EFFECT OF ELECTROMAGNETIC FIELD ON THE NATURAL CIRCULATION IN SOLAR ABSORBER TUBE: REVIEW PAPER

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Abstract

In this paper, collection of research related to the effect of using nanofluids of various kinds on improving heat transfer and increasing the efficiency of solar collectors was reviewed on the other hand studies will be presented regarding the effect of electromagnetic field on improving heat transfer and its effect on solar collectors. In this paper, we have examined the electromagnetic effect of thermo-hydrodynamics behavior of nanofluid.

The results of the previous research that was reviewed clearly showed that the use of nanofluids has a clear effect on improving the thermal efficiency of solar collectors and improving heat transfer in high proportions, as well as between studies that adding the effect of electromagnetic overflow on solar collector systems has had a positive effect in improving heat transfer and improving properties

Physical fluid

Keywords: Solar collector, magnetic nanofluid, Ferrofluid, Parabolic solar trough collector, Solar energy, electromagnetic field, Nanofluid.

I. Introduction

The think about of an electrically conducting liquid in engineering applications has significant intrigued, such as in metallurgical and metalworking forms or division of metallic metals from non-metallic incorporations by the
application of an attractive field. In that case, the liquid encounters a Lorentz constrain. This, in turn, influences the rate of warm and mass exchange (Heidaryet al. 2015). One of the upgrade strategies of convective warm exchange is the utilization of attractive field. Whereas embracing magneto liquid within the sun oriented application needs advancement.

In this study, a outline of the related work with nanofluids, effect of electromagnet field in free circulation of solar collector will be displayed. Among the writing found, two regions may be recognized which are related to this work.

II.

II.i. Using Nanofluid in Solar System

(Heiz et al. 2006) inspected nanofluids (CuO and Al$_2$O$_3$-water based) in laminar stream with constant temperature of a circular tube boundary condition. The test comes about emphasize that the single-phase relationship with nanofluids properties (Homogeneous) isn't able to foresee heat transfer coefficient improvement of nanofluids. The comparison between test comes about gotten for both shows that heat transfer coefficient proportions for nanofluid to homogeneous show in moo concentration are near to each other but by expanding the volume division, higher heat exchange upgrade for Al$_2$O$_3$-water can be watched.

(He et al. 2011) studied experimentally the nanofluids heat transfer characteristics flow in vacuum tube sun oriented collector. Used two nanofluids, CNT/H$_2$Oand TiO$_2$/H$_2$O, are utilized to show the impact of the light-heat change nanofluids characteristics. The experimental test appear an awfully great light-heat change characteristic of the CNT/H$_2$O nanofluid when (0.5%) a weight concentration. The results are accommodating for the plan of vacuum tube sun powered collector.

(Yousefi et al. 2012) studied experimentally used nanofluid (Al$_2$O$_3$-water) effect on the thermal efficiency of the solar collector type flat plate (FPC). The nanofluid of volume concentration of (0.2, 0.4)% has particle size of 15nm. The experimental investigated was executed without and with Triton X-100 as a surfactant. The results presented a 28.3% increment in efficiency with 0.2% weight division nanofluid. Moreover, by expanding the mass stream rate and utilizing the surfactant efficiency increase by 15.63% is observed.

(Khullar et.al 2012) explored aluminum-based nanofluid both theoretically and experimentally on concentrating parabolic solar oriented collectors (CPSC). This work endeavors to present the thought of solar radiant collecting through the utilization of nanofluid-based concentrating allegorical sun based collectors. This target has been scientifically modeled, and the overseeing differential equations have been numerically illuminated utilizing finite difference methods. The comes about of the demonstrate were compared with the exploratory results about of conventional parabolic solar collectors beneath comparative conditions. The parameters secured in this work were: solar insulation, the convective heat transfer coefficient and incident angle. The theoretically comes about show that the NCPSC has the potential to tackle sun oriented brilliant vitality more effectively than a routine illustrative trough.
(Faizal et al. 2013) analyzed the impact of utilizing nanofluid (Al₂O₃-water) as a retaining medium within the flat-plate solar collector and assessed the potential of measure lessening. When applying the same yield temperature of Al₂O₃ nanofluid as that for water, it can be watched that the collector's measure can be diminished up to 24% of its unique measure.

