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Enhancement of Thermal and Acoustical Properties of Hybrid Nano Fluid

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Abstract: *In this paper, ash from agriculture waste i.e., sugarcane bagasse was used in the synthesis of silica. Nanoparticles were followed by using leaching and acid treatment. The required ash from agriculture waste (sugarcane bagasse) are subjected to sintered at 700°C a t 5hours in order to reduce the residuals from the ash. The obtained powder was treatedwith1M of NaOH for leaching and then acid treatment with 0.5M H_2SO_4 to precipitate pure SiO_2 Nanoparticles powder. The synthesized silica were charecterized by XRD,FTIR). Using neem leaves extract, extraction of silver (Ag) nanoparticles was obtained. These plant extract (neem leaves) can be act as capping agent and reducing agent. Charecterization were done for this process i.e., XRD and FT-IR. This procedure requires 15min for conversion of silver ions to silver nanoparticles, without any harmful chemicals. Nanofluids were prepared by synthesized Ag-SiO_2 nanoparticle dispersed into water i.e.,base fluid using ultrasonication method. These nanoparticles were characterized by zeta potential, FT-IR and Ultrasonic Inferometer. Nanofluid with volume fraction of 0.04% and 0.06% at different temperature are using for the measurement of ultrasonic velocity(v),then predict the adiabatic compressibility(β),intermolecular free length(Lf), Accoustical Impedence(Z) and thermal conductivity(k) of nanofluids. This experiment mainly concluded that agricultural wastages, converted into a valuable product, reducing environmental impact of disposal problems. Increase the thermal conductivity of metal by adding metal oxides for nanofluids.*

Keywords: *Silica, Nanoparticles, sugarcane bagasse, Neem leaves, Ultrasonic inferometer*

I. INTRODUCTION

Developed countries have followed that the concept of "no waste" and all such materials are termed as "new resources" for new material development through value addition. Silica, the industrial materials and the precious inorganic chemical compounds. Most commonly silica found in nature as quartz, sand or flint, and also can be formed in the crystalline and amorphous in nature. There are natural reservoir of silica from agricultural waste i.e., sugarcane biogases, bamboo leaves, rice husk. They have a great possible and capacity for eco-friendly and economically practicable for 'green' synthesis of silica.

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Silica were used in several industries like rubber industry, in cosmetics, an anticaking agent in salts , in tooth pastes, chromatography and soon.

The burning of agriculture waste(sugarcane biogases, coconut coir, bamboo leaves) ash contain extensive SiO2 content with 10 to 20% of carbon contents and other organic components depends upon the burning conditions, climate, furnace type and geographical area. Silica will obtain in the amorphous in nature. In industrial application, usage of purity silica are high in cost due to its high melting point of 1700 °C . Silica from agricultural waste is one of the ways to reduce the cost and can be utilized high content of silica These ashes (sugarcane biogases, coconut coir, bamboo leaves, rice husk) were used to extract the pure form of silica by several chemical methods. Acid leaching for the agriculture wastes (sugarcane biogases, coconut coir, bamboo leaves, rice husk) were carried out to get rid of impurities and to improve pure form of silica content. These ashes can be decomposed under sintering conditions.

1.1 NANOFLUIDS

Nanofluids are colloidal suspension of nanometric-sized nano particles in basefluid. The nanometer sized particles are used for the dispersion in base fluids of nanoparticles. In fluids, heat transfer is an important role for many industrial heating (or) cooling equipments. Conductive heat transfer is a major part in the small equipment under millimeter size. There are many types of nano particles like metals(Cu, Ag, Au) and oxides(Sio_2,Cuo,Zno) and the basefluids are water, ethylene glycol and oil were used. These nanofluids are widely used in the heat transfer applications. They will give a better thermal performance than conventional fluids because the presence of colloidal suspension nanoparticles which will enhance the thermal conductivity. Addition of the nanoparticles with basefluids even at low volume fraction can give a increase in thermal performance. The nano particles which dispersed in the base fluid has an important effect on the rate of increase in thermal conductivity coefficient of nano fluids. These nanofluids are widely used in the heat transfer application such as cooling and heating, vehicles air conditioning, coolong system of most of the processing plants. Compare with all the application, heat transfer process will have greater efficiency on the thermal conductivity than conventionally used fluids. While selecting nanomaterials, these are the main factors to be considered for preparing nanofluids are:

- Chemical stability
- Availability
- Thermo physical properties
- Toxicity
- Cost

Compatibility with base fluids

1.2 ESSENTIAL FEATURES IN NANOFLUID

Nanofluids had some of the better features to be used in various engineering applications.

