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DESIGN AND EXPERIMENTAL ANALYSIS OF PLASTIC DEFORMATION OF NANO COMPOSITE MIXTURES WITH POLYPROPYLENE FOR DIAGNOSTIC TUBES

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ABSTRACT:

Analysis of fluid flow in lateral NANO tube application is quite natural but the angular flow of velocity and mass flow rates have to observe to fulfil the application combination of two or more materials, which results in better properties than the individual compounds used alone, can be described as a composite material. Contrary to polymer alloys, the separate chemical, physical and mechanical characteristics of each material continue. The motion of a fluid is governed by the global laws of conservation of mass, momentum, and energy. A polymer composite NANO maximizes the scale of the polymer / part interfacial surface of the large surface area of the NANO particles. Moreover, the amount of point of contact between particles increases with decrease in particle size when percolating network is involved. Therefore, it is fair to expect the interfaces to play an important part with respect to NANO's thermal conductivity. NANO tube NANO composite samples of polypropylene have been prepared with the good NANO tubes dispersed with no organic processing of the NANO tube surfaces. Without the use of organic treatment. The thermal stability of PP in Nitrogen and Air is improved by MWNTs with the exception of 205,80^{C} (1080C / min heating) where oxidative thermal stability is reduced.

Key words: Advanced manufacturing, NANO composites, Polymers

INTRODUCTION

Carbon nanotubes, which have been discovered just over 10 years ago, have gained considerably recognition from renowned experts for their exceptional properties and their unique structure. Carbogenoidal nanotubes, or tubes that roll up graphic sheets, are an allotrop of carbon. Based on the reaction conditions, these nanotubes form either in single walled nanotubes (SWNTs) or in multi walled nanotubes (MWNTs).

The nanotubes are sturdy and thermally favorable to a large extent. The electrical conductance of each tube is centered by its own design on a semiconducting to metallic conductivity. The texts include numerous papers concerning carbon nanotubes composites and polymer networks. The results show that even small nanotube measurements (< 5 WT percent) can have an effect on the composite's electrical and mechanical properties.

- This detailed data provides an outline of the latest writing of polymer nanotubing composites, the characteristics of and their application of carbon nanotubes. Nano composites involve at least one phase as far as nanoscale in metres.

- The property of nano composites is derived from the inherent nano systems used, allowing drastic modifications to the composite characteristics with just a small number of preparations for the final. One of the most significant Nano inclusions is carbon nano tubes.

1.2 Fabrication nature of carbon nanotubes with polymers

A single wall nanotube of carbon (SWCNT) is one sheet of graphite that is placed in a tube position. Most of the graphite sheets are stackable and shaped into the state of the tube. However, there are multi-wall carbon nanotubes(MWCNTs), which are not resistant to SWCNTs. CNT radii are measured in nano meters and calculated in micrometers in the lengths of them. The structure of the nano, metal or semi-conductive tube depends upon the chiral vector; the integer and vectors in the diagram are n and m.

Table 1.1 Properties of carbon Nanotubesin comparison with other common fiber reinforcement materials

Fiber	Diameter (μm)	Density $\left(g/cm\right.$	Tensile Strength (GPa)	Modulus (GPa)
Carbon	7.00	1.66	2.40-3.10	120-170
S-glass	7.00	2.50	3.40-4.60	90
Aramid	12.00	1.44	2.80	70-170
Boron	100-140	2.50	3.50	400
Quartz	9.00	2.20	3.40	70
SiC fibers	10-20	2.30	2.80	190
SiC whiskers	0.002	2.30	6.90	-
CNTs	0.001-0.1	~1.33	Up to ~50	Up to ~1000

1.3 PROPERTIES STUDY OF NANOTUBES

The combination of electrical, mechanical and thermal properties of the carbon nanotubes is excellent, mainly because of their extraordinary structures and their large conjugated μ-frame. Metal nanotubes can be as conductive as coffee and, in worst conditions, can be semi-leading tubes such as silicone due to a more flexible transporter function. It is suggested that the pipe in the metal nanotube (also pitifully encapsulated) should be ballistic (not dispersing), allowing such pipes to carry high current and a small temperature rise.

