DESIGN, FABRICATION and PERFORMANCE EVALUATION of HYBRID MOTOR CYCLE

Project Reference No.: *45S_BE_3574*

College ***:*** *The Oxford College of Engineering, Bengaluru*
Branch ***:*** *Department of Automobile Engineering*
Guide(s) ***:*** *Dr. Raju B. R.*
Mr. Pradeep C.
Student(S) ***:*** *Mr. Teja M. H.*
Mr. Mohammad Waeiz Ahemd Manaam
Mr. Mayank Rajput
Mr. Mohammed Imaduddin

Keywords:

Designing, Mould making, Fibre glass, Hybrid, Electric, Internal combustion engine, Switchable, Exhaust, Lithium Ion Battery

Introduction:

A hybrid electric vehicle (HEV) is a type of hybrid vehicle that combines a conventional internal combustion engine (ICE) system with an electric propulsion system (hybrid vehicle drivetrain). The presence of the electric powertrain is intended to achieve either better fuel economy than a conventional vehicle or better performance.There is a variety of HEV types and the degree to which each function as an electric vehicle (EV) also varies. Modern HEVs make use of efficiency-improving technologies such as regenerative brakes which convert the vehicle's kinetic energy to electric energy, which is stored in a battery or super capacitor.

Some varieties of HEV use an internal combustion engine to turn an electrical generator, which either recharges the vehicle's batteries or directly powers its electric drive motors; this combination is known as a motor–generator. HEV are usually very slow in speed and have low uphill climb and are not sporty to drive, what we are making is slightly different from other HEV's, that is the motive is to primarily design and fabricate a two-wheeler hybrid vehicle with sporting capabilities. We used a 150CC bike for ICE drive which produces 17.8HP and 14.1Nm of torque with a mileage of 40-45kmpl and a 3-6kw IPM motor powered by a 3kw li-ion battery.

The frame will be modified according to the project’s convenience, Also the fairings will be of our own design and want to make it a UNIQUE one. It has to be both aerodynamic and also be of a good quality fibre glass. The engine will be tuned according to the performance we need after testing by trial error. The combined output expected from this project is all the advantages of HEV with the added advantage of high speed, long range which other HEV's lack.

Objectives:

- Design and fabrication of 2 wheeler Hybrid vehicle (PETROL drive and ELECTRIC drive) using 150cc motorcycle.
- To calculate the maximum power produce in both ICE drive and ELECTRIC drive.
- To calculate the Top speed in ICE drive and ELECTRIC drive.
- To measure the maximum Range in ICE drive and ELECTRIC drive in city, highway, track.
- To analyse the vehicle stability at wide range of speed.
- To characterise physical and mechanical properties of glass fabric reinforced epoxy composites.
- To evaluate the strength and stiffness of the vehicle.
- Durability and reliability of the vehicle in different weather and surface condition.
- To study the different wear mechanisms, the worn surfaces were examined using scanning electron microscopy.
- Calculate the stress points and drag co-efficient of the finished designed product/fairing parts.
- To design an elegant looking and versatile motorcycle in terms of both looks and performance.
- To combine the best aspects of I.C Engine and ELECTRIC drive and minimize the worst of both.
- To design a bike which has options like I.C Engine, ELECTRIC and combination of both which is called series parallel hybrid

Methodology:

Alteration of the motorcycle: Removing the unwanted parts that are not needed for the design like headlight, tail lamps, fuel tank cover, battery, battery cover, mud guards (front and rear), exhaust system, rear sub frame, instrument cluster, seat (front and rear), tyres, handle bar and its mounting points, many other small parts.

Re-Designing the new components:

- **Tail frame:** The original tail used in the vehicle weighed a lot and not suitable for the design, a new tail frame is designed accordingly which is light in weight and strong in strength at the same time.
- **Motor housing unit:** By removing the present exhaust system a motor housing space is obtained as per the motor dimensions.
- **Battery unit:** At the rear of the vehicle a battery housing unit is placed using stainless steel which can hold 1.2kwh battery**.**
- **ECU housing unit: A** unique housing unit for all the controls system is fabricated and installed in sub-frame.