(Omid et al. 2013) presented the examination of the nanofluids' applications in solar building frameworks. The deficiency of fossil fills and natural contemplations persuaded to utilize elective vitality sources such as solar vitality. They concentrated on upgrading execution of the solar thermal system, thermal energy storage, the efficiency, solar cells, solar water heater and solar stills by utilizing nanofluid. There's a restricted number of inquire about works within the zone of solar collectors increased with nanofluids compared with ordinary heat transfer liquids.

(Yang et al. 2013) performed an optimization method on heat transfer upgrade for nanofluid stream in a two-dimensional wavy channel, for Reynolds numbers of 250–1000. They appeared that the improvement in heat transfer basically depends on the nanoparticle volume division, the Reynolds number, and the sufficiency of the wavy divider. Numerical comes about show that the improvement of the thermal can accomplish (15 and 24)% within the wavy channel stream compared with unadulterated liquid, with the molecule of volume concentration of ϕ (3 and 5)% of nanofluids (Cu/water).

(Khalipe et al. 2015) the objective of this work is to study the experimental performance of heat pipe evacuated tube solar collector using CuO/H₂O nanofluid. At the same time the effect of inclination angle and cooling fluid mass flow rate on the performance of heat pipe evacuated tube solar collector is also studied. The thermal performance of nanofluid utilized in the Two-Phase Closed Thermosyphon evacuated tube solar collector is better than conventional heat pipe evacuated tube solar collector. The obtained enhancement in instantaneous collector efficiency is 18-20%.

II.i. Effect of Electromagnetic Field on Nanofluid

Nano ferrofluids or (magnetic nanofluids) comprise of super paramagnetic nanoparticles suspended in a nonmagnetic carrier liquid. These liquids are a present day set of nanofluids due to their one of kind behavior characteristics as savvy or utilitarian liquids. Their properties such as conductivity and viscosity can be changed beneath an outside attractive field and their characteristics rheological can be precisely controlled. These properties and particularly their capability of heat transfer upgrade make this kind of liquid an curiously issue for numerous analysts.

The assimilation of electromagnetic vitality could be a handle ordinarily depicted by its results: it is depicted as where the vitality goes. The vitality of the wave or photon is captured by an electron and changed over into a few frame of chemical, warm, or vibration vitality, whereas the radiation itself is debilitated in escalated (Li et al. 2009, Lee et al. 2010, Bradic 2011).

(Lin et al. 1991) a two-phase blend show were utilized for nanofluids within the theory that Brownian movement and diffusivities thermophoretic are the as it were noteworthy slip instruments between solid and fluid phases. The results demonstrated
that for littler nanoparticle, it is volume division is more uniform and there are no irregular varieties within pressure drop and the heat transfer rate. Also, the heat transfer rate is upgraded within the nearness of the attractive field, particularly for the littler nanoparticles. Besides, as the strength of the magnetic field (Ha) heightens, the top of the speed profile close the dividers is expanded; in any case, the top of the speed profile at the center locale is diminished.

(Ho et al. 2004) explored the impact of including a magnetic field on the solidness of nanofluid (CuO). Tests are proceed by forcing an extra magnetic field to the nanofluid (CuO) arranged by the self-developed Arc-Submerged Nanoparticle Synthesis System (ASNSS), to explore the accumulation wonder and the solidness of the suspension of nanoparticle, figure (1) show a schematic graph of the test setup for the magnetic field. Beneath the impact of the magnetic field strong, the permeance longer time, the more clear the deposition marvel will be owing to the accumulation of the nanoparticle. In any case, the permeance recurrence features a moderately trivial impact on the nanofluid (CuO).

(Lajvardi et al. 2010) investigated experimentally the Ferro fluid heat transfer streaming through a warmed tube made of copper has laminar administration within the nearness of a magnetic field. Critical upgrade of the Ferro fluid heat transfer by applying different orders of the magnetic field is watched in this try. Too, the impact of concentrations of magnetic nanoparticle and it is position have been explored. The most cause for the improvement of the heat transfer coefficient may well be inspired due to exceptional changes within the thermophysical Ferro fluid properties beneath the impact of the connected attractive field.

