PERFORMANCE OF DOUBLE PIPE HEAT EXCHANGER WITH DIFFERENT NANO FLUIDS

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ABSTRACT A warmth exchanger is a gadget that is utilized to move nuclear power (enthalpy) between at least two fluids, between a strong surface and a fluid, or between strong particulates and a fluid, at various temperatures and in warm contact. Warmth exchangers are significant designing gadgets in many cycle businesses since the proficiency and economy of the interaction to a great extent rely upon the exhibition of the warmth exchangers.

The current work is coordinated towards the displaying of twofold line heat exchanger in strong works .CFD investigation is completed for twofold line heat exchanger utilizing water, Ti02 Nano and Al2o3fluids .The LMTD and warmth move coefficient is determined for the warmth exchangers. The stream directions to imagine the subsequent stream field .By noticing the outcomes the warmth move coefficient has been expanded 2.5 occasions by use Tio2 nano liquid in twofold line heat exchanger. By noticing the outcomes the warmth move coefficient has been expanded multiple times by use Al2o3 nano liquid in twofold line heat exchanger. From this we infer that the exhibition of the warmth exchanger will be better when Al2O3 nano liquid as the functioning liquid contrasted and the other two liquids.**Keywords -** CFD analysis double pipe heat exchange water with Ti02 and al03, Nano fluids, comparison.

1. INTRODUCTION TO HEAT EXCHANGERS

A warmth exchanger is a gadget that is utilized to move nuclear power (enthalpy) between at least two fluids, between a strong surface and a fluid, or between strong particulates and a fluid, at various temperatures and in warm contact. In heat exchangers, there are normally no outer warmth and work communications. Run of the mill applications include warming or cooling of a fluid stream of concern and vanishing or buildup of single-or multi part fluid streams. In different applications, the goal might be to recuperate or dismiss heat, or disinfect, sanitize, fractionate, distil, concentrate, take shape, or con¬trol an interaction fluid. In a couple of warmth exchangers, the fluids trading heat are in direct contact. In most warmth exchangers, heat move between fluids happens through an isolating divider or into and out of a divider in a transient way. In many warmth exchangers, the fluids are isolated by a warmth move surface, and in a perfect world they don't blend or break. Such exchangers are alluded to as immediate exchange type, or essentially recover. Normal instances of warmth exchangers are shell-and-cylinder exchangers, auto radiators, condensers, evaporators, air preheaters, and cooling towers. In the event that no stage change happens in any of the fluids in the exchanger, it is in some cases alluded to as a reasonable warmth exchanger. There could be inner nuclear power sources in the exchangers, for example, in electric radiators and atomic fuel components.

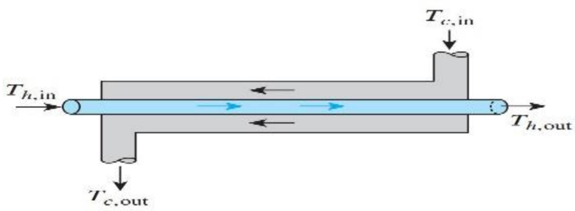


Fig.1.1: Simplified diagram showing the operation of double pipe exchangers

2. LITERATURE SURVEY

Traditional fluid are regularly coolants broadly utilized in heat exchangers to forestall overheating and to disseminate more warmth from heat move supplies like electronic gadgets, car radiators and so forth Anyway a convectional heat move liquid, for example, water or ethylene glycol by and large has helpless warm properties. Numerous test examines have been directed by specialists on fluids containing miniature metallic particles with high warm conductivity fully intent on working on the warm properties of the convectional heat move liquids. The utilization of micron estimated course particles in fluids produce sedimentation arrangement and disintegration of cylinder material and thus shed and subbed by substitute nanoparticles. Choi (1995) and his group created nano-sized particles and got higher warm conductivity by designing the molecule scattering in fluids. In this way the specialists like Masuda et al. (1993), Lee et al. (1999), Wang et al. (1999), Eastman et al. (1999, 2001), Das et al. (2003) for the most part focused on the assurance of compelling warm conductivity of Nano liquids. [1]

Past examinations on the convective warmth move improvement of Nano liquids have been accounted for as follows: Xuan and Li (2003) have first time introduced the experimental relationship for the assessment of Nusselt number in laminar and violent stream condition utilizing Cu Nano fluids[2]. Wen and Ding (2004) saw that Al2O3 nanoparticles when scattered in water can essentially improve the convective warmth move in the laminar stream system and the upgrade increments with Reynolds number, just as molecule focus contrasted with base liquid. Tests with Al2O3/water Nano liquid in the laminar stream scope of Reynolds number in the

3. CAD MODELING IN SOLIDWORKS

MODELLING OF DOUBLE PIPE EXCHANGER

Modeling of double pipe heat exchanger is as follows:

PIPE1:

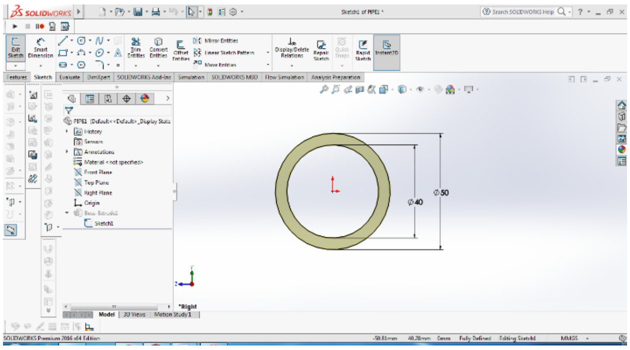


Fig:3.1 sketch of pipe1

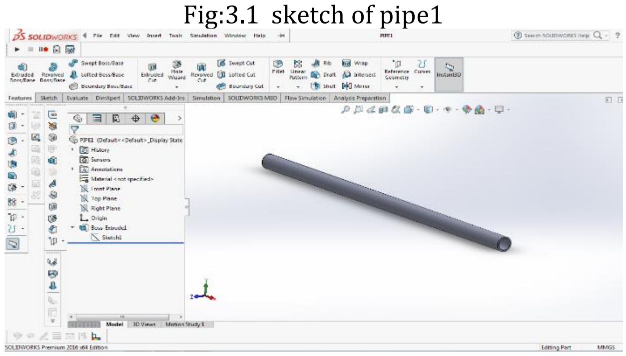


Fig:3.2 Iso view of pipe1 of length 1200mm

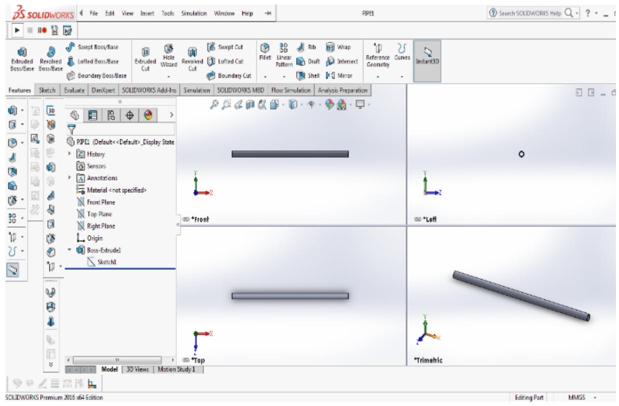


Fig: 3.3 different views of pipe1

PIPE 2:

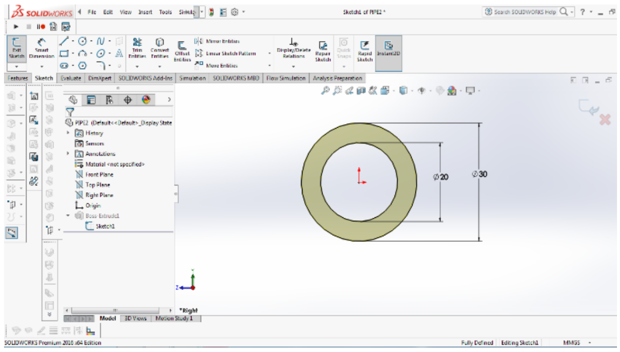


Fig:3.4 Sketch of pipe 2

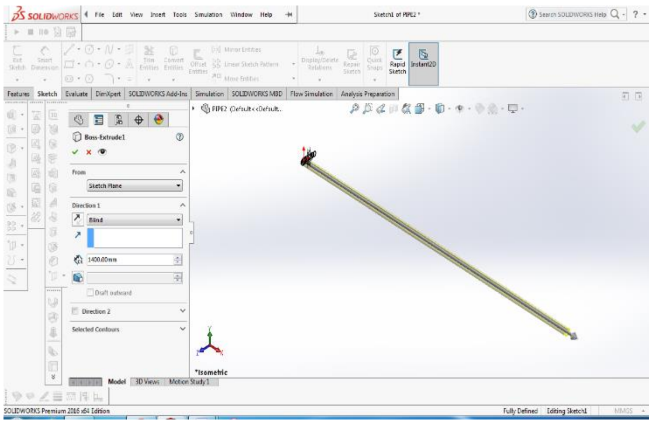


Fig: 3.5 pipe 2 extrusion of 1400mm

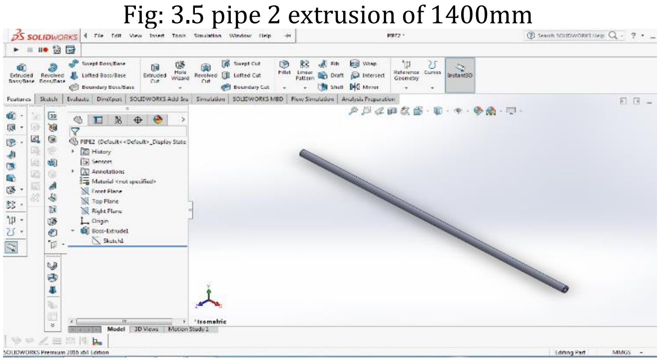


Fig:3.6 Iso view

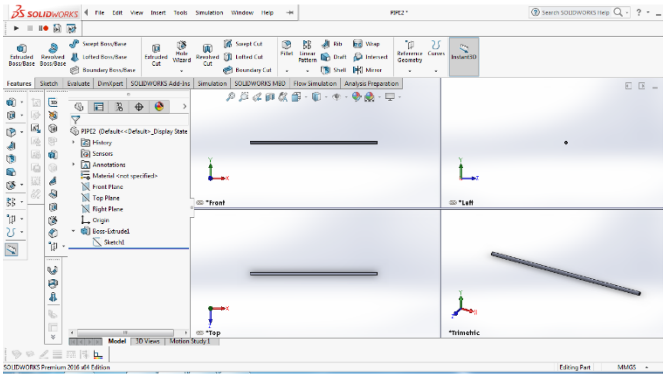


Fig:3.7 Different views of pipe 2

ASSEMBLY OF DOUBLE PIPE HEAT EXCHANGER

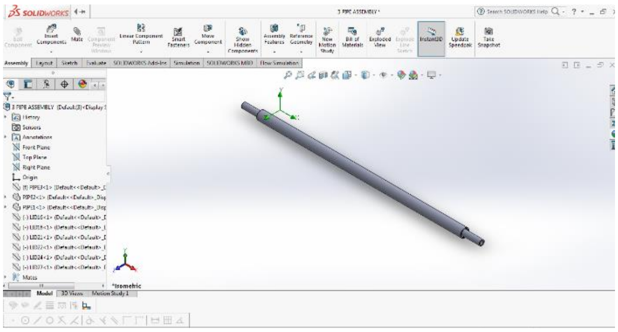


Fig:3.8 iso view

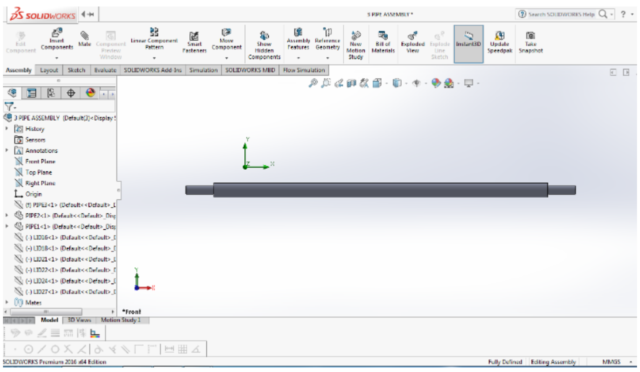


Fig: 3.9 :Front view

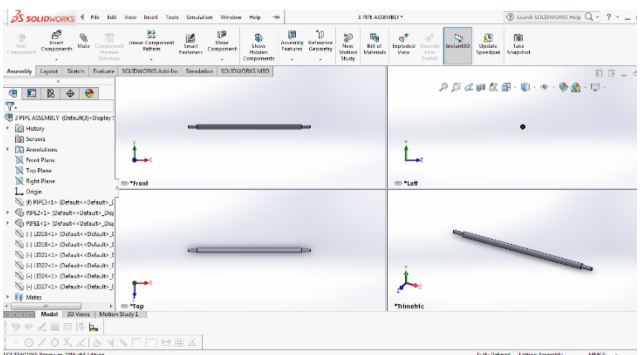


Fig: 3. Different views of Double pipe heat exchanger assembly

4. CFD ANALYSIS OF DOUBLE PIPE HEAT EXCHANGER USING WATER AS FLUID

4.1 CFD analysis is carried out for double pipe heat Exchanger using water as fluid.

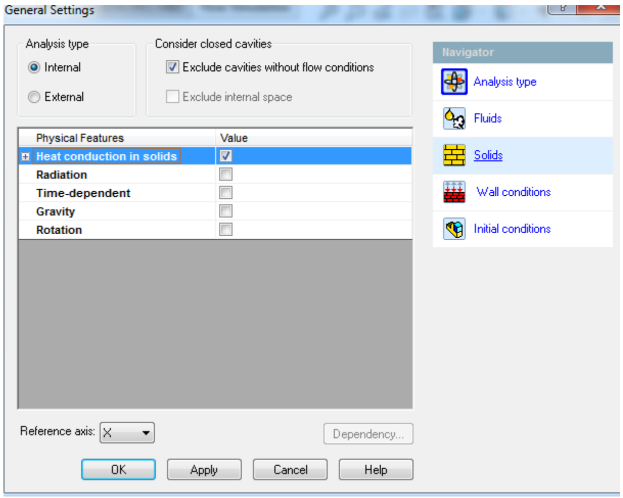


Fig:4.1 Internal analysis

By selecting Flow simulation module in solidworks and creating new project for Internal analysis as shown above.

