

Fabrication of 3 Wheeler Electric Vehicle: A Review

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Abstract: This research paper aims to undertake a comprehensive study of the battery operated e-rickshaws. Auto rickshaws are small, three-wheeled vehicles which are used extensively in many Asian countries for transport of people and goods. The vehicles are small and narrow allowing for easy maneuverability in congested Asian metropolises. In India, auto rickshaws are commonly used as taxis, as they are very inexpensive to operate. Despite the apparent advantages in the vehicle design, auto rickshaws present a huge pollution problem in major Indian cities. This is due to the use of an inefficient engine, typically a 2 or 4 stroke, with almost no pollution control. This paper presents a transportation system based on auto rickshaws that operate in an environmentally friendly way. Existing vehicles are to be replaced by an all-electric counterpart redesigned in a manner which improves the efficiency of the vehicle. Thus far, we have looked at the existing Vehicle and the environment in which it operates, produced a Prototype electric vehicle.

Keywords: Electric Drivetrain, Chassis, Bodyworks, Suspension, Steering, Wheels and Tires, Brakes.

1. Introduction

India today is one of the top ten Automotive markets in the world and given its burgeoning middle class population with buying potential and the steady economic growth, accelerating automotive sales is expected to continue. In the last couple of years, there has been a lot of discussion around the prices of fuel – apart from the deregulation of petrol prices. Moreover the threat of disruption of supplies from the Middle-East has heightened the debate on energy security and brought the focus on to alternate drivetrain technologies. The potential for alternative technologies in automobiles such as electric vehicles (EV) in India, as in the case of many other comparable markets, depends on improved battery technologies, driving ranges, government incentives,

regulations, lower prices and better charging infrastructure. There seems to be a lot of interest on the part of Internal Combustion Engine (ICE) based manufacturers to adopt electric technology, not just supplemental to the ICE, but as a stand-alone offering. There are also specialized EV manufacturers that have come up all over the world.

While many of the factors that influence the EV market are understood intellectually, we carried out a consumer survey to study perceptions and expectations of potential for alternative technologies in automobiles such as electric vehicles (EV) and hybrid EV. Assessing future demand for electric vehicles was somewhat challenging since it meant testing consumer preferences for a product with which they are largely unfamiliar. For this reason, we focused on uncovering consumers' familiarity with EV technologies and products; with their opinions around price, brand, range, charging, the infrastructure, and the cost of ownership; and with the consumer's imagined "fit" of an EV in his or her lifestyle given a range of demographic parameters.

In recent years, rickshaw companies have come out with alternative models such as Compressed Natural Gas (CNG) and Liquefied Petroleum Gas (LPG) rickshaws to mitigate the pollution problem caused by traditional petrol models. Two main disadvantages that exist with incorporating those technologies on the rickshaws are:

- Oil is still added to the chamber in the two stroke configurations, which adds to the pollution, and
- LPG and CNG are non-renewable energy sources.

The best way to redesign the rickshaw is to make the main power source renewable. Rickshaws are an ideal candidate for electrification due to the low speeds of the vehicle and a relatively small distance covered in a day. Therefore, we have set out to make auto rickshaws the

example of environmental consciousness in India by replacing the existing hydrocarbon- powered vehicles with electric vehicles and recharge the batteries using mostly renewable energy sources.

1.1.1 Electric vehicle (EV) industry in India:

During April 2012 Indian Government has planned to unveil the roadmap for the development of the domestic electric and hybrid vehicles (EV) in the country. A discussion between the various stakeholders including Government, industry and the academia is expected to take place during 23–24 February. The final contours of the policy will be formed after this set of discussions. Ministries such as Petroleum, Finance, Road Transport and Power are involved in developing a broad framework for the sector. Along with these ministries big auto industry names such as Mr. Anand Mahindra (Vice Chairman and Managing Director, Mahindra & Mahindra) and Mr. Vikram Kirloskar (Vice-Chairman, Toyota Kirloskar) are also involved in this task. Government has also proposed to set up Rs 740 crore R&D fund for the sector in the 12th five year plan during 2012-17. The idea is to reduce the high cost of key imported components such as the battery and electric motor and develop such capabilities locally.

