

EXPERIMENTAL ANALYSIS OF STABILITY OF Al_2O_3 NANOFLUIDS BY PREPARING Al_2O_3 NANOFLUIDS AT VARIOUS TEMPERATURES

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ABSTRACT

A stability of nanofluids makes an efficient heat transfer enhancement which is applicable in various area such as power generation, micro electronics, defense, space, electronic components cooling, nuclear, biomedical and so on. The stability and durability of the nanofluids which concern the more thermal conductivity in most of the industrial applications. The preparation and stability of nanofluids are the two common kinds which is reports by this article. The two step method is use to prepare the nanofluids. The Al_2O_3 – Distilled water nanofluids with same concentration and different temperature are used in this experiment. Then the two step method is done by using the magnetic stirring and ultrasonic vibrations, the magnetic stirring time and ultra sonication time and temperature makes as efficient and good stability of the nanofluids. The stability of nanofluids is analysed by visual method.

Keywords – Nanofluids preparation, Stability, Magnetic stirring, Ultra sonication time and temperature.

1. INTRODUCTION

Heat transfer technology plays a vital role in the process of increasing the heat transfer rate and improve efficiency of the applicable sources. For making heat transfer by using a fluids such as water, vegetable oil and so on. These fluids makes a corrosion, blockages and some other issue in the flow passages. For these disadvantages of fluids, the nanofluids makes the outstanding performance of heat transfer and reduces the corrosion, blockages and some other issues, it will be preferred in many industrial application. Nanofluids are nano-sized particles in nanometer ($\times 10^{-9}$) in a given fluids which are in colloidal suspension. There are two kind of nanofluids such as metallic and non-metallic nanofluids. The metallic nanofluids such as copper, aluminium, nickel, etc. which are prepared by dispersing nanoparticles from metal. The non-metallic nanofluids such as metal oxides, various allotropes of carbon, etc. these are made by dispersing nanoparticles from non-metals. Many researches were carried out based on the nanofluids.

Generally, the nanofluids preparation were made by two methods. One is one step method and another one is two step method. The one step method is synthesized in a base fluids i.e., chemical method. This one step method also reduce the agglomeration, it is making and dispersion of nanofluids simultaneously. This method of nanofluids is synthesized directly with a base fluids which the agglomeration is reduced and the stability of nanofluids is increases, then it also avoid the storage, transportation, pouring, mixing and drying of nanoparticles. In this one step method, the another efficient method to prepare nanofluids by vacuum submerged arc nanoparticle synthesis system. The main disadvantages in one step method is heavy cost involvement in a large scale, it cannot synthesis the nanofluids. But the advantages of one step method is the developing of nanofluids preparation is very rapidly by one step chemical method which is economical in future. In one step method, the silver nanofluids were prepared with the mineral oil as base fluid.

The two step method is most commonly used for nanofluids, nanotubes and some other nanomaterials. In this method, firstly the nanoparticles are made in dry powdered by means of a physical and chemical process, these nanoparticles are dispersed in base fluids by using magnetic stirring and ultrasonication. The physical method of magnetic stirring and ultrasonication are to make the fluids as more corresponding which the stirring time and ultrasonic vibration and temperature are affected. During this process, they are many bubbles appeared at the surface of suspension nanoparticles after stirring process. It can adhere the bubbles in a beaker wall. Due to high surface activity, the stirring process is easily helps to dissolve the air in the fluids and easily the bubbles were formed. For this problem, the reduction in the stirring speed from 1200 r/min to 800 r/min and the formation of bubbles were reduced effectively. The nanofluids is in the form of dilute suspension is more advantageous over the colloidal solution. These dilute suspension nanofluids have high surface heat transfer between the fluids and particles. For these above reason, the nanofluids have more applicable in heat transfer intensification, transportation, industrial equipment cooling Purpose, magnetic sealing, nuclear cooling, biomedical purpose, etc.,.

