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ADVANCEMENT OF COOLING TECHNOLOGY IN BATTERIES OF ELECTRIC VEHICLES

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Abstract

Due to the continuous usage of gasoline vehicles environment is continuously getting polluted due to which an eco-friendly technology was needed. This led to the invention of electric vehicles. Later it was found out that electric vehicles also faced problem due to heating of batteries which led to the decrease efficiency of the batteries. In warm countries some advanced cooling technology must be introduced so as to overcome heating of batteries. The optimum temperature for batteries is about 25 degree centigrade but due to some internal heating it is difficult to maintain this temperature and due to this various organisations started working for finding an advanced cooling technology so as to increase the efficiency of the batteries and to promote the electric vehicles. Here in this paper some of the current cooling technologies have been discussed along with the comparison with the previous technologies. The preheating of the batteries is also required for starting the electric vehicle and for this sum heat and technologies are the required which are also discuss and this discussion state of charge (SOC) and the health of the batteries should also be maintained in order to increase the life of the battery. For increasing the life of the batteries we have also discuss some technologies in the following pages.

***Keywords**: electric vehicle, thermal management, heat pipes, cooling of batteries, temperature*

Introduction

In the last few decades we have seen that there has been a major problem in environmental degradation. The major cause for the degradation is the pollution cause by the automotive vehicles. This arises the need for some environmental friendly technology in automotive industries. This leads to the invention of electric vehicles. Electric vehicles has become the fastest growing innovations in the automobile industries. Vehicle which do not pollute the environment shows a very promising sign for future development in the industries. Electric vehicles is still at a very prepubescent stage. Lots of research are done to make it more advanced.

Electric vehicles mainly work on lithium batteries. This type of batteries works most efficiently at 25 degree centigrade. In tropical countries like India UAE Malaysia etc average temperature is about 32-40 degree centigrade. Due to high temperature the batteries get heated up which leads to wastage of energy. The internal resistance of batteries will rise sharply when the operating temperature is lower than zero degree centigrade, which can greatly influence the performance of the batteries.

In the current period Passive air cooling is used in electric vehicles for Battery Thermal Management System (BTMS). During charging of battery it will not cool down because cooling of battery is mostly depends upon movement of electric vehicles. That is why, heating of battery led to the decrement in charging time of battery. In tropical countries active cooling system is much more required as heat cannot be transferred easily as in colder region

Literary Survey

[1] Electric and hybrid vehicle's performance and life cycle cost depends totally on batteries which are an energy storage system.

All electric range, power of acceleration, fuel economy and acceptance of charge is directly affected or depends mainly on battery pack installed. Important factors for obtaining a good amount of performance in battery is temperature and uniformity in temperature. Packs installed in modules have to be operated within certain temperature range which is suitable for electrochemical pair. Further this modules should run under uniform temperature, since uneven temperature distribution in packs may affect the charging /discharging behaviour which could lead to unbalance in electric modules and reduce the efficiency of the pack. There has been a need to achieve the desired performance or efficiency in packs which could be brought up by Battery Thermal Management System (BTMS) which could work in any climatic conditions.[2] For starting the Hybrid electric vehicles (HEV) battery preheating is required which is difficult in colder regions and battery preheating can be done by passing fluid which is not very effective due to sluggish during cold temperature. Energy and heat are transferred by passing electricity, heating by electric heaters by hot fluid. testing two batteries lead acid and NiMH batteries AC heating is found to be more effective in preheating the main motive of the BTMS is to increase the efficiency of batteries in HEVs and still test on temperature, SOC state of charge, currents are still going on.[3] For efficient working of batteries optimum temperature is required. For cooling several methods like passive cooling means outside air passage, passive heating and cooling means cabin air passage, active heating by outside, method by liquid includes direct contact of liquid, moderate cooling through liquid circulation, active cooling and heating. Air cooling is less complicated than liquid cooling but even less effective than liquid cooling and NiMH batteries has complicated BTMS(battery thermal management system) than Lithium ion and VRL a batteries. In active vs passive system, active components like evaporation, engine coolants heating core are preferred.[4] The enlarging market of electric vehicles calls for highly specific power and highly specific energy density batteries for the proper ignition of the electric vehicle. The staging of electric vehicle is directly proportional to the staging of electric batteries. For efficient cooling and thermal management many industries widely use heat pipes also called as "super thermal conductors". A conclusion is made at the end that heat pipes are successfully used to cool a battery with a negligible rate of heat generation. An appropriate heat pipe can control the temperature and the temperature difference of power batteries in a specific range. Power batteries thermal management necessarily needs heat pipes to show a positive signs for the desired cycle performance. One of the major factor is the temperature rise, which must be taken into consideration first, for the design of power battery thermal management system which could be achieved by installing well designed heat pipes. [5] For adopting eco-friendly technology electric vehicles come in role in the main problem in electric vehicles is detection of efficient battery, for that state of charge (SOC) of batteries means health of batteries must be good and for (SOC) three things must be monitored, firstly cell voltage monitoring which means charging of batteries should be stopped is voltage is above 4. 2 volts and discharging should be stopped is voltage of cell becomes below 2. 7 volt threshold. Secondly, cell equalization means for having higher energy storage capacity and for that switched register technology should be introduced and lastly, battery management which means monitoring for state of charge and good health of the battery should be monitored.[6] Electric and hybrid electric vehicle's core energy sources are battery, their staging greatly impacts the stability of vehicles. Manufacturers are seeking for the improvement in the battery technology and battery management systems. Due to various environmental degradation of battery, it may vary, chemical reactions in battery are subject to ignition condition. In research and