1.9 PROBLEM STATEMENT

CNT is considered to be the most reliable application for the enhancement of quality components in various applications. Through following the literature survey and summaries performed before trials, the polymers are not specifically sintered and processed with CNTs.A large number of previous models and full-scale and micromechanical methodologies can be used in any situation where the models are sufficiently related, whereas many others are not. Moreover, the curious geometry (small shell-like structure) and the calculation of the carbon nanotubes are exceptional contemplations. This contributes to the processing of embedded nanos in polymers to achieve stabilization of the properties in potential assessment.

1.10 SCOPE OF WORK

As discussed in the organizational systems, the role in the tube creation was crucial by using the devices as one. Further analysis must be done in order to strengthen the framework for economic solution for the future, with respect to the mechanical and thermal elements of the produced product.

Considering the complexity of individual CNTs, the comportability and the creation of material binding must be investigated in order to create economical applications of solely nano-material in order to increase the use of nano-materials directly made by a polymer researcher.

1.11 OBJECTIVES

1. To execute the fabrication process in a proper way of mixing CNTs with polymers.
2. To analyse the micro structural analysis of fabricated CNT polymer composite to check internal bonding and flow of fabricated composite.
3. To estimate the thermal and mechanical properties of CNT –polymer composite.
4. To analyse the CNT-polymer tube by observing fluid flow with different fluids to check internal surface quality of fabrication.
5. To establish the interface thermal conductivity of CNT polymer for better results.

2.0 LITERATURE REVIEW

This chapter reveals the importance of past researches related to polymers as well as polymer matrix composites and CNTs fabrication with polymers. The literature given as follows.

Mamaliset.al [1]The preparation, ratio and use of carbon nanotubes has been documented. The research discusses several forms of CNT manufacturing, such as electrical discharge, laser reduction, and chemical absorption by vapour. The paper further revealed that CNT was being washed with ultrasonic shower in order to remove contaminants on the surface of the pipeline. Substantial calculation and volume of emissions would also be expulsible by the centrifugation method. **Meixner, Forta [2]**The increasing of the individual CNT 's comparison with that of CNT wood produced from impatented films reveals the influence of the effect of temperature, production time, volume weight and strength in terms of growth parameters. Following the option of construction behaviour, a separate CNT of necessary geometry is generated on a guiding principle. **Adebola et.al [3]**Due to their smaller articulated and nano-roast acteristics relevant to the high surface area, electro-spun nanofibers offer another and increasingly increasing inspection area. Poly(styrene-cocryl amide) and polystyrene polymers were combined in the fluid medium with potassium peroxosulfate as the initiator using a blast temperature cleanser free emulsion polymerization. **Amrinder Nain et.al [4]**The large-scale development of nanoscale constructions, devices and structures is one of the main obstacles to achieving the milestones promised with nanotech. The three dimensional modified assemblage of smaller scale / nano-filaments is one of the big obstacles for non-fabrication frames. In this article we introduce a special apparatus that is designed for reproductive and regulated development of small-scale nano-pipettes**Avouriset.al [5]**In directing this transition the nano-tubes play an significant role, in a special type of carbon molecule called the nano-tube, are carbon-micron-long and nanometer-thick pipes, which have demonstrated excellent electric and thermal conductivity. **Birendra Pratap Singh et.al [6]**Materials of this form have other essential properties, such as linear and electrical, nanocomposite electronic and conducting polymer, and have mechanical characteristics, safety and security of the material. Nanocomposite is used as propellant medium and genius copiers for coloring. **Byung Gil Min, Han Gi Chae [7]**Carbon nanotubes have remarkably anisotropical mechanical, electrical , and thermal properties. A variety of composite carbon NANO tube / polymer filaments is produced and this carbon tube capacities are tested such that they have a significant effect on polymer and fiber handling, and composite filaments are prepared using rotating structures, soft rotating and even elektro-turning. In order to allow the best use of these properties. **Ducati and Robertson[8]** agree that plasma-enhanced chemical vapor deposition has created carbon nanotubes at temperatures as low as 120 ° C. A systematic research is performed using the C_2H_2 / NH_3 method and nickel to determine the temperature dependency of the rate of growth and the composition of the formed nanotubes. This proposes that the surface distribution of carbon to nickel be used for growth.

3.0 MATERIALS AND METHODS

In approach, work into the development of carbon nanotube polymers by taking note of the production of layers on arrangements to test their achievability without wasting the material for future generations.