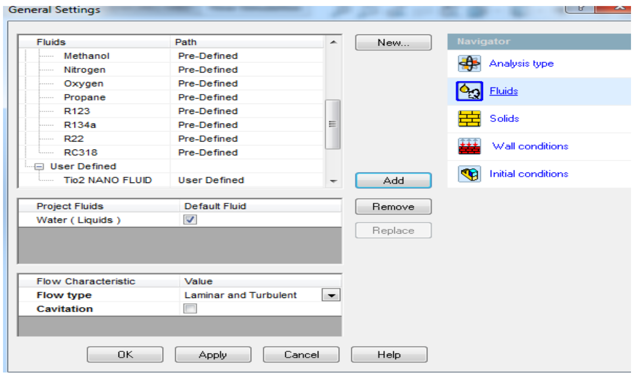


Fig: 4.2 water as fluid

By selecting water as project fluid for analysis

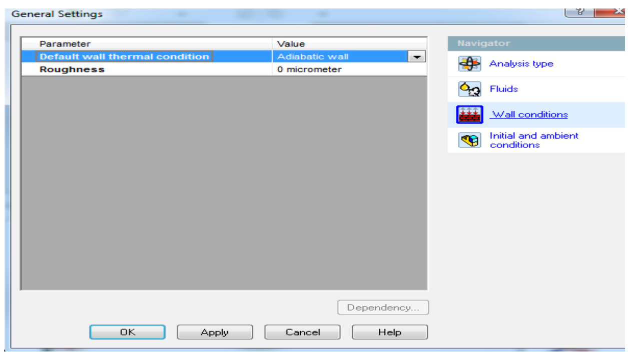


Fig: 4.3 Default conditions

By selecting default wall and thermal conditions as shown above.

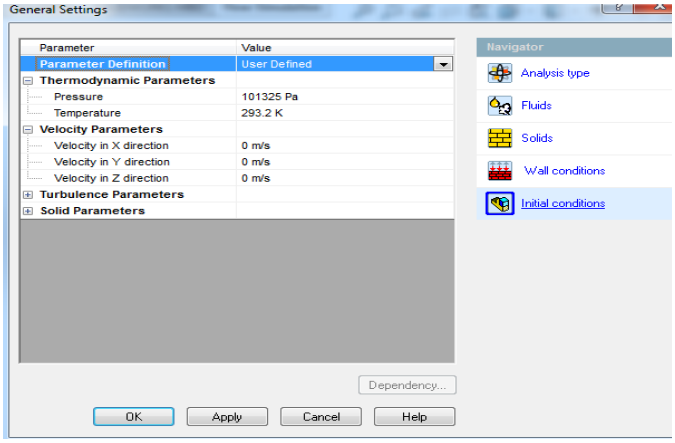


Fig: 4.4 default conditions

By selecting default thermodynamic parameters as pressure 101325 Pa & temperature 293.2K

SYSTEM INFO

Product	Flow Simulation 2016 SP2.0. Build: 3350
Computer name	SANDEEP-PC
User name	Mech wind
Processors	AMD Phenom(tm) II X2 560 Processor
Memory	4093 MB / 8388607 MB
Operating system	Windows 7 Service Pack 1 (Build 7601)
CAD version	SOLIDWORKS 2016 SP2.0
CPU speed	3300 (792) MHz

Model pipe

Project name	CFD
Project path	C:\Users\sandeep\Desktop\
Units system	SI (m-kg-s)
Analysis type	Internal
Exclude cavities without flow conditions	On
Coordinate system	Global coordinate system
Reference axis	Z

Information DATA

Worldwide Mesh Settings

Programmed starting lattice: On

Result goal level: 3

Progressed thin channel refinement: Off

Refinement in strong district: Off

Math Resolution

Assessment of least hole size: Automatic

Assessment of least divider thickness: Automatic

Computational Domain

Starting Conditions

Thermodynamic parameters	StaticPressure: 101325.00 Pa Temperature: 293.20 K
Velocity parameters	Velocity vector Velocity in X direction: 0 m/s Velocity in Y direction: 0 m/s Velocity in Z direction: 0 m/s
Solid parameters	Default material: Copper Initial solid temperature: 293.20 K

BOUNDARY CONDITIONS

4.4.1 COLD FLUID

Type	Inlet Mass Flow
Faces	Face<1>@LID27-1
Coordinate system	Face Coordinate System

Reference axis	X
Flow parameters	Flow vectors direction: Normal to face Mass flow rate: 0.1500 kg/s Fully developed flow: No Inlet profile: 0
Thermodynamic parameters	Temperature: 278.00 K
Turbulence parameters	Boundary layer parameters

HOT WATER

Type	Inlet Mass Flow
Faces	Face<2>@LID34-1
Coordinate system	Face Coordinate System
Reference axis	X
Flow parameters	Flow vectors direction: Normal to face Mass flow rate: 0.2000 kg/s Fully developed flow: No Inlet profile: 0
Thermodynamic parameters	Temperature: 323.15 K
Turbulence parameters	Boundary layer parameters

STATIC PRESSURE 2

Type	Static Pressure
Faces	Face<3>@LID33-1Face<4>@LID21-1
Coordinate system	Global coordinate system
Reference axis	X
Thermodynamic parameters	Static pressure: 303975.00 Pa Temperature: 293.20 K
Turbulence parameters	Boundary layer parameters

