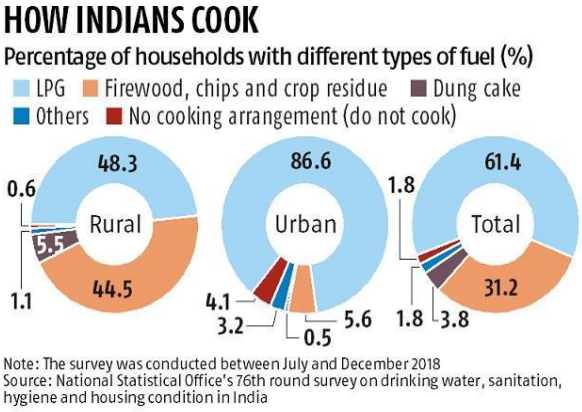


Fig. 1(a) How the India Cook Details

Fig. 1(b) Conventional Cooking Pot

PROBLEM STATEMENT:

As the usage of the energy sources got increased one of that energy resources is the LPG. In domestic usage, the LPG is the main source for cooking purposes. Cookware is the basic component that depends on the usage of the LPG as the material and shape are the internal factors. Cookware is that having a cooking base and heating surface. The usage of gas mainly depends on the heating surface as the loss and gain of heat energy takes place. For efficient heat transfer, the heating surface gets modified by modifying the shape, size, material, etc.

OBJECTIVE

- This research is related to the increase in the production rate by using efficient cookware. Cookware includes a cookware base and having a cooking surface and heating surface.
- The heating surface can have a pattern of fins forming heat exchange channels. The channel fins can improve energy transfer while providing even distribution throughout the cooking surface.
- The use of fins can also improve the

mechanical strength of the cookware. Methods of making energy-efficient cookware are provided. A piece of cookware with a thick base can be provided by casting and by bonding a metal plate to the cookware body.

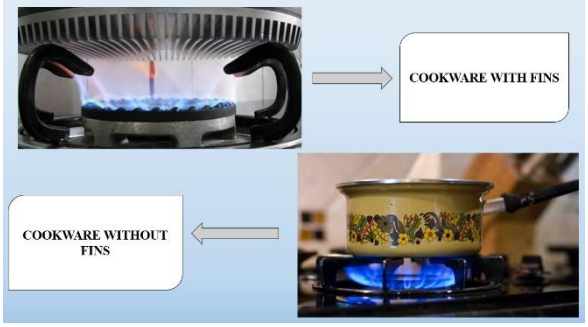


Fig. 2: Concept of the new cooking pot

MATERIAL SELECTION

- ✓ The most common pot or pan in the commercial kitchen is aluminium. They are light, excellent conductors of heat, and are inexpensive compared to other cooking pots and pans.
- ✓ The chemical composition of pure aluminium is about 99.5%–99.9% of Aluminium and 0.12–0.5% of copper would be present. Aluminium is also the third most abundant element in nature.

DIMENSIONS OF COOKWARE POT

According to the "STANDARD BOILING TEST" available for cookware, the dimensions of 5 lit capacity cookware pot are assumed.

The Diameter of the cookware = 25 cm

The Height of the cookware = 18 cm

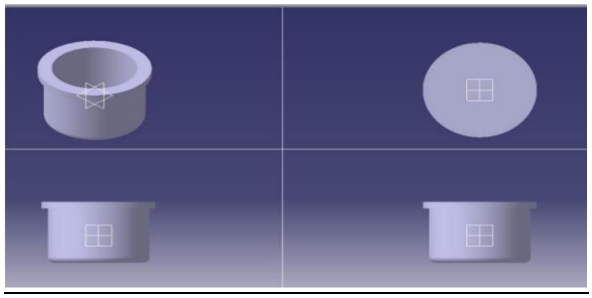


Fig. 3: Modeling of cooking pot

Fig. 4 Cooking pot with and without fins

RESULT AND DISCUSSION

By Comparing the Cookware with and without fins, the heat transfer rate is more in cookware with fins than the cookware without fins.

