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THERMAL AND CFD ANALYSIS FOR FINDING HEAT TRANSFER THROUGH AN ANNULAR BEND TUBE FOR VARIOUS NANO FLUIDS

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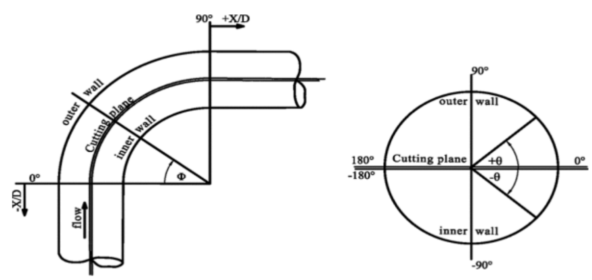
ABSTRACT

Heat transfer by convection is very important for many industrial heating and cooling applications. The heat convection can passively be enhanced by changing flow geometry, boundary conditions or by enhancing fluid thermos physical properties. A colloidal mixture of Nano-sized particles in a base fluid, called Nano fluids, tremendously enhances the heat transfer characteristics of the original fluid, and is ideally suited for practical applications due to its marvelous characteristics.

]In this thesis, different materials will be analyzed for their thermal behavior of an annular bend tube with turbulence flow. The materials considered in this thesis are ethylene glycol, copper and aluminum. Thermal and CFD analysis is performed to determine the thermal behavior using finite element analysis software Ansys. 3D modeling is done in PRO-E. CFD analysis is also done on the tube in tube heat exchanger for water for the above obtained best material materials.

INTRODUCTION

In the simplest of terms, the discipline of heat transfer is concerned with only two things: temperature, and the flow of heat. Temperature represents the amount of thermal energy available, whereas heat flow represents the movement of thermal energy from place to place. On a microscopic scale, thermal energy is related to the kinetic energy of molecules. The greater a material's temperature, greater the thermal agitation of its constituent molecules (manifested both in linear motion and Vibrational modes). It is natural for regions containing greater molecular kinetic energy to pass this energy to regions with less kinetic energy.



CONCEPT OF NANO FLUIDS

ZigBee Nano fluids are fluids containing nano particles (nanometer-sized particles of metals, oxides, carbides, nitrides, or nano tubes). Nano fluids exhibit enhanced thermal properties, amongst them; higher thermal conductivity and heat transfer coefficients compared to the base fluid. Simulations of the cooling system of a large truck engine indicate that replacement of the conventional engine coolant (ethylene glycol-water mixture) by a nanofluid would provide considerable benefits by removing more heat from the engine [7-10]. Additionally, a calculation has shown that a graphite based nanofluid developed jointly by Argonne and Valvoline could be used to eliminate one heat exchanger for cooling power electronics in a hybrid electric vehicle. This would obviously reduce weight, and allow the power electronics to operate more efficiently. The benefits for transportation would be Radiator size reduction, Pump size, Possible of elimination of one heat exchanger for hybrid-electric vehicles and Increased fuel efficiency. Using silicon carbide nanoparticles from partner Saint Gobain, the team has created an ethylene glycol/water fluid with silicon carbide nanoparticles that carries heat away 15 percent more effectively than conventional fluids. And working with industrial partner Valvoline, they've developed a graphite-based nanofluid that has an enhanced thermal conductivity of 50 percent greater than the base fluid, which would, under specific conditions, eliminate the need for a second heat exchanger for cooling power electronics. Nanofluids are dilute liquid suspensions of nanoparticles with at least one of their principal dimensions smaller than 100 nm. From previous investigations, nanofluids have been found to possess enhanced thermo physical properties such as thermal conductivity, thermal diffusivity, viscosity and convective heat transfer coefficients compared to those of base fluids like oil or water. From the current review, it can be seen that nanofluids clearly exhibit enhanced thermal conductivity, which goes up with increasing volumetric fraction of nanoparticles. The current review does concentrate on this relatively new class of fluids and not on colloids which are nanofluids because the latter have been used for a long time. Review of experimental studies clearly showed a lack of consistency in the reported results of different research groups regarding thermal properties. The effects of several important factors such as particle size and shapes, clustering of particles, temperature of the fluid, and dissociation of surfactant on the effective thermal conductivity of nanofluids have not been studied adequately. It is important to do more research so as to ascertain the effects of these factors on the thermal conductivity of wide range of nanofluids. Classical models cannot be used to explain adequately the observed enhanced thermal conductivity of nanofluids.

REQUIRED BENDING DATA

Before an intelligent decision can be made, the potential purchaser must understand the basics of tube bending. Rather than delve into bending theory, we will look at the required physical information about the part. The proposed machinery must have the physical and technical characteristics required to bend the part. The major factors influencing this are:

A: Outside diameter (OD)

B: Wall thickness

C: Bending radius (usually measured from tube center line)

D: Material

E: Part configuration

BENDING METHODS

There are various categories of tube bending equipment available on the market today. It is important a potential purchaser of a machine pay particular attention to required bending data and apply that knowledge to what is commercially available. "Re-inventing the wheel" can be very time consuming and expensive. Tube bending solutions, when approached methodically, can be obvious and profitable.