3.1 BASIC PRINCIPLE OF RAPID PROTOTYPING PROCESSES

The rapid prototyping technique is used in the design of a product to construct a 3-D model of an element or part. In addition to providing 3-D perception of careful rendering of artifacts, rapid Prototyping may be used to evaluate specific design components or product usability, especially prior to assembly. Testing can be on size , weight, consistency, intensity or other contours. The explanation for this pattern may be an invisible substance of its type that was finished until manufacturing. Encouraging the technique has a place-forming process, for instance, in which the components are created by deposition or production of plastics substance, laying, refining, granulation or authoring. In all client quick model methods, the component is fabricated by shaping layers, i.e. two dimensions, into one (x-y).

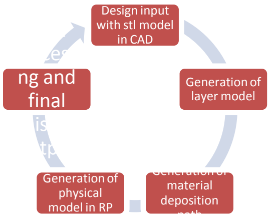

Figure 3.2 Rapid Prototype - fundamental process steps

3.2 LAYER DEPOSITION MODELING (Experimental work&fabrication process)

In the process of Fused Deposition Modeling (FDM), a mobile (x-y-development) stretches liquid chain from the polymer substrate onto a substratum. The substance is heated marginally higher (approximately 0.50 C), so that it hardens within a small period (approximately 0.1s) after expulsion and chilly welds to the past layer, as seen in Fig . 3. Figure 3 is

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shown. 2. Component main variables must be interpreted as coherent sputum and material removal, assist expansion for structural overhangs, highlights, and speed of the sputum head that determines the thickness of the cutting. The FDM system subsequently consists of two spouts, one of a component and the other for the assistance.

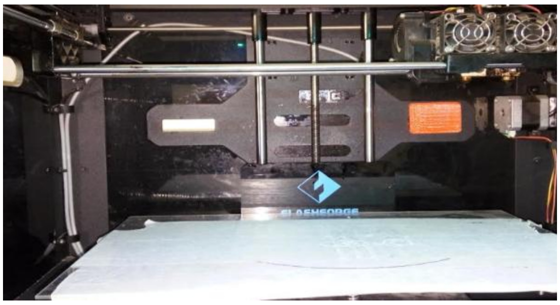

Figure 3.3 Rapid Prototyping System

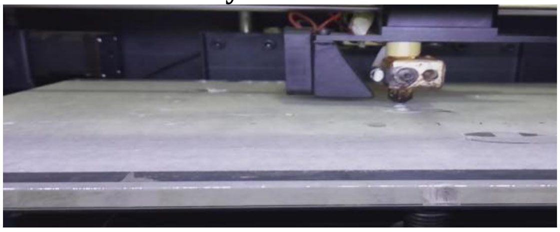

Figure 3.4 Layer Deposition Modeling Process

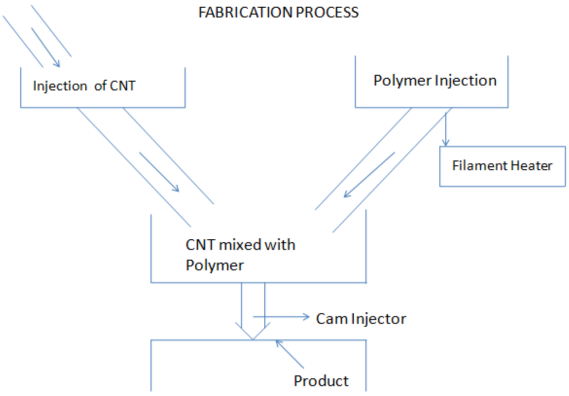

Figure 3.5Line lay out diagram of fabrication process

3.3 CAD MODELING

CAD is the use of software structures to help develop, modify, analyze and streamline a program. Software helps describe CAD. Computer-aided design programming is used to optimize the originator 's performance, allow the setup, boost knowledge interchanges, and create a database for assembly

