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Abstract— In Present scenario Internal Combustion Engines [ICE] is overcome by Electric Vehicles [EV] due to advantages like reduction in carbon-di-oxide [CO_2] emission, cost. Advancement in electric vehicles are extensively going on and one such concept is Battery management system [BMS]in Battery Electric vehicle. In Battery Electric Vehicle there are many types of batteries and from the literature survey Lithium Ion Battery can be concluded to be suitable as it is advantageous in weight, cost, energy density and many aspects. In Battery electric vehicle Battery plays an important role. Battery may be overcharged or it may undergo faults. Hence a proper management system is required to control the Electric vehicle [EV] and it is called Battery Management System [BMS]. In this proposal two battery estimation models are compared and results are tabulated for suitable operation of health status in a Battery Electric Vehicle.

Keywords— Health Status, cell balancing technique.

I.INTRODUCTION

Battery Electric Vehicle:

Battery Electric Vehicles, also called BEVs, and more frequently called EVs, are fully-electric vehicles with rechargeable batteries and no ICE . Battery electric vehicles store electricity onboard with high-capacity battery packs. Their battery power is employed to run the electrical motor and every one onboard electronics. BEVs don't emit any harmful emissions and hazards caused by traditional gasoline-powered vehicles.

Lithium-ion (Li-ion) Battery:

Lithium-ion (Li-ion) batteries became the energy storage system of choice in an array of applications, e.g. as a starter battery in conventional automobiles, but also, and especially , in electric vehicles, in medical applications, professional tools, mobile robots, and UPS. In all of those cases, the battery’s state of health features a direct effect on the capacity of the general system. In terms of electrical cars, the most selling points, – first and foremost the vehicle range but also good acceleration, depend – on the battery. In safetyrelevant applications, like backup systems or mobile medical applications (e.g. defibrillators), it's essential to understand that the battery will supply the specified energy when it's actually needed

Battery Management System: In Battery electric vehicle

Battery plays an important role. Battery may be overcharged or it may undergo faults. Hence a correct management system is required to regulate the electrical vehicle [EV] and it's called Battery Management System [BMS]. To design Battery Management System several concepts, have to be taken care the main function of the Battery Management System is to keep any single cell of the battery pack inside its safe operating area (SOA) by monitoring the subsequent physical quantities: stack charge and discharge current, single cell voltage, and battery pack temperature. Health status has to be determined properly. If it is not determined and if the battery is overcharged then life of battery may reduce.

II. DESCRIPTION OF STATE OF HEALTH

The State of Health could also be a "measurement" that reflects the general condition of A battery and its ability to deliver the specified performance compared with a fresh battery. It considers such factors as charge acceptance, internal resistance, voltage and self-discharge. It is a measure of the future capability of the battery and provides an "indication" not an absolute measurement, of what proportion of the available "lifetime energy throughput" of the battery has been consumed, and the way much is left.

Importance of SOH

Its purpose is to supply a sign of the performance which may be expected from the battery in its current condition or to supply a sign of the what proportion of the useful lifetime of the battery has been consumed and the way much remains before it must get replaced . In critical applications like standby and emergency power station the SOC gives a sign of whether A battery are going to be ready to support the load when called upon to do so. Knowledge of the SOH also will help the plant engineer to anticipate problems to form fault diagnosis or to plan replacement. This is essentially a monitoring function tracking the long-term changes within the battery.

SOH for EV applications

For EV applications, the power to realize the range when called upon to try to to so is most vital , hence the SOH is predicated on a comparison of current capacity with capacity when new.

