HYDROGEN AND FUEL CELL: A NEXT GENERATION TECHNOLOGY OF AN AUTOMOBILE INDUSTRY

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Abstract— *In now days, we are dealing with the fuels which causes Exhaust Emission which was the prime and important source of the Air Pollution. In now days, the main focus is to reduce the exhaust emission by limiting the exhaust from the vehicle. It is well known that Hydrogen has the best property to reduce the undesirable exhaust emission compare to the other gaseous fuels. It can be used as an Alternative fuels for the vehicles. The hydrogen can be produced by the electrolysis process. In now days, one recent trends is the Fuel cell Vehicles. The main focus is to reduce the fuel consumption as well as the reduction of the exhaust emission which produce from the burning of the gaseous fuels. This technology also provides an Alternative Approach to use the Alternative source of Fuel.*

Keywords— Hydrogen;Exhaust Emission;Alternative Fuel;Air Pollution;Fuel Cell

1. INTRODUCTION

A Hybrid Vehicles, A new concept of the Recent Technology. A hybrid vehicle uses at least two different power sources to propel the vehicle of which one of them can generate power for energy storage in an accumulator, in order to increase the driving functions of the vehicle propulsion system. The driving functions can enhance the:

- Emissions
- Comfort
- Drivability (performance)
- Safety

Given its importance in current and future emission scenarios and its near-complete dependence on fossil fuels, innovations in road transport - and particularly vehicle technology are receiving a lot of attention from decision makers and consumers searching for more efficient mobility. Due to its environmental impact, the mobility system is increasingly under pressure [1]. The challenges to cope with climate change, air quality, depleting fossil resources imply the need for a transition of the current mobility system towards a more sustainable one [2].

Heat generation in buildings and industry accounts for more than half of global final energy consumption and a third of global energy-related carbon dioxide (CO2) emissions [3]. There is widespread acceptance that current hydrocarbon fuels used for heat generation will need to be substituted by low-carbon alternatives if global greenhouse gas emissions are to be reduced sufficiently by 2050 to avoid dangerous climate change [4].

Fuel cells can produce the highest proportion of electricity of any CHP technology. They are a flexible, modular technology that can easily be scaled up from serving individual homes to large office blocks and industrial complexes. While some systems are designed to solely produce electricity, the most common stationary application is CHP, which can provide exceptionally high efficiency e up to 95%6 in total e and reduce dependence on centrally-generated power, potentially saving on electricity costs and carbon emissions [5].

The main activity of the Systems group in the Hub involves the integration of different hydrogen and fuel cell systems and whole system modeling and optimization.

Fig 1. The Research Methodology within the Hub Core Programme

2. HYBRID ELECTRIC VEHICLES

HEVs are powered with a combination of a combustion engine and an electric motor. This design, makes the HEV more energy efficient, potentially achieving almost twice the fuel-mileage compared to conventional vehicles and reducing tailpipe emissions substantially. Another driver for the high interest in hybrid technology is that HEVs can act as a stepping-stone for future zero-emitting fuel cell and electric vehicles, Fuel cell vehicles and HEVs share several critical components such as the electric motor, power controls, and high power density batteries. By driving the cost reduction and increased performance of these components, the continued development of HEVs will also help the development of the low and zero emission vehicles of the future [6].

Research on HEVs started in the 1970s following the first oil crisis, but decreased in the 1980s with falling oil prices. In 1997 with increasing concern for air quality and energy security the first HEV was launched on the

Japanese market in the form of the Toyota Prius. The Prius was followed by the Honda Insight and later by several other Japanese hybrid models. Since then, US auto manufacturers have also begun to introduce HEVs. Now, a number of countries are competing to lead HEV and electric vehicle development, including Brazil and China.

3. FUEL CELL

Fuel cells produce electricity, employing reaction between hydrogen and oxygen gases, electrochemically. Fuel cells are efficient, environmentally, compact, modular and reliable for power generation. Different types of Fuel cells currently under development are the protons exchange membrane fuel cells, phosphoric acid fuel cells, molten carbonate fuel cells and alkaline fuel cells. Fuel cells operate on hydrogen gas and oxygen from air. Hydrogen can be obtained from a variety of fuels. Fuel cell power plants can be operated with overall system about 45% to 60% or even higher. High conversion efficiency, extremely low or no emissions, noiseless operation, high current density and compactness are some of the advantages that make fuel cells an ideal power option for automobile applications [7].

4. LITERATURE REVIEW

Anwar U. Haque, Waqar Asrar, Ashraf A.Omar, Erwin Sulaeman, and J.S. Mohamed Ali [8]:- This Framework of methodology for estimation of power budget for IC engine was established in this work, with Emphasis on the utilization of existing analytical relationships of aircraft, airships and hybrid airship. Some anomalies in the Existing analytical relationships for the estimation of drag for thrust requirement and condition are also highlighted. It is perceived that the analytical effort done in the present work will help in future for filling the technological gap for estimation of power budget for engines of HB aircraft for greener solution.

