ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Manufacture And Assembly of Hybrid Electric Vehicle

Bharata Abhinav
B.Tech (Mechanical)
Joginpally B.R. Engineering College
Moinabad, Ranga Reddy.

Jaymin Patel
B.Tech (Mechanical)
Joginpally B.R. Engineering College
Moinabad, Ranga Reddy.

J Sai Krishna
B.Tech (Mechanical)
Joginpally B.R. Engineering College
Moinabad, Ranga Reddy.

K Deepak Reddy
B.Tech (Mechanical)
Joginpally B.R. Engineering College
Moinabad, Ranga Reddy.

Abstract

In general, HEVs outperform conventional vehicles in terms of fuel consumption and pollutant emissions. However, the degree of HEV performance and cost savings achieved largely depend on its application (including the types of trips), the level of available technical service and maintenance, fuel price, and the availability of optimal fuel quality. Hybrids have been defined in a variety of ways, few of which help in determining whether a particular model realizes the technology's potential. In general, hybrids with more checkmarks do more to provide energy security and less to harm the environment than those with fewer checkmarks. However, the most effective way to gauge a hybrid's energy security and environmental performance will be to evaluate their fuel economy and emissions performance directly on the road. On this checklist, the Insight and the Civic Hybrid each receives three checkmarks and are thus considered "mild" hybrids. With four checkmarks, the Prius is a "full" hybrid. A vehicle that receives five checkmarks is a "plug-in" hybrid, none of which are yet available in the United States. If a vehicle has only one checkmark it is actually just a conventional vehicle. Two checkmarks qualifies a vehicle as a muscle-hybrid, a vehicle that uses hybrid technology to increase power and performance instead of significantly increasing fuel. economy leading to an expensive vehicle with very low cost-effectiveness. As more vehicles enter the market, this checklist can be used to evaluate the hybrids automakers offer.

A hybrid electric vehicle (HEV) has two types of energy storage units, electricity and fuel. Electricity means that a battery is used to store the energy, and that an electromotor will be used as traction motor. Fuel means that a tank is required, and that an Internal Combustion Engine is used to generate mechanical power, or that a fuel cell will be used to convert fuel to electrical energy. In the latter case, traction will be performed by the electromotor only. In the first case, the vehicle will have both an engine and a motor. Depending on the drive train structure, we can distinguish between parallel, series or combined HEVs. Depending on the share of the electromotor to the traction power, we can distinguish between mild or micro hybrid (start-stop systems), power assist hybrid, full hybrid and plug-in hybrid. Depending on the nature of the non-electric energy source, we can distinguish between combustion (ICE), fuel cell, hydraulic or pneumatic power, and human power.

Keywords: ***fuel cell, hybrid, Hybrid electric vehicle (HEV),Energy management strategy, Plug-in HEV, Through-the-road HEV***

1. Introduction

The world started down a new road in 1997 when the first modern hybrid electric car, the Toyota Prius, was sold in Japan. Two years later, the United States saw its first sale of a hybrid, the Honda Insight. These two vehicles, followed by the Honda Civic Hybrid, marked a radical change in the type of car being offered to the public: vehicles that bring some of the benefits of battery electric vehicles into the conventional gasoline powered cars and trucks we have been using for more than 100 years. In the coming years, hybrids can play a significant role in addressing several of the major problems faced by the United States and the world today: climate change, air pollution, and oil dependence. Whether this

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new technology delivers on its promise hinges on the choices automakers, consumers, and policymakers make over the coming years. Poor choices could result in hybrids that fall short even of what conventional technology could deliver on fuel economy, emissions, or both.

If they are designed well, these hybrids can equal or better the utility, comfort, performance, and safety we've come to expect, while saving us thousands of dollars at the gas pump.