- ❑ Heat Transfer Rate without fins,

  Q = 302.855 Watts
- ❑ Heat Transfer Rate with fins

  Q = 826.5 Watts

Efficient Cookware i.e.… cookware with extended surfaces to reduce heat loss plays a major role in the consumption of LPG.

EXPERIMENTATION RESULTS

	Specification Of Cooking Pot Of 5-litre capacity	Initial Temp in ^{O}C	Final Temp in ^{O}C	Time Taken To Reach From 30°C To 70°C
Ceiling Fan On	Without Fin	25	70	(15-20) min
	With Fin	25	70	(10-12) min
Ceiling Fan Off	Without Fin	25	70	(14-18) min
	With Fin	25	70	(8 - 12) min

CONCLUSION

The overview is that theoretically and practically proven that by using FINS (extended surfaces) The Heat Transfer Rate increases as the area that got in contact increases.

The Point of increasing Heat Transfer Rate is that the energy loss get reduces and also the energy source i.e. LPG consumption get reduced. This overall defines the reduction of LPG usage by EFFICIENT COOKWARE.

Student Article

Fabrication of Copper Based Catalytic Converter

S. Yuvaraj Reddy*, Ch. Pradeep*, KN Karthik*, LJ Emmanuel*, KS Sai*, K. Srinivas#
Guide/ Mentor; * – B Tech student

The article presents an overview of the design and fabrication of a catalytic converter with Cu as coating. It discusses the concept, its applications, and fabrication testing in brief

Introduction

Air pollution is caused by solid and liquid particles and certain gases that are suspended in the air. These particles and gases can come from car and truck exhaust due to the use of internal combustion engines. The main reasons for air pollutants by engines is due to reason that the time available for is limited by the engines cycle to just a few milliseconds. So result of which the pollutants enters air after combustion process. The incomplete combustion of fuels in the engine leads to emission of partially oxidized products like carbon monoxide (CO), oxides of nitrogen (NOx) and a wide range of volatile organic compounds (VOC), including hydrocarbons (HC), aromatics and oxygenated species. These emissions are particularly high during both idling and deceleration, when insufficient air is taken in for complete combustion to occur. Carbon monoxide is a product of a partial combustion of hydrocarbons in fuel. It is always present when there is a lack of oxygen during combustion and thus directly dependent on the applied engine air/fuel ratio. There are several paths that cause hydrocarbons in the exhaust. The most obvious is, as in the case of CO, a lack of oxygen when the air/fuel mixture is rich. The other reasons that can cause hydrocarbon emissions even with lean mixtures are crevices (piston top, threads around the spark plug), the quench layer (due to a lower temperature of the cylinders‟ walls), porous deposits, and absorption by oil. NOx is formed during combustion in the engine when oxygen reacts with nitrogen because of a high combustion temperature. So as a result of which an indigenous device known as catalytic converter was invented in order to decrease pollutants during emission.

Cupric Oxide Coating

A major consideration for the Manual Dispersion coating process is that the coating is done at a necessary thickness, and a number of different techniques are used to get this control, ranging from a simple brush for painting a wall to some various machinery applying coatings in the coating industry. A further measure for 'non-all-over' coatings is that control is needed according to the thickness of the coating to be applied. This

process is followed by manual dipping of the honeycomb structure into the solution of copper oxide and the acid solution and then air-jet spraying over the honeycomb/ monolith10. Hence, this is the cost-effective coating process compared to all the above processes, this is the process that is used for coating honeycomb.

Testing Without Catalytic Converter

A five-gas analyser is used to measure the gases which are released from the exhaust of the engine. A test is conducted to measure the gases released, without a catalytic converter, and readings are noted down.