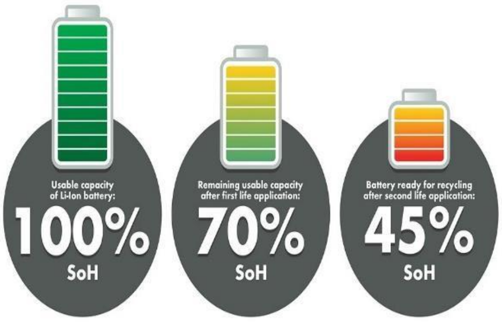
SOH for HEV applications

For HEV applications the power to deliver the required power is most vital then SOH is predicated on a comparison of the DC resistance (or 1 kHz impedance) now with DC resistance (or 1 kHz impedance) when new. The state of health (SoH) of a battery deteriorates over time. This is caused by:

Calendric aging: The battery ages without getting used, simply thanks to time. This process is influenced, especially, by the ambient temperature.

Cyclic aging: It depends on the type of use, but above all on the operating cycles, the (dis)charging stroke, the end-of-charge voltage, and the strength of the charging and discharging currents. The possible number of cycles is decided by the sort and quality of the rechargeable batteries and therefore the temperature.

Determining a battery's state of health



Determining a battery's state of health

Besides its present state of charge (SoC), the real determining factor here is the age and health of the battery. Based on complex chemical reactions inside the battery, there's a gradual degradation in performance over time and therefore the battery's state of health (SoH) consequently suffers. The SoH reflects the ratio between the present maximum practical capacity and therefore the theoretical capacity of A battery , i.e. a 100Ah battery with a SoH of 80% features a residual capacity of 80Ah. It is very difficult to work out or to predict how quickly A battery or the individual cells of A battery pack will age. On the one hand, the capacity can't be measured directly; and on the opposite , the aging process is influenced by variety of things , e.g. by the individual condition of the battery, the charging behaviour, and the temperature.Determination of the SoH is however essential to evaluate the battery life. Depending on its actual application, the top of battery life is reached with a SoH of between 70% and 80%. The battery then frequently swaps its 'first life' for a 'second life', i.e. it is used in an application that demands less capacity. For instance, electric batteries are used as stationary energy storage systems for PV units during their second life. The remaining maximum capacity of the battery within the respective application is mentioned because the remaining useful life (RUL).

III.METHODOLOGY

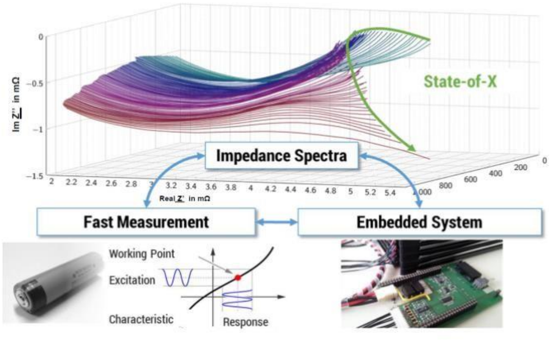
Battery Estimation Methods

1. Analysis of Health Status using coulombmeter

Since it's impossible to easily measure the remaining capacity to work out the SoH and RUL, relatively complex and sometimes inaccurate procedures are in use at present: Before installing the battery, a huge array of knowledge is collected within the lab to characterize the respective battery type. Algorithmic calculations are wont to create a lookup table or an empirical model that describes the battery at defined working points and in various applications. the info are saved within the battery management system and therefore the end of battery life is simply predicted by comparison with the stored data. the particular state of the battery operational is actually not measured. Needless to mention , the bottom data for the battery management system thus remains very inaccurate. A coulombmeter, which measures the charge flowing in and subtracts the charge flowing out, is usually wont to determine the capacity. the info is then compared with the model to draw conclusions about the SoH and therefore the RUL. However, even this method provides relatively inaccurate values, i.e. the determined end of battery life may vary considerably from the particular situation. to make sure the guaranteed battery life, manufacturers need to install more battery cells than necessary within the instrument or the vehicle as a security buffer.