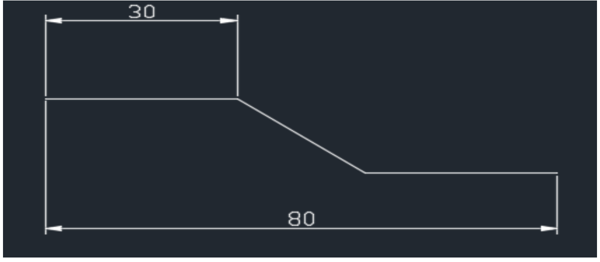

Figure: Layout of the lined tube

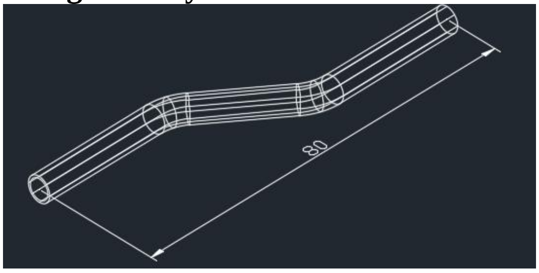

Figure 3.8 Layout Layer material deposition

The module transforms into a three-dimensional structure over two-dimensional diagrams. The Design Module is known to have the extra favorite perspective in NC applications, which means STL drawing or three dimensional drawings, from the key modules that are used by the developer.

3.4 PREPARATION OF COMPOSITE MATERIALS

Table 3.1. Materials taken according to the weight ratio and the example below are combined with the CNTs.

Volume of the designed tube=624.4604mm^3

Density of PP at melt=0.000946gm/mm^3

Density of ABS at melt= 0.00097 gm/mm^3

Table 3.1 Composite mixing and extrusion percentages

S.No	Material name	Raw material(mg)	CNT(mg)
1	PP with 0.1 % CNT	584	6
2	PP with 0.2% CNT	578	12
3	ABS with 0.1% CNT	594	6
4	ABS with 0.2% CNT	588	12

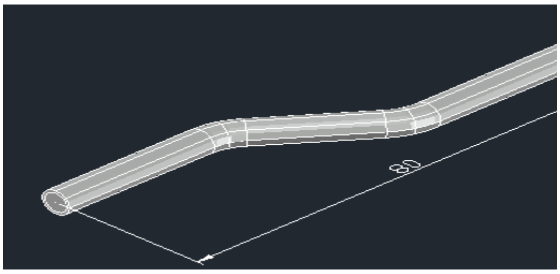

Figure 3.9 Stereo Lithography model for material deposition

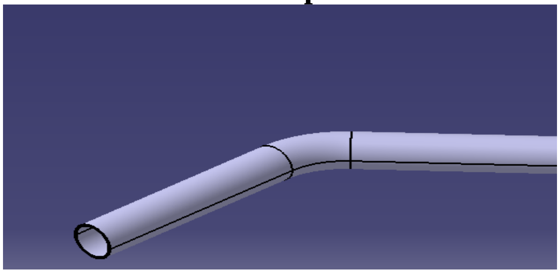

Figure 3.10IGES model for ANSYS conversion in CATIA

The proof analysis was concluded by modular assignment to ANSYS setting. The maps and elements for good research is seen in the above tables. Finite element limits volume with common solver for post-preparation analysis. For the pores and properties of the solver above, used as separate components for persuasive geometry. The CFD is supplied with diverse fluids to the solver according to the knowledge sources with the thermal effects of CNTs.

4.0 RESULTS AND DISCUSSIONS

In addition to the primary material which is equal to the melting temperature of the polymer and layers the polymer material input and the Carbon nanotubes are added at 0.1 and 0.2 per cent according to the input ratio defined in the technique and the whole process performed with good results and the prototype shown in Figure 4.1.

Figure 4.1 Fabricated product of polymer CNT

The polymers PP and ABS mixed 0.1% and 0.2% of CNT ratios. Spray methods as well as methods for deposition and formulation of layer materials for manufacturing tubes to achieve a realistic and simulated performance increase. The rods have been tested to produce greater positive results for structural stability.

4.1SEM (SCANNING ELECTRON MICROSCOPE) &OM (OPTICAL MICROSCOPE) SURFACE RESULTS OF CNT POLYMER TUBES

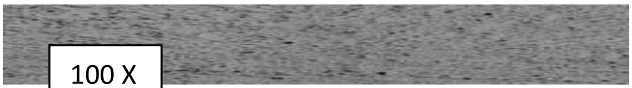

Figure4.2thesurface topology of polymer CNTat 100X

Figure 4.2 shows that the CNT polymer rope surface topology clearly indicates the material composition, a sample extracted to a scale of 100X that can be seen as black spots in the film images for testing the polymer mixture with a little nano content.