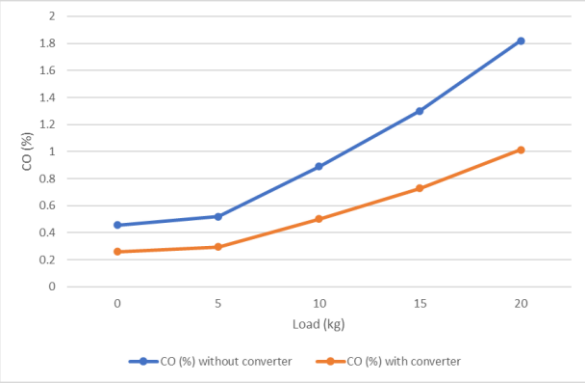


Fig 1. Emission of CO from the IC Engine with and without a catalytic converter

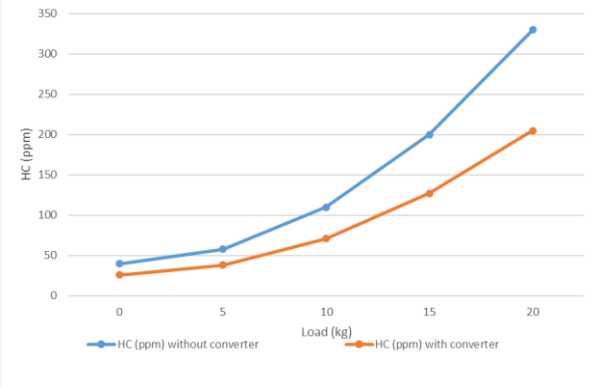


Fig. 2. Emission of hydrocarbons from the IC Engine with and without a catalytic converter

Testing With Catalytic Converter

The test is repeated by using a catalytic converter by using cupric oxide as the catalyst.

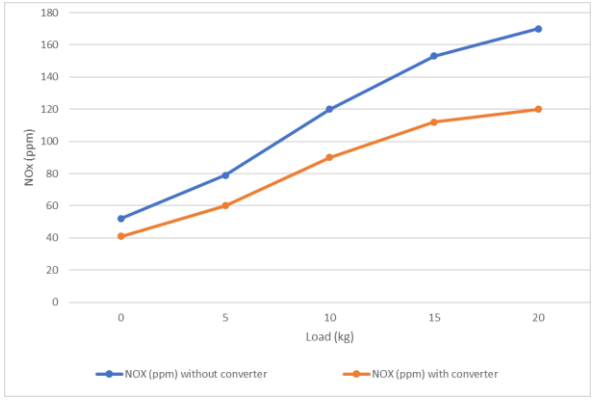


Fig. 3. The emissions of the oxides of the nitrogen from the IC engine when run with and without a catalytic converter

Conclusion

Catalytic converter plays a major role in the reduction of harmful exhaust emissions from automobiles. In our project, it is planned to replace costly noble metals like platinum, palladium, and rhodium with non-noble metal like copper oxide coating on the monolith or steel mesh with a little change in design. It is found that by using cupric oxide instead of noble metals like platinum, palladium, and rhodium the pollutants are reduced by the following percentage at 100% rated load as follows 79.78%, 60.58%, and 41.25% for CO, HC, and NO_x respectively. Hence it observed that by using non-noble metals like copper oxide the harmful emissions can be reduced by nearly 60.53% overall.

Student Article

Biomass Gasification

A. Rohan Raj Varma*, N.V.R Prasanth*, M. Rithika*, D. Sunil*, M. Jogendra Prasad#

* B.Tech Students, # Supervisor

The article presents an overview of Biomass Gasification. It discusses the merits in the usage of Biomass, its Gasification & its applications, in brief

Introduction

Biomass Gasification is a mature technology pathway that uses a controlled process involving oxygen to convert biomass to hydrogen and other products, without combustion.

Biomass is a renewable organic resource, created from living species like plants and animals that includes agriculture crop residues (such as corn stover, bagasse etc.,), forest residues, organic municipal solid waste, and animal wastes.

Gasification is the conversion of solid or liquid feedstock into useful and convenient gaseous fuel or chemical feedstock that can be burned to release energy or used for production of value-added chemicals. Gasification and combustion are two closely related thermochemical processes, but there is an important difference between them. Gasification packs energy into chemical bonds in the product gas; combustion breaks those bonds to release the energy. The gasification process adds hydrogen to and strips carbon away from the hydrocarbon feedstock to produce gases with a higher hydrogen-to-carbon (H/C) ratio, while combustion oxidizes the hydrogen and carbon into water and carbon dioxide, respectively

There are several major motivations for such a transformation and are as follows:

- To increase the heating value of the fuel by rejecting non-combustible components like nitrogen and water.
- To strip the fuel gas of sulphur such that it is not released into the atmosphere when the gas is burnt.
- To increase the H/C mass ratio in the fuel.
- To reduce the oxygen content of the fuel.

