

EXPERIMENTAL INVESTIGATION OF THERMAL DISTRIBUTION FOR SS304 WITH DIMPLED SHAPE

Submitted in partial fulfillment of the requirements of the award of
Bachelor of Engineering degree in Mechanical Engineering

By

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**DEPARTMENT OF MECHANICAL ENGINEERING
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SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

Accredited with "A" grade by NAAC

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **UDDAGIRI DILEEP** (Reg.No.**38150121**) and **PAGIDI GURU SAI SIMHA** (Reg No. **38150074**) who carried out the project entitled "**EXPERIMENTAL INVESTIGATION OF THERMAL DISTRIBUTION FOR SS304 WITH DIMPLED SHAPE**" under my supervision from November 2021 to May 2022.

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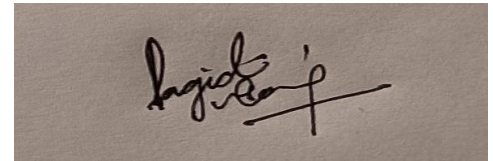
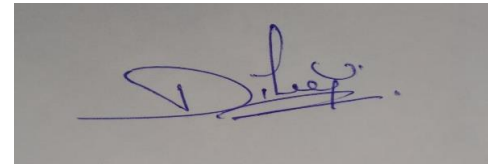
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DECLARATION

We, **UDDAGIRI DILEEP (38150121)** and **PAGIDI GURU SAI SIMHA (38150074)** hereby declare that the Project Report entitled “**EXPERIMENTAL INVESTIGATION OF THERMAL DISTRIBUTION FOR SS304 WITH DIMPLED SHAPE**” done by us under the guidance of **Mr. V. SRIRAM** , is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in Mechanical Engineering.



DATE:

PLACE: CHENNAI

SIGNATURE OF THE CANDIDATE'S

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ABSTRACT

Dimple uses to perform variation of thermal distribution along the pipe from one end to another end and also uses to maintain the constant temperature through the pipe the velocity flow rate decreases, temperature might be constant or a slight change occurs in temperature. Each dimple has some set of dimension values that, the diameter and depth of the dimple is 20mm and 10mm respectively, for one pipe 20 dimples and another pipe it consists of 40 dimples. SS304 of H-grade 1 metre in length, inner diameter of 61.5mm and outer diameter of 64.5mm. the dimples present in the pipe intensify the rate of heat transfer when compared to smooth surfaces. when water is passed through the pipe and heated, the water inside the pipe increases its vapor pressure, the dimples present in the pipe regulates the temperature from one dimple to another dimple, while the temperature at the centre of the pipe will be at the highest temperature throughout the pipe and the velocity of the pipe remains constant. Computational Fluid Dynamics (CFD) has been developed for thermal distribution. CFD analysis is done by the help of ANSYS software. The effect is taken from only a single point at centre of the pipe. There will be a temperature & velocity comparison between the CFD work and experimental work.

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LIST OF KEY WORDS:

DP-DIMPLE PIPE

DT-DIMPLE TUBE

SS304-STAINLESS STEEL 304

RMS-ROOT MEAN SQUARE

DMM-DIGITAL MULTI METER

K-TEMPERATURE IN KELVEN

⁰C-DEGREE CELSIOUS

K TYPE- TERMOCOUPLE K TYPE

CHAPTER-1

INTRODUCTION

1.1 INTRODUCTION ABOUT EXPERIMENTAL & CFD WORK

Prepared two pipes SS304 of each length 1m & made two different set of dimple pipes, for a single ss304 pipe consists of 20 number of dimples with each dimple to dimple there will be 200mm distance of same side dimple, with 100mm alternat side dimples. And for another ss304 pipe consists of 40 in number of dimples with dimples equal length distance is 100mm & alternate dimple has 50mm in length. By using ANYSIS software we prepared computational Fluid Dynamics (CFD) analysis by a thermal distribution of a ss304 pipe. All set of values is given as for the constant numerical, there will be a slight change in temperature difference. Temperature Difference between both the 20DP&40DP is almost same at some set of points but different in alternative points. Experimental work will discuss about the thermal heat distribution, the temperature comparison of whole pipe is not same at inlet side has 473k but for out let has 479k.so for that we measured the temperature at middle point of the ss304 pipe. Dimple is used for to maintain the temperature at every point of pipe but the temperature is not remains constant it's got increasing slightly from one dimple to another dimple. For the velocity and pressure drop structures around DT, I choose the middle part of the pipe to simulated. ANSYA software designed all the flowing models. Moreover, the present analysis work has been carried out in CFD using commercial software ANSYS. The recommended turbulence model in this is the standard temperature k- model.

1.1.1 For example (assumption by reference)

There are many planning applications where stream mixing, and conveyance is a crucial part. The commendable sorts of stream credits upgrades, for instance, balances, helical screw tape, dimples, etc, reliably increase unsettling influence and appropriation. Gas turbine engines are perhaps the most well known kinds of purpose. In such engines, the aftereffect of power and adequacy increases as such improvement is added. One of the critical gas turbine engine parts is the combustor. It directly impacts engine execution. The

most significant issues of the combustors are the high tension air coming from the blower and the other included issue how extraordinary is the mixing between the fuel and the stuffed air. These two real factors could prompt troublesome issues on consuming consistency and total strain incident coefficient. Utilizing pre-diffuser can diminish the effects of previous issues. It is used to decelerate the stream and scatter the air around the combustor reliably and consistently. This cycle should be done with a base outright strain mishap.

1.2 COMPUTATIONAL FLUID DYNAMICS (CFD) WORK

Velocity performances in dimple tube DT. 3-D computational fluid dynamics CFD has been developed to study flow rate. Standard kinetic energy turbulence model values is designed & given as per the numerical simulation. The flow rate and velocity distribution of the SS304 dimple tube DT. CFD analysis is done by the help of using ANSYS software. The effect is taken from only a single point at $\frac{1}{2}$ m. the velocity will be at constant pressure will same & a slight change in temperature. Dimple maintains the constant temp along with velocity through the (SS304H grade) dimple tube DT. Each dimple has same set of dimension values that is diameter & depth of the dimple is 20mm&10mm. For one pipe 20 dimples & another pipe there will be 40 dimples. CFD analysis is done by the help of using ANSYS software. there will be a temperature & velocity comparison between the experimental work and CFD work.

