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COMPARATIVE STUDY ON THE MECHANICAL AND DURABILITY PROPERTIES OF CONCRETE BLENDED WITH SHRINKAGE REDUCING ADMIXTURE, METAKAOLIN AND MONOFIBRE UNDER DIFFERENT CURING CONDITIONS

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ABSTRACT:
*Today Nano materials are used in automotive industries in a wide range***.** *These Nano materials are playing a major role in all the sectors. Particularly in automobile sector these Nano components are used as reinforcement materials in vehicle Production. They possess remarkable electrical, mechanical, optical, thermal and chemical properties, which make them a perfect ―fit‖ for many engineering applications. In this paper various methods of production of carbon nano tubes are discussed outlining their capabilities. The objective of this work is giving a review research of implementation of carbon nano tubes in automobiles products and describing its properties, applications and synthesis. The carbon Nano tubes are used in cars and all automotive vehicles particularly in the field of fuel component system to increase the fuel efficiency of the vehicle.*

Key Words: MWCNT, Mechanical Properties Automotive industry

I. INTRODUCTION

Carbon nano tubes (CNTs) are allotropes of carbon. A carbon nano tube is a one-atom thick sheet of graphite (called graphene) rolled up into a seamless cylinder with diameter of the order of a nanometer. This results in a nanostructure where the length-to-diameter ratio exceeds 10,000. Such cylindrical carbon molecules have novel properties that make them potentially useful in a wide variety of applications in mechanical, structural, thermal, electrical & electronics, optical, biomedical and other fields of science, engineering & medicine. They exhibit extraordinary strength and unique electrical properties, and are efficient conductors of heat. Their name is de-rived from their size, since the diameter of a nano tube is on the order of a few nano meters (approximately 50,000 times smaller than the width of a human hair), while they can be up to several millimetres in length. Single and multi-wall carbon nano tubes have created tremendous expectations as strengthening additives for metallic, ceramic and polymer composites due to their high strength and stiffness. Metal matrix/CNT composites (MM/CNT) have a great potential in load bearing applications

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and electronic packaging due to their high specific strength, high thermal conductivity and low coefficient of thermal expansion. These properties are advantageous in advanced applications like aerospace and automotive structural members where a lower weight leads to savings in energy. Apart from the well-known graphite, carbon can build closed and open cages with honeycomb atomicarrangement.

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II. LITERATURE WORK

Carbon Nano Tubes:

A Carbon Nanotube is a tube-shaped material, made of carbon, having a diameter measuring on the nanometer scale. A nanometer is one-billionth of a meter, or about one ten-thousandth of the thickness of a human hair. The graphite layer appears somewhat like a rolled-up chicken wire with a continuous unbroken hexagonal mesh and carbon molecules at the apexes of the hexagons.Carbon Nanotubes have many structures, differing in length, thickness, and in the type of helicity and number of layers. Although they are formed from essentially the same graphite sheet, their electrical characteristics differ depending on these variations, acting either as metals or as semiconductors.

As a group, Carbon Nanotubes typically have diameters ranging from <1 nm up to 50 nm. Their lengths are typically several microns, but recent advancements have made the nanotubes much longer, and measured in centimeters.

Carbon Nanotubes can be categorized by their structures:

- ✓ Single-wall Nanotubes(SWNT)
- ✓ Multi-wall Nanotubes(MWNT)
- ✓ Double-wall Nanotubes(DWNT)

SINGLE-WALL NANOTUBES(SWNT)

Single-Walled Nano tubes (SWNT) have a diameter of close to 1 nano meter, with a tube length that can be many millions of times longer. The structure of a SWNT can be conceptualized by wrapping a one-atom-thick layer of graphite called graphene into a seamless cylinder. The way the graphene sheet is wrapped is represented by a pair of indices (n,m) called the chiral vector. The integer_s n and m denote the number of unit vectors along two directions in the honeycomb crystal lattice of graphene. If m = 0, the Nano tubes are called "zigzag|| , which is named for the pattern of hexagons as we move on circumference of the tube. If n = m, theNanotubes are called "armchair", which describes one of the two confirmers of cyclohexene a hexagon of carbon atoms. Otherwise,they are called "chiral", in which the m value lies between zigzag and armchair structures. The word chiral means handedness and itindicates that the tubes may twist in either direction.

