

Electricity generation from Multi-Wall Carbon Nano Tubes for Automobiles

T.Leander Sachin¹, Raj Kumar², Swaroop Kishen S.P³

UG Student, Dept of Mechanical, Velammal Engineering College, Chennai, India^{1,2,3}

ABSTRACT: The Present innovation provides a rubber composition in which the tyres with Carbon Nano Tubes are manufactured by reinforcing natural rubber (NR), styrene-butadiene rubber (SBR) and polybutadiene rubber (BR) with Carbon nanotubes. The Heat is generated due to friction as the tyre rolls over the track and the heat is recovered with the help of Micro channels using Nano-Fluids. The size of the Micro channels is in the order of 6mm diameter having wide grooves of 100 µm to carry the Nano-Fluids. The Nanofluids used here are a mixture of various-solution copper (Cu) nanoparticles with an average diameter of 10nm. The various merits and De-merits of this Nanotube tyres are discussed by taking into consideration of various physical, chemical and stability of nanomaterials. The vapours from the Micro Channels are used to run the Turbo-Generator assembly. The Electricity thus Generated is utilised to charge the battery periodically. Alternatively the Vapours are also used for Air Conditioning with the help of Phase Change Materials.

KEYWORDS: -Carbon Nanotubes, Nanoparticles, Micro Channels, Nano-Fluids, Thermal Conductivity.

I. INTRODUCTION

We see in the Present day Scenario that the use of fossil fuels has increased and the World Oil Supply is quickly decreasing. In 2007, the world consumed 29 billion barrels of petroleum, 5 billion metric tons of coal, and 2.7 trillion cubic meters (96 trillion cubic feet) of natural gas [1]. At this rate the availability of Fossil fuels will be lost by 2400.

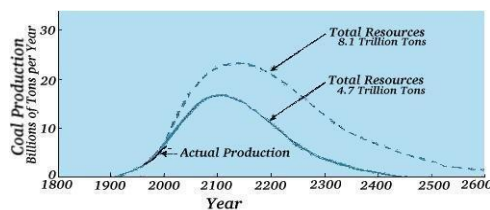


Fig 1. Coal Availability F(Number of Years).

Common air pollutants originating from the Automobiles due to the burning of these fossil fuels have an affect on blood and thus on organs of the body.

Carbon monoxide can exacerbate cardiovascular disease in humans. Some airborne chemicals stimulate the immune system to activate leukocytes and macrophages that can produce tissue damage, especially to the cells that line human blood vessels. The combined effect of these events is to accelerate the changes that eventually lead to hypertension and ischemic heart disease.

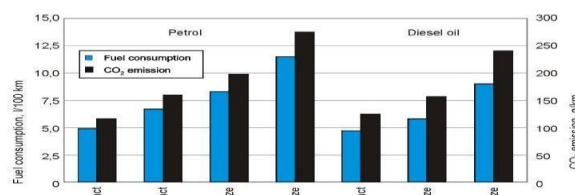


Fig 2. CO2 Emission in Cars in China.

Research has already been made on alternative fuels such as Ethanol, Hydrogen and Various renewable energy sources. In using Bio-Diesel, as a fuel for our automobiles, there are a lot of difficulties to be overcome including, blending of fuels and viscosity of the Fuel etc. The renewable source of energy mainly depends upon the climatic conditions and the high cost involved in converting thermal \rightarrow electrical energy.

OBJECTIVE:

Now our main focus is to reduce the emission of unwanted gases such as Sox, Nox and CO₂, which pollutes our atmosphere and causes Green House Effect. The proposed model is going to use heat resulting from Nanotyres due to friction, which does not evolve any Pollutant gases.

Carbon black or silicone (silane compounds) is used as a reinforcing agent to enhance the tensile stress or durability of the rubber in the production of tyres. However, a carbon nanotube, which is an allotrope of carbon black in the aspect of basic structure, is superior to carbon black in strength and has a tensile stress as high as 100 times that of steel. It possesses the peculiar properties such as high elasticity, high thermal conductivity and high durability. These properties are well known disadvantages of the polymers [2].

It was reported that when polystyrene is added with only 1 % by weight of carbon nanotubes, the tensile stress and elastic stiffness of the product increased by about 25 % and 36-42 %, respectively [3].

II. OUR PRESENT PROPOSED WORK

The System can be divided into three parts as

- a) Heat Generation
- b) Heat Recovery
- c) Generation of electricity The methods can be explained as follows. **a)Heat Generation:**

The First and foremost requirement is the significant amount of heat from the friction of the tyres with the roads during motion of the vehicle and also a large amount of heat when the brakes are applied.