1.3 STREAM FIELD CHARACTERIZE

The stream speed ascends by passing through the dimpled areas in light of decline in the streaming surface region; from that point forward, it would diminish at the behind of them causing an occasional pattern in heat move coefficient graph of profound dimpled tubes against its non-intermittent pattern in plain ones. Additionally, vortexes and pivotal twirling along the cylinder forestall the development of the warm limit layer and cause more homogenous temperature appropriation in profound dimpled tubes where the whirling and vortexes move hot volume of water at divider contiguous the virus community area. These lead to higher Nusselt number of these new sorts of cylinders in contrast with the plain ones.

By expanding the pitch of the dimples, the quantity of dimples decreases, so it adds to a decrease in Nusselt number and erosion factor, while PEC rises. Ascending of the distance across of dimples causes more stream twirling and heat move surface region, which prompts the addition of the Nusselt number, rubbing factor, and PEC at the same time. The profundity of dimples represses the liquid stream along the cylinder and causes high tension misfortune. Additionally, profundity increase prompts more hotness move and Nusselt number, yet it can't beat the grinding factor bounce, so the PEC diminishes by the expansion inside and out of dimples. Among the concentrated-on Reynolds numbers, higher Nusselt number, grinding factor, and PEC have been noticed for higher Reynolds numbers.

1.4 FLOW CHARACTERISTICS AND HEAT TRANSFER PERFORMANCES

presents the speed extent appropriation for various dimpled tubes on $X = 0$ plane. The speed speeds up at the breeze ward surface of dimple and decreases at the leeward surface of dimple for all the dimpled tube. The intermittent variety in speed, which instigated the stream liquid flushing on the cylinder divider and leaving from the cylinder divider, along these lines, further developed the hotness move execution. With further noticed, it can observed that the greatest speed near the focal point of dimples stream channel, and the base speed situate on the leeward surface of dimple in all the dimpled tube. gives speed dispersions for improved tube circular and tear dimples on Z planes. It is apparent that the somewhat low speed typically happens at the dimples the two sides. This peculiarity is inferable from the cross-segment region extension at this area, which caused the speed diminished in every one of the dimpled tube. While, the moderately high-speed area focusses on the focal point of stream channel. Besides, the intermittent variety of the speed is likewise found in these figures, and the speed variety with the changed of cross segment region. The intermittent variety of speed which can work on the liquid blending between the close to divider zone and standard.

1.5 MESHING

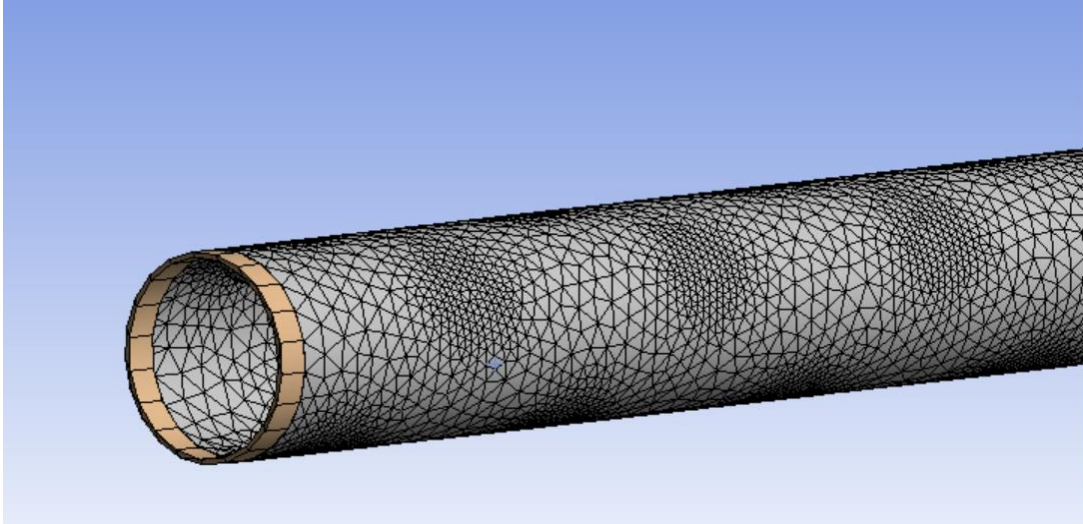


Fig:1.1 :Schematic of the cross-section Meshing

Meshing process is used for to accurately check the each and every point of the pipe ,there fore the configuration of the both dimpled pipes is as 20DP comprises of 1m length at 200mm distance structure dimple to dimple, The internal breadth of the 20DP&40DP contains same as 61.5mm, The external width of both 20DP&40DP has 64.5mm and furthermore both the 20&40 dimpled pipes comprises of 1000mm long in spite of the fact that thickness addresses 3mm for each dimpled pipe. Profundity of the each dimple for 20DP&40DP is 10mm with particular span is 20mm.Its a part of formation of the original pipe into the computational image. Mesh analysis is done and also it contains detail examination of each and every dimple from every part. Here we have 20 number of dimples so mesh analysis is taken by 20 different type of dimple samples and evaluate the all the samples in the meshing progress. computational demonstrating, every one of the factors are instated to zero with the exception of the gulf speed, delta temperature, and cylinder divider temperature. Ordinarily, the computation is started with a few introductory theory of the delta speed and temperature till the stream and hotness move are acclimated to the new circumstances lastly arrive at a consistent state. Choppiness model The tension drops and. the stream structure for a dimpled tube and a diffuser are contemplated in the current examination. The examination utilized the RNG. $k-\epsilon$ as a "disturbance model ". It is fundamentally critical to pick a choppiness model for a specific reproduction. The disturbance model depends on the computational requests and how painstakingly anticipated stream peculiarity. Then, at that point, the RNG. $k-\epsilon$ disturbance model is taken on in the

current review since it can give phenomenal execution to stream, including distribution and turn . The limited amount strategy is utilized to settle "the time free incompressible Navier Stokes conditions ". The limited displaying is accomplished using the business .CFD .(Computational liquid. elements) .programming. ANSYS , The reproductions are finished in three layered areas utilizing the RNG k- ϵ model as a choppiness model" for concentrating on the tension and speed fields. Additionally, the business programming ANSYS is utilized to create the matrix strategy for the dimpled tube and the diffuser. This cross section instrument was used to work the liquid computational area with the .unstructured tetrahedral lattice. The anticipated speed profile for five remarkable matrix freedom has been contrasted with gauge the impact of the network sizes on the precision of the mathematical choices results.