2. Analysis of health status using accurate values with impedance spectroscopy

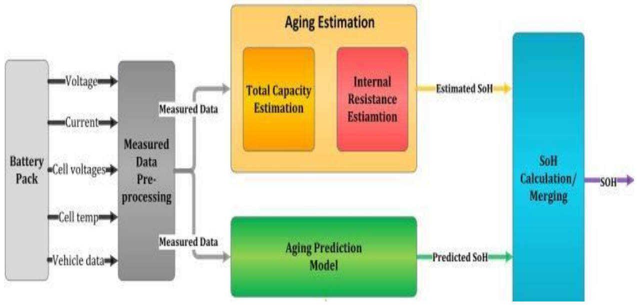
The Professorship for Measurement and Sensor Technology has developed measuring systems supported impedance spectroscopy. this permits the measurement and assessment of battery internal processes like charge transfer, electrode degradation, and diffusion. To do so, the battery is happy with varying AC supply potential. The resulting battery voltage and therefore the excitation current are often wont to calculate the impedance, allowing you to draw conclusions about the health state of the battery.Since impedance with currently used Li-ion cells are often but 1mOhm, the measuring methods and therefore the applied hardware got to meet special requirements. thanks to the extremely low impedance values, but also as a results of low frequencies and an extra frequency range, expensive, precise measuring instruments are necessary along side high-performance devices with large memory capacity to get accurate, dynamic signals. it's for this reason that the tactic has only been applied in laboratory conditions so far where the method is typically monitored by an engineer.To also enable the appliance of impedance spectroscopy in mobile systems, scientists at Chemnitz University of Technology have optimized the methodology for generating the required signal to such a degree that a chip with limited memory capacity and comparatively small processing power can map the procedure without the necessity for extra signal generators. The battery itself or energy from another stack is employed because the source of power, thus reducing the related hardware costs enormously. thanks to the massive frequency range, multispectral methods had to be applied to chop the measuring time. All calculations are often carried at an equivalent time because the measurement because of innovative algorithms. as an example , it had been possible to scale back the memory capacity of the controller to but 500kByte for intermediate storage of the measured data. additionally , the measuring period was shortened to roughly five minutes. this enables you to repeat measurements in defined cycles during operation, e.g. in certain operating conditions. These features also make sure the methodology meets the event requirements for controllers within the automotive sector. The prototype hardware developed at the Professorship for Measurement and Sensor Technology are often wont to diagnose four battery cells simultaneously. However, the hardware can, in theory , be scaled as needed to larger systems. Moreover, the answer meets further requirements of the target applications: it's not only small but also robust and price effective thanks to an embedded microcontroller. The achieved measuring results allow the complete utilization of batteries right up to their actual end of life. this provides manufacturers the chance to extend the range of their electric cars, extend the warranty period for his or her batteries, and to style smaller and thus less costly battery systems – in line with their business model