2. LITERATURE SURVEY

a) Hybrid electric vehicles technology and simulation:

To meet increasing fuel economy and emissions legislation, the automotive industry will need to undergo drastic changes in vehicle and engine designs. Unlike conventional vehicles on the road today, hybrid electric vehicles (HEV) are designed with a smaller engine and an on-board energy storage system. The smaller engine allows the vehicle to achieve better fuel economy and fewer emissions. The efficiency benefits of diesel engines over gasoline engines make the diesel engine a strong contender for further improving fuel economy. The integration of diesel-engine technology into a hybrid electric vehicle configuration is one of the most promising ways to comply with fuel-economy and emissions legislation. Using simulation software, it is possible to quickly and easily optimise the engine and vehicle prior to investing time and money into testing components and building prototypes. The ability to integrate an advanced engine simulation software output and an HEV simulation for the prediction of engine alterations on overall vehicle performance is a critical tool for the success of meeting vehicle emissions and fuel economy goals.

AUTHOR:- **S. Inman, M. El-Gindy, D.C. Haworth**

b) Impact of SiC Devices on Hybrid Electric and Plug-In Hybrid Electric Vehicles

The application of SiC devices (as battery interface, motor controller, etc.) in a hybrid electric vehicle (HEV) will benefit from their high-temperature capability, high-power density, and high efficiency. Moreover, the light weight and small volume will affect the whole power train system in a HEV, and thus performance and cost. In this work, the performance of HEVs is analyzed using PSAT (powertrain system analysis tool, vehicle simulation software). Power loss models of a SiC inverter are incorporated into PSAT powertrain models in order to study the impact of SiC devices on HEVs. Two types of HEVs are considered. One is the 2004 Toyota Prius HEV, the other is a plug-in HEV (PHEV), whose powertrain architecture is the same as that of the 2004 Toyota Prius HEV. The vehicle-level benefits from the introduction of the SiC devices are demonstrated by simulations. Not only the power loss in the motor controller but also those in other components in the vehicle powertrain are reduced. As a result, the system efficiency is improved and the vehicles consume less energy and emit less harmful gases. It also makes it possible to improve the system compactness with simplified thermal management system. For the PHEV, the benefits are more distinct. Especially, the size of battery bank can be reduced for optimum design.

Author:- Burak Ozpineci

3. IMPLEMENTATION:

DEFINING HYBRIDS

Hybrids have been defined in a variety of ways, few of which help in determining whether a particular model realizes the technology's potential. The checklist in below table provides a reasonable method for evaluating which cars and trucks are hybrids and for differentiating among them based on their technologies. In general, hybrids with more checkmarks do more to provide energy security and less to harm the environment than those with fewer checkmarks. However, the most effective way to gauge a hybrid's energy security and environmental performance will be to evaluate their fuel economy and emissions performance directly on the road. On this checklist, the Insight and the Civic Hybrid each receives three checkmarks and are thus considered "mild" hybrids. With four checkmarks, the Prius is a "full" hybrid. A vehicle that receives five checkmarks is

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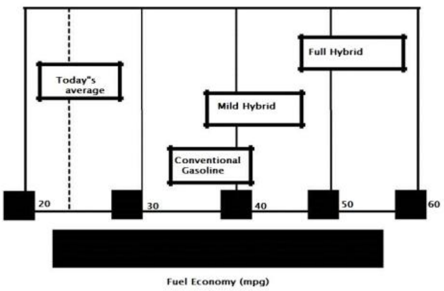
Does this vehicle...	Conventional Vehicle	Muscle Hybrid	Mild Hybrid	Full Hybrid	Plug-in Hybrid
Shut off the engine at stop-lights and in stop-and-go traffic	√	√	√	√	√
Use regenerative braking and operate above 60 volts		√	√	√	√
Use a smaller engine than a conventional version with the same performance			√	√	√
Drive using only electric power				√	√
Recharge batteries from the wall plug and have a range of at least 20 miles on electricity alone					√

Fig; The checklist for evaluating which cars and trucks are hybrids and for differentiating among them based on their technologies.