1.6 ITERATION GRAPHS

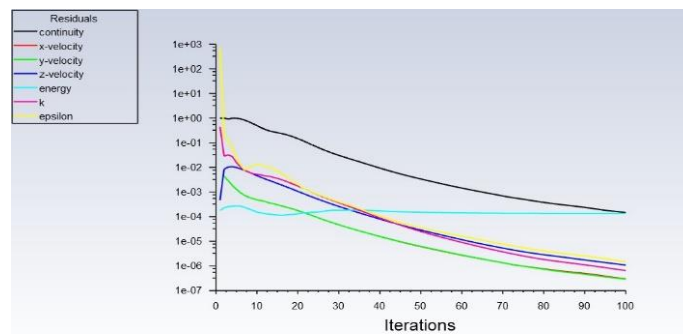


Fig:1.2: Iteration graph for 20DP

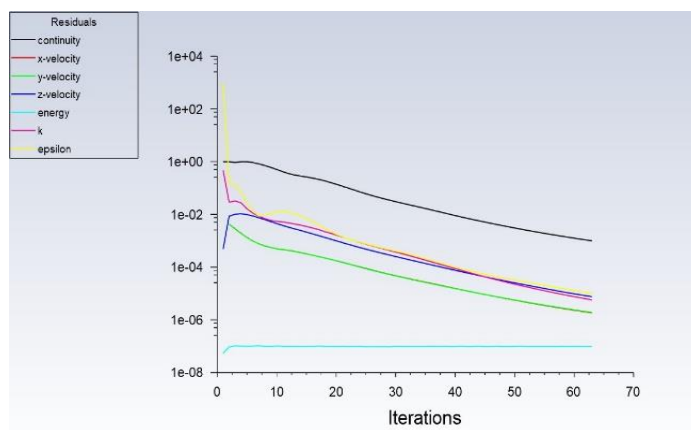


Fig:1.3: Iteration graph for 40DP

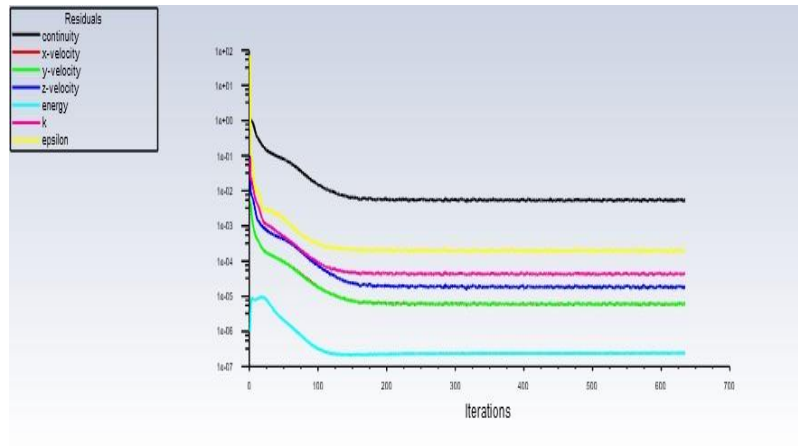


Fig:1.4 :Iterations graph for 20 DP

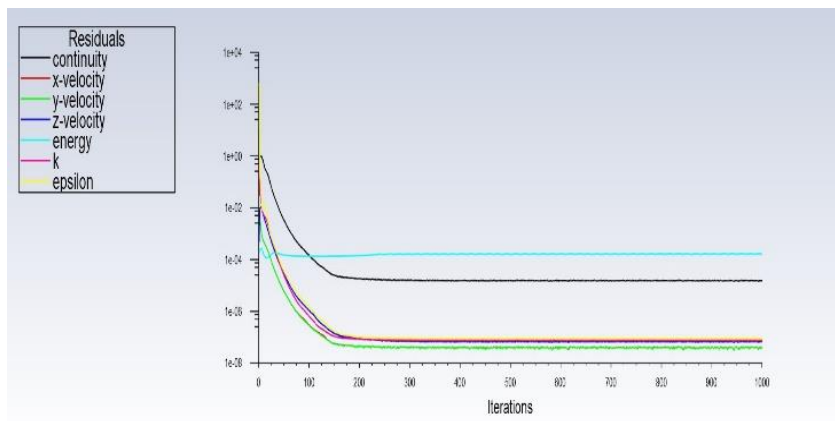


Fig:1.5 :Iterations graph for 40 DP

The iteration process is done by two times for the pipe with a two different type of values that is, from above given fig 1.2 ,1.3 ,1.4 & 1.5. fig 1.2 is represents for 100 times iteration for the 20dimple tube, fig 1.3 represents 100 times iteration for the 40-dimple tube, fig 1.4 along with fig 1.5 explains same process but here the iteration is about to done by 1000 times. here the iteration is nothing but same process is doing again and again for the checking strength and capacity of heat absorption. after doing 100 iterations the process and the capacity of the material will be constant as given in the following graphs 1.4 &1.5 but below the 150rt iteration the graph is changing for every point constantly. here the graph line is presenting that x, y & z axis that axis is known as velocity, one line represents continuity, another represents energy, another two lines represents temperature in K & epsilon, AS given in the above four graphs that is fig 1.2 ,1.3,1.4 &1.5. The setup values are given like

gravity 9.81 , gauge pressure 0 pascal , density 8030kg/m³ , cp (specific heat) 502.48j/kg-k ,turbulent kinetic energy 0.00033m²/s² ,temperature 472.9k ,velocity magnitude 0.2996m/s &turbulent hydraulic diameter 0.0615m.