Why Biomass?

By definition, biomass is a renewable material, as during growth of the plants, crops, and trees, CO2 is withdrawn from the atmosphere (the carbon source) and stored in the biomass as chemical energy. The CO2 cycle is closed again when the CO2 is released during conversion of the biomass and the use of derived products. The renewable and CO2-neutral nature of biomass is the major motivation to use the

material for the energy generation (e.g. green electricity and heat). The same consideration applies for the use of biomass for the production of fuels and products. To date, nearly all transportation fuels and most materials and chemicals are produced from crude oil or natural gas. At a certain moment in the future, the decreasing reserves of these fossil materials will give rise to increasing prices. Therefore, an additional motivation is that to maintain the same production levels, an alternative carbon source is required and biomass is the only carbon source that is renewable. Biomass will be the future feedstock for the production of transportation fuels and chemicals.

Why Gasification?

Gasification is the key conversion technology in all processes for the production of energy, fuels, and/or products from biomass. In electricity production biomass is thermally converted by gasification into a combustible gas that can be used in a gas engine or turbine with electricity as well as heat as products. The advantage of the gasification route is the higher overall electric efficiency compared to the alternative of direct biomass combustion. In the production of fuels and chemicals the combustible gasification gas is used in a catalytic process to synthesise the desired product.

Applications:

- Production of Synthetic Natural Gas (SNG)
- Co-firing & Power Generation
- Combined Heat and Power (CHP) Plants
- Integrated Gasification Combined Cycle (IGCC)
- Production of Transportation Fuels such as Fischer-Tropsch diesel and methanol
- Chemical Synthesis

Conclusion

Biomass will play an important role in the future global energy infrastructure for the generation of power & heat, and also for the production of chemicals and fuels. The dominant biomass conversion technology will be gasification, as the gases from biomass gasification are intermediates in the high-efficient power production or the synthesis from chemicals and fuels.

Student Article

Influence of Manufacturing Variances on the Strength of composite structures

V. Vamsi*, Md. Mustafa*, L. Vinit*, P. Gopichand*, Ch. Sri Chaitanya#

* B.Tech Students, # Supervisor

The article presents an overview of the effect of the manufacturing variances like density, fibre orientation angle and the thickness of the laminate on the strength of the composite structure.

Introduction

The unique and diverse characteristics of composite materials have increased in many Fields. From feather weight rods to high performance aircraft parts, the use of fibre reinforced materials has become a compelling asset due to their high strength to weight ratio and high strength to stiffness ratio combined with easy manufacturing methods. The strength of composite structure is sensitive to the manufacturing variances like fibre orientation angle, thickness of the laminate and the volume fraction of fibre. In the present study, the effect of these parameters on the strength of the composite laminate and the optimum parameters for higher strength. We take E-glass/LY556 epoxy resin for case study.

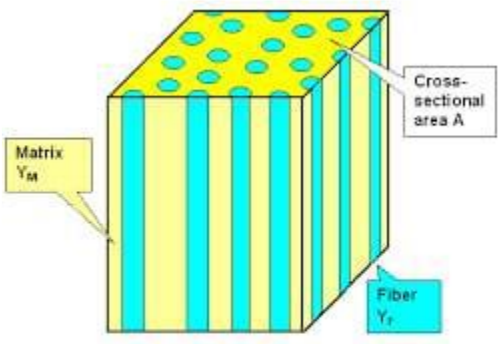


Fig. 1. Composite laminate

Autodesk Helius software provides guidance and virtual testing. When using composite materials these tools help engineers to develop composite based solutions. Early in the design process by exploring design concepts optimizing laminate designs an identifying material failure. Autodesk Helius software enables unmatched virtual prototyping of composite materials helping you to realize the benefits of the composite material revolution.