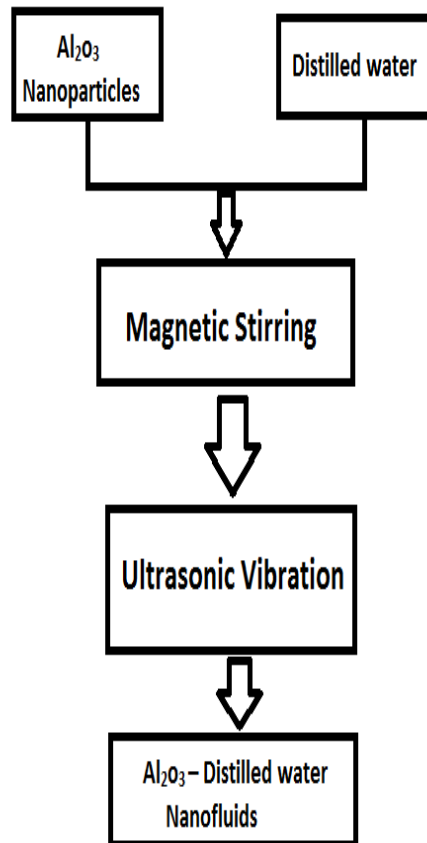


Figure.1: Procedure to prepare Al₂O₃ – distilled water nanofluid using two step method

2. EXPERIMENTEL SETUP

There are two types of methods used for preparing the nanofluids. They are as follows:

2.1. One step method:

The one step method is synthesized in a base fluids i.e., chemical method. This one step method also reduce the agglomeration, it is making and dispersion of nanofluids simultaneously. This method of nanofluids is synthesized directly with a base fluids which the agglomeration is reduced and the stability of nanofluids is increases, then it also avoid the storage, transportation, pouring, mixing and drying of nanoparticles. This method of process can uniformly prepared dispersed nanoparticles, these particles in the base fluids can suspended stably. In this one step method, the another efficient method to prepare nanofluids with different dielectric liquids by vaccum submerged arc nanoparticle synthesis system. The different morphology have mainly influenced and determined by the dielectric fluids with various thermal conductivity properties. The needle-like, square, circular morphology and polygonal shapes are exhibited nanoparticles preparation. The main disadvantages in one step method is heavy cost involvement in a large scale, it cannot synthesis the

nanofluids. But the advantages of one step method is the developing of nanofluids preparation is very rapidly by one step chemical method which is economical in future. In one step method, the silver nanofluids were prepared with the mineral oil as base fluid. The stability and the structure of nanoparticles are controlled by the variation of synthesis parameters.

2.2. Two step method:

The two step method is most commonly used for nanofluids, nanotubes and some other nanomaterials. It is a simple techniques and the cost is lower than the one step method. In this method, firstly the nanoparticles are made in dry powdered by means of a physical and chemical process, these nanoparticles are dispersed in base fluids by using magnetic stirring and ultrasonication. A 250 ml of distilled water is taken in a beaker and then adding exact quantity of 0.2gms concentration (i.e., 0.8gms/litre of distilled water) of Al₂O₃ nanoparticles. After the beaker is placed in a magnetic stirrer and the stirring speed range from 1200 rpm to 800 rpm for 40 minutes.

During this process, they are many bubbles appeared at the surface of suspension nanoparticles after stirring

process. It can adhere the bubbles in a beaker wall. Due to high surface activity, the stirring process is easily helps to dissolve the air in the fluids and easily the bubbles were formed. For this problem, the reduction in the stirring speed from 1200 r/min to 800 r/min and the stirring speed is extended upto 40 min.

By this method, the formation of bubbles were reduced effectively and the obtained nanofluids quality is improved. After the stirring process, the beaker is placed in a ultra sonication process. During this process, the sonication temperature is various from 40°C to 60°C for same concentration. Then make sample for a respected temperature degrees. The sonication time is 45 minutes which makes the nanofluids as a efficient and settlement of nanoparticles in a Al_2O_3 – distilled water nanofluids is decreased. The stability of Al_2O_3 – distilled water nanofluids is achieved with good performance by magnetic stirring time and ultra sonication time and temperature.

These nanofluids is in the form of dilute suspension is more advantageous over the colloidal solution.

3. EXPERIMENTEL PHENOMENA

The Al_2O_3 – distilled water nanofluids are prepared with various temperature from 40°C to 60°C and concentration of Al_2O_3 nanoparticles is 0.8gms/litre of distilled water. we have take the sample of the Al_2O_3 – distilled water nanofluids with the temperature are 50°C, 55°C and 60°C.