Figure; **Passenger Vehicle Fleet Average**

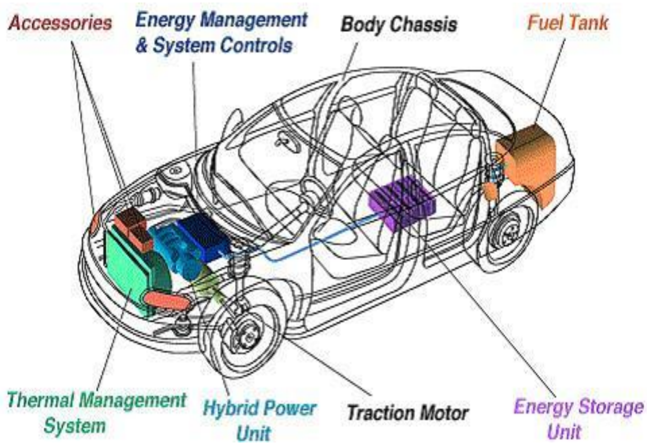
Full hybrids using advanced technology are the key to a passenger car and truck fleet that approaches an average of 60 mpg. The average price increase for such vehicles is about $4,000 and the owners will save nearly $5,500 on gasoline over the life of the vehicle. Including battery replacement, consumers would see an average net savings of $900. Plug-in hybrids would realize even greater energy security and environmental gains, but with higher costs and lower net consumer savings

HYBRID VEHICLES

This study emphasizes the role hybrids must play in our efforts to limit the contribution our cars and trucks make to US oil dependence, global warming, and local air pollution. In the short term, conventional technologies could quickly raise the average fuel economy of the passenger fleet to 40 mpg. Over the long term, we will have no choice but to adopt hydrogen fuel cells and other alternativefuel approaches. But these technologies will not be ready to replace the internal combustion engine in most new cars and trucks for over a decade. Considering the slow turnover of the passenger vehicle fleet, this leaves a significant gap of ten to twenty years after the gains from conventional technology peak and before the promise of fuel cells will be fully realized. During that period, rising travel and increased car ownership will continue to drive us to import more and more oil from politically unstable countries and to add to global average temperature increases of 2.5 to 10.4°F by the end of the century.

HEV COMPONENTS

A hybrid electric vehicle (HEV) is an optimized mix of various components. View a typical hybrid configuration in the diagram below and learn more about the various HEV components by following the links below



Fig;- Hybrid Electric Vehicle Components

HEV MOTORS/CONTROLLERS

Motors are the "work horses" of Hybrid Electric Vehicle (HEV) drive systems. In an HEV, an electric traction motor converts electrical energy from the energy storage unit to mechanical energy that drives the wheels of the vehicle. Unlike a traditional vehicle, where the engine must "ramp up" before full torque can be provided, an electric motor provides full torque at low speeds. This characteristic gives the vehicle excellent "off the line" acceleration.

Important characteristics of an HEV motor include good drive control and fault tolerance, as well as low noise and high efficiency. Other characteristics include flexibility in relation to voltage fluctuations and, of course, acceptable mass production costs. Front-running motor technologies for HEV applications include permanent magnet, AC induction, and switched reluctance motors

HEV BATTERIES

Batteries are an essential component of HEVs. Although a few production HEVs with advanced batteries have been introduced in the market, no current battery technology has demonstrated an economically acceptable combination of power, energy efficiency, and life cycle for high-volume production vehicles.

Desirable attributes of high-power batteries for HEV applications are high-peak and pulse-specific power, high specific energy at pulse power, a high charge acceptance to maximize regenerative braking utilization, and long calendar and cycle life. Developing methods/designs to balance the packs electrically and thermally, developing accurate techniques to determine a battery's state of charge, developing abuse-tolerant batteries, and recyclability are additional technical challenges.

- Nickel-Cadmium Batteries
- Nickel-Metal Hydride Batteries
- Lithium Ion Batteries
- Lithium Polymer Batteries

HEV MECHANICAL ENGINES

HEV Spark Ignition Engines:

A spark ignition (SI) engine runs on an Otto cycle most gasoline engines run on a modified Otto cycle. This cycle uses a stoichiometric air-fuel mixture, which is combined prior to entering the combustion chamber.

Once in the combustion chamber, the mixture is compressed, then ignited using a spark plug (spark ignition). The SI engine is controlled by limiting the amount of air allowed into the engine. This is accomplished through the use of a throttling valve placed on the air intake (carburetor or throttle body).

