Stability test of Copper Oxide Nanofluid prepared using Two step method

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Abstract: Copper Oxide nanofluid has been synthesized using two step method. Here Copper Oxide nanoparticles were synthesized and then dispersed in base fluid. Sol Gel auto combustion method was used for preparation of Copper Oxide nanoparticle. D- Glucose acts as fuel for Combustion. The Prepared sample was analyzed using XRD and average crystalline size was found to be approximately 18.4 nm. The stability of nanoparticles has been observed using sedimentation method.

Keyword: Nanofluid, Copper Oxide, So Gel auto combustion, XRD, Sedimentation.

Introduction:

Conventional fluids such as water [1], glycol [1], Oil and Hydrocarbons [2]plays an vital role in advanced engineering technologies. Thermal conductivity of fluids depends on surface to volume ratio of suspension dispersed [3]. Since heat transfer takes place in surface of materials in such fluids. Because of these condition conventional fluids shows less thermal conductivity [2].These drawbacks can be overcome using nanofluids. Nanofluids are engineering fluids where nanomaterials are dispersed in any base fluid. Generally solid phase materials have been dispersed in liquid phase. The methods for producing nanofluids are one step method and two step method [2]. In one step methods nanoparticle were suspended in base fluid directly. The main disadvantage of this method is that particle size and content of nanofluid gets affected easily [2]. Second method is to prepare nanoparticles and dispersing it in base fluid. This can be done using dispersant and homogenizer. It is a complicated method [2]. This nanofluid exhibits different thermophysical properties which replaces the conventional fluids [4]. The above properties depends on particle diameter, shape & pH, Viscosity, thermal conductivity, volume fraction, specific heat of nanofluid[5].

Nanofluids are being widely used in various industrial sectors because of its high thermal conductivity and heat exchange property. Lubricants, Energy supply and production [6], advanced electronics [3], gas turbine rotor [7]. Solar desalination of water [3], CCHP (COOLING, HEATING AND POWER SYSTEM [6], air conditioning [8]. CuO, Al_2O_3 TiO_2 nanoparticles are dispersed in base fluid to form nanofluid. Apart from the above nanoparticles CuO dispersed in base fluid attain much attention. Chemical co precipitation method, Hydrothermal method, sol gel method, combustion method, ball milling are some of the preparation method for obtaining nanoparticle. Generally conventional fluids such as water, glycol, hydrocarbon, and oil are being used as base fluids. The properties and characterization of these nanofluids can be done by X- Ray powder diffraction, Viscometer, scanning electron microscope, Differential thermal analysis etc.

Generally base fluids used for preparing nanofluid were ethylene glycol and prophelene glycol. These fluids are hazardous to both nature and human. Inorder to retain its effect natural base materials such as water and oil can be used. Sunflower oil, coconut oil, peanut oil has good lubricating property and hence can be used as base material. This paper is based on preparation of copper oxide nanofluid with sun flower oil as base fluid. Copper Oxide nanoparticle has been synthesized using Auto combustion method. The structural property has been investigated using X-Ray powder diffraction analysis. Stability of Copper oxide Nanofluid has been done using 100 day stability test.

Experiment method:

The matreials used for preparation are Cupric Nitrate, D Glucose, Sun flower Oil. The entire above chemical reagent used in this project is of analytical grade.

Synthesis of CuO Nanoparticle:

Copper Oxide nanoparyicles has been prepared using Auto combustion method. 3 gms of cupric Nitrate is mixed with 10 ml of distilled water. The mixture is then homogenized by stirring it continuously for 15 minutes. Blue coloured solution was obtained. Now 2.8 gms of D Glucose has been added in 10ml of distilled water separately. Here, D Glucose is used as fuel for combustion process. The prepared hexamine solution was then added to the copper nitrate solution. The colour and texture of solution gets changed from solution to gel form. Then the solution is been placed in a heating mantle at 80 C. After reaching particular temperature gel starts burned out forming black coloured powder. The ashes obtained after combustion burning was copper oxide nanoparticles which is shown in figure 1.

Figure 1 Combustion burning of Copper Oxide.

Preparation of copper oxide nanofluid:

The prepared copper Oxide nanoparticles are dispersed in 10ml of sunflower oil. The mixture is stirred continuously for half an hour for obtaining saturated fluid. Then the saturated solution is kept in ultrasonicator for 1hour for complete dispersion of nanoparticle in base fluid. Thus the obtained nanofluids have kept undisturbed to study the stability of nanoparticle in base fluid. The stability has been analyzed using sedimentation method.

Result and discussion

X Ray diffraction Analysis

The prepared copper oxide nanoparticles have been investigated using XRD analysis technique. It has been found that the thermal property of nanofluid depends on the size of Particles. Hence the crystalline size has been found using the above method. Xrd were carried out using Angle dispersive X Ray diffraction beam line, RRCAT, Indore. The crystalline size of the obtained copper oxide nanoparticle has been calculated using Debye Scherrer formula. Two sharp peaks are obtained at 35.5 and 38.8 which confirm the presence of CuO. It has been found that sample contains both CuO as well as Cu2O particles along with some impurities. Impurities may be because of unformed Copper oxide. The average crystalline size has found to be approximately 18.4 nm. Figure 2 shows the XRD graph of copper oxide nanoparticle prepared using Sol Gel auto combustion method.

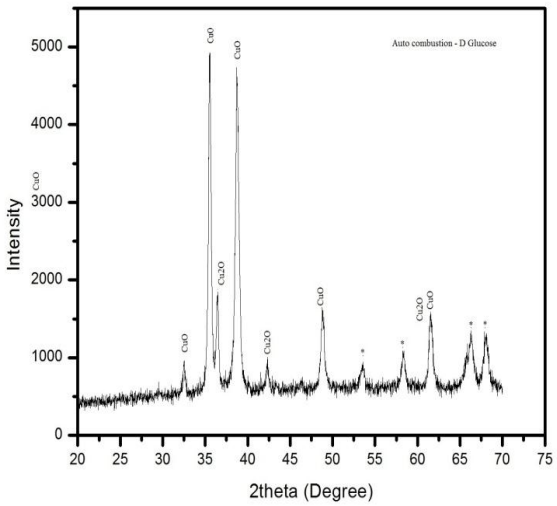

Figure 2 XRD Graph of Copper Oxide Nanoparticle.

Stability test:

Stability test of copper oxide nanofluid has been done manually. The as prepared Nanofluid is kept undisturbed for 50 days. Periodic observation has been done. During first 20 days it has been found that there is no physical change observed in nanofluid. Some amount of nanoparticle has been settled after 50 days has been observed. This may be because of high density of copper nanoparticle .Ideal nanofluid can been obtained when the nanofluid is stable for long period of times.

Figure 3 : Sedimentation test of Copper Oxide nanofluid.

Conclusion:

Copper Oxide nanofluid was prepared using Sol Gel Auto combustion method. Two step method was used for preparing nanofluids. Copper Oxide nanoparticles were prepared using sol gel auto combustion method. The structural property of prepared sample was analyzed using XRD. The average crystalline size was found to be 18.4 nm. Multiphase copper Oxide nanoparticle was detected in this sample. The prepared copper Oxide nanoparticles were then dispersed in base fluid. The stability of nanofluid was then measured using

sedimentation method. It was found that nanofluids are stable for approximately 25 days. After 50 days light settlement was observed this may be due to the particle density.

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