(Aminfar et al. 2012) investigated numerically of the hydro-thermal behavior of a Ferro fluid (4 vol% Fe_3O_4/seawater). Two-phase blend show and control volume
strategy were utilized to analyze the Ferro fluids was in vertical a rectangular conduit under distinctive magnetic fields. Considering the Ferro fluid electrical conductivity, in expansion to the Ferro hydrodynamics standards, the magneto hydrodynamics standards have too been taken into consideration. Three situations for the magnetic field have been treated to ponder blended the Ferro fluid convection: uniform transverse field, on-uniform pivotal field (positive and negative gradient) and another situation when both areas are connected at the same time. The results shown that the negative angle pivotal field and uniform transverse field act so also and improve the Nusselt number and the grinding calculates, whereas the positive angle hub field does the inverse. It is additionally terminated that beneath the impact of both areas, expanding the concentrated of the uniform transverse field comes about in diminishing the impact of non-uniform hub areas.

(Sheikholeslami et al. 2012) studied numerically using the Lattice Boltzmann method on free convection in a concentric annulus between a cold external square and warmed inward circular barrels in nearness of inactive outspread attractive field. The viscosity of nanofluids and effective thermal conductivity are calculated utilizing Brinkman models and the Maxwell–Garnetts (MG), separately. Too, thematic-distribution-function (MDF) demonstrate is utilized for recreating the impact of a uniform attractive field. The comes about uncover that the average Nusselt number is an expanding work of nanoparticles volume division In addition to the Rayleigh number, whereas it may be a diminishing work of the Hartmann number.

(Sheikhzadeh et al. 2012) investigated numerically the blended convection in a differentially warmed lid-driven square depression filled with nanofluid (Cu-water) beneath the impact of a attractive field. The right and left dividers of the depression are kept at temperatures Tc and Thin dividually whereas the level dividers are adiabatic. The beat divider of the depression moves in possess interceptor from left to right. The considered parameters are Richardson number (extending from 0.1 to 10), the volume division of the nanoparticles (extending from to 0.1) and Hartmann number (extending from to 60) on the liquid stream and temperature areas and the rate of warm exchange within the depth. Prandtl number for water is considered as 6.8, when the Grashof number (Gr) is $10^4$.

(Ashorynejad et al. 2013) considered the impact of inactive spiral magnetic field on free convection heat transfer in a cylindrical annulus enclosure horizontal a filled with nanofluid numerically utilizing the Grid Boltzmann strategy (LBM). The internal and external barrel surfaces are kept up the distinctive uniform temperatures. The viscosity of nanofluid and compelling thermal conductivity are calculated utilizing the Maxwell–Garnetts (MG) and Brinkman models, individually. The results uncover that the stream motions can be stifled successfully by forcing an outside outspread attractive field. Too, it is found that the normal Nusselt number is an expanding work of nanoparticle volume division and Rayleigh number, whereas it could be a diminishing work of the Hartmann number.

(Ghofrani et al. 2013) experimentally studied forced convection heat transfer of an aqueous Ferro fluid flow passing through a circular copper tube subjected to a uniform heat flux in the presence of an alternating magnetic field. The essential objective was to heighten the molecule movement and unsettling influence of the
boundary layer by using the magnetic field impact on the nanoparticle for upgrade heat transfer. Convoluted convection administrations inspired by intelligent between magnetic nanoparticle beneath different conditions were examined. The method of heat transfer was inspected with diverse volume concentrations and beneath distinctive frequencies of the connected magnetic field in detail.

(Azizian et al. 2014) examined the impact strength of magnetic field and consistency on the constrained heat transfer convective coefficient. This considers is upheld by reenactments of the magnetic field density conveyance and magnetic drive acting on nanoparticle development. The information appears that a expansive improvement within the nearby heat transfer coefficient can be accomplished by expanding strength of the magnetic field and gradient.

(Sardarabadi et al. 2014) investigated experimentally the impacts of utilizing silica/water nanofluid of 1% and 3% weight concentration as a coolant on the thermal and electrical efficiencies of a Photovoltaic/Thermal system (PV/T). It is organize that the PV/T collector, the thermal efficiency for the two concentrations is expanded by 7.6% and 12.8%, respectively.