CHAPTER - 2

LITERATURE SURVEY

We performed trials to decide the hotness move rate and tension drop in spirally notched tube with water as a functioning medium. Tests were led for laminar to violent scope of Reynolds number. For improving more they embedded bent tapes in spirally furrowed tube. Pongjet Promvonge et al . tests were led to concentrate because of wire loop joined with wound tape embeds for upgrade of hotness move with air as a functioning medium. The impact of consolidated wire curl with various pitch and contorted tapes with wind proportions are analyzed in this trial study and concentrated mathematically and tentatively hotness move rate and erosion element and warm execution of a cylinder outfitted with exemplary and changed tapes. The Nusselt number and warm execution of rough embeds are higher than some other blend contemplated and performed investigations to concentrate on heat move attributes of cylinder fitted full length bent tape and separated contorted tape embeds. It is additionally seen that hotness move coefficient increments with expanding Reynolds number. tentatively concentrated on the hotness move attributes of cylinder outfitted with broken contorted tape embeds. Heat move rate and strain drop in the cylinder outfitted with broken tapes increments with decline in contort proportion J. Chen et.al. concentrated tentatively Nusselt number, pressure drop and upgrade file in a dimpled tube with various dimple profundity and dimple pitch of the dimples P.G. Vicente et.al. announced tentatively the hotness move and contact factor in three dimensional helically dimpled tube in violent stream area. Lee and Yun concentrated tentatively impacts of various boundaries on heat move and tension drop in tube embedded with cut sort balances and furthermore advanced these boundaries utilizing Taguchi strategy.

Q.Liao and M.D.Xin , concentrated on tentatively convective hotness move inside tubes with three dimensional inner expanded surfaces and bent tapes together and noticed higher hotness move rate than the singular procedure utilized alone. S.K.Saha et.al. , directed trials to concentrate on heat move and strain drop in a cylinder with routinely divided turned tapes in a gooey liquid. They presumed that diminishing tape width decreases heat move rate. A.E. Bergles , checked on numerous strategies that have been created to improve heat move rate, presumed that build strategy gives higher hotness move than individual method

utilized alone. P. Promvong et al., concentrated on the joined hotness move strategy for example curved tape embed with wire loop turbulator and saw that presence of wire curl with bent tapes leads twofold expansion in the hotness move rate. S. Eiamsa-ard et al., concentrated on tentatively the hotness move and strain drop of fierce stream in a warming cylinder furnished with punctured bent tapes and assessed by and large execution under same siphoning power conditions. P. Eiamsa-ard et al., concentrated on mathematically the impact of consistently dispersed curved tapes on heat move, grating variable and warm execution figure conduct a hotness exchanger alongside full length turned tapes. M.M.K. Bhuiya et al., this study investigates the impact of the twofold counter bent tapes on heat move and liquid grating in a hotness exchanger tube.

The analyses additionally uncovers that hotness move rate in a cylinder fitted with twofold counter bent tapes was essentially expanded Sibel Gunes et al., concentrated on the ideal upsides of the plan boundaries in a cylinder with wire loop embeds utilizing Taguchi strategy for advancement. They likewise resolved the commitment proportions of every boundary heat move rate and grinding factor. Pranabkumar et al. tentatively examined heat move execution in a conduit with winding groove and angled teeth curved tapes, and observed preferable upgrade over individual procedure acting alone, It is seen from above writing review that, in examination with single improvement method accumulate (more than one improvement strategies together) improvement gives better outcomes as far as expanded pace of hotness move. It is additionally seen that, the compound hotness move improvement procedure utilizing routinely dispersed wound tapes and dimpled tube has not been examined previously. In this concentrate on we have zeroed in on numerical investigation of dimpled tube and consistently dispersed contorted tape embeds, we likewise performed streamlining of various execution boundaries utilizing Taguchi and multi objective Gray social procedure. This is likewise special component of the review completed.

The impact of various examples of conelike dimples on the hotness move improvement was researched by Fan et al. utilizing three layered mathematical simulations. The inline dimple design showed higher hotness move rate when contrasted with staggered dimples. The study prescribed inline ellipsoidal dimples in contrast with conelike and circular dimples for heat move upgrade in tubes. It was seen that the dimple plan

essentially impacted the hotness move rate. The heat move improvement in a cylinder with blend of ellipsoidal dimples in vertical and flat headings, regarding stream course, was studied. Heat move pace of tear-drop dimpled tube showed higher hotness move rate than the ellipsoidal and circular dimpled tubes with lower contact factors. Thermo-water powered execution upgrade of the tear dimpled tube was ascribed to the stream partition behind the dimple and smooth blending in the wake. Since the impact of wake structure appears to the superb component impacting the hotness move improvements, the investigation of execution of the tear dimpled tube was not contrasted and various directions of the ellipsoidal dimple. It is vital to take note of that the complete cylinder volume for each dimple geography should be considered while

Contrasting different mathematical elements. Since the thermo-water powered exhibitions are by and large analyzed for various topological varieties in tubes; the general stream volume is supposed to be kept consistent for comparison. With the presentation of dimples, the neighborhood Reynolds number will be modified which will consequently adjust the stream material science and grating variable of the cylinder.