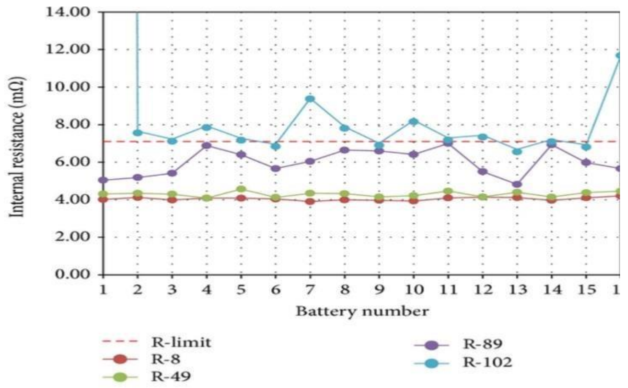


Demonstrator

3. Analysis of health status using on-board internal resistance estimation

For reliable and safe operation of lithium-ion batteries in electric or hybrid vehicles, diagnosis of the cell degradation is important . this will be achieved by monitoring the interior resistance of the battery cells over the entire lifetime of the battery. during this method, the interior resistance during a battery electric vehicle is presented. Therefore, a special purpose model deduced from the same circuit is developed. This model contains parameters counting on the degradation of the battery cell. to realize the specified robustness and stable results under these conditions, the tactic uses specific signal intervals occurring during normal operation of the battery during a hybrid vehicle. This identification signal features a defined timespan and occurs regularly. The identification is completed on vehicle measurement data of terminal cell voltage and current collected with a usual vehicle rate . Using the adapted internal resistance value within the model, a degradation index is calculated by compensating other influences, e.g. battery temperature. This task is that the main challenge, because the impact of the temperature on the resistance, for instance , is one order of magnitude above the influence of the degradation for the investigated lithium-ion cell. The developed estimation and monitoring method are validated with measurement data from single cells and shows good results and really low computational effort.Based on the battery number internal resistance are often accurately known and precise value is decided . Since supported battery number resistance are often known, if any fault occurs at a specific cell ,only that cell are often disconnected and it are often diagnosed.





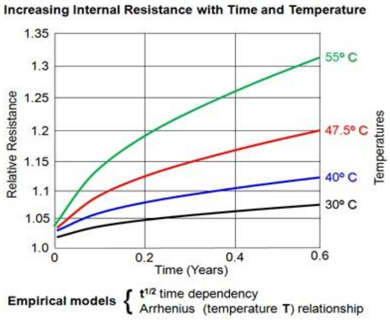
4. Analysis of health status using The Log Book Function

An alternative method of specifying the SOH is to base the estimation on the usage history of the battery instead of on some measured parameter. the amount of charge - discharge cycles completed by the battery are often measured, but this doesn't necessarily consider any extreme operating conditions experienced by the battery which can have affected its functionality. it's however possible to record the duration of any periods during which the battery has been subject to voltages, currents or temperatures also because the magnitude of the deviations. From this data a figure of merit representing the SOH are often determined by employing a weighted average of the measured parameters.

Battery usage data are often stored in memory within the BMS during a "History Chip" and downloaded when required. This alternative method doesn't use any external equipment but it adds complexity and price to the battery.Battery life can usually only be extended by preventing or reducing the explanation for the unwanted parasitic chemical effects which occur within the cells.Ways of improving battery life and hence reliability also are considered below. I. Calendar Life and Cycle Life Battery performance deteriorates over time whether the battery is employed or not. this is often referred to as "calendar fade". Performance also deteriorates with usage and this is often referred to as "cycle fade" Battery Calendar Life is that the time period before A battery becomes unusable whether it's in active use or inactive. There are two key factors influencing calendar life, namely temperature and time, and empirical evidence shows that these effects are often represented by two relatively simple mathematical dependencies. A rule of thumb derived from the Arrhenius Law describes how the speed at which a reaction proceeds, doubles for each 10 degrees rise in temperature, during this case it applies to the speed at which the slow deterioration of the active chemicals increases. Similarly the t1/2 (or √t) relationship represents how the battery internal resistance also increases with time t. The graph below illustrates these effects. Battery time period like calendar life is that the time an inactive battery are often stored before it becomes unusable, usually considered as having only 80% of its initial capacity.

Battery Cycle Life is defined because the number of complete charge - discharge cycles A battery can perform before its nominal capacity falls below 80% of its initial rated capacity. Key factors affecting cycle life are time t and therefore the number N of charge-discharge cycles completed.

Lifetimes of 500 to 1200 cycles are typical. the particular ageing process leads to a gradual reduction in capacity over time. When a cell reaches its specified lifetime it doesn't pack up suddenly. The ageing process continues at an equivalent rate as before in order that a cell whose capacity had fallen to 80% after 1000 cycles will probably continue working to perhaps 2000 cycles when its effective capacity will have fallen to 60% of its original capacity. In both cases the cycle life depends on the depth of discharge and assumes that the battery is fully charged and discharged each cycle. If the battery is merely partially discharged each cycle then the cycle life are going to be much greater. it's therefore important that the Depth of Discharge should be stated when specifying the cycle life.



