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RESEARCH ARTICLE

Comparison of batteries in automotives.

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Abstract

This paper gives a general overview of Comparisons of batteries in automotive. The increasing demand for the depleting non-renewable energy sources led to the increasing need for research and development for harnessing renewable energy sources efficiently. The worldwide increase in demand for fossil fuels for applications like transportation and the pressing need to reduce the greenhouse gas emissions has fostered the meteoric development in electric and hybrid vehicle (HEV) technology. . Using electric energy for transportation purposes will help reduce not only the greenhouse gases but also the dependency on conventional fuels. Using batteries as a source of electric energy along with an internal combustion engine (ICE) supplying the average power required by the vehicle is an efficient way of using the vehicle. Also, less probability for mass production of fuel cell vehicles makes the HEVs a viable near term option to reduce the green house dependency on foreign oil resources gases and also decrease the dependency of foreign oil resource.

Introduction:-

A battery is an electrochemical device which converts electrochemical energy to electrical energy. Many midterm and long-term battery options were investigated by the United States advanced battery consortium (USABC). A battery weighs about 25 – 75% of the vehicle by weight, volume and cost in HEVs. The desired features for a good EV battery are high specific energy, high specific power, high charge acceptance rate, long cycle life, long calendar life, low self-discharge rate, low cost, and recyclability. Initially, HEVs used lead acid batteries

Though calendar life and cost are the most important requirements of batteries used in HEVs, they can be compared based on cost, size and weight, power requirements, number of cells in a battery pack and the available peak power, cell chemistry and geometry, specific energy and power density, charging and discharging cycles, cycle life and calendar of the battery, VI characteristics, state of charge, resistance to overcharging, efficiency, environmental impacts and recycling methods, temperature dependent performance, and safety certifications based on impact, heating, crush, nail penetration, and overcharge tests. In this paper a comparison of NiMH batteries and Li-ion batteries used in automotive applications is presented. Some of the important long term goals set by the USABC for advanced battery system are mentioned in calendar life, energy density, efficiency, cost and environmentally friendliness. Though excellent high rate charge acceptance, high power density, high specific power.

Comparision of batteries:-

NiMH and Li-ion batteries have their own advantages and disadvantages with respect to charge acceptance, calendar life, energy density, efficiency, cost and environmentally friendliness. Though excellent high rate charge acceptance, high power density, high specific power, long calendar life and efficiency are the desired characteristics of batteries used in automotive applications, cost and safety determine their practical applicability [3]. Also, these batteries add an extra 200 to 300 lbs to the vehicle which directly affects the performance and efficiency of the vehicle. Honda Civic is one of the HEVs which use Li-ion batteries and Toyota Prius uses the NiMH battery technology for its energy storage system. This section provides a comprehensive comparison of the two types of batteries with respect to their automotive applications. Table II shows the comparison of these battery technologies in with respect to gravimetric energy, fast charge time, resistance to overcharging, cell voltage, maintenance requirements and cost. A. Chemistry NiMH battery: The anode is made up of rare-earth or nickel alloys, and the cathode is made up of potassium hydroxides. NiMH batteries have great importance in the industrial and consumer applications due to their design flexibility, environmental acceptability, high power and energy densities, and most importantly cost competitiveness [2]. In hybrid electric vehicles NiMH battery technology is the dominant battery technology as they meet the wide ranging requirements set by automotive companies. The following features have established NiMH batteries in the hybrid vehicles industry: flexible sizes ranging from 30 mAh to 250 Ah, safe operation at high voltage, flexible vehicle packaging, safety in charge and discharge, requires no maintenance, has excellent thermal properties, capability to use regenerative braking energy, simple and inexpensive charging and electronic control circuits, and environmentally acceptable and recyclable materials [5]. This battery technology uses non-toxic and recyclable materials.

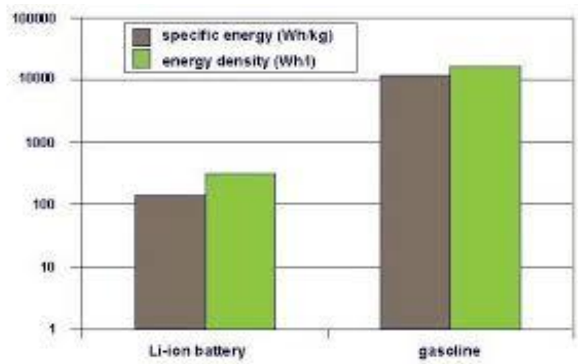

Fig1. Comparison of Li-ion battery and gasoline

Advantage of different type of batteries:-

NiCd batteries-

- Fast and simple charge — even after prolonged storage.
- High number of charge/discharge cycles — if properly maintained, the NiCd provides over 1000 charge/discharge cycles.
- Good load performance — the NiCd allows recharging at low temperatures.
- Long shelf life – in any state-of-charge.
- Simple storage and transportation — most airfreight companies accept the NiCd without special conditions.
- Good low temperature performance.
- Forgiving if abused — the NiCd is one of the most rugged rechargeable batteries.
- Economically priced — the NiCd is the lowest cost battery in terms of cost per cycle.