Bjorn Budde, Floortje Alkemade , K. Matthias Weber [9]:- This paper outlines an approach to explore the actor strategies in sustainability transition processes by analyzing expectations and their influence on actor strategies. The findings presented here suggest that changes in actor strategies as well as differences between the strategies of actors can be regarded as a consequence of different expectations related to the various levels. This paper is a first step towards a better understanding of actor strategies in the field of fuel cell and hydrogen technology. Further research is necessary to provide more empirical evidence supporting the conceptual considerations presented here, e.g. about the emergence and shaping of expectations and their dynamics or the influence of strategic behavior on expectations. Moreover, studies looking even deeper into the organizations appear to be promising.

Junji Sakamoto, Jo Nakayama, Toyoaki Nakarai, Naoya Kasai, Tadahiro Shibutani, Atsumi Miyake[10]:- In this study, the scale of gasoline pool fires in hybrid hydrogen gasoline fueling stations was estimated using TRACE and, subsequently, the temperature and the stress due to temperature distribution were estimated using ANSYS. Based on the results, the safety of liquid hydrogen storage tanks was discussed. It was concluded that the emissivity of the outer material of the tank and the safety distance between liquid hydrogen storage tanks and gasoline dispensers should be less than 0.2 and more than 8.5 m, respectively. Moreover, additional safety measures are suggested to reduce the safety distance.

Nancy L. Garland, Dimitrios C. Papageorgopoulos, and Joseph M. Stanford [11]:- This Paper represents the challenges of the fuel cells and hydrogen and the progress of the hydrogen and fuel cells to be used as an alternative approach. The Fuel Cell Technologies Program continues to promote and strengthen its R&D activities. It is continuing to validate the technology in hydrogen stations, fuel cell vehicles, distributed generation, forklifts, and backup power. Analysis efforts explore not just upfront costs of hydrogen and fuel cell systems – although those are very important – but also life cycle costs, and the analyses are used to guide research, development and demonstration (RD&D) efforts.

Mkhulu K Mathe, Tumaini Mkwizu and Mmalewane Modibedi [12]:- The Hydrogen South Africa (HySA) strategy supports research on electro catalysts due to their importance to the national beneficiation strategy. The work reported here presents choice methods for the production of Platinum Group Metals (PGM) electro catalysts, which are characterized for their performance. Investigations on the commercial feasibility of such electro catalysts in the fuel cells including hydrogen production continue to be subject of global interest, to ensure energy security of supply. The paper aims to present possible synthesis routes for PGM electro catalysts for commercial gains. The synthesis of Pd and Pt based nanostructure electro catalysts were synthesized successfully and fully characterized. The use of these materials in a commercial demonstration unit would be the next steps. It can thus be concluded for any method to be considered successful; it must be evaluated with regards to the overall system performance.

Eng. Waseem Saeed and Dr. Eng. Ghaith Warkozek [13]:- This study aims to analyze a renewable proton exchange membrane PEM fuel cell system, by dividing it into four subsystems (PEM fuel cells as the main power source, PEM electrolyser as hydrogen producer, photovoltaic modules as the renewable source that supplies the electrolyser, and hydrogen tank). Then, a mathematical model of each subsystem is simulated in MATLAB to get the operational curves, which are used to design a 1 kW fuel cell system starting with calculating the amount of hydrogen needed by the fuel cells to work continuously, then the size of the water electrolyser used to produce this hydrogen, and the energy needed for electrolysis process. A renewable fuel cell system was analyzed into four subsystems, each subsystem was modeled according to the mathematical equations that reflect its work. And finally, a numerous example of an integrated system that can supply 1 kW electric load continuously was done, and these are the main results: First, each fuel cell should operate with voltage 0.43V to give its maximum power under 70^{o} C and

1 atm operational conditions, and the amount of hydrogen to ensure its work during the whole day was 2.104 Kg, while the size of the electrolyser connected to the PV modules was 20.441 kW, under the same operational conditions as fuel cells.

S. Hanapia, Alhassan Salami Tijani, A. H. Abdol Rahim, W. A. N. Wan Mohamed [14]:- This paper reports the simulation, experimental and validation tests of the prototype FCV using a custom made inertia dynamometer test bench. This test bench is equipped with data logger that is able to log voltage, current, speed and time. The test bench was designed to simulate actual of vehicle performance parameters such as energy flow, acceleration resistance, rolling resistance and aerodynamic drag. The overall power consumption and energy consumption of the FCV was analyzed as a final outcome. The mathematical analysis allows a model to be developed and an inertia test bench to be designed based on typical PEM fuel cell vehicle parameters. The test bench implemented can emulate a scale of PEM fuel cell vehicle. The equivalences between a real and the scale PEM fuel cell vehicle can be from the vehicle dimensions or capacity of the vehicle. The acceleration curves of the vehicle and the inertia test bench have been presented.