(Mohsen et al. 2014) examined numerically effect of magnetic field on nanofluid(CuO-water) flow and natural convective heat transfer in an enclosure which from below heated. Lattice-Boltzmann-method is applied to solve the governing equations. The results uncover that upgrade in heat transfer increments as Hartmann-number and warm source length increment but it diminishes with increment of Rayleigh-number. Too, it can be found that the impact of warm source length and Hartmann-number is more articulated at tall Rayleigh-number.

(Servati et al. 2014) considered the magnetohydro- dynamic (MHD) of nanofluid (Al₂O₃-water) in a permeable channel. They found that by expanding the nanoparticle concentration, the temperature and average speed at the channel outlet expanded drastically. Moreover, the comes about demonstrated the normal Nusselt number increments marginally with magnetic field concentrated.

(Hussein et al. 2014) numerically study of magneto-hydrodynamic free convection flow of nanofluid (Cu/water) in an open enclosure utilizing the lattice Boltzmann method (LBM). Results demonstrate that supreme values of stream work are declined altogether by expanding Hartmann-numbers whereas these values raised by expanding Rayleigh-numbers. Additionally, the strong volume division detailed a noteworthy impact on heat transfer and stream work, depending on the esteem of Rayleigh numbers and Hartmann.

(Ghadiri et al. 2015) examined experimentally effect of magnetic fluid as a coolant on the efficiency of a PV/T system. The fluids considered are distilled-water and (Fe₃O₄/water) a ferrofluid of volume concentration of (1 , 3)% the working liquid have a closed stream circuit, heat exchanger a shell and tube of a counter-flow plan is utilized to cool the working liquid after being warmed within the PVT collector. The mass stream rate of the working liquid is balanced to 30 L/h. The moment liquid utilized in this warm exchangers is the running city water with mass stream rate of(40) L/h. The Ferro fluids are exposed to constant and alternating magnetic fields in the cooling section of a PV/T system. The comes about are that employing Ferro fluid
(3 wt)%, the in general productivity of the framework progressed by 45%. When a substituting magnetic field of 50 Hz recurrence was connected, the by and large effectiveness is expanded by 50%, compared to that of the refined water as a coolant liquid. The generally exergy yield of the framework without and with Ferro fluid was too compared with exergy of PV framework with no collector. It was watched that by including a warm collector to a PV framework and employing ferrofluid3%wt beneath an substituting attractive field, the overall exergy can be expanded as tall as 48 W. Changing the cooling liquid from refined water to a Ferro fluid, i.e. Fe$_3$O$_4$-water, the in general productivity of the framework for 3%wt moved forward by almost 76%.

(Mohsen and Mohammad 2015) analyzed the impact of spatially variable magnetic field on Ferro fluid stream and warm exchange. The enclosure is full of with nanofluid. They applied The control-volume based finite-element-method (CVFEM) to solve the governing equations. The joint effects of magneto hydrodynamic and Ferro hydrodynamic have been taken under consideration. The impacts of Rayleigh number, nanoparticle volume fraction, Magnetic number, and Hartmann number on the stream and heat transfer characteristics have been inspected.

(Mohsenet al. 2015) investigated numerically effecoted of (MHD) magneto hydrodynamic on the natural convection flow of nanofluid (CuO-water) flow in a rectangular heated body utilizing (LBM) Lattice-Bolzmann-Method. Results demonstration that Dimensionless entropy generation number and the heat transfer rate increment with increment of Rayleigh-number and nanoparticle volume fraction but it diminishes with the increment of the Hartmann-number.

