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Review on Petrol Engine, Steam Engine, Solid Oxide Fuel Cells and Lithium Batteries

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Abstract: *In the present paper Review on Petrol Engine, Steam Engine, Solid Oxide Fuel Cells (SOFC's) and Lithium Batteries are presented. The difficulties with the solid oxide fuel cells and lithium batteries are discussed. The SOFC's are operated at higher temperatures. Considering the higher input thermal energy the efficiency of SOFC's are much lower. It is not good idea to use SOFC's operated at higher temperature. If one is using higher temperature then use of small steam turbines can be used to run the vehicles and to electrify the homes. In the present paper probable new mechanism for the SOFC's using ozone gas and H_2 gas operating at room temperature is presented. It is advisable to use small steam turbines to run the vehicles and to power the homes instead of SOFC's and lithium batteries.*

Keywords: *Petrol Engine; Steam Engine; Solid Oxide Fuel Cells; Lithium Batteries; Ozone.*

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I. Introduction:

Petrol engines are used to run the four stroke engine bikes. The pressure created by burning of petrol is 1.5 MPa which runs the vehicles. The steam engines are used to produce the electricity in thermal power plants by burning the coal and produce the steam which in turn runs the steam turbines to produce electricity. The steam engine produces pressure equivalent to 1.38 MPa to 1.5 MPa. The bigger steam turbine produces power equivalent to 150 MW. The solid oxide fuel cells are used to produce electricity by combining the O_2 and H_2 by converting it in to H_2O which in turn produces electricity to run the vehicles. These SOFC's are operated at higher temperatures (500-1200 ^oC). Lithium ion batteries are use to power the small domestic electrical appliances. The lithium batteries do not run for longer time to power the domestic electrical appliances. These batteries are needed in large number to power the domestic appliances. In the present paper Review on Petrol Engine, Steam Engine, Solid Oxide Fuel Cells and Lithium Batteries have been carried out and the results are presented.

II. Results and Discussion:

The reaction or mechanism of Solid oxide fuel cells (SOFC's) as shown by NETL is as given below [1].

$H_2 \rightarrow 2H^+ + 2e^-$ (at anode)
$\frac{1}{2} O_2 + 2H^+ + 2e^- \rightarrow H_2O$ (at cathode)
The overall reaction is $H_2 + \frac{1}{2} O_2 \rightarrow H_2O$

Solid oxide fuel cells (SOFC's) are operated at higher temperatures (500-1200 ^oC). Considering higher input thermal energy the efficiency of SOFC's is much lower. Considering higher input thermal energy, small steam engines can be operated instead of SOFC's and lithium batteries and other type of batteries. It is not clear in literature how the required operating temperature is created to run the high temperature SOFC's. In four stroke bike burning of petrol and diesel creates pressure equivalent to 1.5 MPa to run vehicles. The steam also produces pressure equivalent to 1.38-1.5 MPa. By establishing small engines in four stroke bike one can run the bike. By establishing small steam engines on the roof of houses also produce the needed electricity to power the homes for longer time. The steam engine can be used in a dual purpose. One purpose is to run the vehicles and the other purpose is to produce the electricity for domestic use. If one is using electrical furnace then this is not feasible idea to operate the high temperature SOFC's.

Lithium ion batteries are used to produce the electricity to run vehicles and also to power the electricity in homes for domestic use. A lithium-ion or Li-ion battery is a type of rechargeable battery that uses the reversible intercalation of Li^+ ions into electronically conducting solids to store energy [2]. Li-ion batteries are

characterized by higher specific energy, higher energy density, higher energy efficiency, a longer cycle life, and a longer calendar life.

Inside a lithium-ion battery, oxidation-reduction (Redox) reactions take place.

Reduction takes place at the cathode. There, cobalt oxide combines with lithium ions to form lithium-cobalt oxide (LiCoO2). The half-reaction is:

$CoO2 + Li+ + e- \rightarrow LiCoO2$

Oxidation takes place at the anode. There, the graphite intercalation compound LiC6 forms graphite (C6) and lithium ions. The half-reaction is:

$LiC6 \rightarrow C6 + Li+ + e-$

Here is the full reaction (left to right = discharging, right to left = charging):

$LiC6 + CoO2 \rightleftarrows C6 + LiCoO2$

To run the vehicles for longer time and to power the homes for longer time large number of lithium batteries are required. This is not cost effective and not feasible run the vehicles and to electrify the homes for longer time. The lithium batteries have difficulty in operating at higher temperature due to Ohmic losses.

The probable new mechanism for the SOFC's using ozone gas and H_2 gas is presented below [3]. The ozone gas gets dissociated in to oxygen and oxygen ion under visible sunlight. Then the oxygen ion gets converted in to oxygen molecule and four electrons (at cathode). Then at anode the hydrogen reacts with oxygen molecule and four electrons to produce water. The electrons flow from cathode to anode. The important point regarding the SOFC's using ozone and H_2 gas is that it can be operated at room temperature whereas conventional SOFC's are operated at higher temperatures (500-1200 ^oC). The mixed or combined gases (O_3 and H_2) can be passed at both the anode and cathode sides to produce electricity and this can be operated at room temperature. This is one advantage of SOFC's using ozone and H_2 gases. SOFC's utilizing ozone and H2 needs a trial.

$O_3 \rightarrow O_2 + O^{-2}$ (under sunlight)

$2O^{-2} \rightarrow O_2 + 4e^-$ (at cathode)

$2H_2 + O_2 + 4e^- \rightarrow 2H_2O$ (at anode)

Over all equation are $2H_2 + 2O^{-2} \rightarrow 2H_2O$

Steam is used to run the steam turbines to produce electricity and the output power generator is given below. The steam is produced in boilers using heated coal as main source of energy.

• Inlet Steam Condition (Steam Pressure / Temperature) :0.2MPaG / Sat. ~ 14MPaG / 570℃

• Power Output :~150MW / unit

The energy density of coal, i.e. its heating value, is roughly 24 megajoules per kilogram (approximately 6.7 kilowatt-hours per kg). For a coal power plant with a 40% efficiency [4], it takes an estimated 325 kg (720 lb) of coal to power a 100 W light bulb for one year.

To produce the power output of 150 MW, bigger steam turbine is needed. For domestic house hold the power needed for one month is around 600 KWhr. To produce this much of power it requires small steam turbine (250 times lesser than bigger turbine to produce 150 MW). Then this small steam turbine is used to run the vehicles and to power the domestic homes for longer times. One needs to consider how temperature of 570 ^oC to 1000 ^oC is produced instead of burning the coal. It is also not clear how temperature is created to run the higher temperature SOFC's. If one is using electrical furnace then this is not feasible idea to operate the high temperature SOFC's. In this regard SOFC's utilizing Ozone and H_2 operated at room temperature need to be studied and adopted.

III. Conclusions:

Review on Petrol Engine, Steam Engine, Solid Oxide Fuel Cells (SOFC's) and Lithium Batteries and their difficulties are presented in this paper. The SOFC's are operated at higher temperatures. Considering the higher input thermal energy the efficiency of SOFC's are much lower. It is not advisable to use the SOFC's operated at higher temperature. If one is using higher temperature then use of small steam turbines will be advisable to run the vehicles and to electrify the homes. Probable new mechanism for the SOFC's using ozone gas and H_2 gas operating at room temperature is presented. It is advisable to use small steam turbines to run the vehicles and to power the homes instead of SOFC's and lithium batteries.

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