MULTI WALLED CARBON NANOTUBES(MWNTS):

There are two models which can be used to describe the structures of multi-walled nanotubes. In the Russian Doll model, sheets of graphite are arranged in concentric cylinders, e.g. a single-walled nanotube (SWNT) within a larger single-walled nanotube. In the Parchment model, a single sheet of graphite is rolled in around itself, resembling a scroll of parchment or a rolled newspaper. The interlayer distance in multi-walled nanotubes is close to the distance between graphene layers in graphite, approximately 3.3 Å (330pm). The special place of double-walled carbonnano tubes (DWNT) must be emphasized here because their morphology and properties 70

are similar to SWNT but their resistance to chemicals is significantly improved. This is especially important when Fictionalization is required (this means grafting of chemical functions at the surface of the nano tubes) to add new properties to the CNT. In the case of SWNT, covalent Fictionalization will break some C=C double bonds, leaving "holes" in the structure on then a nano tube and thus modifying both its mechanical and electrical properties. In the case of DWNT, only the outer wall is modified.DWNT synthesis on the gram-scale was first proposed in 2003 by the CCVD technique, from the selective reduction of oxidesolutions in methane and hydrogen.

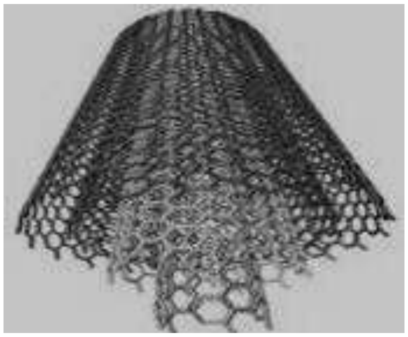

Fig-1 Multiwalled Nanotubes

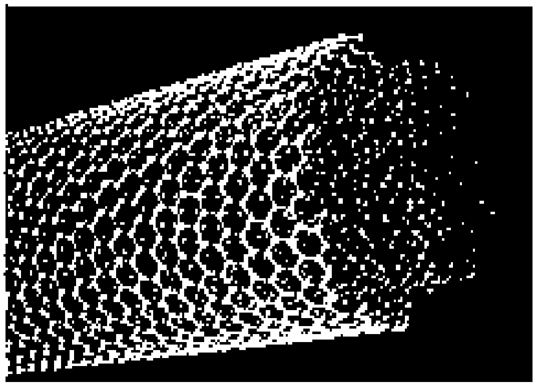

Fig-2 Double-wall Nanotubes (DWNT)

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Function Of Carbon Nanotubes

The carbon atoms in nanotubes are great at forming covalent bonds with many other types of atoms for several reasons: Carbon atoms have a natural capacity to form covalent bonds with many other elements because of a property called electronegativity. Electronegativity is a measure of how strongly an atom holds onto electrons orbiting about it. The electro negativity of carbon (2.5) is about in the middle of the range of electro negativity of various substances from potassium (0.8) to fluorine. Because carbon has electro negativity in the middle of the range, it can form stable covalent bonds with a large number of elements. All the carbon atoms in nanotubes are on the surface of the nanotube and therefore accessible to other atoms. The carbon atoms in nanotubes are bonded to only three other atoms, so they have the capability to bond to a 71

fourth atom. These factors make it relatively easy to covalently bond a variety of atoms or molecules to nanotubes, which changes the chemical properties of the nanotube. This method is called Fictionalization

III. STRENGTH AND PROPERTIES OF CARBON NANOTUBES

Since their discovery, and Sumio Iijima‘s watershed paper in 1991, there has been unprecedented academic and industrial interest in carbon nanotubes and their potential use in a wide range of commercial applications. There is no denying that the basic properties of both single and multi- wall carbon nanotubes are truly remarkable. Recent studies have suggested that single-wall carbon nanotubes have a tensile strength of 50-100 GPa and a modulus of 1-2 TPa. This places them well ahead of steel in both strength and modulus and all for one sixth the weight. Combine this with their high thermal and electrical conductivity and you begin to understand why so many scientists and commercial organisations have sat up and taken notice.

Synthesis ofCNT

Chemical vapour deposition (CVD) is the dominant mode of high-volume CNT production and typically uses fluidized bed reactors that enable uniform gas diffusion and heat transfer to metal catalyst nanoparticles (15). Scale-up, use of low cost feed stocks, yield increases, and reduction of energy consumption waste production (16)have substantially decreased MWNT prices large- scale CVD methods yield contaminants that can influence CNT properties and often require costly thermal annealing and/or chemical treatment for their removal. These steps can introduce defects in CNT sidewalls and shorten.[1] JIANG Jin-long, WANG Hai-zhong YANG hua ,XU Jin-cheng The basic properties of the individual carbon nanotube (both single and multi-wall) have been considered in some fascinating potential applications. In essence carbon nanotubes are advanced fillers - highly conductive (thermally and electrically), extremely strong and light- weight. Add to this their apparent ability to

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absorb electro-magnetic interference and the fascinating photo-acoustic effect (whereby they spontaneously ignite when exposed to an intense light source) and you are left with some intriguing possibilities for advancedcoatings.