HEV Compression Ignition Direct Injection Diesel Engines:

Progress continues to advance the compression-ignition direct-injection (CIDI) engine, (more commonly called the diesel engine), which has the highest thermal efficiency of any internal combustion engine. Challenges to improvements include a lower specific power than the gasoline engine; significant particulate matter and nitrogen oxides in the exhaust; and the noise, vibration, and smell of the engine.

HEV Gas Turbine Engines:

The gas turbine engine runs on a Brayton cycle using a continuous combustion process. In this cycle, a compressor (usually radial flow for automotive applications) raises the pressure and temperature of the inlet air. The air is then moved into the burner, where fuel is injected and combusted to raise the temperature of the air. Power is produced when the heated, high-pressure mixture is expanded and cooled through a turbine. When a turbine engine is directly coupled to a generator, it is often called a turbo generator or turbo alternator.

HEV FUEL CELLS

Fuel cells generate electricity through an electrochemical reaction that combines hydrogen with oxygen in ambient air. Pure hydrogen, or any fossil fuel that has been "reformed," can be used to produce hydrogen gas.

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Methanol is a common fuel choice. For the most part, the fuel cell's only emission is water vapor, giving it potential as the cleanest hybrid power unit alternative.

Efficient, quiet, and reliable, fuel cells are predicted to demonstrate energy conversion efficiencies up to 50%; relatively high in comparison to the 20%-25% efficiency of standard SI gasoline engines.

The choice of fuel for a fuel-cell-powered HEV has important implications for required infrastructure, system accessories, efficiency, cost, and design.

Although its viability has been well-proven in the space program, as well as in prototype vehicles developed by the U.S. Department of Energy (DOE) and industry partners, very high capital costs, large size, long start-up times, and immature technologies make it a longer-term enabling technology for an HEV.

HEV FUEL SYSTEMS

The two primary fuels used in automobiles today are gasoline and diesel. The infrastructure is in place to produce, refine, truck, or tank diesel and gasoline. Many of today's HEVs, and the ones that will be available in the near future, will use either gasoline or diesel to fuel the hybrid power units. However, to ensure the security of our oil supply and to address increasing environmental concerns associated with gasoline and diesel, alternative fuels are very attractive. The opportunity for fuels such as biodiesel, natural gas (CNG & LNG), ethanol, hydrogen, and propane to be used as alternative fuels for vehicles is great. Many alternative fuel vehicles are already being used effectively around the world. These fuels have the potential to be used in HEVs as well.

WORKING OF HEV's

Hybrid-electric vehicles (HEVs) combine the benefits of gasoline engines and electric motors and can be configured to obtain different objectives, such as improved fuel economy, increased power, or additional auxiliary power for electronic devices and power tools

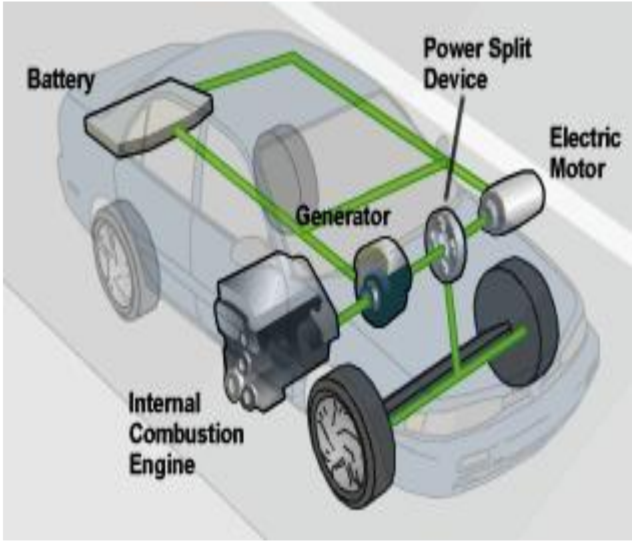

Fig: 4.1 Main Components of HEV

Regenerative Braking: The electric motor applies resistance to the drivetrain causing the wheels to slow down. In return, the energy from the wheels turns the motor, which functions as a generator, converting energy normally wasted during coasting and braking into electricity, which is stored in a battery until needed by the electric motor.