The figure.2 shows the Al_2O_3 – distilled water nanofluids which is freshly prepared. The well dispersed Al_2O_3 nanoparticles in the distilled water is shown in milky white of uniform color. The samples of Al_2O_3 – distilled water nanofluids are placed in the gravitational field without any disturbance and then observed the suspension stability. The figure shows the photos of freshly prepared Al_2O_3 – distilled water nanofluids.

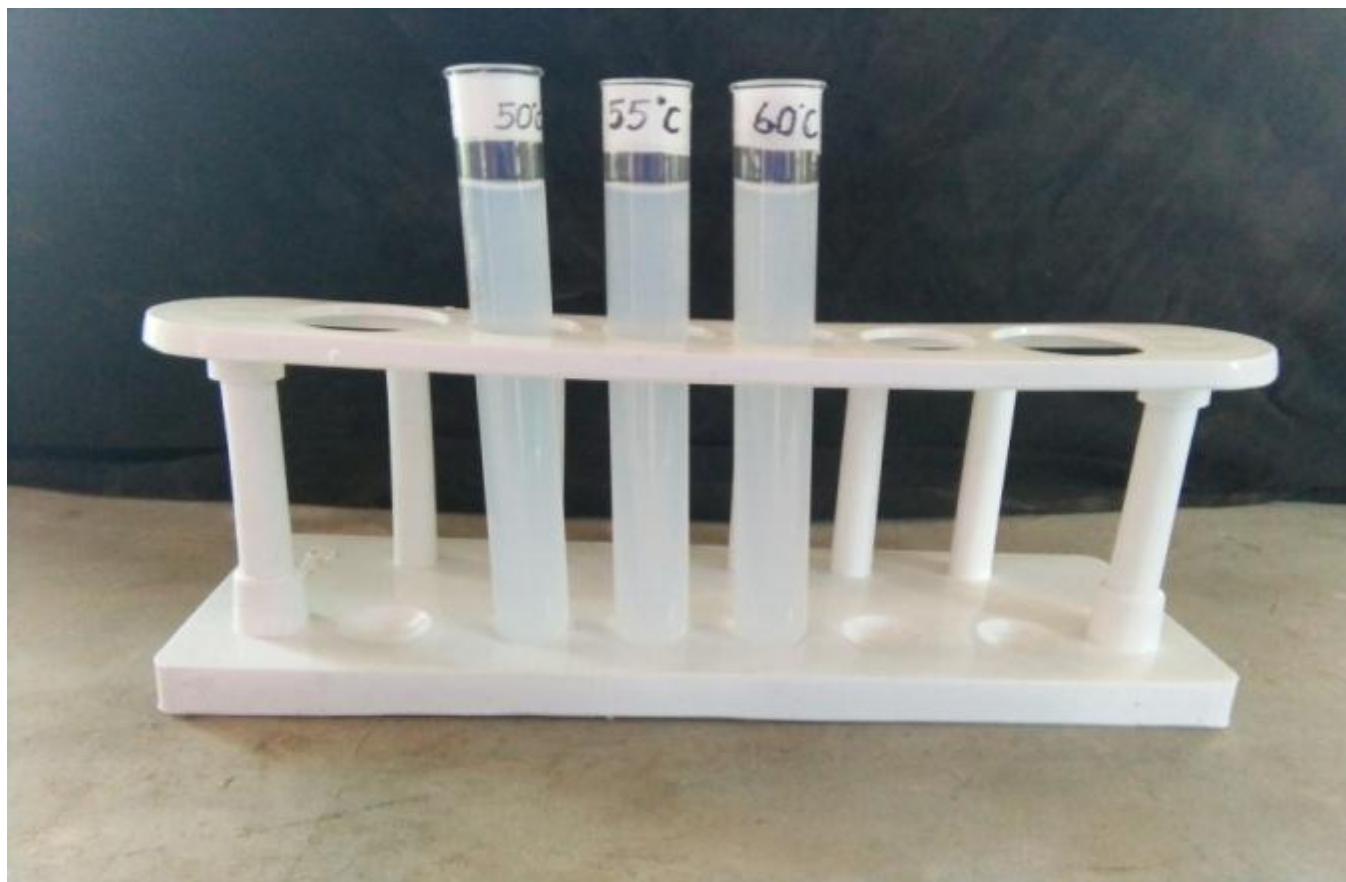


Figure.2: Freshly prepared Al_2O_3 – distilled water nanofluids (Milky white of uniform color)