- Enhancement in thermal conductivity
- Higher in theoretical predictions.
- Fast heat transfer ability
- Better stability compared with colloids
- Reduction of clogging and erosion in the micro Chamber
- Better lubrication
- Reduce friction coefficient
- Reduction in pumping power

II. CHARECTERIZATION OF NANO PARTICLES

"This kind of analysis on impact tests, the necessary purpose to be noted is that the form of impact that we tend to get elastic or plastic impact. Negligible amount of energy are going to be losing in elastic impact in between to impacting bodies. Impact between to table game balls are often thought-about as associate example. Appreciable quantity of energy dissipation are going to be going down in plastic impact. Impact between two automotive vehicles or at least between a rigid body and an automotive vehicle in which the vehicle gets crumple on an impact. It is also an example of an elasto-plastic impact."

Nanoparticles, physical properties measures total explantion about morphology (size, shape). Various methods for characterization of nanaoparticles i.e., XRD,FT-IR, SEM and soon. Microscopy methods, generates metaphors of nanoparticles, to describe its size(morphology). X-ray diffraction (XRD),used to identify the crystanallity nanoparticle, and atomic spacing. It is used to identify the fine-grained minerals i.e., clays and mixed layer clays. It also measure the purity of materials. Before, applications characterizations are done for their behavior, safety, efficacy and its distribution. Characterization was performed by using various technique like XRD, FT-IR, SEM and soon.

2.1 MEASURING VELOCITY OF ULTRASONICS IN NANOFLUIDS

Pour liquid into the cell and screw the knurled cap after adjusting the cap reflector from the fluids respectively.

Wipe out excess liquid overflowing from the cell.

Place the cell and screw it with the side screw provided.

Put the R1 at middle approx. and R2 knobs at max positions. Then, move the micrometer slowly either clockwise or anti clockwise direction.

Digital micrometer shows the reading, if it shows minus readings then with the help of R2 knob, shift it to the plus reading respectively.

In micrometer, take reading of micrometer. Take averages of all wavelength ($\lambda/2$).

Ultrasonic velocity can be calculated after wavelength is obtained.

2.2 EFFECTS OF TEMPERATURE ON VELOCITY IN NANOFLUID AT DIFFERENT CONCENTRATRATION

The effect of temperature on velocity in nanofluids, change the temperature of fluid by passing hot water at different temperature of different concentration. To study the effect of nanoparticle concentration on velocity of ultrasonic in the given fluid, change the concentration of the fluid by known proportion and determine the velocity of the ultrasonic.

2.3 ACCOUSTICAL AND THERMOPHYSICAL PROPERTIES

Meaurement of adiabatic compressibility (β)

Adiabatic compressibility (β) is the decrease in the volume per unit increase in the sound pressure, without any heat transfer to the surroundings.

$\beta = 1/U \rho 2$ kg-1ms2

U =Ultasonic velocity ρ =density of the fluid

Accoustic Impedance (Z):

Sound waves travels through the materials under the influence of pressure. Atoms (or) molecules of a solid are bound elastically to each other, the desirable pressure results in wave propagation through the solid.

The acoustic Impedance is defined as the product of its density (ρ) and ultrasonic velocity (U) as given by;

$Z = U\beta$

Intermolecular free length (Lf):

The intermolecular free length is the distance covered by sound wave between the surfaces of the proximate molecules. The increase or decrease in the intermolecular free length specify the weakling and strengthen of intermolecular attraction.

The adiabatic compressibility (β) can be indicated in terms of Intermolecular free length (Lf) which is the sound wave between the surfaces of the proximate molecules and is given by;

$Lf = kT\beta 1/2$ $KT = (93.875 + 0.345T) x 10^{-8}$

III. EXPERIMENTAL METHOD

3.1 SYNTHESIS OF SILICA NANOPARTICLES BY SUGARCANE BAGASSE

Collect the sugarcane bagasse from the sugarcane shop (or) sugarcane industry. Bring sugarcane bagasse and washed with distilled water to remove dust and dirt which are present on it, then dried it. The washed and dried sugarcane bagasse is then burnt in a muffle furnace at 200°C/hr to become a sugarcane bagasse ash. The ash should be sintered at 700°C for 5hours, to remove explosive gases, it should be converted into ash powders. Silica nanoparticles should be equipped using dissolution and precipitation process. Acid leaching is the process, to dissolve material; 1M of sodium hydroxide is used.