The stream rates, temperatures, and tension drops of wind current were estimated to decide the hotness move coefficient and erosion component of the cylinder side. Channel and outlet temperatures, and stream pace of high temp water were likewise estimated to direct the hotness balance test to each trial run. Albeit an enormous number of studies have dissected the impact of dimple boundaries on stream attributes and hotness move execution in heat move tube, there is no compelling strategy to improve the plan of dimple. Be that as it may, in the field of mechanical tribology, the dimples were likewise used to work on the tribological properties of grinding matches and the ideal plan technique for dimple boundaries is proposed according to the point of view of skewness and kurtosis. This is principally because of the way that different dimple boundaries contrastingly affect the surface unpleasantness boundaries of the erosion pair, and the skewness furthermore, kurtosis harshness boundaries are simpler to precisely depict the boundaries contrasts of dimples. Finally, the impact law of dimple boundaries on stream and hotness move execution is talked about by consolidating skewness and kurtosis. That is to talk about the relationship between the change law of skewness and kurtosis and the change law of warm water driven Performance. For the most part, a definitive point of this study is giving a few rules to the ideal

plan of dimples according to the point of view of unpleasantness boundaries skewness and kurtosis, and afterward no important reenactment or trial research is required.

To accomplish precise reproductions, the nature of the lattice is indispensable, particularly for this confounded type of the improved cylinder, remembering a few profound dimples and therefore varieties for the stream design. A non-underlying cross section was accommodated all the deepdimpled and plain cylinders. A thick cross section with crystal layers was given at the close divider locales particularly at the main, following edges and focuses of dimples where the most inclinations in speed Application of upgraded tubes is developing fundamentally, and more undertaking is expected to upgrade the warm proficiency of them. The motivation behind the current review is to research a deepdimpled kind of improved tube Albeit a few examinations have been helped out through dimpled tubes and tentatively, barely any quantities of exploration such as have been directed to concentrate on tubes furnished with profound dimples. In this review, a laminar example of stream at the delta, a uniform hotness transition applied over the outer surface of upgraded cylinder and water as the functioning liquid, are thought of. Reproductions cover a wide scope of arrangements of profound dimples on the outer layer of the cylinder. None of these circumstances has been researched by others previously.

The curiosity of this study is the mathematical arrangement of the concentrated on improved tubes, which incorporates profound dimples against the traditional dimpled tubes. These profound dimpled tubes increment the hotness move through the cylinder by expanding the liquid disturbance, interruption of the warm limit layer, and development of hotness move surface region. They cause three instruments of liquid stream, i.e., augmentation of neighborhood stream speed, the development of vortexes behind the dimples and pivotal whirling of the course through the cylinder; which cause higher PEC instead of recently concentrated on dimpled tubes. Additionally, the laminar stream heat move. improvement has been the point. Dimples were utilized in the cutting edge gas turbine as chilling methods to chill the temperature of the stream around the turbine edges. Wenwu et al. directed an exploratory examination to concentrate on the attributes of the tempestuous

limit layer stream over dimpled surfaces as cooling methods. Then, the discoveries were analyzed to those over regular level plates.

The speed structures and the strain drop can be upgraded by presenting the stream aggravation through dimples. This paper centers around stream way investigation and streams field attributes. Dimples were extremely fascinating in light of the fact that they could produce distribution stream and horseshoe vortices remembering the opening for the surface permitting the liquid to stream across it to improve heat move. The super actual instruments causing this upgrade were the age and augmentation of the solid longitudinal vortices in the opening, which were receptive with the warm limit layer. The examination is performed to get the test information. Literature survey shows that, a cross over deterrent incites the creation s one to examine the chance of utilizing the dimpled surfaces in both regular hotness exchangers and gadgets of gasdynamic energy partition.

CHAPTER - 3

AIM AND SCOPE OF PRESENT INVESTIGATION

The upsides of the dimpled tube, wound tape and compound heat move improvement, displayed in writing audit above, persuade us to research heat move improvement by utilizing the dimpled tube along with the wound tape as compound improving gadget. In the current work, the impacts of pitch and contort proportions on the heat move coefficient and strain misfortune qualities in the completely created tempestuous progression of a dimpled tube with a wound tape embed are inspected. The Reynolds numbers are gone from 12,000 to 44,000 with hot/cold water as working liquid. The test results of the hotness move improvement and strain misfortune The exploratory work was directed to arrive at a more functional check out at the impacts of a dimpled tube related for both hotness move improvement and tension misfortune Before the investigations utilizing the dimpled tube joined with the curved tape, and the grating variable in a plain tube was estimated. The test information was, then looked at with the outcomes given by the notable relationships under a comparative condition, to assess the legitimacy of the plain cylinder.

Improved cylinders can be utilized for some applications for example, evaporators, condensers, oil radiators and hotness exchangers for cleaning processes. This study is focused on further developing hotness exchangers utilized for cleaning natural liquids, through helically dimpled tubes. In these heat exchangers the natural liquid courses through tubes also, is warmed by steam or high temp water streaming on the outside. Natural liquids typically show high thickness and inner stream can be either laminar or fierce at low Reynolds numbers. Consequently the cylinder side film coefficient overwhelms the general hotness move coefficient. Vital harshness procedures are reasonable in violent stream however they are not successful in laminar stream on the grounds that main the stream in the gooey limit layer is blended. At any rate, pressure drop and hotness moves. The progress district was dissected in both strain drop and hotness move tests. A exhaustive review focused in three dimpled tubes was to the point of deciding the dimpled tubes warm way of behaving for laminar stream.

The smoke line directions displayed inside the pits both a distribution zone and sets of auxiliary streams in the streamwise and spanwise-ordinary planes, separately. At a later stage, the stream showed a solid up-wash locale, where an essential sets of counter-turning vortices were catapulted vertical from within the hole. In this way, the mushroom-formed smoke design was advected downstream, decreasing in size and extended with a more significant level of vorticity, prior to entering the accompanying spaces. Also, two optional sets of vortices were created and shot out from the locale close to the right and left spanwise edges of a dimple. The shedding system of the essential what's more, optional vortical liquid designs included the entire exhibit of dimples, contributing basically to the ascent in the worldwide hotness move rate and disturbance transport in the stream encompassing the deterrents. Outstandingly, the it was unpredictable to shed of the vortices as in one of the two vortices became more grounded than the other and got shot out downstream of the dimple. This peculiarity happens on the other hand, with a steady recurrence, relies upon the Reynold number and the channel stature to-print performed by Zhou is in concurrence with the tempestuous designs experienced by the smoke representations portrayed previously. Crafted by Tay et al. characterized wrongly this peculiarity as a "twister like vortex", which produces an ascent in both hotness move and water driven obstruction of the stream.