(Abdulhassan et al. 2016) presented an exploratory work of heat-transfer and flow of nanofluid (Fe$_3$O$_4$/ water) of volume concentrations of (0.3, 0.6, 0.9)% in a horizontal-pipe subjected to magnetic field constant, figuar (2) show schematic diagram of the experimental test rig. These tests are executed with uniform heat flux (11262-19562W/m$^2$) and range of Reynolds number (2900-9820). The results demonstration that, the increment of magnetic flux and nanofluid concentration, the Nusselt number increments. The upgrade in Nusselt number is (5.4, 26.4 and 42.7)% for the Ferro fluid of volume concentrations of (0.3, 0.6, 0.9)%consecutive. The heat transfer improvement diminishes with the increment of Reynolds's number utilizing magnets. The contact calculate increments with expanding nanoparticle volume concentration and the escalated of magnet & diminishes with the increment of Reynolds's-number.
analyzed numerically the steady free convection in a vertical cylinder full of with nanofluid $\text{Al}_2\text{O}_3$ subjected two different external magnetic fields radial $B_r$ or axial $B_z$ directions. The comes about show that for little values of Hartmann number, the normal Nusselt number diminishes when expanding the strong volume division. This diminish is more imperative in case the attractive field is connected within the pivotal heading (expanding the Hartmann numbers). The increment within the strong volume fraction increments the execution of heat transfer within the nanofluid.

investigated analytically the nanofluid hydrothermal behavior inside an enclosure in the presence of a variable magnetic field using the Differential Transformation Method (DTM). The fluid in the enclosure is water containing different types of nanoparticles $\text{Al}_2\text{O}_3$ and CuO. Results appear that the skin friction coefficient increments with increment of the Hartmann number and squeeze number but it diminishes with increment of nanofluid volume fraction. Nusselt number increments with Hartmann number, expand of nanoparticles volume division, whereas it diminishes with increment of the crush number.

investigated electromagnetohydro-dynamic (EHD) flow driven by peristaltic pumping, they inspected the effects of EDL thickness and Hartman number on flow characteristics. EHD problem is additionally streamlined beneath the Debye-linearization. Closed form arrangements for the linearized dimensionless-boundary esteem problem are determined. With expanding Hartmann-number, the
formulation of the bolus within the administration (related with catching) is hindered up to basic esteem of the magnetic field. Axial velocity, local wall shear stress, and flow rate are unequivocally diminished with more prominent Hartmann number while weight contrast is upgraded with higher Hartmann number at moo time but decreased with more noteworthy pass in time. The simulations find applications in electromagnetic peristaltic micro-pumps in medical engineering and also “smart” fluid pumping systems in nuclear and aerospace industries.

(Irwan et al. 2016) Investigate expermaintaly enhancement thermal properties (kinematic viscosity and the thermal conductivity) of nanomaghemite of volume concentrations of (0.1, 0.2, 0.3, 0.4, 0.5, 0.6)% subjected to the external magnetic field in distinctive introductions (perpendicular and parallel). The comes about appear that the thermal conductivity improvement of maghemitenanofluid increments with an increment within the strength of magnetic field. The results too appear that the kinematic viscosity improvement of the maghemitenanofluids increments with an increment within strength of the magnetic field. Moreover, the highest kinematic kinematic consistency upgrade (31.91)% is achieved at the over said exploratory conditions.

(Ellahi et al. 2017) explored the effect of magneto-hydrodynamics (MHD) on a non-Newtonian peristaltic stream of Carreau liquid in a uniform channel of rectangular cross-section. An connected attractive field is considered though the actuated attractive field is taken to be zero here due to little magnetic Reynolds number. Their comes about uncovered that the impact of the attractive field upgrades the pumping rate within the peristaltic and retrograde pumping ranges.

(Maouassi et al. 2017) outlined how commonsense application of utilizing nanoparticles (SiO$_2$) as a working liquid to fortify efficiency of solar collector type flat plate with heat-transfer adjustment properties. A numerical think about of laminar constrained convection nanofluid, lasting and stationary (SiO$_2$), is conducted in a sun powered level plate solar collector. The obtained results of pressure drop coefficient; Nusselt number, and temperature are discussed. Finally, concluded that warm exchange increments with expanding both nanoparticle concentration and Reynolds-number. Figures 3 represents the Nusselt-number evolution as a function of Reynold-number and the volume fraction $\phi$. 

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Dheya A. Khalaf et al
(Heidary et al. 2017) analyzed fluid flow and heat transfer in a wavy channel, whereas a magnetic field is connected in transverse heading to the most stream. As of late in a numerical think about, it is watched that usage of wavy channel rather than straight one upgrades warm trade between the center stream and hot dividers. Otherwise, the utilization of magnetic-field transverse to hot dividers can upgrade heat transfer in a straight channel. They inspected in case the nearness of these two strategies at the same time is valuable for the upgrade of warm trade or not. Figures 4 shows the variation of average Nusselt-number of the hot walls of channels versus Hartmann-numbers for wave amplitude (0, 0.1, 0.2, 0.3).