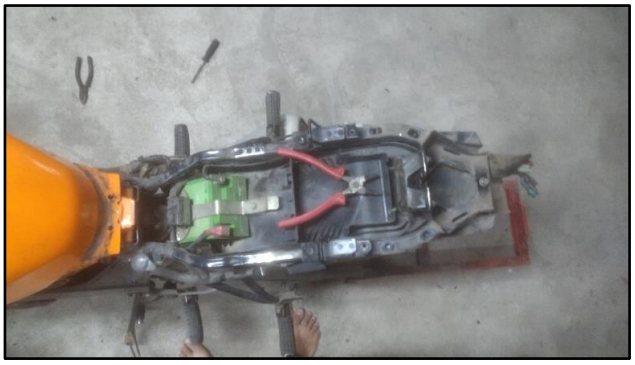
Assembly of Electric Drive Unit:

- **Electric Drive unit consists of the following parts:**
  - Motor
  - Controllers
  - Throttles

- Battery
- Battery management system

Side Fender fabrication:

- A pre-design is creating using dry clay which is hand crafted to meet the desired shape and dimensions**.**
- Using epoxy resign and fibre glass composite a very light and strong mould is obtained.
- The mould is crafted according to design and dimensions already fixed.
- Thus creating a side fender that is aerodynamically good and beautiful to look.


Results and Conclusion:

- Dual power: Depending on driving circumstances, power can come from either the engine, motor or both. The electric motor is in use at low speeds. When you pick up the speed, your combustion engine kicks in. Afterward, the electric battery recharges itself using the combustion engine. The electric motor also provides additional power to assist the engine in accelerating or climbing.
- Environmentally Friendly: One of the biggest advantages of a hybrid bike over a gasoline-powered car is that it runs cleaner and has better gas mileage, which makes it environmentally friendly. A hybrid vehicle runs on twin powered engine (gasoline engine and electric motor) that cuts fuel consumption and conserves energy.
- Financial Benefits: Hybrid bikes are supported by many credits and incentives that help to make them affordable. Lower annual tax bills and exemption from congestion charges come in the form of less amount of money spent on the fuel.
- Less Dependence on Fossil Fuels: A Hybrid car is much cleaner and requires less fuel to run, which means fewer emissions and less dependence on fossil fuels. This, in turn, also helps to reduce the price of gasoline in the domestic market.
- Assistance From Electric Motor: The electric motor assists the internal combustion engine in case of accelerating, passing or climbing a hill.
- Smaller Engines:The gasoline engines used in hybrid bike are usually small, light, and highly efficient as they don't have to power the bike alone.

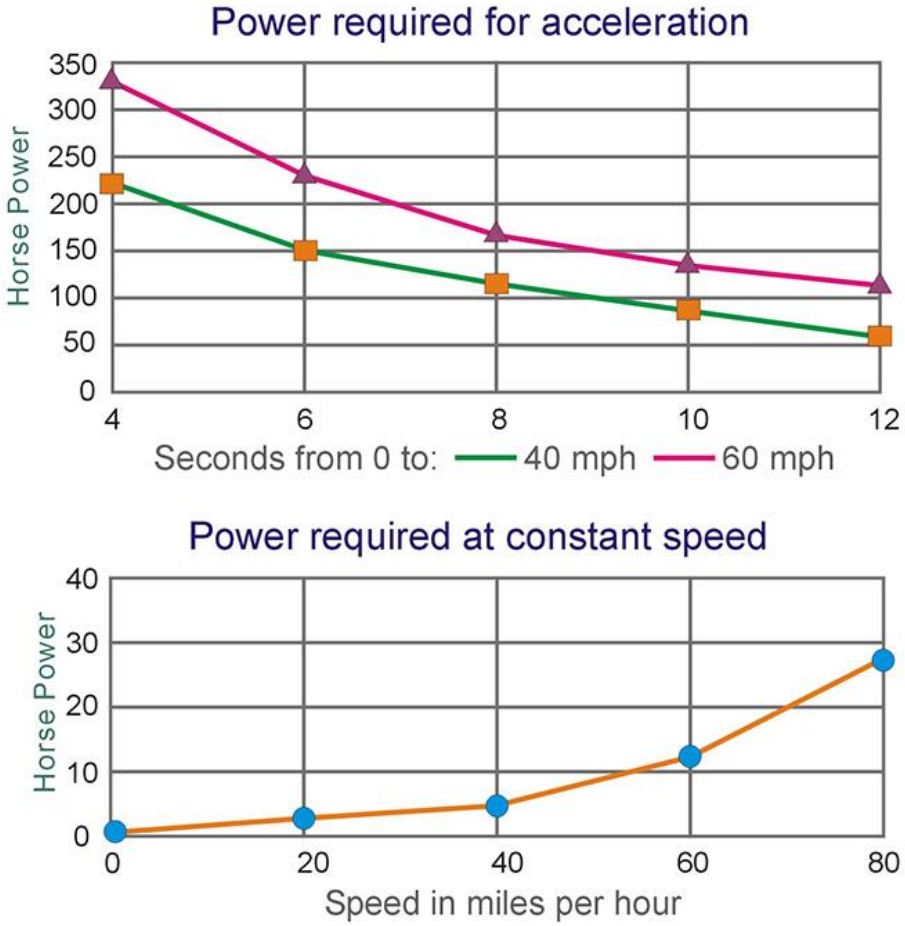
Hybrid vehicles can be driven entirely with electricity. This usually happens while moving at low speeds, when the engine is idling at a stoplight or when the engine starts up. Normally, the internal combustion engine starts operating only at higher speeds, where it has more efficiency. This helps increase the overall fuel efficiency of the vehicle.