A Carbon Nano Tubes In Fuel System Fuel System Components

For more than 20 years, the automotive industry has been setting higher safety and environmental standards. In fuel lines, the substitution of plastics parts for metal has introduced a risk of explosion in fuel systems because of electrostatic discharge (ESD). ESD phenomena can arise during the flowing of fuel in the fuel delivery system to the engine. To prevent ESD in fuellines,engineersareusingNanocylCarbonNanotubes infuelpumps,fuelfilterhousings,

fuel line connectors, fuel line clips, fuel reservoirs, fuel filler pockets and related electronic housings.

NANO HYDROGENFUELS

Nano Hydregen fuels powered cars is that they‘re about 10 years away–and always will be. The technology has been held up largely by the high cost of hydrogen fuel cells, but now researchers say they‘ve found a way to bring down the cost dramatically by making a key component out of carbon nanotubes instead of platinum. More than half the cost of fuel-cell stacks comes from platinum, according to the Department of Energy. ―Fuel cells haven‘t been commercialized for larger-scale applications because platinum is too expensive,‖ says Liming the lead author of the new study.

IV. SYNTHESIS OF CARBON NANO MATERIAL ARC-DISCHARGE

The carbon needles, ranging from 4 to 30 nm in diameter and up to 1 mm in length, were grown on the negative end of the carbon electrode used for the direct current (dc) arc-discharge evaporation of carbon in an argon-filled vessel (100 Torr). [9]Ebbesen and Ajayan reported large-scale synthesis of MWNT by a variant of the standard arcdischarge technique. Iijima used an arcdischarge chamber filled with a gas mixture of 10 Torr methane and 40 Torr argon. Two vertical thin electrodes were installed in the center of the chamber. The lower electrode, the cathode, had a shallow dip to hold a small piece of iron during the evaporation. The arc- discharge was generated by running a dc current of 200 A at 20 V between theelectrodes. The use of the three components—argon, iron and methane, was critical for the synthesis of SWNT. The nanotubes had diameters of 1 nm with a broad diameter distribution between 0.7 and 1.65 nm. In the arc-discharge synthesis of nanotubes, Bethune et al. used as anodes thin electrodes with bored holes, which were filled with a mixture of pure powdered metals (Fe, Ni or Co) and graphite. The electrodes were vaporized with a current of 95–105 A in 100–500 Torr of He. Large quantities of SWNT were generated by the arc-technique by Journet10 et al. The arc was generated between two graphite electrodes in a reactor under helium atmosphere (660mbar).

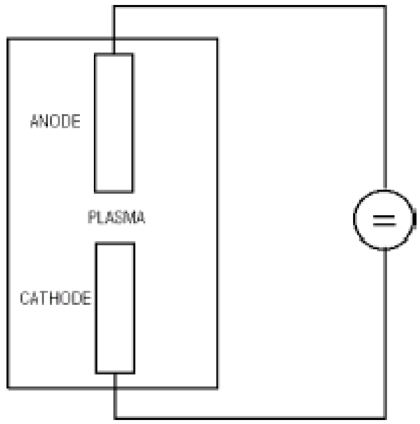

Fig- 3 Arc-discharge

LASER-ABLATION

Laser-ablation scheme: Laser beam vaporizes target of a mixture of graphite and metal catalyst (Co, Ni) in a horizontal tube in a flow of inert ga at controlled pressure and in a tube furnace at 1200 0C. The nanotubes are deposited on a water-cooled collector outside the furnaceCopper- Carbon Nano tube SystemMuch work has been devoted to develop copper-CNT composites.   73

These composites are excellent candidates for thermal management applications due to the high conductivity of Cu (~400 W/m.K) as well as of CNTs (~3000 W/m.K). Most of the researchers have utilized the powder metallurgy technique. Few studies are on developing sensors where Cu particles are deposited on the CNTs or they are electrochemically deposited. Most of the studies have used ball milling to disperse CNTs in Cu odder. Ni-coated CNTs synthesized by electro- deposition or electroless deposition are better reinforcement because they lead to better bonding between the CNT and the Cu matrix.

The molecular level mixing (MLM) method was carried out in a Cu-CNT system and excellent dispersion was obtained in the powder. In this method, CNTs are dispersed in a Cu-salt solution followed by drying, calcinations, and H2 reduction to get the powders. Consolidation has been carried out by pressing and sintering, rolling, equal channel angular pressing, SPS, sandwich processing, and high-pressure torsion. M.Balasubramanian, V.Jayabalan, V.Balasubramanian [11]et al indicated the Mathematical modeling can be done in the future work to establish a mathematical model, which will give a fair idea of the process. Response surface methodology can be used to optimize the process parameters.