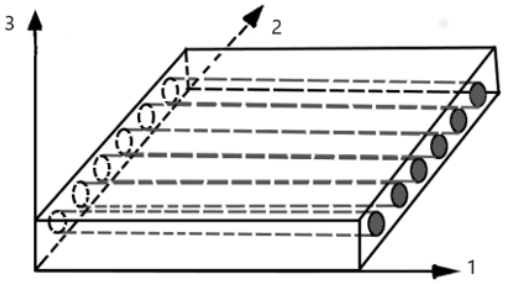


Fig. 2. Orientation of the composite material

Advantages of Optimization

- Improves the design and performance of the product or system.
- Provides multiple design options.

- Optimization minimizes overall cost.
- Optimization reduces error.
- Multi-objectives can be easily achieved by optimization.

Results

The effect of the Orientation angle, Lamina Thickness, and Fibre volume fraction on the strength of the pressure vessel.

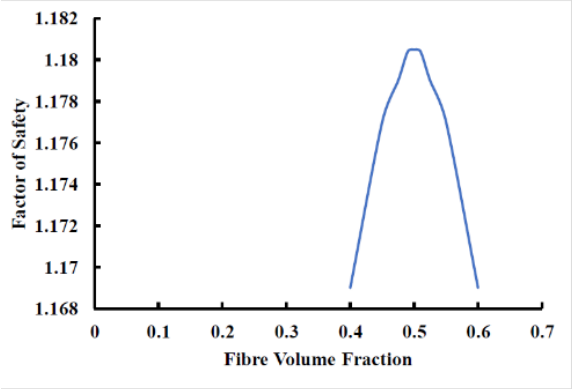


Fig. 3. The factor of safety of the composite structure as a function of the fibre volume fraction in the composite

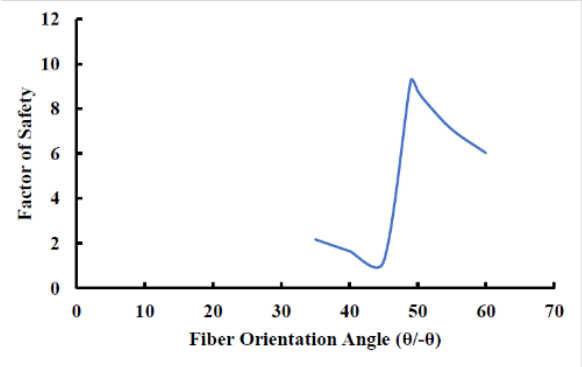


Fig. 4. The factor of safety vs the fibre orientation angle of the composite laminate.

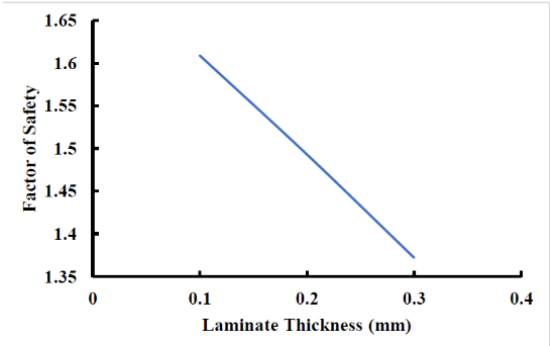


Fig. 5. The effect of the laminate thickness on the factor of safety of the composite structure.

Conclusions

The conclusions of the study are

1. Eglass fibre and LY 556 Epoxy are a good combination for the composite structure
2. The Optimum fibre volume fraction was found to be 0.5.
3. The optimal orientation angle for the composite structure was found to be 50^{o}/-50^{o}.
4. The optimum lamina thickness was found to be 0.1 mm.
5. The optimal winding angle is independent of the thickness of the lamina and the volume fraction of the fibre in the matrix.

Student Article

An Analysis to Optimize the Process Parameters of Friction Stir Welding (FSW) of Aluminum Alloy Plates

S. Sai Yaswanth*, A. Sohel*, B. Rajesh*, K. Arun*, P. Pavan*, V. Bapi Raju#

* B.Tech Students, # Supervisor

This report provides an experimental analysis regarding the optimization of process parameters for friction stir welding regarding the process parameters involved in FSW.

