IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE)
e-ISSN: 2278-1684, p-ISSN: 2320-334X
PP 80-87
www.iosrjournals.org

Effct of Physco-Chemical Properties of Nanotube Blended In Biofuel

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ABSTRACT: *Globally, industrial technologies are shifting toward the development of new products that are greenhouse gas-neutral, cleaner burning, and more environmentally sustainable. This is being driven by a variety of factors including tremendous advances in science and technology, climate change policies, consumer demand for green products, the rising price of oil, and the discovery of new functionalities of petroleum replacements. In order for the growing interest in developing the replacement of the combustion engine fuel that mainly consider on physical and chemical properties of the fuel change. The combustion of fuel will mainly based on physical and chemical properties of the fuel .The fuel generally having high carbon content and carbon nanotubes also having high carbon content her our idea goes to the fuel and carbon nanotubes mix to produce alternate fuel. The changes of properties will result the fuel burning temperature increases. The fuel having higher calorific value, engine performance increases and emission of co and nox level decreases. and also the fuel will be renewable, sustainable and alternative for compression ignition engines. Combustion engine fuel instead of diesel using biofuels mixing with carbon nanotubes what are all the physical and chemical properties changes refer to the standard fuel value. .****Keywords*** *Carbon nanotubes, physical-chemical properties, performance, standard fuel value*

I. INTRODUCTION

We are known that currently 90% of the energy used for transportation, power production, and heating is produced by combustion of liquid, solid, and gaseous fuels. Although significant increases in the price of oil and natural gas are certain to occur during the early part of the next century, it is unlikely that this percentage will change significantly for many years. Thus the study of combustion is of continuing importance, especially if we’re to conserve our source of energy and reduce air population and increasing energy needs.

The engineer intending to study combustion will find that current sources of information fall into two categories-literature on the scientific aspects of combustion, and literature on the increasing the engine performance by physical and chemical properties of the fuel and reducing the emission producing level. That is reason only we are adding carbon nanotubes with biofuel burning in combustion engine the required high surface to volume ratio of nanotubes, which allow them to act as more efficient chemical catalysts, thus increase the fuel combustion. The generally the process will increase the reaction rate. Her function but increase the rate combustion, the chemical content will be carbon nanotubes catalyst consider the biofuel.

The nature of the combustion also depends on whether the fuel is gaseous, liquid, or solid. The gaseous fuel are easy to feed and mix, and are generally clean burning. Liquid fuels are typically sprayed in the nozzle at a high pressures, while solid fuels are usually crushed ,pulverized, or chipped before feeding into the combustor. In our project consideration of liquid fuel physical and chemical changes while adding carbon nanotubes with biofuels towards increase the combustion rate engine.

Diesel is essential for transport and heavy-duty engines. It contributes to the prosperity of the worldwide economy since it is widely used due to high combustion efficiency, reliability, adaptability and cost-effectiveness. However, pollutant emissions are a major drawback. Emissions from diesel engines seriously threaten the environment and are considered one of the major sources of air pollution.

1.1 Historical Review of Fuel

Fuel is a substance which, when burnt, i.e. on coming in contact and reacting with oxygen or air, produces heat. Thus, the substances classified as fuel must necessarily contain one or several of the combustible elements : carbon, hydrogen, sulphur, etc. In the process of combustion, the chemical energy of fuel is converted into heat energy. To utilize the energy of fuel in most usable form, it is required to transform the fuel from its one state to another, i.e. from solid to liquid or gaseous state, liquid to gaseous state, or from its chemical energy to some other form of energy via single or many stages. In this way, the energy of fuels can be utilized more effectively and efficiently for various purposes. Generally they are two types,

- Conventional fuel- Non-Renewable fuels
- Non-conventional fuel-Renewable fuels

1.2 Types of Fuels
1.2.1 Conventional Fuel
This fuel are non renewable fuels and having the three main types of fuel
1.2.2 Solid fuels
Solid fuels are mainly classified into two categories, i.e. natural fuels, such as wood, coal, etc. and manufactured fuels, such as charcoal, coke, briquettes, etc.
The various property of the solid fuels are

Carbon	50-95%
Sulphur	0.5-7%
Hydrogen	2.5-5%
Nitrogen	0.5-3%
Oxygen	2-4%
Ash	2-30%