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Microscale composites for thermal management have been prepared by electrochemically depositing Cu on aligned CNT arrays. [2] A.K. Srivastava, C. L.Copper-CNT composites have also been prepared by electrodeposition and electroless deposition of Cu on CNTs. They have also been prepared by mixing in mineral oil and making paste for sensor applications. Formation of carbides or any interfacial products has not been reported in any of the studies mentioned previously. The various aspects of the work carried out on Cu-CNT composites.

NICKEL-CARBON NANOTUBESYSTEM

In terms of the number of publications, Ni-CNT composites and coatings of thickness less than 200 µm have received the maximum attention but they are restricted for non-structural applications. Electro- and electroless deposition are the most researched methods for the deposition of Ni-CNT and Ni-P-CNT coatings. This method is also utilized to deposit Ni coating on CNTs because Ni results in better wetting and bonding with other metal matrices. [3] Central composite design can be used to decide the optimum number of experiments to be conducted to find out the output. (Journal of Materials and Manufacturing Process, 23, 2008, pp.1-5).Pulsed reverse electrodeposition has also been used since it results in coatings with lower porosity and nano-crystalline structure. The CNTs are added to the electrolytic bath and their dispersion is maintained by providing agitation and adding dispersant. Ni has also been co-deposited with Co by electrodeposition. The idea is to replace Ni plating with Ni-CNT plating, could have an increased lifetime due to higher wear resistance. Hence, most of the studies report the hardness, tribological, and electrochemical properties of Ni-CNT coatings. Very few studies have been carried out using other consolidation processes like SPS for Ni-CNT composites. Formation of nickel carbide has not been reported in any of the studies previously mentioned summarizes the efforts in synthesis of Ni-CNT coatings.

MAGNESIUM-CARBON NANOTUBE SYSTEM

Magnesium and its alloys are important candidates for structural applications in the automobile and aerospace industry due to their low density and good cast ability. They also find applications in the electronic industry such as in cell phones and laptop casings. The number of reports on Mg-CNT composite is fewer as compared to those in Al, Cu, and Ni-CNT composites. MBalasubramanian, V Jayabalan, V Balasubramanian [8] et al indicated a cause and effect diagram could be drawn to interpret the problems associated with the effectsMg-CNT composites are being developed largely for improved mechanical properties for structural applications. Some researchers have also focused on the effect of CNTs on the hydrogen storage abilities of Mg for fuel cell applications. Addition of CNT to Mg has been done mainly by powder metallurgical and casting route. Most of the studies on metal-CNT composites by the casting method are on Mg-CNT systems. A DMD method has been developed for the deposition of Mg-CNT composites . The molten metal is mixed with CNTs and stirred by a stirrer that is coated with ceramic to avoid contamination. The molten mixture is then allowed to pass through a nozzle and the stream is atomized with two argonjets.

TYPES OF CARBONNANOSPRAYS:

THERMALSPRAYING

It is coating processes in which melted (or heated) materials are sprayed onto a surface. The "feedstock" (coating precursor) is heated by electrical (plasma or arc) or chemical means (combustion flame). Thermal spraying can provide thick coatings (approx. thickness range is 20 micrometers to several mm, depending on the process and feedstock), over a large area at high deposition rate as compared to other coating processes such as electroplating, physical and chemical vapor deposition. Coating materials available for thermal spraying include metals, alloys, ceramics, plastics and composites. They are fed in powder or wire form, heated to a molten or semi molten state and accelerated towards substrates in the form of micrometer-size particles. Combustion or electrical arc discharge is usually used as the source of energy for thermal spraying. Resulting coatings are made by the accumulation of numerous sprayed particles. The surface may not heat up significantly, allowing the coating of flammable substances. Coating quality is usually assessed by measuring its porosity, oxide content, macro and micro-hardness, bond strength and surface roughness. Generally, the coating quality increases with increasing particlevelocities.

FLAMESPRAY

Flame spray is divided into three subcategories, based on the form of the feedstock material, either powder, wire or rod-flame spray. Flame spray utilizes combustible gasses to create the energy necessary to melt the coating material. Combustion is essentially unconfined, in that there is no extension nozzle in which acceleration can occur. M Balasubramanian, V Jayabalan, V Balasubramanian[9] et al in their work explained about the central composite design can be used 75

to decide the optimum number of experiments to be conducted to find out the outputCommon fuel gases include hydrogen, acetylene, propane, natural gas, etc. The lower temperatures and velocities associated with conventional flame spraying typically result in higher oxides, porosity, and inclusions in coatings. the cross section of a Flame Gun.