2.1 LITERATURE REVIEW

2.1.1 Review of the Powertrain System:

Paul Chambon [1] emphasizes on the accelerated development of a printed range-extended electric vehicle (REEV) by Oak Ridge National Laboratory, by paralleling hardware-in-the-loop development of the powertrain with rapid chassis prototyping using big area additive manufacturing (BAAM). A.Sasikumar [2] derived the vehicle dynamic behaviors, such as the acceleration, the speed, the tractive forces and vertical forces of the HEV. Based on theoretical analysis of the HEV powertrain, various influences on the vehicle dynamics have been investigated and analyzed with respect to the electrical quantities. Sharad Patel [3] designed and analyzed three wheeler campus mobility vehicle and concluded that after doing all the analysis and design calculation the design is safe against corresponding various load conditions. Various parameters were noted after testing to evaluate vehicle's performance. The model satisfies the primary requirement of campus mobility.

Sharada Prasad N [4] identified the major challenges for HEV design which were managing

multiple energy source, highly dependent on driving cycles, battery sizing and battery management. Electric scooter prototype was developed with design and analysis. Real time traffic and speed were recorded for further analysis. Rushikesh Trushar Soni [5] analyzed and concluded that the transmission of power using freewheels and chain wheels is very cheap and reliable with one disadvantage which is driving on electric power resulting in not a good option for a long distance travel. Though this combined power train system can become much useful in more stop and go traffic situations. With the use of this powertrain system, the overall fuel consumption and fuel economy is improved.

2.1.2 Review of the Vehicle Dynamics System:

T S Manjunatha [6] manufactured a carbon fiber composite helical spring. They used E-glass in the form of mat and L-12/K-6 Lapox epoxy system for laminating applications. Experiments were conducted as per ASTM standards for testing and they found that the weight of the spring manufactured from fibers is less than steel spring, the stiffness of the carbon fiber springs is greater than the other two types of composite coil springs, fatigue life of the fiber spring will be more compared to steel spring. Prof. S. N. Shinde [7] showed the basic study of welding fixtures and positioners, latest trends in industries, objectives of welding fixtures & positioners along with its advantages. They explained the design of fixture and the material that should be used for it. Houman Alipooramirabada [8] explained the effects of welding on residual stresses, microstructure and mechanical properties of HSLA steel. They used three type's shielded metal arc welding (SMAW) and a combination of modified short arc welding (MSAW) and flux cored arc welding (FCAW). They found that with the SMAW process, high levels of tensile residual stresses were found further away from weld centerline. Combination of MSAW and FCAW resulted from smaller prior austenite grain size.

N. Jeyaprakash [9] explained the parameters and equipment's used in TIG welding. They in detail explained the principle of TIG welding, TIG welding equipment, types of welding current in TIG welding, TIG welding torches and electrode shaping. The choice of the welding depends on several factors; primarily among them are the compositional range of the material to be welded, the thickness of the base materials and type of current. Risto Laitinen [10] showed the effect of edge preparation on the fatigue strength of the structures made by high and ultra-high strength steels. They performed hardness and fatigue test on the specimens and they found that fatigue strength values

plasma cut specimens when the yield strength was 500 MPa or lower.

2.1.3 Review of the Brakes System:

Brijendra Gupta [11] showed that the objectives of improve vehicle fuel efficiency and lower emissions will mean that brakes will have to be lighter and not release any toxic and carcinogenic substances into the atmosphere during use. This means that the choice of brake friction materials will need to be more environmentally friendly and not include toxic substances such as asbestos. Sunil Prashanth Kumar S [12] proved that brakes can be incorporated in heavy vehicles as an auxiliary brake. The electromagnetic actuating coil is controlling the current supplied to produce the magnetic flux. Making some improvements in the brake it can be used in automobiles in future. Sriram T. Mutalik [13] mentioned that braking system is efficient and cost effective. With the increased torque absorbing capacity almost twice the conventional braking system, the vehicle will come to stand still with less braking distance. Braking is more efficient as both radial and axial force is applied.