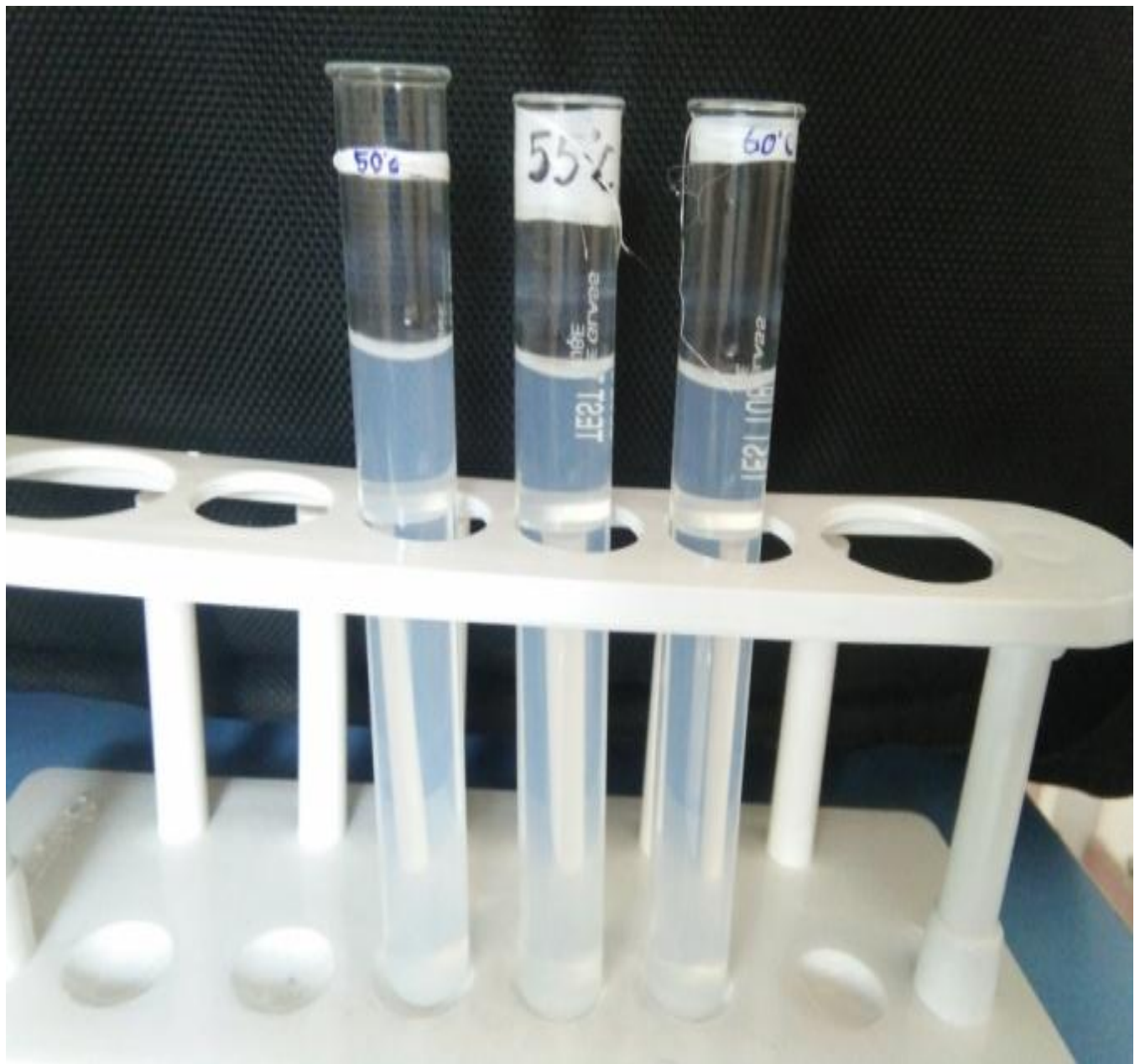


Figure.3: Prepared Al₂O₃ – distilled water nanofluids after 3 days