COLD FLUID INLET

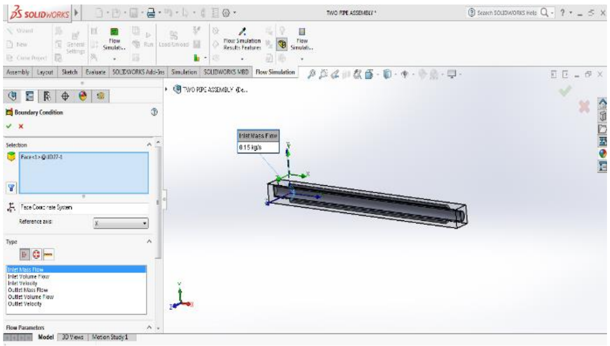


Fig:4.5 Cold fluid inlet TCI

By selecting the lid of outer pipe for cold fluid inlet with inlet mass flow of 0.15kg/s

HOT WATER INLET

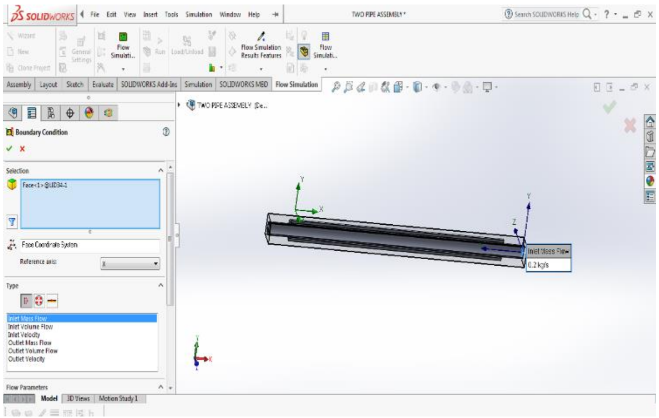


Fig: 4.6 Hot water inlet THI

By selecting the lid of inner pipe for hot fluid inlet with inlet mass flow of 0.2kg/s

ENVIRONMENT PRESSURE AT OUTLETS

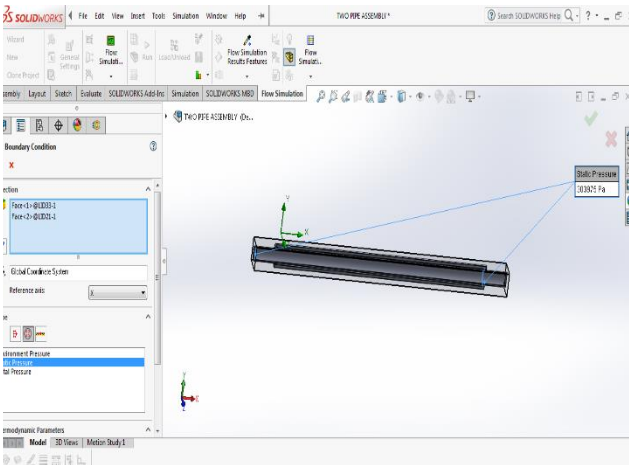


Fig: 4.7 Environment pressure at outlets

By selecting the environment pressure for the outlet lids.

RESULTS:

TRAJECTORIES OF COLD AND HOT

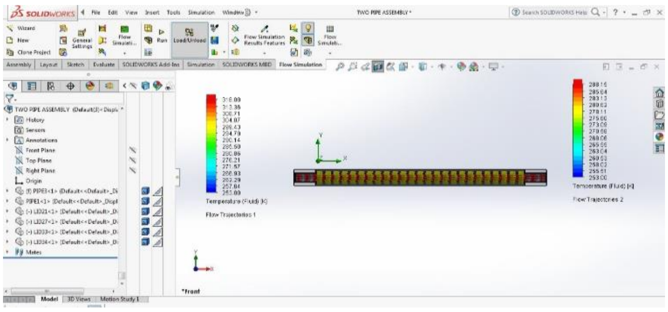


Fig:4.8 Flow Trajectories of cold and hot fluid

Flow trajectories of cold and hot fluid are shown as above. The heat lost by hot fluid is to be 318k from 323k . The heat gain by cold fluid is 288.15k from 278.15k.

TRAJECTORIES OF COLD FLUID

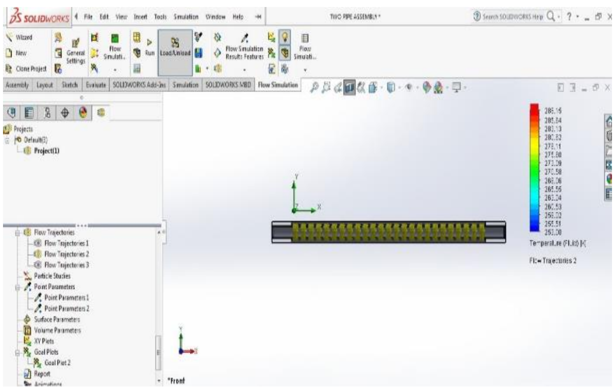


Fig: 4.9 Flow Trajectories of cold fluid

The heat gain by cold fluid is 288.15k from 278.15k.

