NATURAL CONVECTION ON NANO FLUIDS IN SOIL AND CROP PRODUCTION

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Abstract: -

In this paper, we show the effects of thermal properties in soil and Crop Production. Nanoparticles play important role in soil system, water resources, energy conservation and in other areas. By the help of nanoparticle and zeolites, we have tried to enhance the quality of applied fertilizer. Few studies have been done, by which Nano fluids show their effect on soil conservation. Hence, this paper highlights the key role of Nano tributes, and new ideas leading us to understand the suitable mode of action of Nano fluids in soil. Finally, we have tried to show that nanotechnology can be used to increase the nutrients in soil, decrease soil toxicity and minimize the potential negative effects associated with over dosage, and decrease the frequency of uses.

Key words: Thermal preparation, Nano fluids, Nano tributes.

Introduction: -

India is a country of villages about 70% of population belongs to rural India. Rural population depends on agriculture so; we can say that agriculture is back bone of India and their developing countries. Agriculture does not only help in fulfilling the food requirement of the people but is also important for the economic development of the nation. According to 2010 -11 census, India's population is about 1.20 billion. It is great challenge to provide food to such a big population. So there must be a new technology giving more yields in limited land. In this situation, nature is complex which will have imbalances directly or indirectly to crops, soil and animal. In additional to this, there are a lot of factors which affect soil deficiencies in micro and macro nutrient content. Population explosion, industrialization, depletion of water sources, difference in soil condition and erosion of top soil. In crop the main reason to use fertilizer is to give full-fledged macro and micro nutrients which generally the soil lacks. About 35 to 45 percent of crop productivity depends on chemical fertilizer, some of the fertilizer, affects the crop production directly and some indirectly. To overcome these problems, nanoscience may be one of the sources. Since fertilizers are key component, developing Nano based fertilizer would be a new technology in this filed. Generally,

fertilizers are sprayed in many ways like roots, through soil or along with seeds. Generally, fertilizers are composed Nitrogen Phosphorus and potassium in 3:2:1 ratio [1].

Nano fertilizers can increase the neutrinos of soil by 3 to 5 times. It also increases stress tolerating ability. Nanoscience is also used to increase the BioSource. It is beneficial and eco-friendly in nature. Nanotechnology builds carbon uptake and increase soil aggregation. It collects information of molecules in Nanoscale range, with consideration of physical, magnetic, optical and catalytic preparation [2-3].

In comparison to chemical fertilizers, Nano fertilizers are cheaper and are require in lesser amount. Nowadays sensors devices are in used to detect disturbance in soil.

Sensors give better results with the lives pictures and condition of the soil. It monitors changes caused by various pesticides and also the physical condition of soil like pH, growth condition and moisture level. It constantly monitors the toxicity present in the field.

The word "Nano" is derived from Greek word "Nanos" which means dwarf, and denoted by a factor 10^{-9} meter. Basically, nanotechnology understands of matter in Nano scale, which ranges from 1-100 nanometre [4-5]. Nano scale shows some special characteristics like optical magnetic, electrochemical etc.

Characteristics of the Nano fields: -

There are two main factors which make it different form other materials first one is surface area and the second one is quantum effects.

Theories of Nano fluids: -

The thermal conductivity of Nano fluids is much less than usual suspensions. It shows abnormal rise in thermal conductivity. Generally, we use base fluids as water for soil. We divide nanoparticles into three groups: carbon nanotube, pure metallic particles and ceramic particles. Different combinations of the nanoparticles make different Nano fluids.

Carbon Nano-tube: -

It shows that increment in thermal conductivity by 150 percent by just 1% increase the volume fraction of nanotubes. The reason for this abnormal rise of enhancement depends on two facts. First the thermal conductivity of carbon nanotubes is very high; second, the nanotubes have a very high aspect ratio. Xie et al have measured thermal conductivity of multiwall carbon nanotube having diameter ranges from 15 nm to 39 μm, which are suspended in water [6]. It was found that there were more enhancements for some volume fraction in the fluid that has lower conductivity.

Metallic Nano fluids: -

Patel etal have prepared Nano fluids by gold and silver. For this, they have used a transient hot wire method for measuring thermal conductivity. It was shown that at room temperature,

the conductivity of Toluene Nano fluid was increased by 3-8% for a volume fraction of only 0.005 to 0.011%, whereas the enhancement of water gold Nano fluid was 3.2-6 percent for vanishing small concentration. The main reason behind this is very small in size (10 to 20 nm). The enhancement was greater with water gold based on Nano fluids because particles were used, and was lower for toluene based Nano fluids. We have also an example of lower conductivity of water, silver Nano fluids. It is clearly observed that even though silver is higher in conductivity, it provides less enhancement because its size was relatively large. It means particle size can override concentration effects, which is useful in soil conservation. Xie etal studied dependency of thermal conductivity of nanoparticle fluids mixture of the base fluid. Some investigators have also studied particles of Al_2O_3 dispersed in deionized water, ethylene, and glycol-water mixture. It was found that thermal conductivity ratio decreases with increased thermal conductivity of the base fluid.