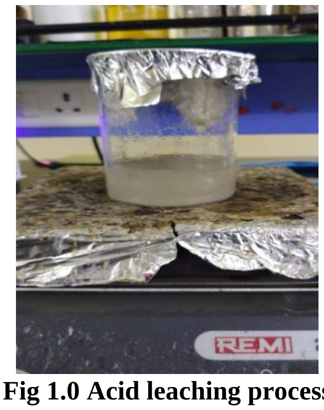

Fig 1.0 Acid leaching process

The required sodium silica was filtered and dried for 24 hrs at required temperature.

The precipitation silica nanoparticle by sodium silicate solution by 0.5M sulfuric acid at pH=11.8 and ageing for 12hrs.The required material should be centrifuge and washing the precipitate with hot water. Then, precipitate should be dried at 80°C for 24hrs.

3. 2 SYNTHESIS OF PLANT EXTRACT (NEEM LEAVES)

3.2.1 PREPARATION OF PLANT EXTRACT

Due to its ease of availability, cost of effectiveness and its medical property, these neem leaves were used. Fresh green leaves were collected and wash it with a water to remove dirt and dust from the leaves, and dried at room temperature. About, 10gms of green leaves were kept in the beaker with 100mL of double distilled water for about 30min. The plant extract (neem extract) were cool down and filtered with whatman paper and were stored at 4°C for other use.

3.2.2 GREEN SYNTHESIS OF SILVER NANOPARTICLES

This method is used by using two-step method. Wet chemical method is used to synthesis of the silver nanoparticles. In this procedure, 0.01M of silver nitrate and 0.02M of $NaBH_4$ with 30ml of double distilled water. The 0.02M of $NaBH_4$ will be added to the solution by drop-by-drop with continuous stirring at room temperature. Then, the colour was turned from grayish black to brown. This process will be incubated at closed chamber. Then colour will changes to reddish brown. This indicates that reduction of silver ions to silver nanoparticles. This, method is easy to use, easily available, cost effectiveness.

Fig 2.0 .Green synthesis of Ag nanoparticle

Characterization should be done before the application method. Due to the characterization, can observe the morphology, shape, size, stability etc., of the particle. XRD and FT-IR should be done for the synthesis of silica nanoparticles

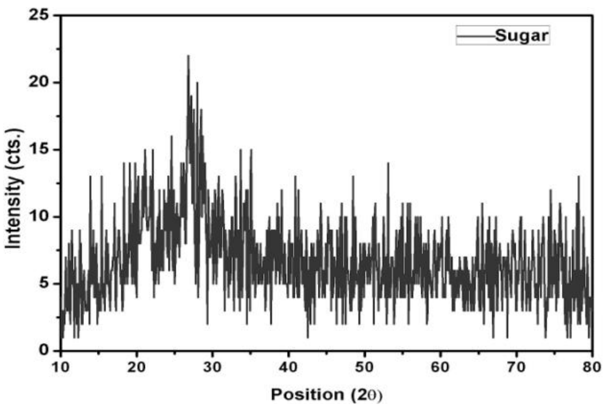

Fig 3.0 XRD of silica nanoparticle by sugarcane bagasse

After the synthesis of silica, characterization will be done i.e., XRD was done to the silica. The peak will be formed at around 28° as per the XRD results. It shows the shape of quartz and crystobalite phase respectively. According to the literature survey, it was confirmed. The peak will be observed at around 20° and 28°, it indicate the presence of calcite as per the literature survey. This XRD will shows, pure form of silicate without any sodium and magnesium contaminants. In this sample, aluminium and magnesium can be observed in the silicate network. Hence, pure silica can be obtained in amorphous form from the sugarcane bagasse which is environmental contaminants.

FT-IR

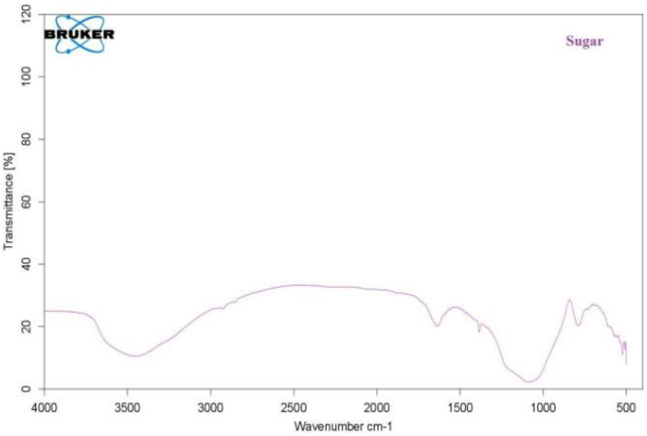

Fig 4.0 FT-IR for silica nanoparticle by sugarcane bagasse

It is used to find out the absorbance changes and bands of the material. It gives us greater accuracy, reproducibility.