Table 1.1 Properties of Solid Fuel

1.2.3 Liquid fuels

Carbon	79.5 to 87.1%
Hydrogen	11.5 to 14.8%
Sulphur	0.1 to 3.5%
N and O	0.1 to 0.5%

Table 1.2 Properties of Liquid Fuel

1.2.4 Gaseous fuel
Gaseous fuels occur in nature, besides being manufactured from solid and liquid fuels. The advantages and disadvantages of gaseous fuels are given below Advantages Gaseous fuels due to erase and flexibility of their applications, possess the following advantages over solid or liquid fuels,

- They can be conveyed easily through pipelines to the actual place of need, thereby eliminating manual labour in transportation.
- They can be lighted at ease.
- They have high heat contents and hence help us in having higher temperatures.
- They can be pre-heated by the heat of hot waste gases, thereby affecting economy in heat.

1.3 Non Conventional-Renewable Fuels
The various type of the renewable energies are given below

- Solar energy
- Wind energy
- Fuel from biomass and biogas
- Ocean thermal energy conversion
- Tidal energy
- Geothermal energy
- Hydrogen fuel

1.4 MATERIALS AND METHODS
1.4.1 Measurement of different fuel properties
The important physical and chemical properties of oil and biodiesel were determined by standard methods. In order to measure the properties of the diesel fuels, the biodiesels and the blends, the test methods were used asfollows:
1.4.1.1 Relative density

Density is an important property of biofuel. Density is the mass per unit volume of any liquid at a given temperature. Density measurements were carried out using a pycnometer at a temperature of 312K.Testing will atmosphere pressure and temperature of the fuel considered.

1.4.1.2 Flash and fire point

The flash point temperature of biodiesel fuel isthe minimum temperature at which the fuel will ignite(flash) on application of an ignition source. Flash point varies inversely with the fuel's volatility. Minimum flashpoint temperatures are required for proper safety an handling of diesel fuel. Fire point is the lowest temperature at which a specimen will sustain burning for 5seconds.These two parameters have great importance while determining the fire hazard (temperature at which fuel will give off inflammable vapour). Flash point of the samples were measured in the temperature range of 60 to190°C by an automated Pensky-Martens closed cup apparatus.

1.4.1.3 Calorific value

Calorific value of a fuel is the thermal energy released per unit quantity of fuel when the fuel is burned completely and the products of combustion are cooled back to the initial temperature of the combustible mixture. It measures the energy content in a fuel. This is an important property of the bio-diesel that determines the suitability of the material as alternative to diesel fuels. The calorific value of vegetable oils and their methyl esters were measured in a bomb calorimeter according toASTMD240 standard method. An oxygen-bomb was pressurized to 3MPa with an oxygen container. The bomb was fired automatically after the jacket and bucket temperature equilibrated to within accuracy of each other.

1.4.1.4 Viscosity measurements

Viscosity is a measure of the internal fluid friction or resistance of oil to flow, which tends to opposeany dynamic change in the fluid motion. As the temperature of oil is increased its viscosity decreases and it is therefore able to flow more readily. The lower the viscosity of the oil, the easier it is to pump and atomized achieve finer droplets. Viscosity is measured using Redwood viscometer. The Redwood viscosity value is the number of seconds required for50 ml of oil to flow out of standard viscometer at a definite temperature.

1.4.1.5 Cetane number

The physical and chemical properties of fuel play a very important role in delay period. The Cetane number(CN) of the fuel is one such important parameter which is responsible for the delay period. Cetane number of a fuel is defined as the percentage by volume of normal cetane in a mixture of normal cetane and α-methyl naphthalene which has the same ignition characteristics (ignition delay) as the test fuel, when combustion is carried out in a standard engine underspecified operating condition. A fuel of higher cetane number gives lower delay period and provides smoother engine operation. Biodiesel has a higher CN than petro-diesel because of its higher oxygen content.

Measuring devices and test methods for measuring fuel properties.