Electric Motor Drive/Assist: The electric motor provides additional power to assist the engine in accelerating, passing, or hill climbing. This allows a smaller, more efficient engine to be used. In some vehicles, the motor alone provides power for low-speed driving conditions where internal combustion engines are least efficient

DEGREES OF HYBRIDIZATION

Hybrids have been traditionally classified by the amount of driving power supplied by the electrical system and the amount supplied by the engine (Figure). For battery electric vehicles and hybrid electrics with large electrical systems and very small engines, this definition works pretty well. It also works relatively well for vehicles that do not have a downsized engine and have simply added on a technology referred to as an integrated starter generator: these are just conventional vehicles that can turn the engine off when the vehicle is stopped.

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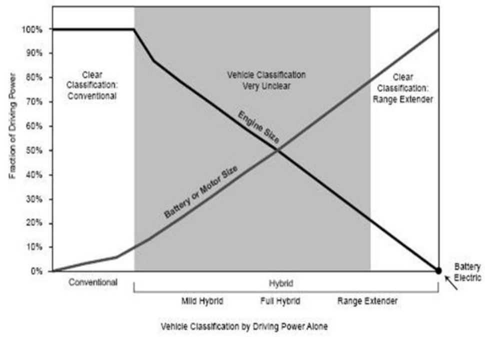
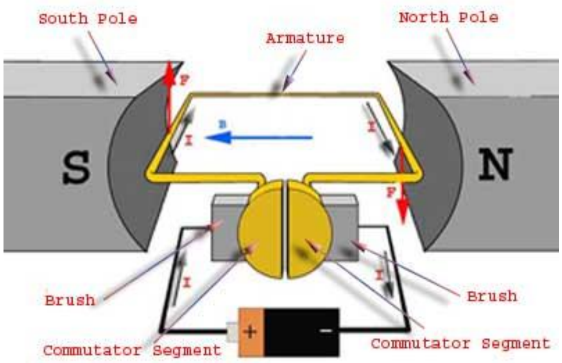


fig: 5.1 An Attempt to Classify HEV's by the Amount of Onboard Electrical Power

ELECTRICAL ENGINE/DC MOTOR

A machine that converts dc power into mechanical energy is known as dc motor. Its operation is based on the principle that when a current carrying conductor is placed in a magnetic field, the conductor experiences a mechanical force.



DC motor in simple words is a device that converts electrical energy (direct current system) into mechanical energy. It is of vital importance for the industry today, and is equally important for engineers to look into the working principle of DC motor in details that has been discussed in this article. In order to understand the operating principle of DC motor we need to first look into its constructional feature. The very basic construction of a DC motor contains a current carrying armature which is connected to the supply end through commutator segments and brushes. The armature is placed in between north south poles of a permanent or an electromagnet as shown in the diagram above. The very basic construction of a DC motor contains a current carrying armature which is connected to the supply end through commutator segments and brushes. The armature is placed in between north south poles of a permanent or an electromagnet as shown in the diagram above.

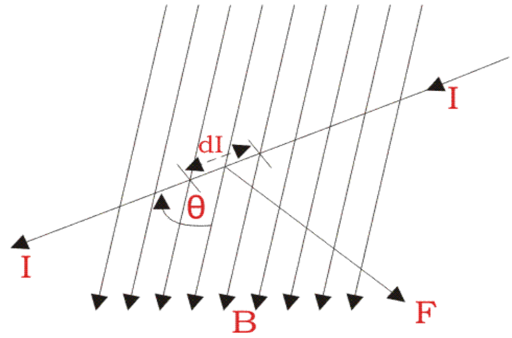


Fig: 7.3 Direction of Forces

We know that when an infinitely small charge dq is made to flow at a velocity 'v' under the influence of an electric field E, and a magnetic field B, then the Lorentz Force dF experienced by the charge is given by:-

$$dF = dq(E + vB)$$

For the **operation of DC motor**, considering E = 0

$$dF = dq \times v \times B$$

i.e. it's the cross product of dq v and magnetic field B.