Sourav Das [14] showed that braking efficiency is found as a function of brake force. The braking efficiency of LM30 alloy is 36 % at 5 N force is increased to 95 % when the brake force is increased to 20 N. However, speed does not have any correlation with the braking efficiency. ADC12 alloy shows lesser braking efficiency than LM30 alloy. Khyati Sharma [15] showed that the energy efficiency of a conventional brake is only about 20 percent, with the remaining 80 percent of its energy being converted to heat through friction. The miraculous thing about regenerative braking is that it may be able to capture as much as half of that wasted energy and put it back to work. This reduces fuel consumption by 10 to 25 percent. Hence regenerative braking plays an important role in fuel consumption and also in the field of speed.

2.1.4 Review of the Chassis System:

M. Aghakhani [16] showed that gas metal arc welding is a fusion welding process having wide applications in industry. In this process proper selection of input welding parameters is necessary in order to obtain a good quality weld and subsequently increase the productivity of the process. In order to obtain a good quality weld, it is therefore, necessary to control the input welding parameters. Taguchi's method of design of experiments a mathematical model was developed using parameters such as, with

feed rate (W), welding voltage (V), nozzle-to-plate distance (N), welding speed (S) and gas flow rate (G) on weld dilution.

Bhavin Shah [17] presented a review on Activated Flux Welding Process (ATIG). In present age of competition distinct types of organizations are striving hard to control costs, maintain high levels of productivity, meet changing expectations of the customers and attain quality. Gas tungsten arc welding is fundamental in those industries where it is important to control the weld bead shape and its metallurgical characteristics. Hamad Mohammed Abouhenidi [18] showed the study and design of Jig and Fixture for Base frame of Canopy Fabrication of Generator. Base frame is very important part of generator canopy. The jigs and fixtures assure that there will be accurate assemblage of part so the main components of generator like engine, alternator will mounted properly on base frame. Jigs and fixtures are manufacturing tools that are employed to produce interchangeable and identical components.

Rushikesh D. Bhosale [19] showed the study and design of Jig and Fixture for Base frame of Canopy Fabrication of Generator. Base frame is very important part of generator canopy. The jigs and fixtures assure that there will be accurate assemblage of part so the main components of generator like engine, alternator will mounted properly on base frame. Jigs and fixtures are manufacturing tools that are employed to produce interchangeable and identical components. Mohammed Noorul Hussain [20] presented the fabrication of chassis. The fabrication of the vehicle is a simple but time taking process. The basic frame has 9 pipe bends and 12 weldments and requires approximately 7.5 meters of pipe. After addition of other parts like seats and tires the vehicles weighed 80 Kilograms. The fasteners used were of metric grade M8.8. Electric arc welding was used to do the welding. Shoe brakes were used for both the rear wheels to provide ample breaking force.

2.1.4 Review of the Bodywork System:

Vijay Kumar Bhanot [21] has explained about various properties of glass fiber reinforced plastic. It was concluded that the density of the glass fiber is low and the impact load is very high. The glass fiber can be used with epoxy resin in many places to reduce weight and cost of product and increase its impact strength. Narayan Prasad Shanu [22] gave a description about composites and types of composites used in vehicles. It was explained that the mechanical properties of carbon fiber are better than glass fiber. It was also said that glass fiber is cost effective material. Since glass fiber

cheaper rate. Saleel Visal [23] has given a detail explanation on the properties of carbon fiber reinforced polymer. An impact test was done on the test pieces made of carbon fiber reinforced plastic laminates. The results show that the modified composite papers show better mechanical properties than unmodified composite papers.

Hanumant N. Kale [24] explains the parameters affecting seat design which are very complex in nature and require detailed study of human anthropometry, seat dimensions and its mechanisms, materials of seat components and advanced system for safety. Apart from all other parameters safety and health related parameters are very important. Praveen Padagannavar [25] has said that the quality function deployment is a perfect method to solve the current problem and particularly the house of quality matrix which is effective approach to satisfy the customer expectation and design the product accordingly.

Conclusion:

The manufacturing and fabrication of 3 wheeler electric vehicle by using various techniques and unique components in each system like Roll cage chassis, TIG welding and hand lay-up composite bodywork which makes the electric vehicle light weight, cost efficient and easy to manufacture.

Future Scope:

There is no work found on the fabrication of 3 wheeler electric vehicle. The further work on this can make this will make it easy to manufacture in mass quantity and commercially available as a means of transport to everyone. Due to its light weight it will be more efficient and the cost of production per unit will be low.

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