The Nickel-Metal Hydride (NiMH) battery-

- 30 – 40 percent higher capacity over a standard NiCd. The NiMH has potential for yet higher energy densities.
- Less prone to memory than the NiCd. Periodic exercise cycles are required less often.
- Simple storage and transportation — transportation conditions are not subject to regulatory control.
- Environmentally friendly — contains only mild toxins; profitable for recycling.

The Lead Acid battery-

- Inexpensive and simple to manufacture — in terms of cost per watt hours, the SLA is the least expensive.
- Mature, reliable and well-understood technology — when used correctly, the SLA is durable and provides dependable service.
- Low self-discharge —the self-discharge rate is among the lowest in rechargeable battery systems.

The Lithium Ion battery-
- High energy density — potential for yet higher capacities.
- Relatively low self-discharge — self-discharge is less than half that of NiCd and NiMH.
- Low Maintenance — no periodic discharge is needed; no memory.To ensure a high-quality product, diagrams and lettering MUST be either computer-drafted or drawn using India ink.

Limitation of different type of batteries:-

The Nickel Cadmium (NiCd) battery-
- Relatively low energy density — compared with newer systems.
- Memory effect — the NiCd must periodically be exercised to prevent memory.
- Environmentally unfriendly — the NiCd contains toxic metals. Some countries are limiting the use of the NiCd battery.
- Has relatively high self-discharge — needs recharging after storage

The Nickel-Metal Hydride (NiMH) battery-
- Limited service life — if repeatedly deep cycled, especially at high load currents, the performance starts to deteriorate after 200 to 300 cycles. Shallow rather than deep discharge cycles are preferred.
- Limited discharge current — although a NiMH battery is capable of delivering high discharge currents, repeated discharges with high load currents reduces the battery's cycle life. Best results are achieved with load currents of 0.2C to 0.5C (one-fifth to one-half of the rated capacity).
- More complex charge algorithm needed — the NiMH generates more heat during charge and requires a longer charge time than the NiCd. The trickle charge is critical and must be controlled carefully.
- High self-discharge — the NiMH has about 50 percent higher self-discharge compared to the NiCd. New chemical additives improve the self-discharge but at the expense of lower energy density.
- Performance degrades if stored at elevated temperatures — the NiMH should be stored in a cool place and at a state-of-charge of about 40 percent.
- High maintenance — battery requires regular full discharge to prevent crystalline formation.
- About 20 percent more expensive than NiCd — NiMH batteries designed for high current draw are more expensive than the regular version.

The Lead Acid battery-
- Cannot be stored in a discharged condition.
- Low energy density — poor weight-to-energy density limits use to stationary and wheeled applications.
- Allows only a limited number of full discharge cycles — well suited for standby applications that require only occasional deep discharges.
- Environmentally unfriendly — the electrolyte and the lead content can cause environmental damage.
- Transportation restrictions on flooded lead acid — there are environmental concerns regarding spillage in case of an accident.
- Thermal runaway can occur with improper charging

The Lithium Ion battery-
- Requires protection circuit — protection circuit limits voltage and current. Battery is safe if not provoked.
- Subject to aging, even if not in use — storing the battery in a cool place and at 40 percent state-of-charge reduces the aging effect.
- Moderate discharge current.
- Subject to transportation regulations — shipment of larger quantities of Li-ion batteries may be subject to regulatory control. This restriction does not apply to personal carry-on batteries.

Lithium-ion cells and batteries:-

The term lithium-ion (Li-ion) battery refers to an entire family of battery chemistries. It is beyond the scope of this report to describe all of the chemistries used in commercial lithium-ion batteries. In addition, it should be noted that lithium-ion battery chemistry is an active area of Research and new materials are constantly being developed.