CELL BALANCING

In order to enhance the health of A battery , cell balancing plays a prominent role. Cell balancing is meant to equalise the charge on every cell within the pack and stop individual cells from becoming over stressed thus prolonging the lifetime of the battery.

Cellequalization

To provide a dynamic solution to the present problem which considers the ageing and operating conditions of the cells, the BMS may incorporate a Cell Balancing scheme to stop individual cells from becoming overstressed. These systems monitor the State of Health (SOH) of every cell, or for fewer critical, low cost applications, simply the voltage across, each cell within the chain. Switching circuits then control the charge applied to every individual cell within the chain during the charging process to equalise the charge on all the cells within the pack. In automotive applications the system must be designed to deal with the repetitive high energy charging pulses like those from regenerative braking also because the normal trickle charging process.Several Cell Balancing schemes are proposed and there are trade-offs between the charging times, efficiency losses and therefore the cost of components.

Activebalancing

Active cell balancing methods remove charge from one or more high cells and deliver the charge to a minimum of one or more low cells. Since it's impractical to provide independent charging for all the individual cells simultaneously, the balancing charge must be applied sequentially. Considering the charging times for every cell, the equalization process is additionally very time consuming with charging times measured in hours. Some active cell balancing schemes are designed to halt the charging of the fully charged cells and continue charging the weaker cells till they reach full charge thus maximizing the battery's charge capacity.

Charge Shuttle (Flying Capacitor) Charge Distribution With this method a capacitor is switched sequentially across each cell within the series chain. The capacitor averages the charge level on the cells by learning charge from the cells with above average voltage and dumping the charge into cells with less than average voltage. Alternatively, the tactic are often sped up by programming the capacitor to repeatedly transfer charge from the absolute best voltage cell to the lowest voltage cell. Efficiency is reduced because the cell voltage differences are reduced. the tactic is fairly complex with expensive electronics.

Inductive Shuttle Charge Distribution This method uses a transformer with its primary winding connected across the battery and a secondary winding which can be switched across individual cells. it's used to take pulses of energy as required from the entire battery, rather than small charge differences from one cell, to top up the remaining cells. It averages the charge level just like the Flying Capacitor but avoids the matter of small voltage differences in cell voltage and is consequently much faster. this technique needs well balanced secondary transformer windings otherwise it'll contribute to the matter . Passivebalancing

Dissipative techniques find the cells with the absolute best charge within the pack, indicated by the upper cell voltage, and deduct excess energy through a bypass resistor until the voltage or charge matches the voltage on the weaker cells. Some passive balancing schemes stop charging altogether when the first cell is fully charged, then discharge the fully charged cells into a load until they reach the same charge level because the weaker cells. Other schemes are designed continue charging till all the cells are fully charged but to limit the voltage which can be applied to individual cells and to bypass the cells when this voltage has been reached.This method levels downwards and since it uses low bypass currents, equalisation times are very long. Pack performance determined by the weakest cell and is lossy because of wasted energy within the bypass resistors which could drain the battery if operated continuously. it's however rock bottom cost option. Charge Shunting

The voltage on all cells levelled upwards to the rated voltage of an honest cell. Once the rated voltage on a cell has been reached, the entire current bypasses fully charged cells until the weaker cells reach full voltage. this is often fast and allows maximum energy storage however it needs expensive high current switches and high-power dissipatingresistors.