Ceramic Nano fluids: -

First time conductivity was measured in water with fluid containing Al_2Co_3 and CuO nanoparticles. On the basis of measurement, we can say that thermal conductivity of Al_2O_3 and CuO Nano fluids were high. They had used volume fraction of only 1 to 5%. The enhancement was lower in the presence of water as a base fluid. Maxwell had included that effect of particle size also affects the thermal conductivity. These models predict that effective thermal conductivity is essential for a weighted average of solid and liquid conductivity derived from a point source method. The Maxwell model is:

$$\text{Б}_{eff}/\text{б}f=1+3(\text{Б}_p/\text{б}_f-1)\,\varphi \,/\, (\text{Б}_p/\text{б}_f+2) - (\text{Б}p/\text{б}_f-1)\,\varphi \text{ ------- (1)}$$

Whereas the Hamilton –Crosser [7] model read as:

$$\text{Б}_{eff}/\text{б}_f=\text{б}_p+ (n-1)\,\text{б}_f-(n-1)\,\varphi\,(\text{б}_f- \text{б}_p) \,/\, \text{б}_p+ (n-1)\,\text{б}_f+ \varphi\,(\text{б}_f- \text{б}_p) \text{ ------- (2)}$$

This model was used for Al_2O_3 –Water and CuO-Water Nano fluids.

The measurements showed that a clear effect of particle size and method of dispersion. Some scientists had measured the thermal conductivity of aqueous Al_2O_3 Nano fluids with even smaller particles. They also observed the effect of particle size in addition to the effect of base solution.

Thus, it has been generally found that oxide ceramic particles which themselves do not exhibit very high thermal conductivity can enhance the thermal conductivity of fluids in Nano-suspensions.

Temperature effect: -

Nano fluids strongly depend on temperature. By using the temperature oscillation technique, the thermal conductivity of oxide can be measured over the temperature range of 21^0-50^0 C. The thermal conductivity of Nano fluids increases 3 times for copper oxide and alumina Nano fluids. It is also important to note that both Al_2O_3 and CuO do not follow the prediction

of Hamilton-Crosser model because the model is not sensitive to temperature over this temperature range. The Hamilton-Crosser model at room temperature was purely accidental because of its larger particle size. These results have revolutionized the concept of Nano fluids from application point of view. They have indicated a much larger thermal conductivity in the heated state. They also indicate that some kind of particle movement that dramatically changes with temperature must be taking place within the fluid.

Thermal conductivity of Soils: -

Some of the solar radiation that reaches the Earth slowly penetrates the soil profile largely by conduction; this is the same process by which heat moves to the handle of a cast-iron frying pan. The movement of heat in soil is analogous to the movement of water, the rate of flow is determined by a driving force and by the ease with which heat flows through the soil. This can be expressed as Fourier's law:

$$Q_h = \sigma * \Delta T/x$$

Where Q_h is the thermal flux, the quantity of heat transferred across a unit cross-sectional area in a unit time; σ is the thermal conductivity and $\Delta T/x$ is the temperature gradient over a distance x that serves as the driving force for the conduction of heat. The thermal conductivity σ of soil is influenced by a number of factors, the most important being the moisture content of the soil and the degree of compaction. Heat passes through water many times faster than through air. As the water content increases in a soil, the air content decreases, and the transfer resistance is also lowered. When sufficient water is present to form a bridge between most of the soil particles, further additions will have little effect on heat conduction. Heat moves through mineral particles even faster than through water, so when the particle-to-particle contact is increased by soil compaction, heat transfer rates are also increased. Therefore, a wet, compacted soil would be the poorest insulator or the best conductor of heat. Here again the interconnectedness of soil properties is demonstrated.

Relatively dry soil makes a good insulating material. Buildings which are built mostly underground can take advantage of both the low thermal conductivity and relatively high heat capacity of large volumes of soil.

Nomenclature:-

$б_{eff}$ = Effective thermal conductivity of suspensions.

бf = Thermal conductivity of liquid.

$б_p$ = Thermal conductivity of solid particle.

n = Shape factor.

Φ = Volume fraction.

Conclusion: -

In present scenario the extensive use of chemical fertilizer to boost agricultural production has polluted not only the soil but also food and water. We should try to increase the crop production without damaging the ecosystem. For this, we have to develop a new thinking; Nanoscience is increasing its significant for crop production in the agriculture sector. Some development has taken in the field of fertilizers, pesticides and genetic material. By the use of Nano fluids, we can control the quantity. We can also reduce the dosage and pH value of soil. By beetroot production we can control pH value. Nanotechnology is able to control the temperature of the soil and water sustainability. We should try to use Nano sensor to detect pathogens. It is used in detection of pollutants in the environment, sensing and remediation.

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