Density	Hydrometer ASTM D941
Flash and fire point	Penksy martins apparatus ASTM D93
Viscosity	wood viscometer ASTM D445
Cetane number	Ignition quality tester ASTM D613

Table 1.3 Measuring devices and test methods

II. CARBON NANOTUBE

2.1 An overview

Carbon nanostructures are perhaps the most important discovery in the 21st century. They have already spun off the augmentation of the nanotechnology research in a new dimension. A brief discussion on the structure and synthesis process of the one dimensional carbon nanostructures is given in this section followed by its several important properties and various technological applications.

Carbon, (atomic weight = 12.0) is one of the most abundant elements in the universe. It has four valence electrons. Carbon can form various structures with entirely different properties using these valence electrons.

2.2 Structure

The bonding in carbon nanotubes is sp^2, with each atom joined to three neighbours, as in graphite. The tubes can therefore be considered as rolled-up graphene sheets (graphene is an individual graphite layer). There are three distinct ways in which a graphene sheet can be rolled into a tube. The terms “armchair” and “zig-zag” refer to the arrangement of hexagons around the circumference. The third class of tube, which in practice is the most common, is known as chiral, meaning that it can exist in two mirror-related forms. There are many possibilities to form a cylinder with a graphene sheet: the simplest way of visualizing this is to use a "de Heer abacus": A “de Heer abacus”: to realize a (n,m) tube, move n times a1 and m times a2 from the origin to get to point (n,m) and roll-up the sheet so that the two points coincide.

2.3 According to the structure types of CNTs

CNTs are the hollow one dimensional carbon nanostructures. These hollow, cylindrical tubes of graphitic carbon are characterized by a single tube wall or a large amount of ordered tube walls. Their length can vary from a few hundred nanometers to several hundred microns. The diameter can be varied from 0.37 nm to 100 nm. Bonding in the nanotubes is essentially through sp2 hybridization. The sp2 hybrid orbital allows carbon atoms to form pentagon and hexagon units by in-plane r-bonding and out-of-plane p-bonding. However, the circular curvature will cause quantum confinement and r–p rehybridization, in which three r bonds are slightly out of plane . Consequently, the p orbital is more delocalized outside the tube, that is, the p-character in the hybridization is increased to some extent than that of the graphite. This makes nanotubes mechanically stronger, electrically and thermally more conductive and chemically and biologically more active than graphite. CNTs can exist as single tubes (called single-walled nanotubes, SWCNT) or in the form of concentric tubes (termed multi-walled nanotubes, MWCNT). A SWCNT is a hollow cylinder of graphite sheet whereas a MWCNT is a group of coaxial SWCNTs. SWCNTs were discovered in 1993, two years after the discovery of MWCNTs. Brief descriptions of these two are presented in the following subsections.

2.3.1 Single-walled CNT’s

These are the stars of the nanotube world, and somewhat reclusive ones at that, being much harder to make than the multi-walled variety. The oft-quoted amazing properties generally refer to SWNTs. As previously described, they are basically tubes of graphite and are normally capped at the ends although the caps can be removed. The caps are made by mixing in some pentagons with the hexagons and are the reason that nanotubes are considered close cousins of buckminsterfullerene a roughly spherical molecule made of sixty carbon atoms, that looks like a soccer ball and is named after the architect Buckminster Fuller (the word fullerene is used to refer to the variety of such molecular cages, some with more carbon atoms than buckminsterfullerene, and some with fewer).

The theoretical minimum diameter of a carbon nanotube is around 0.4 nanometers, which is about as long as two silicon atoms side by side, and nanotubes this size have been made. Average diameters tend to be around the 1.2 nanometer mark, depending on the process used to create them. SWNTs are more pliable than their multi-walled counterparts and can be twisted, flattened and bent into small circles or around sharp bends without breaking. Most single-walled nanotubes (SWNT) have a diameter close to 1nm, with a tube length that can be many thousands of times longer. SWNTs are very important carbon nanotube because they exhibit important electric properties that are not shared by the multi-walled carbon nanotubes (MWNT) variants. SWNTs can be excellent conductors and the most building block of SWNT system is the electric wires. One useful application of SWNTs is in the development of the first intermolecular field effect transistors (FETs).

2.3.2 Multi-walled CNT’s:

Multi-walled nanotubes (MWNT) consist of multiple rolled in on themselves to form a tube shape. There are two models which can be used to describe the structures of multi-walled nanotubes.