$$dF = dq\frac{dL}{dt} \times B \qquad \left[V = \frac{dL}{dt}\right]$$

Where dL is the length of the conductor carrying charge q.

$$dF = dq\frac{dL}{dt} \times B$$

$$or,\ dF = IdL \times B \qquad \left[Since,\ current\ I = \frac{dq}{dt}\right]$$

$$or,\ F = IL \times B = ILB\sin\theta$$

$$or,\ F = BIL\sin\theta$$

From the 1st diagram we can see that the construction of a DC motor is such that the direction of current through the armature conductor at all instance is perpendicular to the field. Hence the force acts on the armature conductor in the direction perpendicular to the both uniform field and current is constant.

$$i.e.\ \theta = 90^\circ$$

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So if we take the current in the left hand side of the armature conductor to be I, and current at right hand side of the armature conductor to be − I, because they are flowing in the opposite direction with respect to each other. Then the force on the left hand side armature conductor,

$$F_i = BIL\sin 90^\circ = BIL$$

Similarly force on the right hand side conductor

$$F_r = B(-I)L\sin 90^\circ = -BIL$$

Therefore, we can see that at that position the force on either side is equal in magnitude but opposite in direction. And since the two conductors are separated by some distance w = width of the armature turn, the two opposite forces produces a rotational force or a torque that results in the rotation of the armature conductor. Now let's examine the expression of torque when the armature turn crate an angle of α (alpha) with its initial position. The torque produced is given by,

$$Torque = (force,\ tangential\ to\ the\ direction\ of\ armature\ rotation) \times (distance)$$

$$or,\ \tau = F\cos\alpha \times w$$

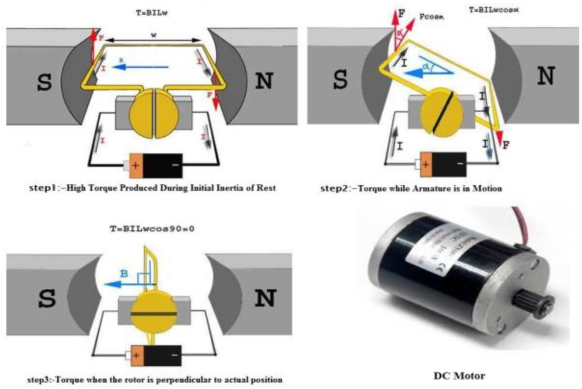
$$or,\ \tau = BILw\cos\alpha$$

Where, α (alpha) is the angle between the plane of the armature turn and the plane of reference or the initial position of the armature which is here along the direction of magnetic field. The presence of the term cosα in the torque equation very well signifies that unlike force the torque at all position is not the same. It in fact varies with the variation of the angle α (alpha). To explain the variation of torque and the principle behind rotation of the motor let us do a step wise analysis.

Step 1: Initially considering the armature is in its starting point or reference position where the angle α = 0.

$$\therefore\ \tau = BILw \times \cos 0^\circ = BILw$$

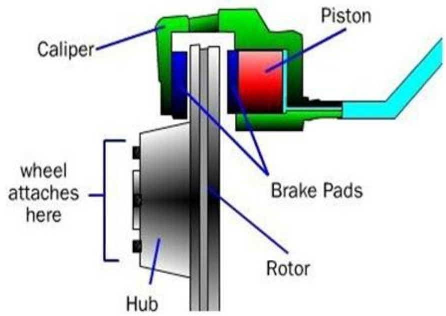
Since, α = 0, the term cos α = 1, or the maximum value, hence torque at this position is maximum given by τ = BILw. This high starting torque helps in overcoming the initial inertia of rest of the armature and sets it into rotation.



DISC BRAKE

A disc brake is a type of brake that uses calipers to squeeze pairs of pads against a disc in order to create friction that retards the rotation of a shaft, such as a vehicle axle, either to reduce its rotational speed or to hold it stationary. The energy of motion is converted into waste heat which must be dispersed. Hydraulic disc brakes are the most commonly used form of brake for motor vehicles but the principles of a disc brake are applicable to almost any rotating shaft.