commercial products battery management system framework was proposed to deal with the deficiency of current battery management systems. Therefore different ways should be applied to improve and optimize the performance of battery management systems in future electric and hybrid electric vehicles.

[7] Liquid cooled plate heat exchanger is required to improve the state of charge of battery and health of battery in electric vehicles. The battery of electric vehicle undergoes various problem like premature aging because of continuous heating of battery at the time of charging and discharging. For understanding the temperature distribution of battery, computational fluid dynamics (CFD) is used. Water is used as heat transfer fluid when different amount of water is passed with different flow rate. The surface temperature is maintained which is required for self-operation of battery by heat exchanger plates.[8] The battery in electric vehicles consists of module of cells and due to the high temperature and inappropriate voltage lead to imbalance and can decrease the performance of pack by 25%. Battery management system (BMS) provides voltage measurement, equalization and management of charge. Battery packs can be controlled by the software which can balance the cell and equalise the battery. Modularization can avoid wiring harness and can reduce the number of modulus and even cost of modularization also increase energy density which leads to high energy storage capacity of batteries.[9] For personal transportation electric vehicles were accepted by most of the researchers in place of vehicles which consume primary energy. Conventional vehicles are less efficient in terms of energy than electric vehicles. Conventional vehicles work at 18% efficiency whereas electric vehicles are operated at 46% efficiency. Zero vehicular emissions are produced by electric vehicles. However, when the source fuel is converted into electrical power, emissions are produced at the generation site. The emission of electric cars therefore depends on the emission profile of regional generating plants. [10] SLI Lead-Acid batteries life cycle has a linear relationship with temperature i.e. when life cycle of battery decreases, temperature increases. Similarly, the charge efficiency increases linearly. Thermal control is necessary at near ambient temperature for battery systems. As the temperature dropped the rate of charge acceptance also dropped suddenly. Several lead acid EV battery pack's performance and life are dependent on temperature gradient. Subsequently it was found that temperature gradient between modules reduces overall pack capacity. The temperature distribution for maintaining the pack is 35 degree to 40 degree centigrade for lead acid batteries that are used presently.

Findings

For starting an electric vehicle preheating of battery is required which can be done by sparking and passing fluid through it. But afterwards cooling of batteries is must so as to keep the efficiency of battery balanced. So cooling outside air passage, passive heating and cooling, cooling by liquid, cooling by ventilation, engine coolants can be used. State of charge and health of battery can be maintained by maintaining voltage across the battery during charging and discharging. Most of the research is carried on Lithium ion and NiMH batteries. It is necessary to keep temperature uniform since temperature plays an important role. There is a need to keep optimum temperature so as to keep the performance of the battery module. Uneven temperature may affect charging and discharging behaviour of the battery which could make an impact on performance of batteries. Heat pipes are used for uniformity of temperature in batteries. The main source of energy on EVs and HEVs are batteries and therefore the performance of EVs and HEVs is greatly influenced by stability of vehicle. Battery Thermal Management System (BTMS) is a way in which we could keep a control over all the problem listed above.

Recommendation & Conclusion

After the invention of Eco Friendly Technology as electric vehicles various problems also associated with the usage of HEVs. The major problem was related to battery and the problems were preheating of batteries, cooling of batteries and state of charge of batteries by the continuous efforts in research various technologies emerged which can resolve the above problems to some extent and the major outcomes were passive cooling of batteries. Battery Thermal Management System is a way we can ensure that the performance of batteries in EVs and HEVs is efficiently working. Conventional Vehicles are less efficient in term of energy and performance in batteries whereas Electric Vehicles have high efficient battery with good performance which will keep the EVs and HEVs stable .Also there is a need to maintain temperature gradient or make temperature uniform so that battery does not change its behaviour while charging or discharging.

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