Braking is deceleration or negative acceleration provided by friction between two contacting surfaces. The energy developed by the power of the brake friction appears as 'heat' and if the heat produced is accumulated at one place it causes damage to the various automobile parts.

Thermal Conductivity:

The proposed Model uses carbon Nanotubes which generates heat because of the high thermal conductivity in the order of 37,000 W/mk. It consists of a carbon atom bound to three adjacent carbon atoms. The bonding between those carbon atoms results in a hexagonal cyclic structural unit. A number of such units of repeated hexagonal structures in the form of honey comb and the plane rolls into a cylindrical tube to constitute a Nanotube finally.

Extensive researches on the synthesis of carbon nanotubes are being carried out because the nanotubes have good thermal, mechanical and electrical properties resulting from their characteristic chemical bonding [9].

At $T = 100$ K, carbon nanotubes show an unusually High thermal conductivity value of 37 000 W/mK. This value lies very close to the highest value observed in any solid, (i.e.) 41,000 W/mK that has been reported for a 99.9% pure crystal at 104 K. The room temperature value of 6600 W/mK is still very high, exceeding the reported thermal conductivity value of 3320 W/mK for nearly isotopically pure diamond [10].

Because of the tubular structures of carbon nanotubes, they have extreme high thermal conductivity in axial directions. Atomic force microscope (AFM) has been introduced to measure the thermal transport of nanostructures with nanometer-scale high spatial resolution, providing a promising way to probe the thermal properties with nanostructures [11].

The high thermal conductivity of carbon nanotubes were first proved by some theoretical calculations [12,13].

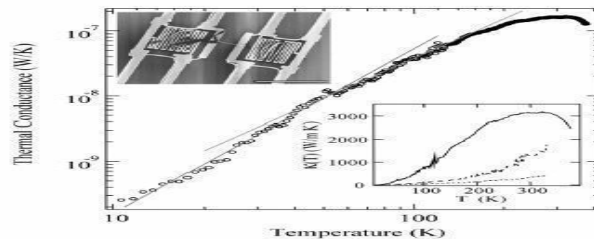


Fig 3. Thermal Conductivity of CN

This graph shows the Thermal Conductivity of a Single Nano tube and proves that it is very high compared to any other material. It also shows that the thermal conductivity of an isolated (10, 10) nanotubes is dependent on the temperature and an extraordinarily high value of ~6600W/mK is resultant at room temperature. But not only is this enough for it to be used as Car Tyre Replacement. It should have good flexibility and mechanical Strength as well.

Strength & Flexibility: An enhancement of mechanical properties of Nanomaterials can result due to the modification in size, which generally results in structural perfection of the materials. The small size either renders them free of internal structural imperfections such as dislocations, micro twins, and impurity precipitates.

Impurities present cannot multiply sufficiently to cause mechanical failure. The imperfections within the Nano dimension are highly energetic and will migrate to the surface to relax themselves under annealing, purifying the material and leaving perfect material structures inside the nanomaterials.

Carbon nanotubes, which are formed of seamless cylindrical graphene layers, represent the ideal carbon fiber and should presumably have the best mechanical properties in the carbon fibers species, showing a high Young's modulus and high tensile strength [8].

Micrometer size nano-fillers were used in traditional polymer composites and showed improvements in their mechanical properties such as the modulus, yield strength and glass transition temperature. These properties of the *Carbon Nano Tubes* make it the perfect Material for the Manufacture of tyres of Automobiles.

b) Heat Recovery:

Recently, as an innovative material, nanometer-sized particles have been used in suspension in conventional heat transfer fluids. The fluids with these solid-particle suspended in them are called '*Nanofluids*'.

Nanofluids are generally referred to the solid-liquid composite materials, which consist of nanomaterials of size in the range 1-100nm suspended in a liquid. The suspended metallic or nonmetallic nanoparticles change the transport properties and heat transfer characteristics of the base fluid which have been proved by many experimental works.