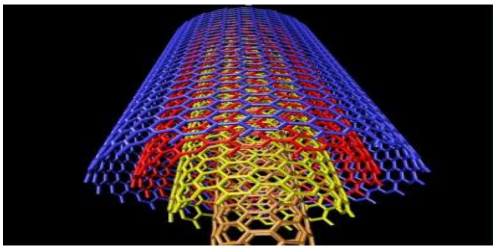

Fig 2.1 Multiwall CNT structure

In the Russian Doll model, sheets of graphite are arranged in concentric cylinders. In the Parchment model, a single sheet of graphite is rolled in around itself, resembling a scroll of parchment or a rolled up newspaper. The interlayer distance in multi-walled nanotubes is close to the distance between graphene layers in graphite, approximately 0.33 nm.

Although it is easier to produce significant quantities of MWNTs than SWNTs, their structures are less well understood than single-wall nanotubes because of their greater complexity and variety. Multitudes of exotic shapes and arrangements, often with imaginative names such as bamboo-trunks, sea urchins, necklaces or coils, have also been observed under different processing conditions. The variety of forms may be interesting but also has a negative side—MWNTs always (so far) have more defects than SWNTs and these diminish their desirable properties.

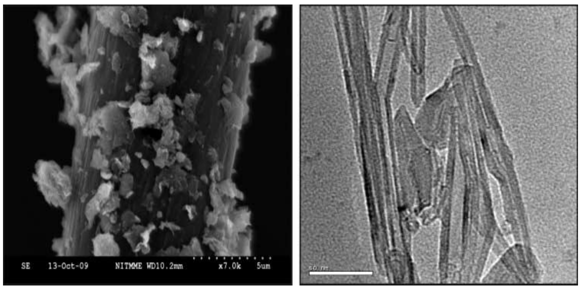

Fig 2.2 SEM Analysis of CNT

Many of the nanotube applications now being considered or put into practice involve multi-walled nanotubes, because they are easier to produce in large quantities at a reasonable price and have been available in decent amounts for much longer than SWNTs. In fact one of the major manufacturers of MWNTs at the moment, Hyperion Catalysis, does not even sell the nanotubes directly but only pre-mixed with polymers for composites applications.

2.3.3 The Physical Properties of Carbon Nanotubes

Carbon nanotubes are being hailed as on the best discoveries of the 20^{th} century, and the amazing physical properties of carbon nanotubes have extended their implications for science well into the 21^{st} century as well. But what is it that makes these macromolecules so special and why are scientists working with them on a daily basis? It's because of their amazing physical properties so incredible that today they are still being disputed and also discovered.

When Sumio Iijima discovered carbon nanotubes in 1991, they were just thin and long cylinders of carbon and it was unknown at the time what the implications of this discovery would be. The physical properties of carbon nanotubes, including their size, shape and ability to be manipulated, yet stay strong, have made them a unique find amongst other macromolecules. Essentially, a carbon nanotube is a thin to a sheet of graphite that has been rolled up into a cylindrical shape. What's more, this sheet is comprised of a hexagonal latticework, making the physical properties of carbon nanotubes that much more fascinating and strange to both scientists and physicists.

But it isn't simply the construction of the physical properties of carbon nanotubes that makes them so unique and such a hotly debated topic. Carbon nanotubes have been known to change depending on the situation they are placed into. They are capable of adapting and changing to meet the needs of electronic, thermal and structural properties. Additionally, the physical properties carbon nanotubes change based on the type of nanotube being used the type being defined by the length and diameter of the nanotube as well as the twist (also known as the chirality).

The type of carbon nanotube as defined has a great deal to do with determining the electronic properties of a carbon nanotube. The chirality itself determines whether the carbon nanotube is a metal, semimetal or semiconductor and its implications for science and electronics will be determined by its makeup. Carbon nanotubes have been known for some time to be excellent conductors of electricity.