The utilization of "cyclone like" for the violent structures seen in round holes is deluding. Kiknadse wrongly proposed this term years prior to name upward arranged vortices, with next to no future confirmations. Concerning the fierce constructions launched out from within the dimples, Turnow et al. came up with similar ends, utilizing of fierce move through a channel upgraded with profound dimples. Just the principal mode, of a of the stream, shows the presence of huge pivoting structures, began inside the hole, and progressively ousted outward. The violent stream was all things considered ruled by little scopes since the POD gave a similarly circulated across every one of the modes. This isn't in line with what was asserted, where the stream inside the round depressions was overwhelmed by sets of counterrotating vortices. In any case, there is a decent arrangement in the levels of improvement in heat move and grating coefficients, which results to be separately, times the qualities seen for a smooth channel. Those outcomes are for channels outfitted with a variety of dimples whose profundity to-print.

Taking into account that the outcomes found in the writing propose the dimples to be the divider impediments which give the best thermohydraulic execution, a solid exertion was placed in their shape improvement. Especially, the interest was to boost the by and large hotness move, keeping the grating misfortunes as low as could really be expected. For the instance of fierce channel streams, Chen et al. proposed an awry dimple, which heightened the strength of the sets of vortices inside the hole. As per the creator, this can be accomplished primarily by slanting the most profound mark of the circular space in the downstream course. In the writing, elective arrangements, for instance, the utilization of tear-drop molded holes. also, planar additions situated inside symmetric dimples are considered to change both the detachment reattachment peculiarity and further develop the hotness move. Moreover, V-formed clusters of dimples in channels were tried by Jordan and Wright. The estimation of the Nu circulation over the improved surface affirmed the hotness move expansion when contrasted with smooth channels.

Considering the outcomes referenced here above, efficiencies of cylindrical hotness exchangers are likewise considered for enhancements, exploiting the divider dimpling strategy. In the, truth be told field of steam breaking processes, rounded reactors with folded dividers can diminish their inward divider temperature during the breaking of hydrocarbons.. This diminishes the pace of coke statement, the last option being an undesirable item during compound responses. Taking into account that, likewise, pressure drop punishments adversely add to the selectivity of wanted items, the decision of involving dimples as hotness move increase gadgets has critical potential. The violent designs in the stream inside the dimples are additionally experienced in increased rounded reactors by Dedeyne The creators made an awareness examination utilizing LES to mimic tempestuous streams in cylindrical frameworks, dimpled in a few ways, to find out the most performant arrangement. The mathematical outcomes concerning the utilization of dimples in pipes for heat move enhancements experience the ill effects of an absence of approval. To the best of the creator's information, while numerous trial examinations were centered around various dimpled square channels and level plates, little air warm information are accommodated the instance of cylinders. The improvement of hotness move was me

CHAPTER - 4

MATERIALS AND METHODS

4.1 MATERIALS

4.1.1 Pipe configuration

STAINLESS STEEL Pipe of H grade among specification is SS304: The Length of the Stainless Steel304 is 1Meter long and it's Thickness of the SS304 pipe is 3mm and The Outer Diameter of the Stainless Steel304 is 64.5mm Along the Inner Diameter of the Stainless Steel304 is 61.5mm, Thickness of the Stainless Steel304 is 0.2 mm, Diameter of the dimple in Stainless Steel304 is 20mm, Depth of the dimple in Stainless Steel304 is approximately 10mm, Distance between each and every dimple is 200mm. This is the overall SS304 pipe configuration for both 20dimple tube and 40dimple tube, Distance between each and every dimple is 200mm. This is the overall SS304 pipe configuration for both 20dimple tube and 40dimple tube. Here for measuring the temperature distribution ,Thermocouple k type wire is used ,the k type wire is connected to the RMS digital multimeter. Dimple configuration is about it's depth of the dimple for 20dt&40dt is 10mm, Diameter of the 20dt&40dt id 20mm, Radius of the 20dt&40dt is 10mm

4.1.2 Dimple configuration

Diameter of 20DP dimple is 20mm, Depth of the 20DP dimple is 10mm, Diameter of 40DP dimple is 20mm, Depth of the 40DP dimple is 10mm