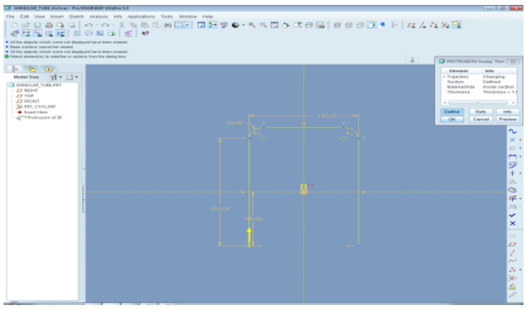
1. Manual bending

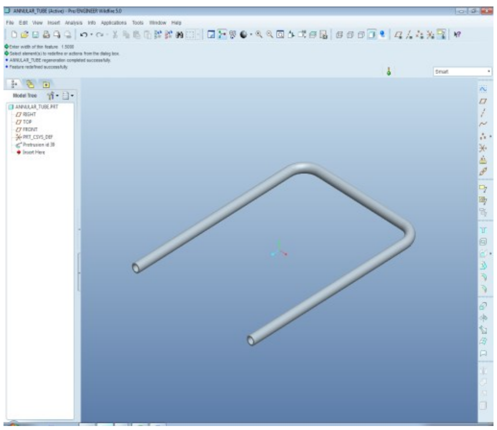
2. Semi-automatic bending

3. CNC bending

4. Special application bending

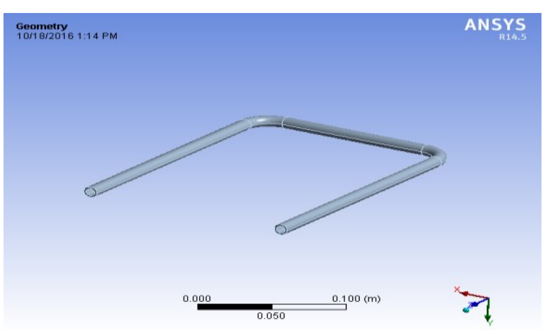
DESIGN OF ANNULAR TUBE



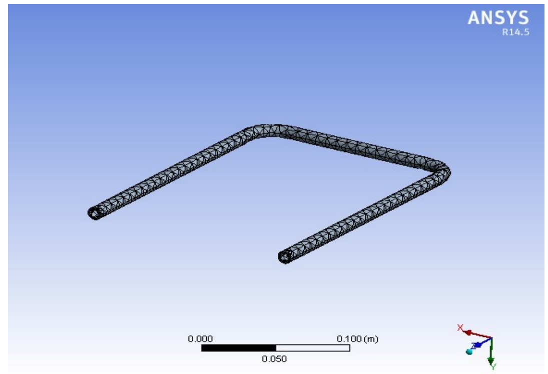


Model (A4)

Geometry

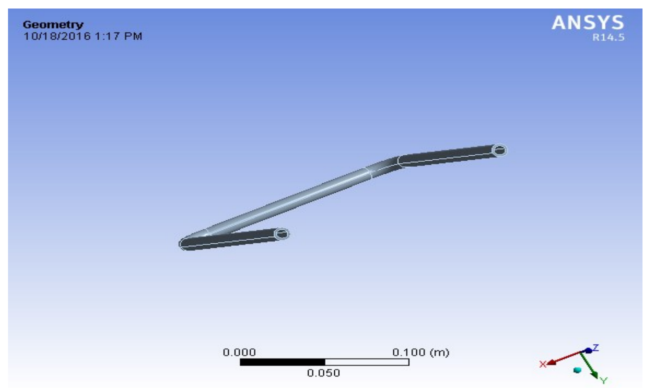


Mesh



THERMAL ANALYSIS OF ANNULAR BEND TUBE USING COPPER MATERIAL

Geometry



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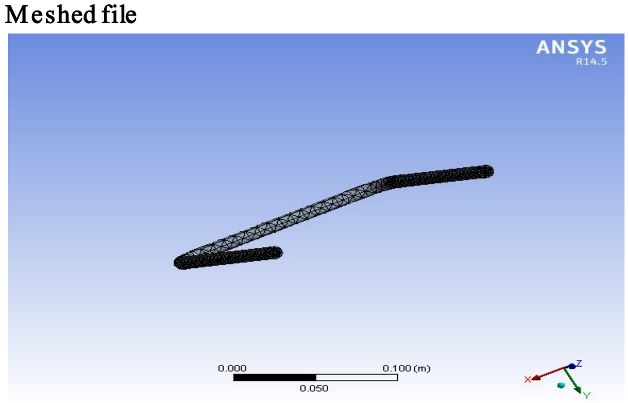
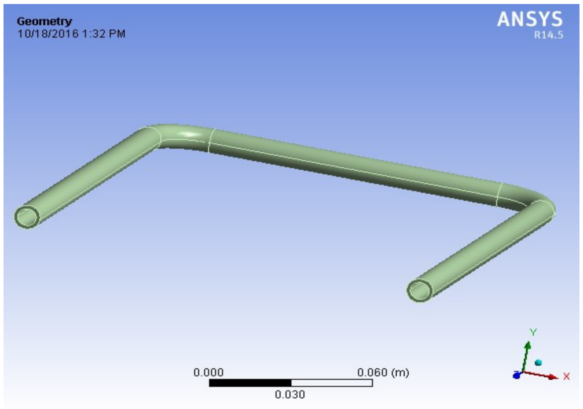