Introduction

Friction stir weld is often used for materials like aluminum and magnesium and rarely used for metals like steel and other materials. This is a non-fusion welding process in which we use a non-consumable electrode to join two work pieces. The frictional force developed in this is responsible for the joining of the metals. This input slow energy which is capable of producing very high strength welds in wide range of materials with low cost. It over takes many problems occurred by conventional welding process. During the process of welding plastic flow of material occurs which helps in the joining of the work pieces. Major process parameters used in this are tool design or shape of the tool, tool rotation speed, welding feed speed etc. Material used here is Aluminum 6351 alloy plates. Different grades of aluminum alloys are available starting from the 1000 series to 8000 series. In this generally the softness of the material decreases from lower series to the higher one based on the various compositions like silicon, magnesium, zinc, manganese and lithium. The 6000 and 7000 series have high strength to weight ratio which is used for various applications like in air craft and defense industries. 1000, 3000, 5000 series aluminum alloys are non-heat treatable alloys and are strain harden able alloys. 2000, 6000, 7000 series alloys are heat treatable alloys which gain their materials properties after heat treatment. After welding generally material properties are lost if we do heat treatment in such cases some of the properties can be recovered. This is the reason for the selection of 6000 series alloy material.

Experimental Method

Here we use Taguchi optimization technique in which we take L4 orthogonal array. We use this method to maximize the hardness of material Process parameters taken here are tool tilt angle, rotational speed of tool, welding speed. Here HSS tool is taken the tool consists of three parts namely, pin, shoulder and the body.

The material we used to make the tool is SS rod of 18mm diameter and 120mm length.

The pin diameter of the tool is 2.7mm and the pin length is 2.7mm.

Fig.1. Tool used for the study

Taguchi Method

This mainly contains two steps as shown below

Step 1: use the S/N ratio to identify those control factors that reduce variability.

Step 2: identify the control factors that bring the mean to target and have little or no effect on the S/N ratio. Usually, the calculation of the main effect of the S/N ratio and mean response is done by three categories of quality characteristics, as listed below.

Experiment no	Rotational speed	Travel speed	Tilt angle
1	1130	11	0
2	1130	18	1
3	2000	11	1
4	2000	18	0

Fig. 2. Control Factors

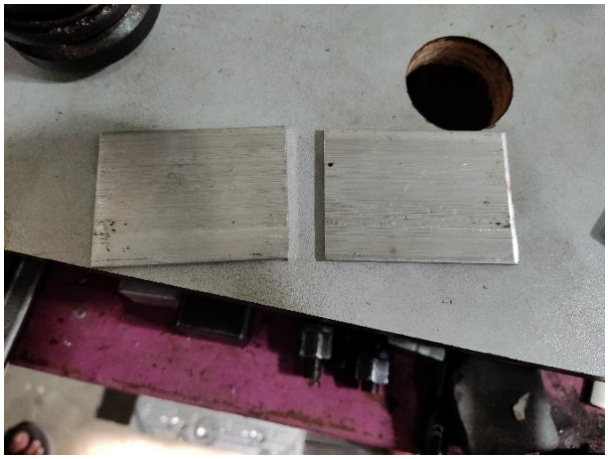


Fig. 3. Samples before welding

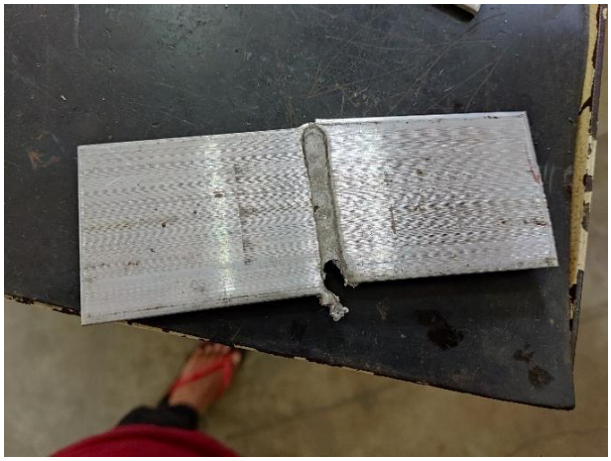


Fig. 4. Samples after welding

Above pictures shows plates before and after welding

After this hardness test is conducted. Here we use Brinell hardness test for calculating hardness of the material. Hardness is calculated as shown below

Brinell Hardness Number (BHN)=$2P/\{\Pi D[D-\sqrt{(D^2-d^2)}]\}$

Where

P=Load applied in kgf.