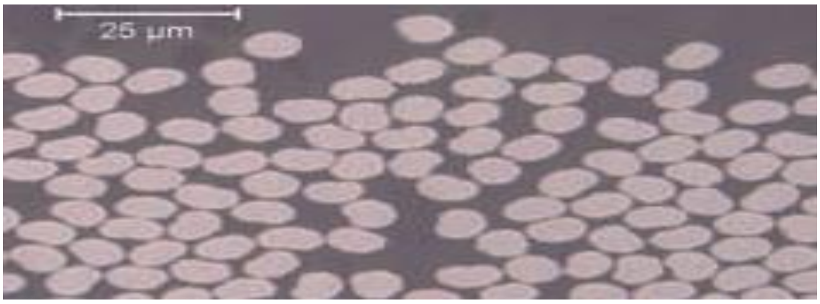

Figure 4.3 SEM micro structural result of polymer CNT with 25µm scale

The above figure 4.3 shows the SEM micro structural result of the NANO polymer tube at 25µm and the particle depositions shown with even integrity.

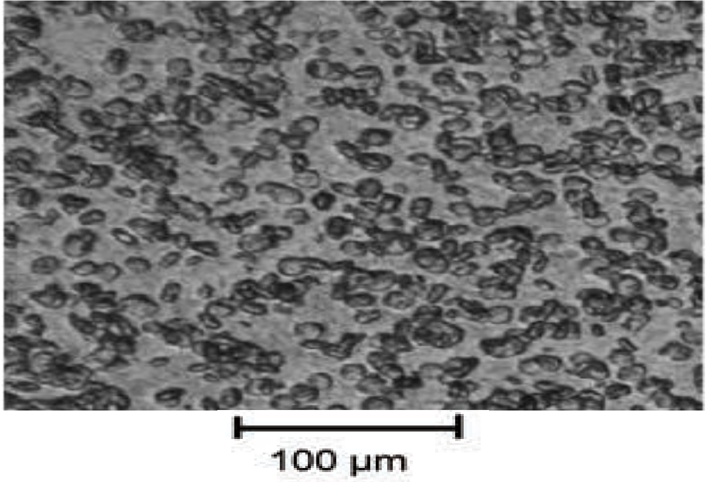

Fig 4.4 SEM micro structural result of polymer CNT with 100µm scale

Figure 4.4 above shows the microstructural outcome from the SEM of a 100µm CNT polymer tube where the connection between the particles is strong.

The table above indicates a 0.1 percent to 0.2 percent percent of the nano particles in terms of power, elasticity modules and the fault line of the nano polymer loop.

Table 4.3Test results of 0.2 % CNT Poly Propylene tube

S.NO	Test	Test method	Result	Unit
1	Tensile strength at yield	DIN-53455	41.2	N/mm^2
2	Elongation at break	DIN-53455	390	%
3	Specific gravity	DIN-53479	0.9381	-
4	Shore d hardness	DIN-53505	70.0	-
5	Impact strength	DIN-53453	151.39	mj/mm^2
6	Abrasion resistance	ASTM D-1044	68.4	Mg
7	Breaking strength	DIN-53455	36.19	N/mm^2
8	Compression strength	DIN-534551	24.07	N/mm^2

9	Bending strength	DIN-53455	24.89	N/mm^2
10	Co-efficient of friction	DIN-53375		
A	Static		0.14	
B	Kinetic		0.11	
11	Torsion strength at 23^{o}c	DIN-53477	263.63	N/mm^2

The above table shows the test results of 0,2 percent of PP under a variety of conditions including traction power, elongation, friction coefficient, bending strength, torque strength, static and kinetic frictions, etc.

By measuring the inspections of the material validity in polymers, the results of the development and the other tests are well known with 0.2 percent CNT, i.e. Sample 2. The polymers have been tested with similar results for mechanical properties and structural strengthening properties for MMC and PMC tubes. The results for PMC tubing fluctuated between 106 MPa and 121MPa and MMCs between 120 and 126 MPa, so the results and properties showed similitudes with the use of polymer nanotubes because of the uncorrosive nature and resistance of their abrasion. For flow analysis, the tubes should be simulated with ANSYS 15.0 to provide better optimized validation with a standard laminar nanotube analysis.

4.8 strength comparison for tested samples

S.No	Materials with composition	Strength (MPa)
1	0.1% CNT add to PP	109
2	0.2% CNT add to PP	115
3	0.1% CNT add to ABS	113
4	0.2% CNT add to ABS	121

When comparing the enhancement characteristics in both cases , i.e. polymer and MMC, it is clear that polymer has reached almost value as MMC and the work therefore moves to the internal surface of polymer tubing through the CFD analysis.