TRAJECTORIES OF HOT FLUID

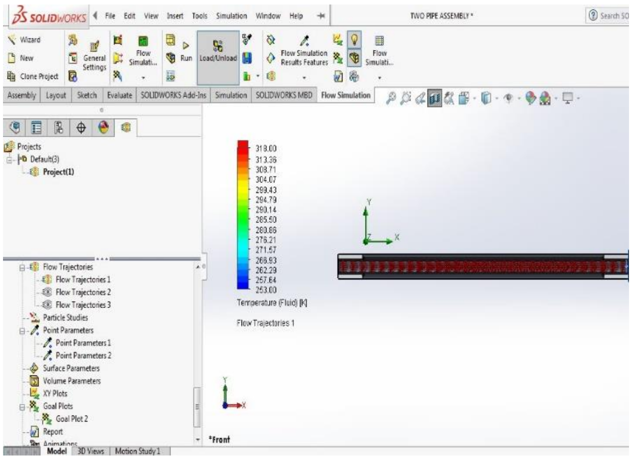


Fig:4.10 Flow Trajectories of hot fluid

The heat lost by hot fluid is to be 318k from 323k .

CFD ANALYSIS OF DOUBLE PIPE HEAT EXCHANGER USING Tio2 NANO FLUID

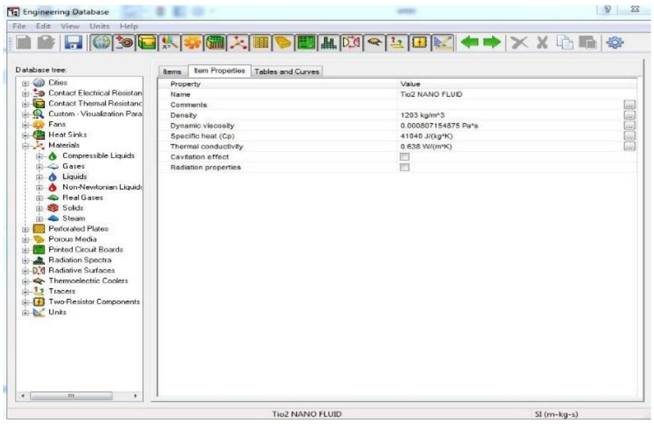


Fig: 4.11 Tio2 nano fluid properties

By applying same boundary conditions as above just changing project fluid as Tio2 nano fluid the results are as follows:

Tio2 NANO TRAJECTORIES OF HOT AND COLD FLUID

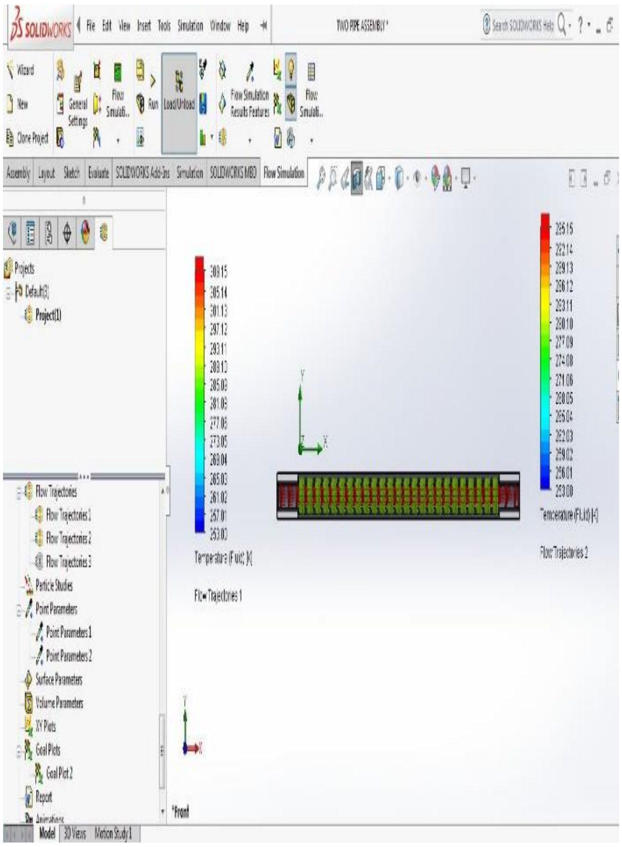


Fig:4.12 Flow Trajectories of hot and cold fluid

Flow trajectories of cold and hot fluid are shown as above. The heat lost by hot fluid is to be 309.15k from 323k . The heat gain by cold fluid is 295.15k from 278.15k.