This silica sample were characterized by the FT-IR process. The vibration band rings of the silica will be observed at 770cm-1. The bands will be observed at the 820cm-1. The decreasing peak will be obtained at the 3500cm-1. The bands are 770, 820, 3500cm-1 are obtained. The broad band will be observed at 3300-3800cm-1, because of its absorption gap. At the bands of 3400 and 1450, there will be a vibrations and bending stretching molecules. Strong band at the 800 and weak band at 750cm-1 approximately at the asymmetric stretching vibrations. The intense band will be observed at the 500cm-1 approximately.

3.3 VARIATION OF ULTRASONIC VELOCITY WITH TEMPERATURE IN Ag-SIO2 NANOFLUID

At 0.04% and 0.06% concentration

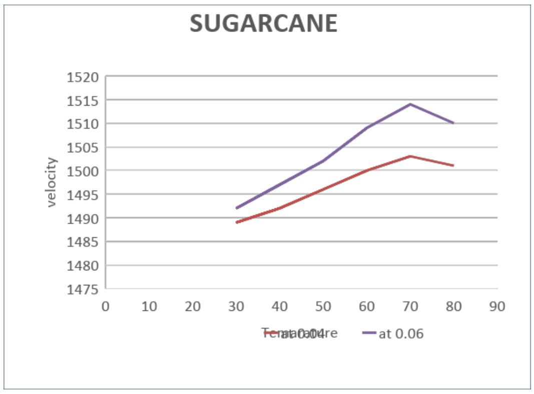

Fig 5.0 .Variation temperature of Ag-SiO2 nanofluid

Variation can be observed at different concentrations i.e., at 0.04% and 0.06% at different temperatures respectively.
It is clear from the figure that Accoustical impedance and inter molecular free length increases with increasing the concentration and temperature respectively. Similarly, the adiabatic compressibility decreases when increasing the concentrations. As per the Brownian motion, it will attributes the molecular force of attraction will be decreases. At different concentration, ultrasonic velocity and thermal conductivity increases rapid. Temperature increases ultrasonic velocity increases, but at the temperature 80°C, it decreases. Whereas thermal conductivity increases.
From this experiment, it concludes that when ultrasonic velocity increases with increase of concentration, but when the temperature increases, velocity slightly decreases because of viscosity decreases, therefore there is an increase in thermal conductivity.

IV. RESULTS

Sugarcane bagasse, a waste material, was produced high purity silica (SiO_2) content, by using leaching process.
Under temperature of 700° C, the sugarcane biogases ash will be obtained amorphous nature and forms white colour. After, leaching process, 68% of silica obtained from sugarcane ash. This method suggests that sugarcane is an alternate method for amorphous silica. For preparation of silica from waste material is the promisingly low cost.
XRD results confirmed that, an average crystalline size of silica nanoparticle size is 23nm.
FT-IR results found that the broad band can be observed at 3300-3800cm-1.
Using Ag nanoparticles from neem leaves is a eco-friendly method.
Using plant extract is a cost-effective, can minimize environmental problems and can be used in the bio-medical applications.
By increasing the thermal conductivity of metal by adding metal oxides.
Ultrasonic inferometer is used for achieving the acoustical and thermal properties respectively.
At different temperatures, at 0.04% and 0.06% concentrations, we find out the ultrasonic velocity and acoustical parameters.
In this experiment, it proves that when fluid interaction increases, then there will be increase in the velocity.

V. CONCLUSION

Though Silica and Silver nano particles have various usaes together when SiO_2 + Ag Nano fluid added to paints it provides good surface finish as well as anti boils effect.
The paint with SiO_2 + Ag nanoparticles can be painted below water tanks, pipe lines and building roofs to protect from algi bacterial growth and improving structural life. The paints mixed with SiO_2 + Ag nanoparticles can be used for equipments and structures installed in costal environment as silica nano particles provide weather shield and silver nano particles will prevent biological growth on surface

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