Chargelimiting

A crude way of protecting the battery from the results of cell imbalances is to simply cut the charger when the first cell reaches the voltage which represents its fully charged state (4.2 Volts for many Lithium cells) and to disconnect the battery when rock bottom cell voltage reaches it stop point of two Volts during discharging. this may unfortunately terminate the charging before all of the cells have reached their full charge or stop the power prematurely during discharge leaving unused capacity within the great cells. It thus reduces the effective capacity of the battery. Without the benefits of cell balancing, cycle life could even be reduced, however for well-matched cells operating during a good temperature environment, the effect of these compromises could be acceptable

Lossless balancing

Recent developments have produced a superior way of cell balancing by means of software control which is both simpler and lossless and avoids the various problems of every of the above methods. All of those balancing techniques depend upon having the ability to work out the state of health of the individual cells within the chain. the only of those methods uses the cell voltage as a sign of the state of health. the most advantage of this method is that it prevents overcharging of individual cells, however it are often susceptible to error. A cell may reach its stop voltage before the others within the chain, not because it's fully charged but because its internal impedance is above the opposite cells. during this case the cell will even have a lower charge than the opposite cells. it'll thus be subject to greater stress during discharge and repeated cycling will eventually provoke failure of the cell. More precise methods use Coulomb counting and appreciate of the temperature and age of the cell also because the cell voltage. Redox Shuttle (Chemical Cell Balancing)

The Redox Shuttle is an effort to supply chemical overcharge protection in Lithium cells using the same method thus avoiding the necessity for electronic cell balancing. A chemical additive which undergoes reversible chemical process absorbing excess charge above a pre-set voltage is added to the electrolyte.

The reaction is reversed as voltage falls below the pre-set level. For batteries with but 10 cells, where low initial cost is that the main objective, or where the value of replacing a failed battery isn't considered prohibitive, cell balancing is usually dispensed with altogether and long cycle life is achieved by restricting the permitted DOD. This avoids the value and complexity of the cell balancing electronics but the trade-off is inefficient use of cell capacity. Whether or not the battery employs cell balancing, it should incorporate fail safe cell protection circuits.

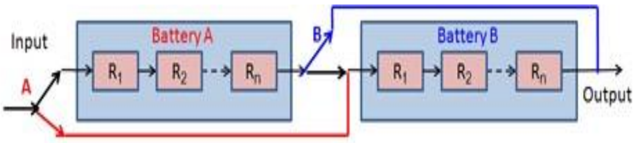
IV.RESULTS AND DISCUSSION:

Battery life can be protected by incorporated the following techniques:

Cyclic Redundancy

Because of the likelihood of uneven ageing between the active cells within the battery and therefore the redundant cells, steps must be taken to stay the redundant cells at an equivalent State of Health (SOH) as the active cells so that, if a redundant cell is called into play, it will not unbalance the battery. In principle this is often simply accomplished by exchanging a special cell from the series chain with the previously redundant cell, every charge - discharge cycle, but it requires some complex electronics to implement. There is however a compensating upside to this action. The number of cycles completed by each cell will be reduced in proportion to the ratio of active cells to the total cells. As well as improving reliability, cyclic redundancy effectively increases the battery cycle life by utilising the excess capacity normally associated with the idle redundant cells to provide extra load cycles spread over the lifetime of the battery, thus sharing the load between all of the cells on a temporal basis.In the 1 for 8 redundancy example above, cyclic redundancy would increase the battery cycle life from 1000 cycles to 1125 cycles, while none of the 9 cells within the battery would exceed its specified 1000 cycle charge - discharge limits. Emergency Battery Power Through Segregation For electric vehicles, a Limp Home mode, which provides emergency power just in case of one cell failure, are often implemented by dividing the battery into two sections. This allows the failed cell to be isolated, preventing it from disabling the whole battery.

A switch associated with each section enables the failed section to be bypassed allowing the battery to continue to function, but only at half power. Complete system failure only occurs if both sections fail. This solution needs two expensive heavy duty circuit breakers which are capable of switching the complete battery current.