Fig. 3: Heat transfer coefficient versus: (a) Reynold-number and (b) different concentrations of nanoparticles SiO$_2$. (Maouassi et al. 2017)

Fig. 4: Test of parametric thinks about within the display computation; graph of average Nusselt number versus Hartmann-numbers for various wave amplitude at Re=250. (Heidary et al. 2017)
(Kefayati and Tang 2017) in this work entropy generation, and free convection of nanofluid (non-Newtonian) enclosed in a cavity subjected to a uniform magnetic field, using the Buongiorno's mathematical model. This model is solved by the (FDLBM) Finite Difference Lattice Boltzmann method. Comes about demonstrate that the increase of the Hartmann-number causes mass transfer and heat transfer to drop. The modification of the power law file changes to (mass & heat) transfer. Other than, the rise of the Hartmann-number decays sheathing behavior. The increment within the Lewis-number expands mass exchange whereas it causes warm exchange to drop.

(Hariri et al. 2017) numerically investigated the effect of the strong of magnetic-field on the ferrofluids flow in the tube a three-dimensional. This ponder comprehensively analyzes the impact of a non uniform magnetic-field on the ferrofluid (water & 0.86% Fe$_3$O$_4$) interior the tube. Results appear, the nearness of a non uniform magnetic-field altogether increments the Nusselt-number more than (300)% interior the tube. Moreover, the attractive field initiated by the parallel wire influences the velocity of the Ferro fluids and shapes two solid vortexes within a tube.

(Mokhtari et al. 2017) analyzed the enhancement performance of heat transfer of nanofluid of volume concentration of (water/Fe$_3$O$_4$) flow in tube subjected to magnetic flux, with and without turned. The exportary information are approved with numerical simulations with sensible inconsistency. Parametric thinks about are performed to uncover the impact of different components such as such as magnetic field intensity, the concentration of nanoparticle, Reynolds number, shape geometry of and twisted-tape on the heat-transfer are explored. Agreeing to the gotten results, the average Nusselt-number of magnetic fluid (ferrofluids) increments by more than 200% because it streams interior the tube with bent tapes. Moreover, the attractive field initiated by parallel wire upgrades the normal warm exchange of the whirling Ferro fluid (approximately 30%). The comes about moreover appear that the Nusselts-number moreover rises as the concentrations of the nanoparticles is expanded.

(Sha et al. 2017) an exploratory examination to analyze the impact of the attractive field on heat exchange convective of nanofluid (Fe$_3$O$_4$-water) in a turbulent stream administration. It appeared that the heat transfer coefficient expanded with the increment of the nanofluids (Fe$_3$O$_4$-water) concentration, magnetic field intensity, and temperature. Too, the upgrade expanded beneath the gradient magnetic-field than that beneath the uniform magnetic field. Without the impact of the magnetic-field, the most extreme found the middle value of convective heat transfer-coefficient of nanofluid (Fe$_3$O$_4$-water) is over that of Distilled Water by 5.2% at a volume concentration of 3% and the temperature of 40 °C., the greatest found the middle value of improvements of the convective heat transfer coefficient over that of within the nonattendance of the magnetic field were 4.2% and 8.1%. The test comes about concurred well with the non-dimensional investigation.

(Hatami et al. 2017) experimentally study heat transfer (forced convection)in the horizontal pipe laminar flow of nanofluid (Fe$_3$O$_4$-water) of volume concentrations of (0.1, 0.5, 1)% subjected to magnetic field and constant heat flux conditions. Results appeared that by the nearness of a magnetic field, the increment in nanoparticle

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Dheyaa A. Khalaf et al
concentration caused a diminishment within the convection heat transfer coefficient. In this condition, heat transfers diminished up to 25%. Where, within the nonattendance of an outside magnetic field, including magnetic nanoparticles expanded convection heat transfer more than 60%. It was watched that the Nusselt number is diminished by expanding the Hartmann number at a indicated concentration of magnetic nanofluids, that lessening was around 25% in heat transfer rate.