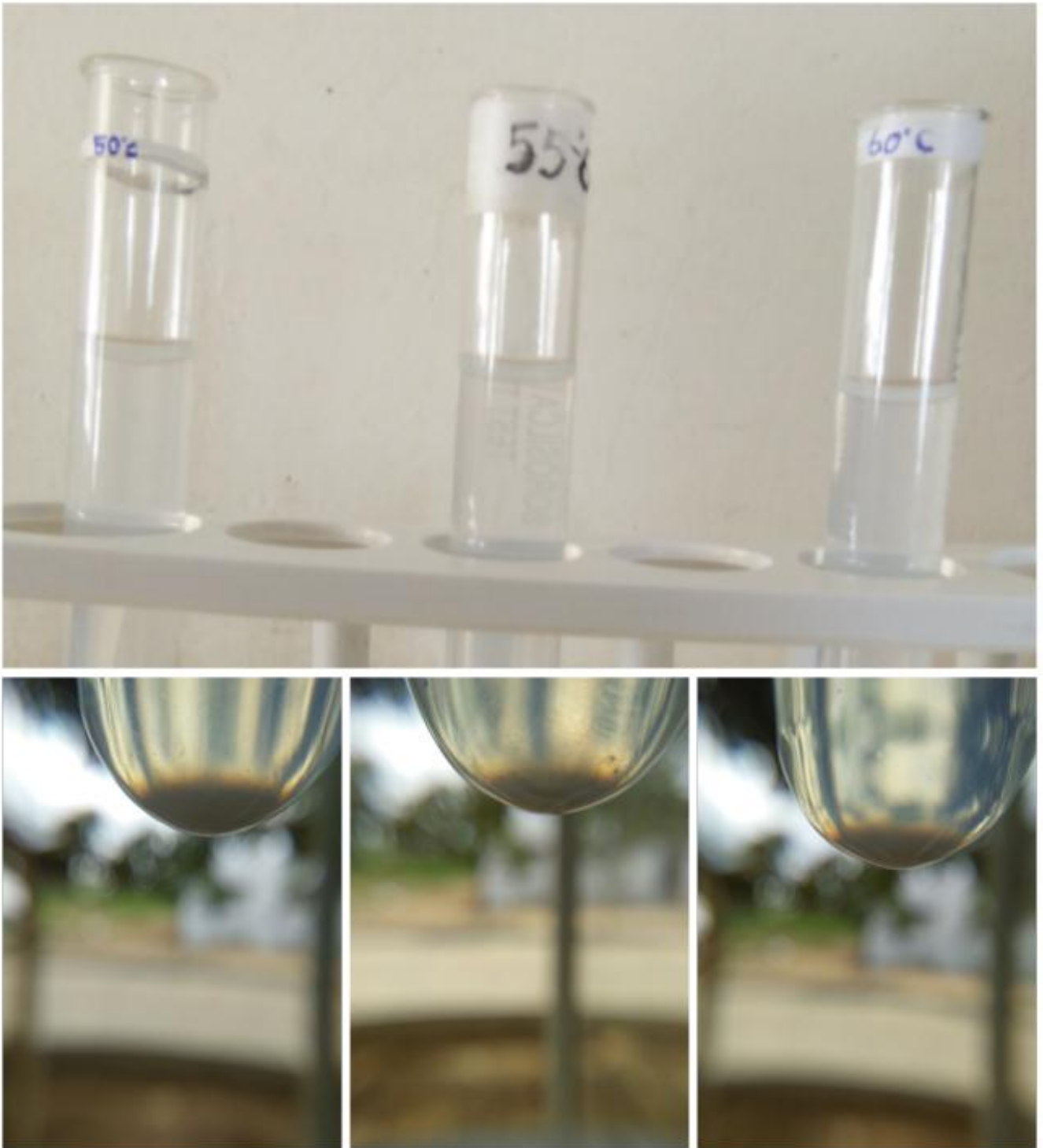
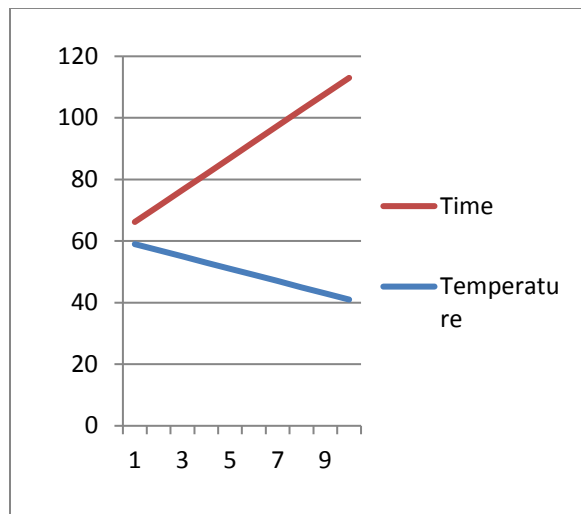