Tio2 NANO TRAJECTORIES OF COLD FLUID

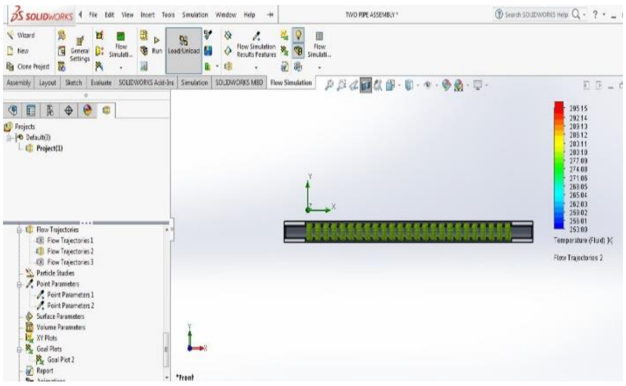


Fig:4.13 Flow Trajectories of cold fluid

The heat gain by cold fluid is 295.15k from 278.15k.

Tio2 NANO Trajectories of Hot Fluid

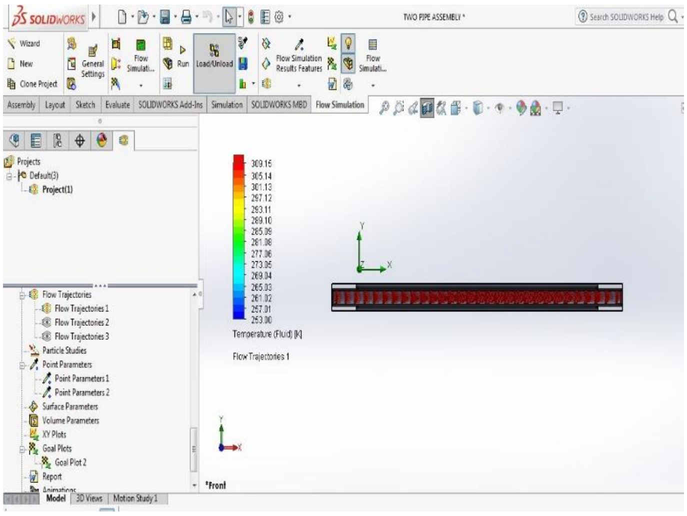


Fig:4.15 Flow Trajectories of hot fluid

The heat lost by hot fluid is to be 309.15k from 323k .

CFD ANALYSIS OF DOUBLE PIPE HEAT EXCHANGER USING Al2O3 NANO FLUID

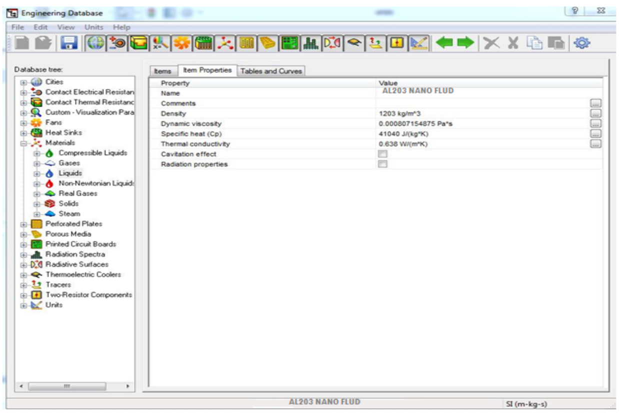


Fig:4.16 Al2o3 nano fluid properties

By applying same boundary conditions as above just changing project fluid as Al2o3 nano fluid the results are as follows:

Al2O3 NANO TRAJECTORIES OF HOT AND COLD FLUID

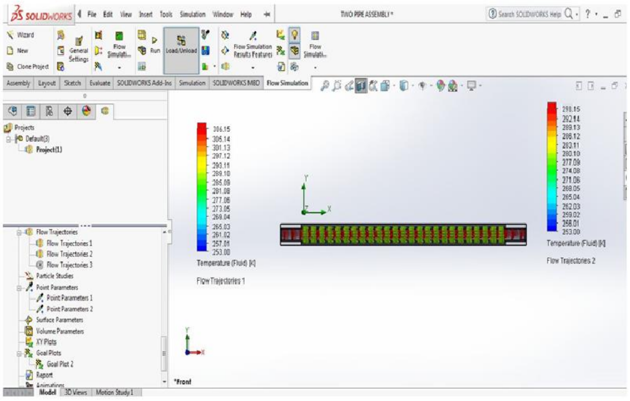


Fig: 4.17 Flow Trajectories of hot and cold fluid

Flow trajectories of cold and hot fluid are shown as above. The heat lost by hot fluid is to be 306.15k from 323k . The heat gain by cold fluid is 298.15k from 278.15k.

Al2O3 NANO TRAJECTORIES OF COLD FLUID

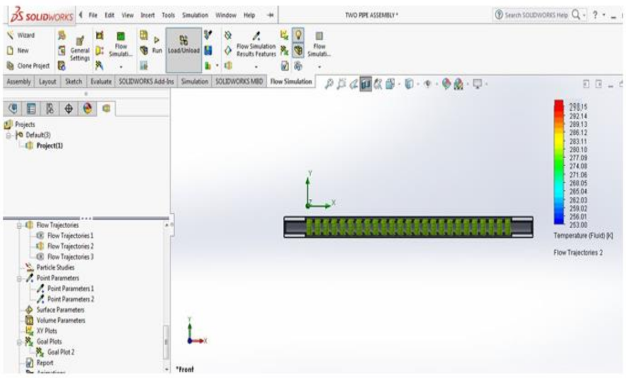


Fig: 4.18 Flow Trajectories of cold fluid

The heat gain by cold fluid is 298.15k from 278.15k.