Aysel Ersoy Yilmaza and Mehmet Murat Ispirli [15]:- In this study, data were taken at the temperature of 25°C for 6 different membrane thicknesses and 13 different conductivities from the PEM type fuel cell modeled using the finite elements method 2 dimensionally. According to the thickness of the membrane used; as a result of the calculations made on the model for 6 different values from 1 mile to 10 miles, it was observed that the thickness of 1 mile yields the most productive result based on the current density taken from the anode surface. The membranes and the electrolytes are pressed to one another at a certain temperature and bonded together. Thus, what is important for an electrolyte to be chosen above 5000S/m is the corrosion time of the material. Thereby, a longer cell life may be ensured.

Nizovskii A.I., Belkova S.V., Novikov A.A. and Trenikhin M.V. [16]:- The paper discusses the issues concerning producing of compact hydrogen resources for fuel cells. The suggested alternative is implementation of the reaction of activated aluminum with water. In the paper, as an activator Ga-In liquid eutectic alloy is used. The suggested method of aluminum activation provides efficient hydrogen production from water under standard conditions of the reaction beginning. Using aluminum, activated by Ga-In eutectic, it is possible to create compact hydrogen source for a portable hydrogen fuel cell. It is demonstrated, that activated aluminum can be prospective energy carrier for small-scale hydrogen power energetic.

A. Mohamed M. EL-Kassaby, Yehia A. Eldrain Mohamed E. Khidr, Kareem I. Khidr [17]:- The objective of this work was to construct a simple innovative HHO generation system and evaluate the effect of hydroxyl gas HHO addition, as an engine performance improver, into gasoline fuel on engine performance and emissions. HHO cell was designed, fabricated and optimized for maximum HHO gas productivity per input power. The optimized parameters were the number of neutral plates, distance between them and type and quantity of two catalysts of Potassium Hydroxide (KOH) and sodium hydroxide (NaOH). HHO cell can be integrated easily with existing engine systems. The engine thermal efficiency has been increased up to 10% when HHO gas has been introduced into the air/fuel mixture, consequently reducing fuel consumption up to 34%.The concentration of NOx, CO and HC gases has been reduced to almost 15%, 18% and 14% respectively on average when HHO is introduced into the system.

Rachan D Shekar and H R Purushothma [18]:- This paper presents Hydrogen as additives to the bio diesel Mixtures. It also gives the various methods of inducing hydrogen .By the detail review of this paper, it can be said that hydrogen can either replace diesel totally as a fuel in the CI Engine or can be used as additives either in the form of gas along with atmospheric air or mixed with the fossil diesel fuel oil.

Shivaprasad K V, Raviteja S, Parashuram Chitragar and Kumar G N [19]:- This article experimentally investigated the performance and emission characteristics of a high speed single cylinder SI engine operating with different hydrogen gasoline blends. For this purpose the conventional carbureted high speed SI engine was modified into an electronically controllable engine with help of electronic control unit (ECU) which dedicatedly used to control the injection timings and injection durations of gasoline. They conclude that the addition of hydrogen helps in improving Bmep. The maximum Bmep obtained at 20% blend of hydrogen for an engine operating at 3000 rpm speed. The addition of hydrogen is effective on improving engine brake thermal efficiency. An increase of brake thermal efficiency was observed till a hydrogen fraction of 20%. The volumetric efficiency decreases as the percentage of hydrogen increases as hydrogen tends to replace air from the mixture.

Paul E. Dodds , Iain Staffell , Adam D. Hawkes , Francis Li , Philipp Grunewald , Will McDowall , Paul Ekins [20]:- This review examines the potential benefits of these technologies across different markets, particularly the current state of development and performance of fuel cell micro-CHP. Fuel cells offer some important benefits over other low-carbon heating technologies, and steady cost reductions through innovation are bringing fuel cells close to commercialization in several countries.

5. CONCLUSION

Most of the energy used in the world is obtained from fossil fuels. Some reasons like air and environmental pollution, high energy costs and depletion of fossil fuels, increased the importance of studies about new and renewable energy sources in the world. Among the new and renewable energy sources hydrogen has great importance. Hydrogen and Fuel cells which are used have a great importance in now days to reduce the air pollution and the reduction of the Fuel consumption. This article tries to represents the advantage of using the new Futuristic technology in An Automobile sector like Hydrogen And Fuel cells.

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