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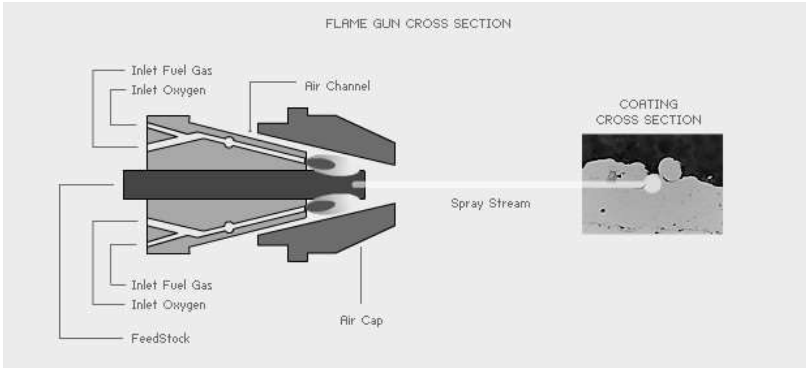

Fig-4 Flame Gun Cross Section

PLASMASPRAY

Plasma spray is the most versatile of the thermal spray processes. Plasma is capable of spraying all materials that are considered sprayable. In plasma spray devices, an arc is formed in between two electrodes in a plasma forming gas, which usually consists of either argon/hydrogen or argon/helium. M Balasubramanian, V Jayabalan, V Balasubramanian[7] et al Explained the Mathematical modeling can be done in the future work to establish a mathematical model, which will give a fair idea of the process the plasma gas is heated by the arc, it expands and is accelerated through a shaped nozzle, creating velocities up to MACH 2. Temperatures in the arc zone approach 36,000°F (20,000°K). Temperatures in the plasma jet are still 18,000°F (10,000°K) several centimeters form the exit of thenozzle.

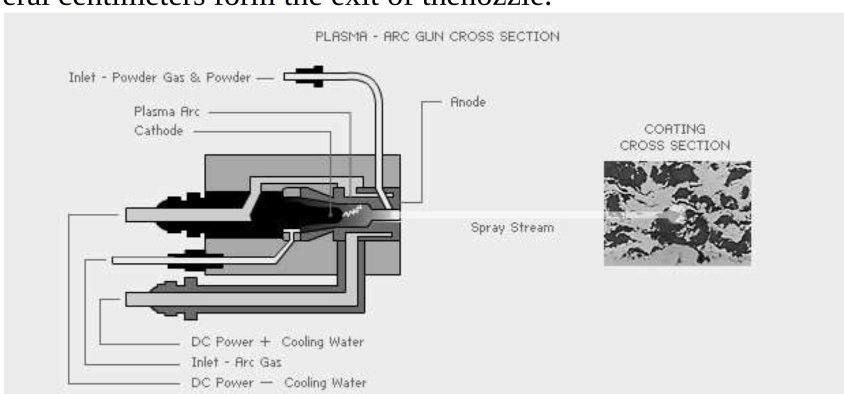

Fig-5 Plasma Gun Cross Section

DETONATION GUNSPRAY

The D-gun, shown schematically, includes a long, water cooled barrel with an ID of about 25mm (Schwarz, 1980). A mixture of oxygen and acetylene is fed into the barrel, together with a charge of powder. The gas is ignited, explodes and its detonation wave accelerates the powder. In order to avoid _backfiring‘, i.e. explosion of the fuel gas supply, an inert gas, such as nitrogen, is used between the portions of exploding mixture.

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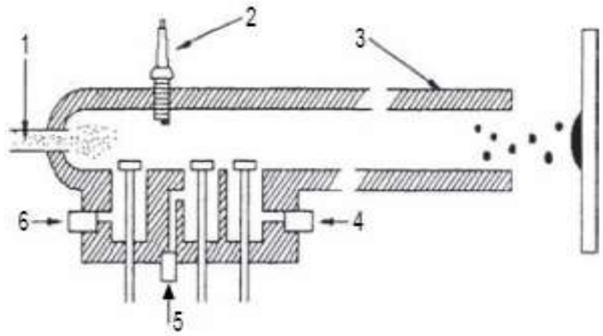

Fig-6 Schematic of D-gun process

V. CONCLUSION:

Carbon Nano tubes are used in various fields to develop the product and in automobile this is mainly used manufacturing the spare parts and components to increase the stability of the material and increase the strength of the material . decreases the weight loss of the material and make lighter that gives fuel efficiency of the vechile in higher growth.

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