CFD analysis of annular bend tube

Geometry



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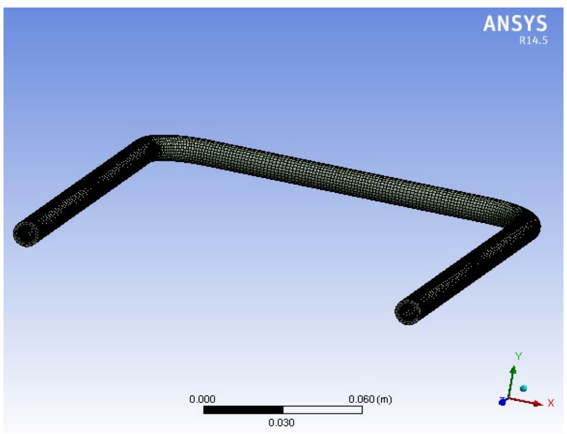
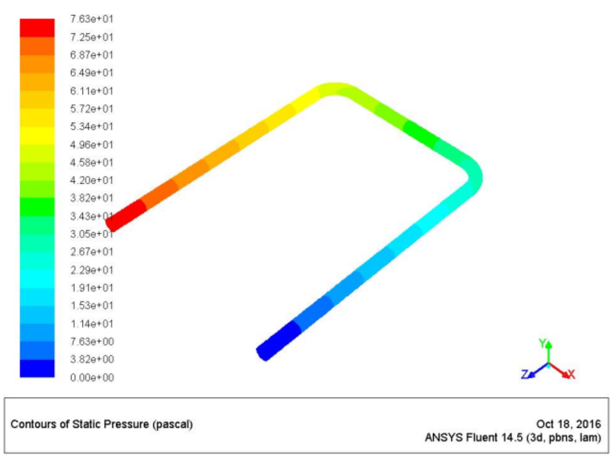
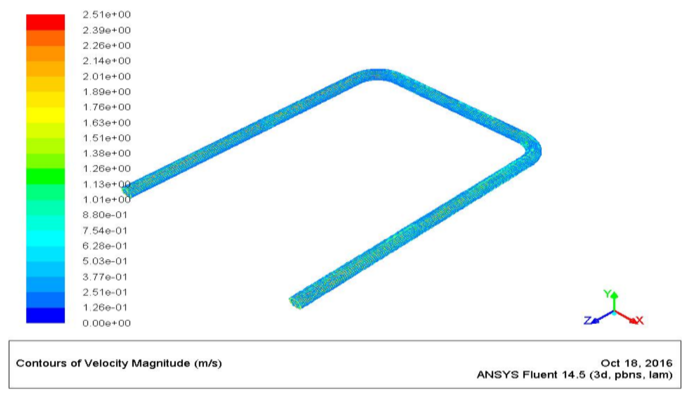


pressure



Density

Velocity



Stress

TABLES

		Al 2024	copper	Ethylene glycol
Temperature	min	127	127	127
	max	127	127	127
Total heat flux	min	0.052435	0.00022333	0.060955
	max	0.19226	0.020483	0.19009
Directional heat flux	min	-0.17945	-0.0082508	-0.18484
	max	0.18803	0.0098322	0.18664
Thermal error	min	4.1685e-17	5.6557e-21	1.6296e-14
	max	7.6292e-13	1.6687e-14	5.159e-10

Cfd

	MIN	MAX
Pressure	0	7.63E+1
Density	1.23e+0	
Velocity	0	2.51E+0
Temperature	3.0E+2	
Stress	0	1.41E-1

CONCLUSION

As here all the analysis results are detailed mentioned in the above tables and in the graphical format. So here our aim is to check the flow of the fluid for the best Nano fluid.

As if we see thermal analysis done by using carbon steel material. This material used in annular bend tubes. In this project we observe thermal results of annular bend tube by using carbon steel material. This will show how tube life efficiency.

Then we done CFD analysis by using al2024, copper, ethylene glycol, and water Nano fluid. Analysis results here, temperature is same for all the materials, but if we go the pressure, here we can observe clearly that the Copper fluid is having the least pressure created inside the tube. While coming to the velocity, here also the cooper got the lesser value than the other materials. But here the stress is less for water than cooper fluid. But while considering all the comparisons cooper fluid is having the better flow.

So by seeing all the results we can conclude that if we use cooper fluid as the operating fluid in the annular bend tube the life efficiency increases and gives better life output for the carbon steel material annular bend tube

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