(Khosravi et al. 2018) explored the characteristics of Ferro fluids and its properties of heat transfer within the nearness of a magnetic field for in a absorber tube for diverse mechanical applications.

(Malekan et al. 2018) created a consider based on CFD recreation and versatile neuro fuzzy deduction framework optimized with molecule herd optimization to survey the impact of the magnetic field on heat-transfer of nanofluid Fe$_3$O$_4$-water in the tube. It was accomplished that the heat-transfer of Fe$_3$O$_4$-water upgrades with the nearness of a magnetic-fields. Moreover, the created cleverly demonstrate effectively predicts the heat transfer coefficient of Ferro fluid with distinctive force of the magnetic-field. Several examinations (experimental and numerical) have been created to estimate the impact of the magnetic-field on heat-transfer improvement of nanofluid.

(Amir et al. 2018) in this study the Magneto hydrodynamic currents are utilized, to increase the level of heat-transfer in heat-exchangers, channel cross-section, and using nanofluids can be addressed. Overall, by the presence of a magnetic field that covers the current inside the duct, fluids or particles which have magnetic characteristics will be affected and some forces in special directions are affected. Using the MHD current, the current and heat transfer inside the pipes can be controlled in an arbitrary direction. In this research, the MHD current is investigated in the presence of nanofluids inside a triangular duct and magnetic field in slow flow in the form of completely two phases in ANSYS CFX software. Because it can be seen in figure 5 by increment of Reynolds number the esteem of warm transfer coefficient of surface increments in normal, besides, the changes from single stage show to two stage leads to extend of warm exchange coefficient.
Fig. 5: surface heat transfer coefficient with Reynold-number in different volume fractions for 1 phase model (1pm) and two phases model (2pm) (Amir et al. 2018)

(Seth and Mandal 2018) this ponder explores heat-transfer in (MHD)magneto hydrodynamic free convection stream of Ferro fluid alongside an swaying vertical plate. Water with nanoparticle of magnetite Fe$_3$O$_4$ is selected as well as not magnetic aluminum oxide nanoparticles Al$_2$O$_3$ are utilized. The issue was modeled in terms of fractional differential conditions with the starting and boundary-condition. Explanatory arrangements are gotten for speed and temperature by utilizing the Laplace-transform-technique. The numerical comes about for speed and temperature are gotten and plotted graphically. Too, numerical values of skin grinding and Nusselt-number are displayed in tables and talked about.

(Naphon and Wiriyasart 2018) examined throbbing stream and attractive field impacts on warm exchange upgrade of nanofluids TiO$_2$-water in a helically layered tube. Exploratory set up is outlined and built to be tried beneath changing nanofluid mass stream rate of (0.01–0.10) kg/s, nanofluid of volume concentration of (0.25, 0.50)%, nanofluid throbbing stream recurrence of 10, 15, 20 Hz and the helically folded rib with the profundity and pitch of 1.25 mm, 6.35 mm, individually. As compared with the plain tube, the physical-properties of nanoparticles and aggravating the thermal-boundary zone of working liquid have a noteworthy impact on the improvement of heat transfer. Moreover, the aggravating of nanoparticle Brownian movement suspending within the base liquid by magnetic-field and throbbing stream recurrence have a critical increase of warm exchange. It can be seen that a combined heat-transfer improvement strategies fulfill the commonsense applications to move forward the heat execution of thermal gadgets.

(Sheikholeslami et al. 2018) assessed numerically the impact of not uniform magnetic-field on the heat-transfer improvement of the Ferro fluids in a 90° elbow channel. The finite-volume-method with the algorithm SIMPLEC is connected to
uncover the impacts of the not uniform magnetic-field on heat and grinding calculate for the show work. Comprehensive parametric considers are done to think about the impact of different variables such as the concentrated of the magnetic field and Reynolds-number on heat-transfer. Comes about illustrated that Ferro fluid Nusselt-number increments more than 28.6% as the magnetic field Mn=9.32 *106 the elbow. Besides, heat transfer is expanded by around 18% as the Reynolds-number interior the elbow is expanded from 50 to 100.