Figure.4: Prepared Al_2O_3 – distilled water nanofluids after 3 days in bottom closed view the partially settlement of Al_2O_3 nanoparticles in the distilled water

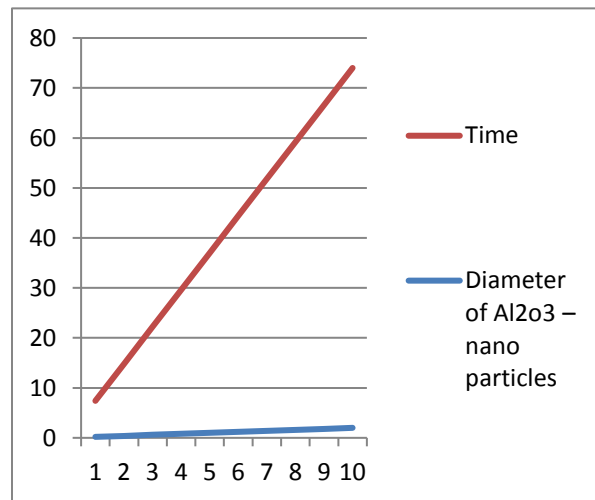
After 3 days from the preparation of Al_2O_3 – distilled water nanofluids which is shown in the figure.3 & 4. The gravitational field in the Al_2O_3 – distilled water nanofluids after the 3 days from the preparation which makes

settlement of Al_2O_3 nanoparticles in the distilled water. The figure.3 & 4 has some difference from the freshly prepared Al_2O_3 – distilled water nanofluids.



Graph.1: Time Vs Temperature

The Graph.1 shows the time Vs temperature i.e., the settlement time for after 3 days with the respected temperature from 40°C to 60°C.



Graph.2: Time Vs Diameter of nanoparticles

The Graph.2 shows the time Vs Diameter of the Al₂O₃ – nanoparticles, i.e., the settlement time for after 3 days with the diameter of the settlement of Al₂O₃ –nanoparticles.

4. RESULTS AND DISCUSSION

In this article, the physical dispersion method of magnetic stirring and ultrasonication makes the Al₂O₃ – distilled water nanofluids as more stable and uniform. The observing before and after standing, this proved by the settlement of the Al₂O₃ nanoparticles in the distilled water. The concentration of the Al₂O₃ nanoparticles is one of the important factor for the stability of the Al₂O₃ distilled water nanofluids. If the concentration of nanoparticle increases, the nanofluids suspension stability becomes worse. To increase the stability of nanofluids, mainly considered the concentration of nanoparticles, the magnetic stirring time, the ultrasonication time and temperature.

5. CONCLUSION

Thus, the magnetic stirring and ultrasonication, the Al₂O₃ – distilled water nanofluids with concentration of the Al₂O₃ nanoparticles is 0.2gms for 250 ml of distilled water were prepared by the two step method. The settlement of the Al₂O₃ – distilled water nanofluids for 60°C sample is less than the 55°C sample settlement of the Al₂O₃ – distilled water nanofluids. The settlement of the Al₂O₃ – distilled water nanofluids for 55°C sample is less than 50°C sample settlement of the Al₂O₃ – distilled water nanofluids. The stability of the Al₂O₃ – distilled water nanofluids is efficient when the magnetic stirring time is above 40 minutes, the ultrasonication temperature is above 60°C and the sonication time is above 45 minutes. If the concentration of nanoparticle increases, the nanofluids suspension stability becomes worse.

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