This chapter provides an overview of the technology and focuses on the characteristics of lithium-ion batteries common to the majority of available batteries. Additional detailed information with regard to lithium-ion batteries is available in a number of references including Linden's Handbook of Batteries, 1 Advances in Lithium-Ion Batteries edited by Schalkwijk and Scrosati, 2 and a large volume of research publications and conference proceedings on the subject. In the most basic sense, the term lithium-ion battery refers to a battery where the negative electrode (anode) and positive electrode (cathode) materials serve as a host for the lithium ion(Li+). Lithium ions move from the anode to the cathode during discharge and are intercalated Into (inserted into voids in the crystallographic structure of) the cathode.

The ions reverse Direction during charging as shown in Figure 3. Since lithium ions are intercalated into host Materials during charge or discharge, there is no free lithium metal within a lithium-ion cell, 3, 4 And thus, even if a cell does ignite due to external flame impingement, or an internal fault, metal Fire suppression techniques are not appropriate for controlling the fire.

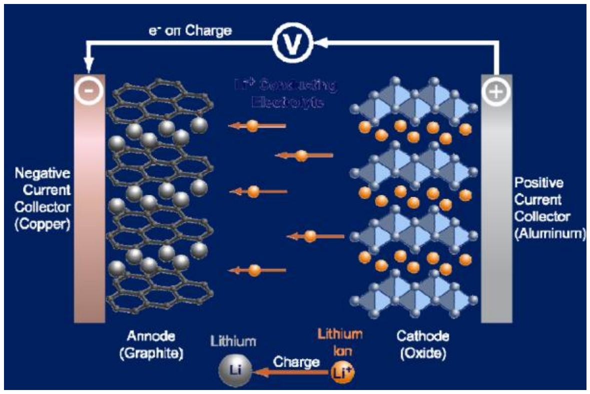

Fig.2 Lithium-ion cell operation, during charging lithium ions intercalate into the anode, the reverse occurs during discharge.

Lithium-ion technology applications:-

Lithium-ion cells have gained a dominant position in the rechargeable battery market for consumer electronic devices.41 Market research data14 indicates the lithium-ion cell market is growing by approximately 20% per year, while the nickel metal hydride (NiMH) battery market has stagnated (or only grown slightly due to increased demand for HEV vehicles), and the nickel cadmium (NiCad) market has a negative annual growth rate of 16%. Lithium-ion technologies have almost entirely displaced other chemistries in cell phone and notebook computer applications. Lithium-ion cells have begun to displace NiCad and NiMH cells in power tools and household products such as remote controls, mobile phones, cameras, and some toys.

The primary reason for lithium-ion battery dominance is the chemistry's high specific energy (Wh/kg) and high energy density (Wh/L), or more simply, the fact a lithium-ion cell of a specific size and weight will provide substantially more energy than competing technologies of the same size or weight. Lithium-ion cells have enabled smaller, more slender, and more feature rich portable electronics designs. Now that lithium-ion cells are readily available and cost has decreased, designers are more likely to select this technology for a wide range of applications. For example, in 2010, Best Buy Corporation42 estimated.

They had approximately "12,000 activeSKU's of consumer electronics and appliances" many of which contained lithium or lithium-ion batteries. Best Buy estimated that products containing lithium-ion batteries included: portable GPS devices, portable game players, portable DVD players, portable TVs, portable radios, cell phones, music players, e-readers, notebook computers, cordless headphones, universal remote controls, cameras, camcorders, two-way radios, rechargeable vacuums, electric razors, electric toothbrushes, electric vehicles, and more.

Many small devices implement only a single lithium-ion cell (3 to 4 V systems) with fairly rudimentary protection electronics. The smallest lithium-ion cells are found in devices such as hearing aids, 43 Bluetooth headsets,44 and very small MP3 players.45 Very small cells are also being implemented in medical devices such as part of sensor packages that can be attached to the human body and allow patient monitoring.46 Some highly specialized implantable lithium-ion batteries are also available.9,47 Larger single cell applications include batteries for digital cameras, MP3 players, and e-readers. The most common single cell lithium-ion battery application is cell phones and smart-phones. As a result, for most single cell applications.

Bio battery:-

The first bio battery:-

The Bio Battery, based on the work of Professor Kenji Kano (Kyoto University), is a type of battery that uses energy sources such as carbohydrates, amino acids and enzymes from a variety of sources. Anode consists of sugar-digesting enzymes and mediator, and the cathode composes of oxygenreducing enzymes and mediator. The mediators in this case are Vitamin K3 for the anode and potassium ferricyanide for the cathode. When sugar is added to the mixture, the anode garners the electrons and hydrogen ions. When the battery generates power, the protons travel to the cathode through the electrolyte to combine with the oxygen to produce water. Since the biocatalysts (enzymes) are very selective catalytically, the miniaturized bio-fuel cell could in principle be fabricated as a membrane-less fuel cell.