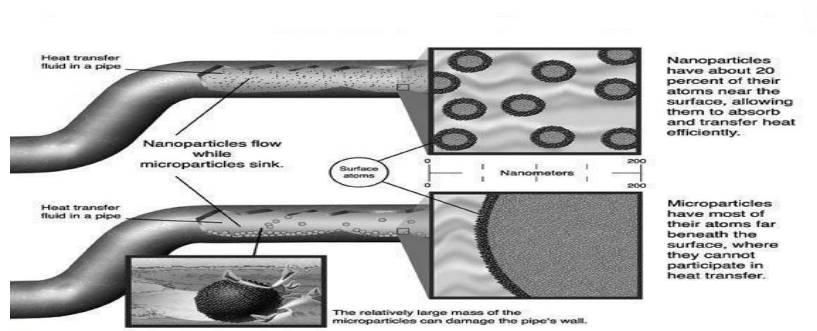


Fig 4. Speciality of Nano-Fluids[15].

It was also proved that Nano particles have an appreciable effect on the development of boundary layer, and hence, greater sensitivity to heat fluxes. There is an increase of 40% in thermal conductivity when any Nano-material gets mixed with base-fluid such as water/ethylene glycol mixtures and oils. The result shows that the thermal conductivity is a function of volume percentage of Nano particles loading [16].

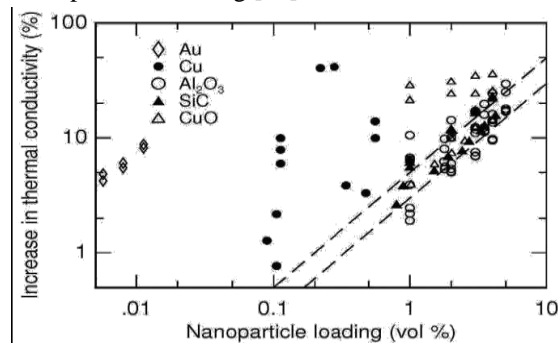


Fig 5. Relative increase in the thermal conductivity a F(volume fraction of Nanoparticles)[14]

The Nano fluid that is heated by the heat of friction is used to run the Turbines with the help of flat Micro channels. A micro channel is an extremely efficient heat conductor; its effective thermal conductivity is typically 10 to 100 times better than that of copper.

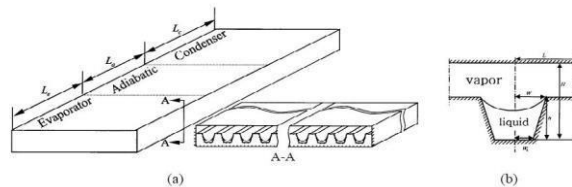


Fig 6. Sections of Micro Channels

A micro channel uses thermal energy generated by a heat source, in our case the Nanotube tyres, as latent heat to change the phase of the working nanofluid in the Micro channels. The thermal heat generated by the heat source (Nanotube tyres) makes the working nanofluid boil and vaporise in the hot end of the Micro channels, i. e. the Evaporator of the Micro channels.

Due to a generated pressure difference (Adiabatic Process), the vapour moves to the other, cold end of the Micro

channels, i. e. the condenser of the Micro channels, where the vapour is used to run the series of turbines to produce electric current

To efficiently analyze the characteristics of heat transport of Micro channels, the following assumptions are introduced as:

- (1) Heat transfer processes in the Micro channel container and working fluid are considered to be one dimensional in the radial direction, such that axial heat conduction is neglected. The working fluid flows only along the axial direction.
- (2) No part of the condenser is blocked by the liquid working fluid.
- (3) The liquid is distributed uniformly between the grooves.

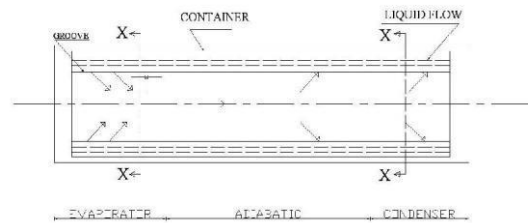


Fig 7. Internal Structure of Micro Channels

C) Generation of Electricity

The vapor thus generated in the micro Channels is used to run the remaining parts of our circuitry.

The various components required for conversion into electrical energy are:

1. Turbo Generator
2. Condensing unit
3. High pressure pump

The next few Steps done in our Engine Model are:

Vapours are obtained from the Micro Channels originating from the Nano Tube Tyres. The amount of vapour produced in this case is higher since smaller the area of the

Micro Channels, larger will be the density of Vapours produced.

The thus produced vapour is used to run Turbo-Generator which produces electricity to charge the 12V series batteries which provide the electrical power to run the car.

The vapour after expansion in the turbine is allowed to pass through the condensing unit and thus the working fluid gets condensed and fed for the next cycle of operation.

Disadvantages of Electric Cars.