4.4 SIMULATION RESULTS

The optimal test results, the enhancement of the PP with 0.2 percent CNT, are approximately identical in comparison with the composite matrix so that the simulation must be observed with the aid of advanced ANSYS FLUET software, for fluid flow inside the tunnel.

Two different fluids with different viscous properties were studied, which are water and diesel.

The type of boundary condition that can be defined depends on the boundary or interface on which one is placed. The outflow limitations are determined

Inlet Boundary condition

- Inlet mass flow rate (kg/s) - 0.000744
- Inlet Temperature (K) - 300^0
- Turbulence Intensity (%) - 10
- Turbulent Length Scale(m) - 9

Outlet Boundary condition

- Gauge pressure (Pa) - -50662.5
- Back Flow Turbulent Intensity (%) - 10
- Back Flow Hydraulic Diameter (m) - 9
- Outlet temperature (K) - 300

Boundary assignment for a specification of a fluid continuum form to an object in volume; model is specified such that equations of momentum, continuity and transport of species apply within the volume to the mesh nodes or cells. Conversely, only energy and species transport equations (without convection) apply on mesh nodes or cells that occur within the volume, when a solid continuum form specification is assigned to a volume instrument.

4.4.1 PP (Poly Propylene with0.2 % CNT) with water as fluid

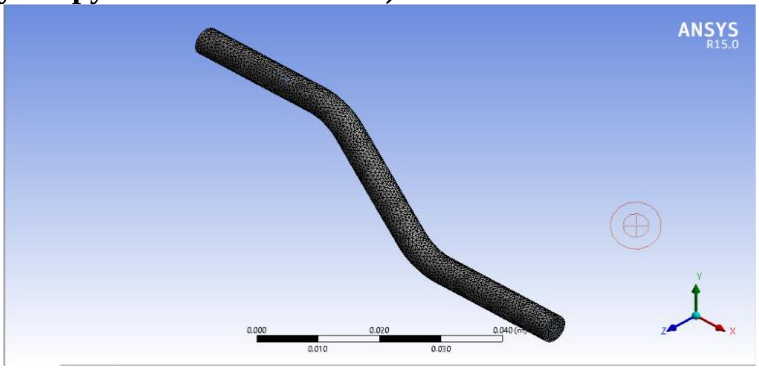

Figure 4.38 Meshing of the object PP with 0.2% CNT

The figure above shows a fluid mesh for the PP vapor. The meshing is achieved such that the load is evenly distributed during the meshing cycle on the pipe such that maximum deformation exists.