D=Diameter of the indenter in mm.

d=Diameter of the indentation in mm,

Here in the conducted experiment diameter of indenter is 5mm and load applied is of 250 kgf.

Results and Conclusions

The results are shown in the following figures

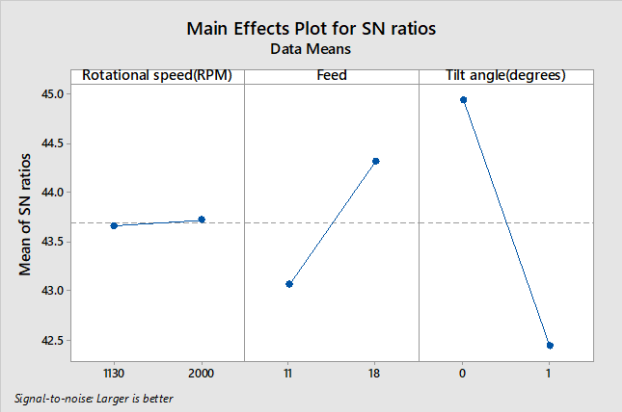


Fig. 5. Mean of SN ratios

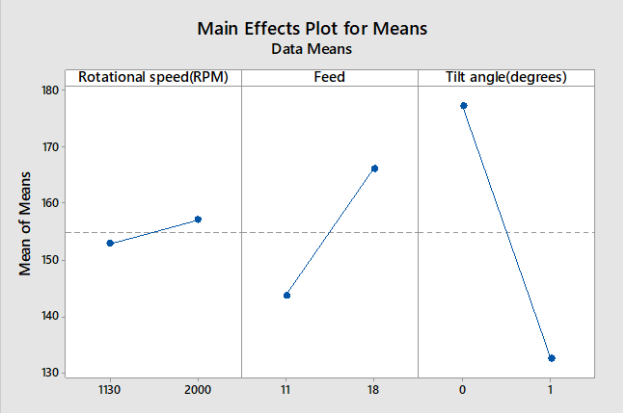


Fig. 6. Mean of Means

The above two graphs show the mean of SN Ratio and second one shows the mean of the process parameters. Here from the graph, we can conclude that rotational speed has the least effect and next feed or welding speed has the next increasing effect, whereas the tool tilt angle has the major effect for the output that is the hardness of the material. As tool angle increases hardness increases and for the increase in rotational speed and welding speed hardness increases.

PROGRAMME OUTCOMES

PO1 Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and engineering specialization to the solution of complex engineering problems.

PO2 Problem analysis: Identify, formulate, research literature, and analyse engineering problems to arrive at substantiated conclusions using first principles of mathematics, natural, and engineering sciences.

PO3 Design/ development of solutions: Design solutions for complex engineering problems and design system components, processes to meet the specifications with consideration for the public health & safety, and the cultural, societal, and environmental considerations.

PO4 Conduct investigations of complex problems: Use research-based knowledge including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5 Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO6 The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7 Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of and need for sustainable development.

PO8 Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9 Individual and team work: Function effectively as an individual and as a member or leader in teams, and in multidisciplinary settings.

PO10 Communication: Communicate effectively with the engineering community and with society at large. Be able to comprehend and write effective reports documentation. Make effective presentations, and give and receive clear instructions.

PO11 Project management and finance: Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work, as a member and leader in a team. Manage projects in multidisciplinary environments.

PO12 Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES

PSO1: Apply their knowledge in the domain of thermal systems to solve engineering problems using modern technological tools.

PSO2: Develop and implement new ideas related to product design and manufacturing for societal and industrial needs using modern CAD/CAM/ CAE tools.

DEPARTMENT OF MECHANICAL ENGINEERING

VELAGAPUDI RAMAKRISHNA
SIDDHARTHA ENGINEERING COLLEGE

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