Al2O3 NANO TRAJECTORIES OF HOT FLUID

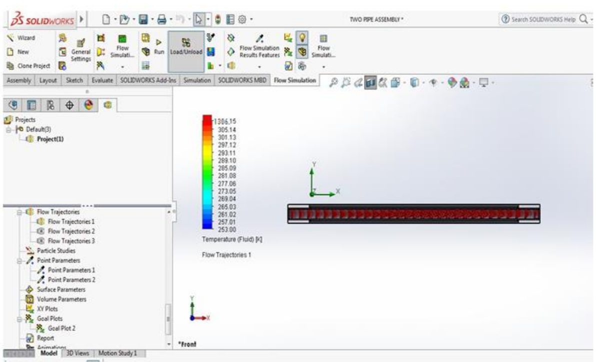


Fig: 4.19 Flow Trajectories of hot fluid

RESULTS AND DISCUSSION FOR DOUBLE PIPE HEAT EXCHANGER

S.NO	THI	THO	TCI	TCO	LMTD(K)	QAV(KW)	H(W/M2K)	FLUID
1	323.15	318.15	278.15	288.15	37.4	5.23	59.85	Water
2	323.15	309.15	278.15	295.15	29.47	11.18	151.74	Tio2 nano
3	323.15	306.15	278.15	298.15	26.4	15.49	234.69	Al2o3 Nano

By observing the above results the heat transfer coefficient has been increased 2.5 times by Ti02 nano fluid and almost 4 times by use Al2o3 nano fluid in double pipe heat exchanger.

SAMPLE CALCULATION FOR DOUBLE PIPE HEAT EXCHNAGER:

Thi= 323.15k

Tho= 318.15k

Qh= mxcx(Thi-Tho)= 0.2x4.187x5=4.187kw

A=SURFACE AREA=DxL=0.0025X1=0.0025m2

Tci=278.15k

Tco=288.15k

Qc= mxcx(Tco-Tci)= 0.2x4.187x10=6.28kw

Qavg=(Qh+Qc)/2=5.23kw

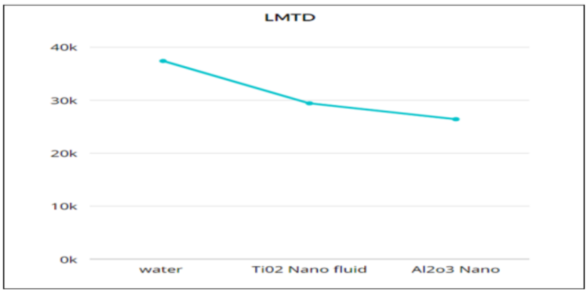
ΔT1=Tho-Tci=318.15-278.15=40k

ΔT2=Thi-Tco=323.15-288.15=35k

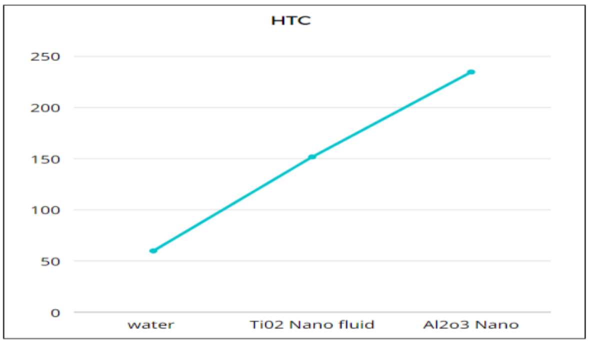
LMTD=(ΔT1-ΔT2)/ln(ΔT1/ΔT2)=37.4k

Heat tramsfer coefficient,h= Qav/(AxLMTD)= 59.8 w/m2k

Graph: 1



Graph: 2



5. CONCLUSIONS

Warmth move liquids like water, mineral oils and ethylene glycol assume a significant part in numerous mechanical areas including power age, substance creation, cooling, transportation and microelectronics. The presentation of these ordinary warmth move liquids is frequently restricted by their low warm conductivities. Driven by mechanical necessities of cycle heightening and gadget scaling down, advancement of elite warmth move liquids has been a subject of various examinations lately.

The current work is coordinated towards the displaying of twofold line heat exchanger in strong works .CFD examination is done for twofold line heat exchanger utilizing water, Ti02 Nano and Al2o3fluids .The LMTD and warmth move coefficient is determined for the warmth exchangers. The stream Trajectories to picture the subsequent stream field.

By noticing the outcomes the warmth move coefficient has been expanded 2.5 occasions by use Tio2 nano liquid in twofold line heat exchanger.

By noticing the outcomes the warmth move coefficient has been expanded multiple times by use Al2o3 nano liquid in twofold line heat exchanger.

From this we infer that the presentation of the warmth exchanger will be better when Al2O3 nano liquid as the functioning liquid contrasted and the other two liquids.

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