III. APPLICABILITY

The motor vehicles on the road have been increasing annually. World motor vehicle production in 2009 approached 62 million units. Consequently, the consumption of tires has also been on the rise; about 1.4 billion units were produced around the world in 2007 [1]. The disposal of scrap tires is a serious environmental problem. The worldwide disposed of waste tires is almost 1 billion units per year with an expected increase of around 2% each year. However, less than 7% of produced waste tire are recycled (excluding reuse, retreading or incineration). The waste rubber tires area thermoset polymer, which cannot be reprocessed like thermoplastics polymers, therefore the recycling of this material requires special techniques that demand big investments.

A solution to the disposal of waste tires is the sequential pyrolysis/combustion process. Past research showed that waste tires are an attractive potential fuel due the high heating value (29-37 MJ/kg), which is comparable, or even higher to those of typical bituminous coals [4,5]. Pyrolysis is a process wherein the material is thermally decomposed at elevated temperatures at the absence of an oxidizing gas. Combustion is characterized by the addition of the oxidizing gases during the process. Several studies indicate that the pyrolysis and combustion proce sses for the tires treatment have a great energy conversion potential.

Results showed that nanomaterials can be produced from pyrolysis/combustion of waste automobile tires. A high density of entangled nanomaterials, with diameters of 20-200 nm and lengths of about 40 µm, were generated on stainless steel meshes under all conditions tested. Produced materials had typically a tubular form with parallel graphene layers around the hollow cavity, which represents the structure ofmulti-wall carbon nanotubes.

Fig 2.3 Waste Tyres in Auto Mobiles

Fixed carbon Mass	Volatile Mass	Ash Mass	Apparent Density	Heating Value	Specific Area
24.9%	69.7%	4.0%	0.4 g/cm3	39 MJ/kg	74 m2/g
Element	Tire chips	Burned fraction		Carbon black residue	
Carbon	85.8	87.4		84.2	
Hydrogen	7.3	10.2		<0.5	
Sulshur	2.3	2.4		2.2	
Others	4.6	0.0		15.1	

Table 1.4 property Of CNT

The chemical vapor deposition (CVD) method used in this work basically consists of thermal dehydrogenation reactions whereby a transition metal catalyst was used to "crack" the hydrocarbon gases into carbon and hydrogen studied the growth of carbon fibers, and described that the catalytic decomposition of hydrocarbon sources start on the active transition metal surface.

IV. MIXING RATIO

The Biofuel and carbon nanotubes consider as various mixing ratios are
Biofuel-95% and carbon nanotubes-5%
Biofuel-90% and carbon nanotubes-10%
The Ultrasonicator method used to mixing the Biofuel and CNT
After mixed fuels will consider various standard measuring equipment(ASTM) to find the physco-chemical properties changes measure.

V. VARIOUS PROPERTY AND MEASURING EQUIPMENTS

Density	Hydrometer
Flash and Fire Point	Penksy Martins Apparatus
Calorific Value	Bomb Calorific Value
Viscosity	Redwood Viscometer
Cloud Point	Wax Crystal Modifier
Pour Point	Wax Crystal Modifier
Cetane Number	Ignition Quality Tester

Table 1.5 Property and Measuring Method

VI. STANDARD PROPERTY VALUE FOR IC ENGINE FUEL

Density	800-1010	(kg/m3)
Flash and Fire Point	40-70	(°C)
Calorific Value	>37500	(kJ/kg)
Viscosity	2.7-10	(cSt)
Cloud Point	-10-25	(°C)
Pour Point	-3- -7	(°C)
Cetane Number	40-55	-

Table 1.6 Standard Property Value For IC Engine Fuel

VII. PROPERTY VALUE FOR BLENDED BIOFUEL WITH DIESEL

Fuel Property	**STD Value**	**CN5+B95**	**CN10+B90**
Density	800-1010	895	910
Flash & Fire Point	40-70	54	56
Calorific Value	>37500	47500	48500
Viscosity	2.7-5.2	7.8	4.8
Cloud Point	-10-25	3	3
Pour Point	-3- -7	-2.5	-4.5
Cetane Number	46	48	49

Table 1.7 Property of Blended Fuel Value

VIII. RESULT AND DISCUSSION

The properties of the alternate fuel value will more or less same for the standard internal combustion fuel value. The generally carbon nanotube having the carbon content will nearer to diesel fuel.in future the carbon nanotube blended biofuel fuels will playing important role and also our work will continue performance analysis of this fuel in future.

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