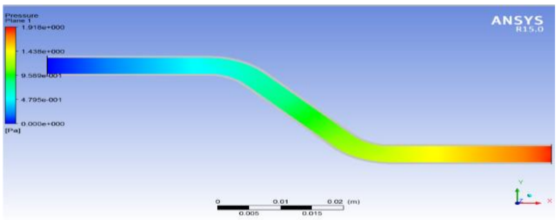

Figure 4.39Pressure flow along 0.2% CNT Poly Propylene tube

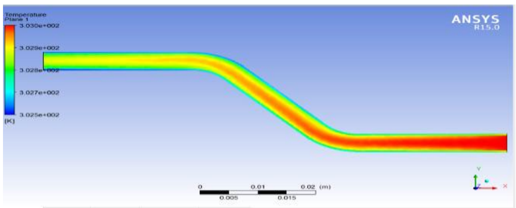

Figure 4.40Temperature inlet vector of 0.2% CNT **Poly Propylene tube**

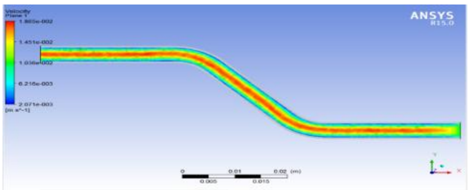

Figure 4.41Velocity flow of fluid along 0.2% CNT Poly Propylene tube

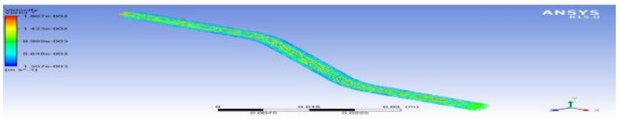

Figure 4.42Velocity vector of 0.2% CNT Poly Propylene tube   in x-direction

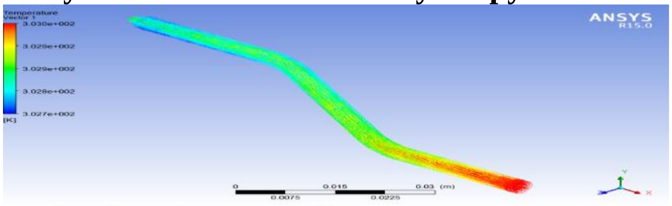

Figure 4.43Temperature vector of 0.2% CNT Poly Propylene tube in x-direction

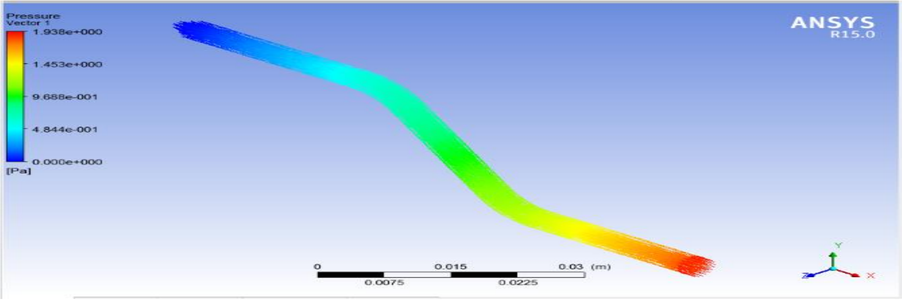

Figure 4.44Pressure steam line of0.2% CNT PolyPropylene tube in x- direction

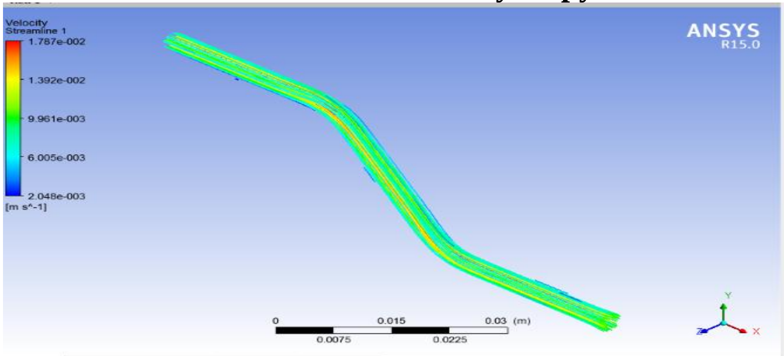

Figure 4.45Velocity streamline of 0.2% CNT Poly Propylene tube
in xz-direction

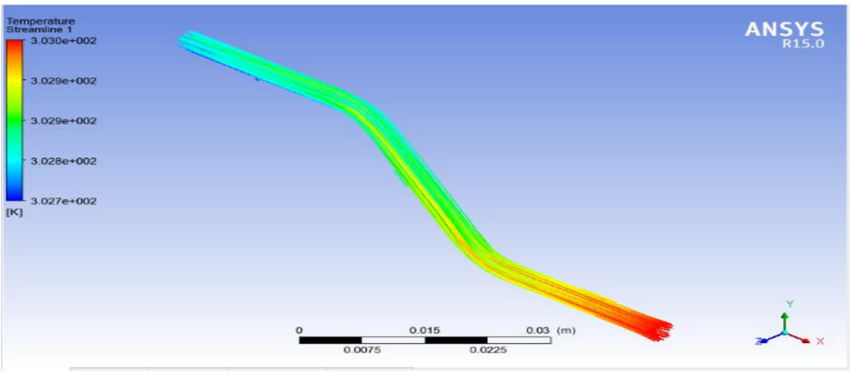

Figure 4.46Temperature stream line of 0.2% CNT Poly Propylene tube inxz-direction