Example

To demonstrate the size of the reliability improvement using the above scheme, for simplicity we will assume a continuing failure rate. (The reality will however be a time varying wearout rate) Consider an 80 cell battery divided into two 40 cell sections A and B, each cell having an MTBF of 10,000 hours, equivalent to a failure rate of 10-4 failures/hour. The MTBF of the 80 cell battery (A plus B) are going to be 10,000/80 = 125 hours and therefore the failure rate are going to be 80 x 10-4 = 0.008 failures per hour The MTBF of each 40 cell section (A or B) will be

10,000/40 = 250 hours and the failure rate will be 40 x 10-4 = 0.004 failures per hour

Because the second section effectively provides redundancy, both sections would need to fail for the battery to fail

The probability of both sections A and B failing is given by the merchandise of their failure probabilities that's 0.004 x 0.004 = 0.000016 = 1.6 X 10-5 failures per hour.
Thus the MTBF of a 2 x 40 cell battery with redundancy = 1/ 0.000016 = 62,500 hours which is over 6 times better than the MTBF of the individual cells.

Cyclic Redundancy

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Impedance and Conductance Testing

The test method involves applying alittle AC voltage "E" of known frequency and amplitude across the cell and measuring the in phase AC current "I" that flows in response thereto .

The Impedance "Z " is calculated by **Ohm's law** to be Z=E/I

The Conductance "C" is similarly calculated as C=I/E (the reciprocal of the impedance).The impedance increases because the battery deteriorates while the conductance decreases. Thus C correlates directly with the battery's ability to provide current, that is, its capacity, whereas Z gives an inverse correlation. The conductance of the cell therefore provides an indirect approximation to the State of Health of the cell. This measurement are often refined by taking other factors into account . additionally to impedance and conductance these tests will detect cell defects like shorts, and open circuits. Impedance and conductance testing are reliable, safe, accurate, fast which they do not affect the battery performance. they're going to be administered while the battery is in use or they will be used to continuously monitor the battery performance, avoiding the need for load testing or discharge testing

DCmeasurements

DC measurements don't recognise capacitance changes and thus measurements of the inside resistance of the cell don't correlate so well with the SOH of the cell. employing a conventional ohmmeter for measuring the resistance of the cables, contacts and inter-cell links isn't satisfactory because the resistance is extremely low and thus the resistance of the instrument leads and therefore the contacts causes significant errors. More accuracy are often achieved by employing a Kelvin Bridge which separates the voltage measuring leads from this source leads and thus avoids the error caused by the volt drop along the present source leads.

BatteryAnalysers

Battery analysers are designed to supply an quick indication of the State of Health (SOH) of the battery. Some analysers even have the twin function of reconditioning the battery.There are not any industry standards for this equipment, mainly because there's no standard definition of State of Health. Each equipment manufacturer has their own favourite way defining and measuring it, from an easy conductance measurement to a weighted average of several measured parameters and therefore the equipment is meant to supply the corresponding answer. this could not be a drag if an equivalent equipment is employed consistently, however it does cause problems if equipment from different manufacturers is employed to hold out the tests.

IV.CONCLUSION:

Electric vehicles are trending nowadays compared to Internal combustion engine because of its advantages and less limitations. Global warming is effective with electric vehicles because of no emissions of gases. Limitations are the installed charging stations are not able to meet the increasing charging demand of Electric Vehicles. So, if that is overcome then effectively electric cars can be into effect. Among the configurations of electric vehicles battery Electric Vehicles is more advantageous because of its features. Within that Battery Management System plays a key role in Battery Electric Vehicles. Lithium Ion battery is used among all other batteries. Finally, battery management system is used to control EV in estimating its state of charge conditions. For monitoring the charge and status suitable algorithms are required and, in this proposal, Comparison between Kalman filter and Open circuit voltage is explained mathematically with suitable experimental and simulation results. In Kalman filter method For a Lithium ion battery module, The proposed improved Thevenin model has been implemented, and its parameter identification is performed using the EKF algorithm and there is no feedback compensation mechanism and it is very hard to implement. In Open circuit voltage data retrieval is not possible. Hence to overcome the disadvantages of open circuit voltage and Kalman filter, modified coulomb counting method can be implemented and suitable results can be tabulated.

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