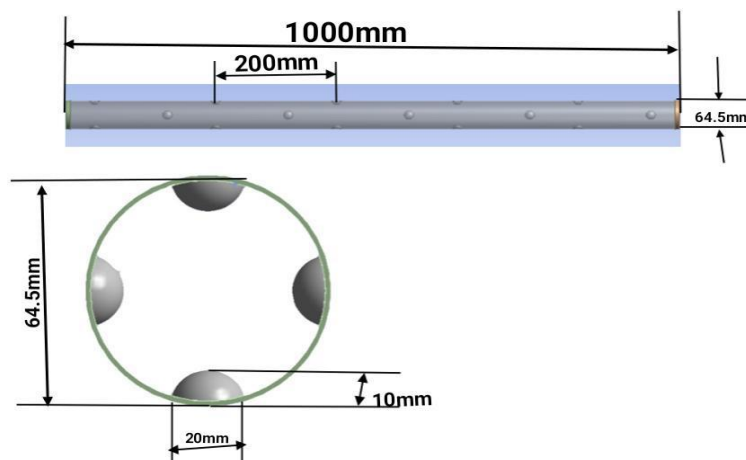


Fig:4.1 : 20dimple pipe

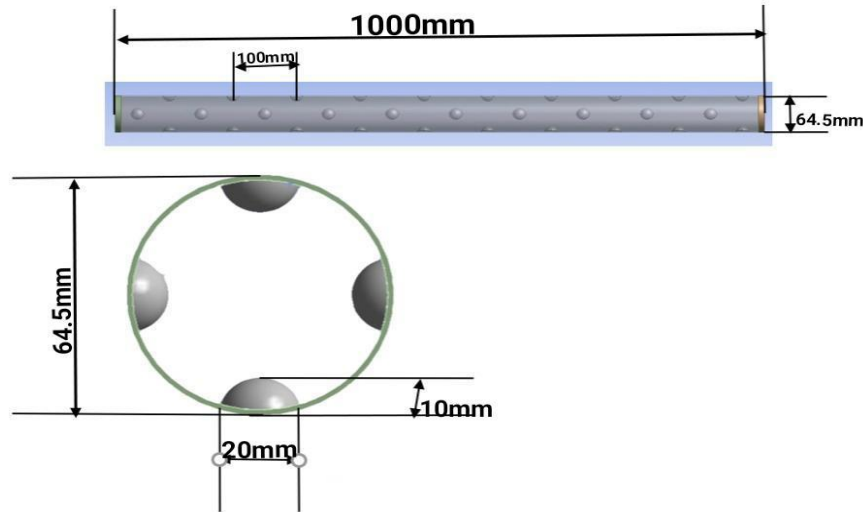


Fig:4.2 : 40dimple pipe

4.2 METHODS

4.2.1 Process of making dimples

Prepared a steel pipe of ss304 grade H of 1m length. Two set of pipes for one pipe 20dimples another one consists of 40 dimples. For a first pipe dimple to dimple 200mm & in middle of the 200mm there will be opposite direction dimple is presented. And for 40DP also same but instead of 200mm there will have 100mm although for middle instead of 100mm it has 50mm. There is a lot of ways to made a dimple to the pipe here I have chosen a way. prepare a solid rod of inner diameter of pipe with opposite side dimples with 20mm diameter along 10mm depth, then insert the solid pipe into the ss304 pipe and by using hydraulic pressure both sides of the pipe will press and the dimple may form. A single image is given in the following while the dimple is making. Now the detail explanation of making a dimple for ss304 pipe at first we need to take the measurements of the pipe and then go for marking at starting stage for closing purpose of the pipe, leave some gap of 5-10mm after that make a mark(A) ,from the mark(A) placed to make an another mark(B) at 200mm distance straight, By helically middle point of the both marks(A&B) place a mark(C) that contains 100mm length from the starting mark(A).As the at from mark(B) take another 200mm and place a mark(D) ,as given above between the mark(B&D) consists of a middle region has a mark€. As like that we need to place marking at the edge of the pipe.

4.2.2 Dimple formation

There is a lot of types of techniques to make a dimple but Here I take help of a Hydraulic machine. so for now we need to make a set up for making a dimple for ss304 pipe. First point the inner diameter of the pipe is 61.5mm so now we need to make or take 61mm solid rod with grooving of the measurement that which we need for the dimple and then we need to insert the solid rod into the steel pipe where we have marked mark(A).then by using Hydraulic piston we need to press the pipe at 10mm depth .for all the markings consists of same process.



Fig:4.3 : Process of dimple making



Fig:4.4:Pressing to make a dimple

4.3 AFTER THE FORMATION OF DIMPLE



Fig:4.5: 40dp after the formation of dimples



Fig:4.6: 20dp after the formation of dimple

CHAPTER - 5

RESULTS AND DISCUSSION PERFORMANCE ANALYSIS

5.1 RESULT

Here, in the inlet of the ss304 pipe we are passing the water at 473k in temperature and now we are calculating the thermal distribution that means temperature calculating at a middle point of the pipe for both twenty dimple pipe and forty dimple pipe for given images 20dp consists of middle region temperature is 202 degree Celsius and as for the 40dp contains 203 degree Celsius ,by using rms multi meter we are calculating the temperature variations, Here we use a sensor called thermocouple k type wire which is connected to rms multimeter and ss304 pipe.



Fig:5.1: Temperature reading for 20DP



Fig:5.2:Temperature reading for 40DP

5.2 DISCUSSION

From the overall information on heat move, dimpled surfaces can make at least one mixes of the accompanying circumstances that are positive for upgrading the hotness move: the interference of the advancement of the limit layer; increment of the level of disturbance; increment of a compelling hotness move region; and age of turning as well as optional streams. Here we center around an extra viewpoint, the grating punishment of accomplishing improved heat move which any plan must be touchy to. The rubbing obstruction and hotness move are the two critical significant elements in the plan of improved tubes. In this paper, we mostly talk about, The nearby liquid stream and hotness move attributes of a dimpled tube exhaustively, which have not been considered in the open writing research, based on neighborhood examination, the mathematical calculations are completed to explore the impacts of the Reynolds number, the dimple plan, and dimple size on in general liquid stream and hotness move qualities. Besides, a smooth cylinder is utilized in the mathematical recreation. Smooth cylinder results are utilized to decide the upgrade created by dimpled tubes.

Limit Conditions The overseeing conditions are elliptic in the Cartesian directions; subsequently limit conditions are expected for all limits of the computational space. The expected circumstances are portrayed for the three locales (upstream expanded district, dimpled area, downstream broadened area), USED implies the upstream expanded space, and DSED implies the downstream expanded space.