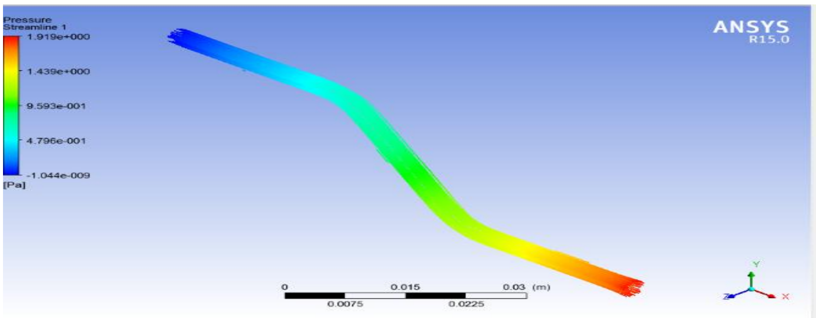

Figure 4.47Pressure stream line0.2% CNT Poly Propylene tube inxz-directions

The simulation results are built in a tabular way for better positive comparison of results to continue working on the device thermal conductivity framework as a finite element method of heat transfer. Results indicate a constant pressure of 1.9 MPa and a constant speed of 3 m / s as input parameters of all fluids with the use of various applications, such as thermal interchange, automotive and human use. The acquired parameters are considered responsible and the observations indicate that tubes were not deformed during the simulation at certain pressure and velocity inputs.

Table 4.9Maximum Input and Output Temperatures

S. No	Material	Type of fluid	Maximum temperature input K	Outlet temperature K
1	PP	Water	303	301
2	PP	Diesel	303	302
4	ABS	Water	303	301
5	ABS	Diesel	303	302

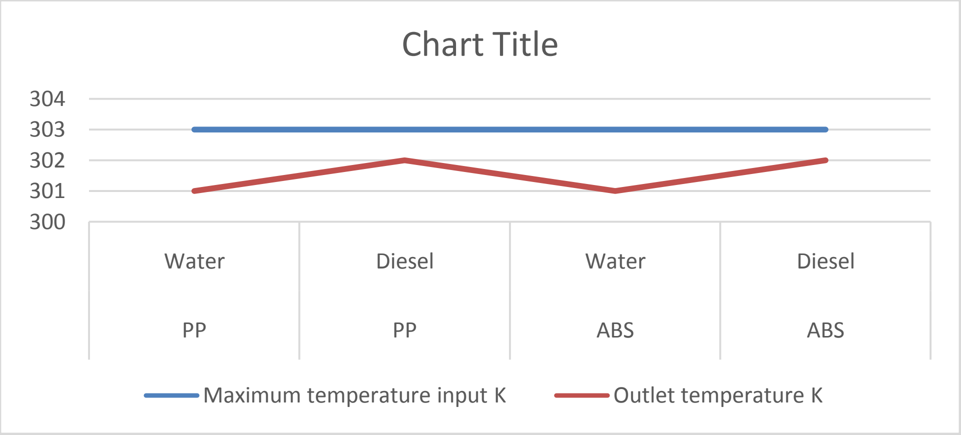

Figure 4.94 Maximum Input and Output Temperatures

The table above shows the average input and outlet temperatures for PP & ABS materials in various fluids such as water and diesel The average input temperature in all conditions is the same and varies during outlet.

A stream line flux was shown with a continuous flow in both materials by testing the fluid flow and temperature variants. Considerable points were made about the fining of PP material for various fluids for further applications in interface geometry.

Conclusion &Future scope

By practical as well as simulation analysis observed at the time of research the following conclusions made with obtained results.

- It has also attempted to integrate some of the important considerations which need to be taken into account before taking part in the filing process for the proper usage of RP capacities.
- Even though stitching can be very good for some applications, there may be problems with the difference between the properties of stitching materials, such as microcracking.
- Practical results show that PP 's intensity with 0.2 percent CNT variation has similar effects.
- The solution implementations often studied with CFD solution in different fields.
- Optimize the resin carbon nanotube in compliance with the application of thermal conductivity measures such as heat and CFD approaches to fluid fluxes.
- The goal is clearly seen from the manufacture of layered formation tubes and the properties evaluated by the testing of tubes that PP is regarded as the key research object for the thermal modeling preparation.
- Layer technologies for simulation modeling of 10 layers considering the thickness of the NANO layer by 0.05. Structural stability in experiments of various approach methods until the simulation model is completed.
- Pressure and speed of the fluids in both pp and abs tubes have been shown to achieve streamlines of fluid flow without barriers and speed, pressure changes. pressure differences have been observed.
- The heating penetration is less than metals and the processing equipment, as can be found in simulations as well, due to the thermal conductivity of the system.

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