(Zonouzi et al. 2018) a combined heat transfer upgrade strategies: throbbing stream, nanofluid, micro finned tube, and magnetic-field are explored. Tests are performed beneath condition of Reynolds-number shifting from 1000 to 2400, and nanofluid of volume concentration of (0.25 and 0.50)%. It can be seen that a combined heat transfer upgrade procedures are a great potential to make strides the warm execution of heat gadgets. The throbbing stream and magnetic-field have an advantage on the Brownien movement of nanoparticle within the base liquid streaming through the framework. Comes about appear that heat transfer upgrade increments essentially with the increment in nanoparticle concentration, the throbbing recurrence, and magnetic field strength. Be that as it may, they are somewhat influenced by the weight drop.

(Alsaady et al. 2018) investigated experimentally of the execution of little scale coordinate assimilation sun based collectors utilizing Ferro fluid as a safeguard was conducted. Nanoparticle of volume concentration 0.05% at the operational temperatures range (19-40)°C were utilized within the current think about. The comes about appear that utilizing Ferro fluids as a heat transfer liquid increments the collectors efficiency. Within the nearness of the outside attractive field, the collector productivity increments to the greatest, 25% higher than the ordinary illustrative trough. At higher temperatures, the Ferro fluids appear much way better proficiency than customary heat transfer liquid. The consider shown that nanofluids, indeed of low content, have great assimilation of sun based radiation, and can progress the outlet temperature and framework efficiencies. The ponder appears the potential of utilizing Ferro fluids within the coordinate absorption collector sun oriented.

(Gan et al 2018) showed that Ferro fluids (magnetic nanofluids) have thermal conductivity higher than their base watery or oil based liquids due to the strong magnetic nanoparticle that makeup the Ferro fluids. Heat transfer properties of the stream are improved with the utilize of Ferro fluids which the fabric makeup of the Ferro fluids influences these properties. Results show that convective heat transfer rates for Ferro fluids are expanded by expanding the strong volume concentration of magnetic-particles within the investigated range (0.2–0.4%). Interestingly, increasing magnetic flux decreases heat transfer improvement. Comes about shown that the treated conciliatory molds were almost four times smoother than the untreated molds (allude to Table 1) which the cross area got to be circular.
Table 1: Results of Surface Roughness (Gan et al 2018)

| Sample | 2D surface roughness (µm) | 3D surface roughness (µm) |
|--------|---------------------------|---------------------------|
|        | Top | Bottom | Top | Bottom |
| Sample 1       | 8.12 | 33.35 | 9.02 | 47.53 |
| Sample 2       | 9.04 | 28.48 | 7.41 | 36.31 |
| Sample 3       | 10.32 | 11.82 | 13.97 | 15.52 |
| Sample 4       | 5.43 | 10.09 | 15.29 | 14.26 |

(Mohammad et al. 2018) studied nanofluid (Fe$_3$O$_4$-water) subjected to magnetic as the auxiliary liquid within the proposed twofold tube heat exchanger. The heat transfer of compressed discuss is retained by the auxiliary liquid and it is put away in an disconnected tank. The comes about illustrated that expanding the mass stream rate of the auxiliary liquid diminishes the cavern temperature. Too, the esteem of convective warm exchange and pressure drop with the friction factor of Ferro fluid increments when the volume division of nanoparticle as well as attractive field increments. Another critical parameter for execution investigation of the warm exchanger is the outlet temperature of both discuss and Ferro fluid/water. Because it can be seen from figure 6 a, the contrast between discuss outlet temperatures for all cases is less than 3%, which suggests that attractive field has least impact on the discuss flow characteristics. Be that as it may, Ferro fluid leads to have an increment within the outlet temperature comparing to the base liquid temperature, see figure 6 b.

![Fig. 6: Thermal efficiency of the current solar collector with different working fluids.](Mohammad et al. 2018)

III. Conclusions

Through the research group that was reviewed, these studies demonstrated that adding nanoparticles to fluids improves the physical properties of these fluids. Also, the effect of those nanoparticles was evident on improving heat transfer and equivalent thermal conductivity significantly. Studies have also demonstrated that
adding magnetic field to solar collector systems has had a clear impact on improving these systems. Affected by the magnetic field, the particles inside the nanofluid would become unstable within a short period.

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