The micro fluidic bfc:-

Lim and Pal more at the Brown University have reported a micro fluidic BFC with many channels connected in parallel In this configuration, the design allows streams of fuel and oxidant to flow in parallel within a micro channel without using a membrane as a separator and showing a power density>25 uW/sqcm. Several potential applications of BFCs have been reported or proposed in the literature for implantable devices, remote sensing and communication devices as a sustainable and renewable power source. However, there areno BFC design formats or templates that allow for the production of a working device with a size on the order of 1cc, which are needed for several "real world" applications.

Fig.3 An Mp3 powered battery

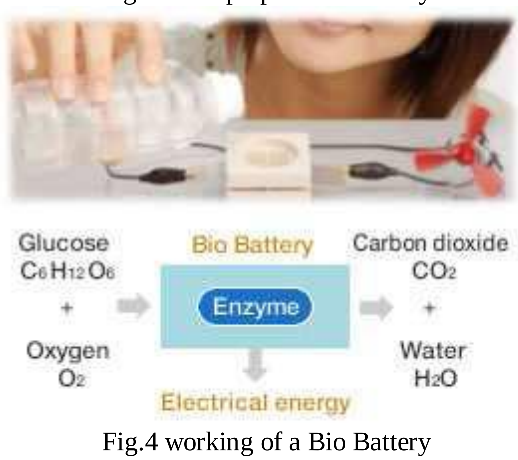

Fig.4 working of a Bio Battery

Conclusion:-

In these report we mentioned different type of batteries there limitation and advantages as well as brief introduction

about lithium ion battery application Lithium-ion cell operation, During charging lithium ions intercalate into the anode, the reverse occurs during discharge measured flash points, auto-ignition temperatures, and heats of combustion of some typical lithium-ion cell organic electrolyte components.
Working of bio battery and also an mp3 powered battery And also mentioned the micro fluid as given brief introduction and also have mention in comparison of batteries the battery vs load current Lithium-ion battery technology has been developing rapidly, especially at the cell level, but costs are still high, and the potential for dramatic reductions appears limited.

References:-

1. waleeda. oraibi*,abadal-salam t. hussain*, f. malek*,ahmed k. abbas* uav storage devices circuitry integration with electrical power generation syste international journal of research in engineering & applied sciences volume 5, issue 1 (january 2015)
2. E. Jensi Miriam1, S. Sekar2, S. Ambalavanan3 Artificial Neural Network Technique for Predicting the Lifetime and Performance of Lead - Acid Battery IRACST – Engineering Science and Technology: An International Journal (ESTIJ), ISSN: 2250-3498,Vol.3, No.2, April 2013
3. Wasana Kowhakul, Kazuki Yoshimura, Hiroshi Masamoto, and Mikiji Shigematsu Thermal Behavior of Used Alkaline Primary Button Batteries Disposed as General Waste Wasana International Journal of Chemical Engineering and Applications Vol. 5, No. 6, December 2014
4. *Katepogu Raju and T. Damodharam Effect Of Battery And Pharmaceutical Industrial Effluents On Photosynthesis Pigments In Rice (Oryza Sativa L.) International Journal Of Plant, Animal And Environmental Sciences Volume-5, Issue-1, Jan-Mar-2015
5. Sakti, Apurba, Carnequie Mellon University, A Validation Study of Lithium-ion Cell Constant C-Rate Discharge Simulation with Battery Design Studio® International Journal of Energy Research Sakti et al. 2012, Carnegie Mellon University
6. S.Balu, M.Mahalakshmi Paper Batteries: I Paper Thin Power National Seminar On Emerging Trends In Plasma Technology 24 -Aug-2014
7. Urba Ziyauddin Siddiqui, Anand k. pathrikar The future of bio batteries Ec department,savitribai phule humen engineering college, Maharashtra, india 11 Nov 2013
8. Peter K.Dunn Comparing The Lifetime Of Two Brands Of Batteries Journal Of Statistics Education Volume 21 1nov 2013
9. Jia Wang,Yourong wang,Wei Zhou, Comparisons of electrochemical activity of Nano sized Li-ion secondary battery using different collectors International journal of electrochemical science Jul 05
10. Aditya p.jayam Comparison of NiMH and Li-ion batteries in automotive applications IEEE vehicle power and propulution conference Sep 08.