- Electric Cars have limited range (i.e.) they get exhausted over a short period of time, due to the low energy

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density of batteries. □

□

□ Electric Cars have very long recharge times for their batteries. □

Advantages over Electric Cars

In our model a part of the Electricity produced from the Turbines is supplied to the 12V Batteries and they are thus recharged simultaneously.

But for our case there is no need to refill anything. Everything gets recycled back using condensing unit and thus the recharge time loss is also avoided.

Our Model achieves higher energy conversion efficiency over the full range of speeds and power output and can be precisely controlled. This can be combined with

“Regenerative braking systems” that have the ability to convert movement energy back into stored electricity. The Generator is rotated on its own and mechanical energy is converted back into Electricity and stored in the 12V Battery.

This “secondary” source of electrical power is captured and stored, and can thus be useful for other utilities like Lighting and Radio as well. This can be used to reduce the wear on brake systems. The Air Conditioning ill effects on the

Atmosphere can be reduced by the use of PCM’s as well.

III.COST ANALYSIS

Table I. Initial Investment in our Model

Carbon Nanotube tyres (\$0.25/Gram) comes upto \$500 per tyre Cost of Four Tyres	2240\$ which gives around Rs. 1,35,000
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Table II. Money Spend on an Average Car

<i>Fuel Consumption for average city run. Milage considered as 10KM per litre</i>	5,00,000 kms* Rs.75/lit	Rs. 3,75,00,000
<i>Maintenance cost of a car</i>	<i>Rs.15000 per 20,000Kms</i>	<i>Rs. 4,00,000</i>
<i>So the Total comes upto</i>		<i>Rs.3,79,00,000</i>

Comparison with internal combustion engine vehicles (ICEVs)

Running costs

Our Proposed Electric car operating costs can be directly compared to the equivalent operating costs of a petrol-powered vehicle. A litre of petrol contains about **8.9 kW·h of energy**. To calculate the cost of the electrical equivalent of a litre of petrol, multiply the utility cost per kW·h by 8.9. This is because automotive internal combustion engines are only about

20% efficient.

A car powered by an internal combustion engine at 20% efficiency, getting 6 L/100 km, will require $(8.9 \times 6) \times 0.20 = 10.68$ kW·h/100 km. But theoretically there is no energy loss. The maintenance of ICEV car should be done every 2000 kms on an average which cost about Rs.3000. In our model the only thing we need to replenish every 15,000 kms (approx) is the n-Butane which cost (Rs.33.43/L. taking into consideration a 20 L boiler) we have

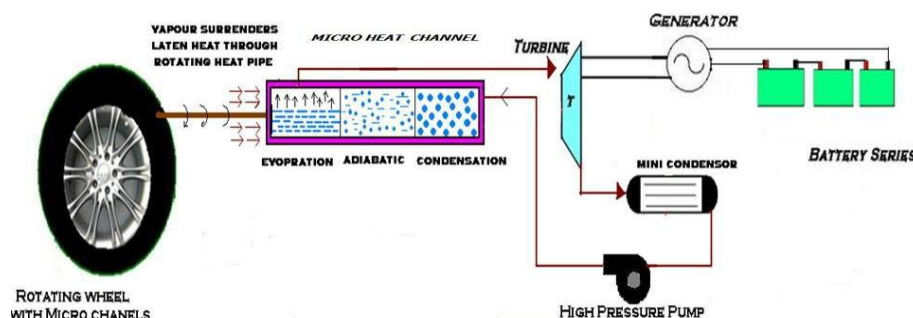
Carbon dioxide emissions Based on the results our proposed electric cars can achieve up to 100% reductions in CO2 emissions with renewable electric generation vs 77% in Bio-Diesel car. Of course at present only 32% reductions of carbon dioxide can be achieved for ICEV cars with current US Grid due to heavy fossil fuel use and inefficiencies.

Preliminary Work:-

As the first stage to our project we prepared the Rubber re-enforced with CNT's by dissolving the CNT's in Toluene and mixing it with the composition of 10 grams of Rubber dissolved in 1000ml of Toluene.

In the experimental Setup We made use of DUTYMAX Servo Motor with a maximum speed of 4000 RPM. CNT material encapsulated on Flywheel Design over a width of 25mm is rotated by an external motor. Materials with relative roughness of 100-400 Microns are chosen. CNT Encapsulated Flywheel run by the motor is run over this material. Micro Thermosensor is used to measure the temperature.

IV. BLOCK DIAGRAM OF OUR MODEL



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