Internal combustion engines operate best when under a constant load. Engines operating at their most efficient configuration will have increased longevity, be less complex, cost less to manufacturer and emit lower emissions. Hybrid drivetrains will combine the ICE and electric motor to take advantage of the best characteristics of both. The hybrids of the future will circumvent the trade-off between power and efficiency that current internal combustion engine powered cars are subject to. Hybrids have been sold in the U.S. for over 20 years and there is opportunity for many future refinements. Hybrid vehicles will bridge the gap between fuel-powered only to all-electric power. The hybrid of the future will be less expensive to own and operate, plus provide consumers with a fun, environmentally friendly driving experience.

Scope for future work:

Powertrain configurations that will be used for hybrid cars of the future could take many forms. Because the reason for hybrids existing in the first place is energy efficiency it makes sense that the internal combustion engines (gasoline or diesel fuelled) and electric motors used for hybrids be as efficient as possible. All internal combustion engines (ICE) are the most efficient when they are operated under a constant load. An ICE running at full power will extract the most heat energy from the fuel it consumed. Vehicles that use only an ICE cannot operate constantly at full power because the engine's power output must be

regulated for slower or faster driving conditions. This throttling of the engine causes it to be less efficient. Conversely, an electric motor is highly efficient under variable loads because maximum torque is available at all speeds. In addition, they can be used to recover lost energy through regenerative braking (see sidebar). A hybrid vehicle combines the advantages of both types of power sources — gasoline (or diesel) and electricity.



The upper graph shows how much horse power is required for acceleration of a 1383 kg (3050lb). car with a frontal area of 22 square feet (Toyota Prius numbers). To go from 0-to-96 kmph (0-60 mph) in 10 seconds requires 140 horse power. 0-to-64 kmph in 10 seconds takes about 85 H.P. The faster the car is accelerated from a stop the more power is required. For example, 0-to-96 (0-to-60 mph) in 4 seconds takes 330 horse power (Tesla model S numbers). The lower graph shows that the same vehicle only needs a fraction of the power used for acceleration to maintain constant speeds. In this example just 12 horse power can maintain a steady speed of 60 mph.

Regenerative braking: Einstein once said, “Energy cannot be created or destroyed, it can only be changed from one form to another.” and that is the premise of regenerative braking. The average car weighs around 3200 pounds with light trucks adding another 2000 pounds to that figure. To accelerate this mass to 60 miles per hour takes heat energy that comes from fuel or a battery in a hybrid. Conversely to slow down the same amount of mass also takes an equal amount of energy. The braking systems on cars and trucks convert the energy of motion into heat through friction. The heat is dissipated and its potential energy is lost. Regenerative braking can recover much of this heat loss and turn it into work to power a vehicle.