Compared to drum brakes, disc brakes offer better stopping performance because the disc is more readily cooled. As a consequence discs are less prone to the brake fade caused when brake components overheat. Disc brakes also recover more quickly from immersion (wet brakes are less effective than dry ones).



Working of Disc Brake

GASOLINE (PETROL)

Gasoline, also known as petrol outside North America, is a transparent, petroleum-derived liquid that is used primarily as a fuel in internal combustion engines. It

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International Journal & Magazine of Engineering, Technology, Management and Research
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consists mostly of organic compounds obtained by the fractional distillation of petroleum, enhanced with a variety of additives.

The characteristic of a particular gasoline blend to resist igniting too early (which causes knocking and reduces efficiency in reciprocating engines) is measured by its octane rating. Gasoline is produced in several grades of octane rating. Tetraethyl lead and other lead compounds are no longer used in most areas to regulate and increase octane-rating, but many other additives are put into gasoline to improve its chemical stability, control corrosiveness and provide fuel system 'cleaning,' and determine performance characteristics under intended use. Sometimes, gasoline also contains ethanol as an alternative fuel, for economic or environmental reasons.

Gasoline, as used worldwide in the vast number of internal combustion engines used in transport and industry, has a significant impact on the environment, both in local effects (e.g., smog) and in global effects (e.g., effect on the climate). Gasoline may also enter the environment uncombusted, as liquid and as vapors, from leakage and handling during production, transport and delivery, from storage tanks, from spills, etc. As an example of efforts to control such leakage, many (underground) storage tanks are required to have extensive measures in place to detect and prevent such leaks. Gasoline contains benzene and other known carcinogens.

AMLAKARA SUVAN FUELS ANALYSIS

1.Emission Analysis of Pure Petrol

2.Emission Analysis of ASF (P70, E20, G10)

3.Emission Analysis of ASF (P80, E00, G20)

4.Emission Analysis of ASF (P90, E00, G10)

5.Emission Analysis of ASF (P50, E00, G50)

6.Emission Analysis of ASF (P60, E30, G10)

7.Emission Analysis of ASF (P50, E40, G10)

CONCLUSION

HEV's should be used to achieve a **Cooler, Cleaner and More Secure Future.** The technology exists to build a future with a significantly lower dependence on oil and a cleaner, cooler atmosphere. With sufficient political will and automaker participation, this future can arrive in time to address these significant and growing problems. Hybrids can play an important role in realizing this future, filling the gap between immediate improvements through conventional technology and the long-term promise of hydrogen fuel cells and alternative fuels. Building on a 40-mpg fleet that relies on existing conventional technology, HEV technology for both light and heavy duty applications is commercially available today and demonstrates substantial reductions in tail-pipe emissions and fuel consumption, even when compared to other available low emission technologies. Encouraging hybridization of vehicle fleets through enabling policies and incentive structures can serve to lower both conventional and CO_2 emission, thus improving public health, energy security, and reducing fuel costs. Continuing innovation in hybrid technology and a growing demand for cleaner vehicles will mean that costs are likely to fall, particularly in second hand vehicle markets. While OECD countries need to be the avant-grade in doubling vehicle fuel efficiency in the next twenty years, the majority of vehicle growth will take place in non-OECD countries.

Result

amlakara suvan flux emits less carbon di oxide than non hybrid vehicles

pollution standards

the pollution stabdards with pure petrol (P100, E00, G00)

level of co-4.822

level of hc-8261

level of co_2 -1.98

level of O_{2-} 13.22

level of lamda- 1.15

the pollution stabdards with pure amlakara suvan flux (P60, E30, G10)

level of co- 0.216

level of hc-3996
level of co_2 -2.32
level of O_{2}- 16.68
level of lamda- 2.85

4. ACKNOWLEDGEMENT

We would like to thank all the authors of different research papers referred during writing this paper. It was very knowledge gaining and helpful for the further research to be done in future.

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