5.3 TEMPERATURE OF WHOLE PIPE

Temperature distribution occurs at circumferences of the whole pipe

5.3.1 *Temperature distribution*

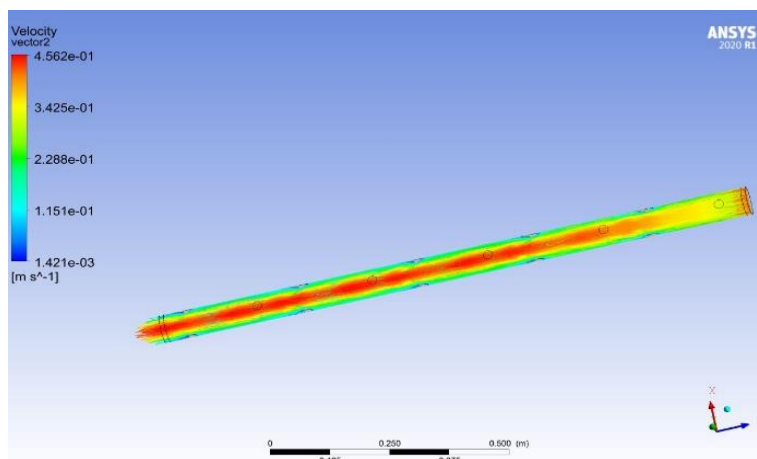


Fig:5.3 :temperature velocity for 20DP

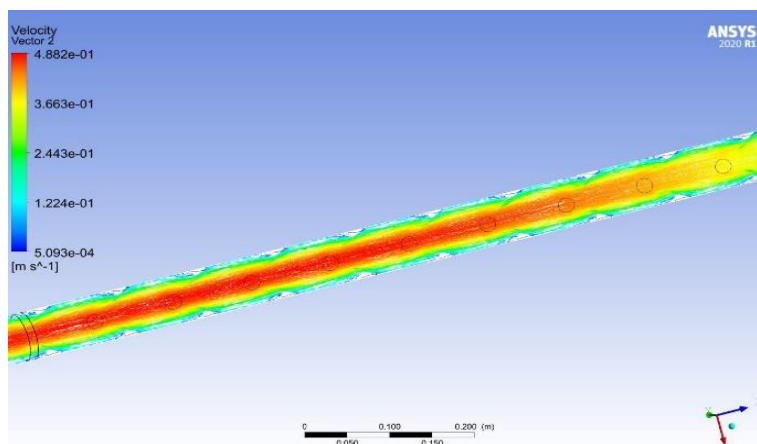


Fig:5.4:temperature velocity for 40DP

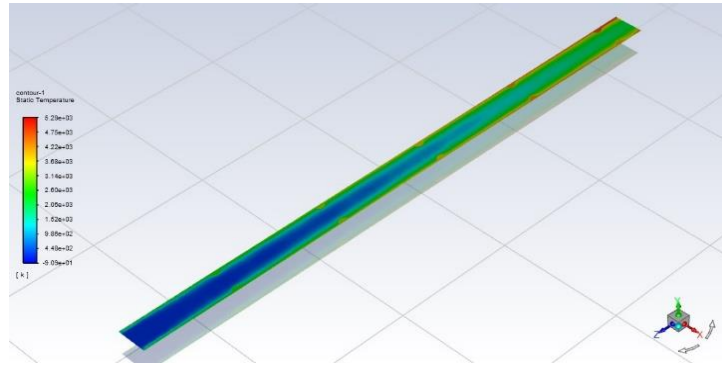


Fig:5.5 : Static temperature

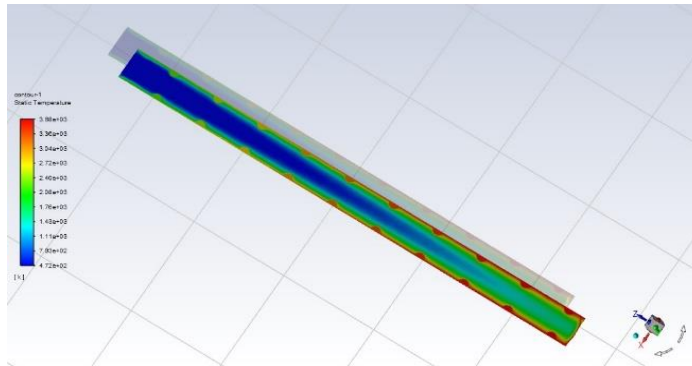


Fig:5.6: Static temperature

From Fig 5.3 & fig 5.4 Temperature is extremely high at the place of center locale of outline and furthermore from fig 5.5 & 5.6 the static temperature is noticeable, At static temperature pipe gulf the water fluid stream at a less number of K temperature for the 20 dimple pipe while the source for the equivalent 20dimple pipe there will be expanding in temperature in spite of the fact that there will be a less number of K temperature is expanded. While from 40 dimple pipe additionally same as 20 dimple pipe the gulf of the 40 dimple pipe is consistent typical temperature in K is given and consequently the out of the line is marginally different by the boundry surface of the pipe. The static temperature of the 20dimple line and 40 dimple pipe has a slight change in temperature. From fig 5.3 & 5.4 the fierce progression of a temperature is pretty much as same as the given qualities the limit surface of the line. Layer arrangement of the temperature distinction is displayed in the above fig 5.5 & 5.6. The vector pivot is taken as 3d - x, y and z plane hub delta is taken as z hub and remaining hub is taken as the side and base references.

From Fig 5.3 & 5.4 Temperature is high at the point of middle region of circumference compared with inlet side and also from fig 5.3 & 5.4 the static temperature is visible, At static temperature pipe inlet the water liquid flow at a less number of K temperature for the 20 dimple pipe while the outlet for the same 20dimple pipe there will be increasing in temperature although there will be a less number of K temperature is increased. While from 40 dimple pipe also same as 20dimple pipe the inlet of the 40dimple pipe is constant normal temperature in K is given and therefore the out of the pipe is slightly changed by the boundary surface of the pipe. The static temperature of the 20dimple pipe & 40 dimple pipe has a slight change in temperature. From Fig 5.3 & 5.4 the turbulent flow of a temperature is as same as the given values the boundary surface of the pipe. Layer formation of the temperature difference is shown in the above Fig 5.3 & 5.4 . The vector axis is taken as 3d – x, y & z plane axis inlet is taken as z axis and remaining axis is taken as the side & bottom references. Boundary conditions and mesh processing the inlet boundary is set at the entrance of the diffusing channel with respective to air and working fluid. At the inlet, the flow has a standard velocity of 100 m/s and the inlet temperature is fixed as 473 K. In addition, the relative outlet is approximately 474-479K.

5.3.2 Effect of including dimples on ss304 pipe

For the stainless-steel pipe these dimples are made by using hydraulic press, dimples regulate the temperature flow inside the pipe. In normal pipe the temperature flow will be less with the fluid flow while after adding dimples the flow of temperature inside the pipe will be increased and temperature flow will be increasing along with the flow of fluid present inside the pipe.

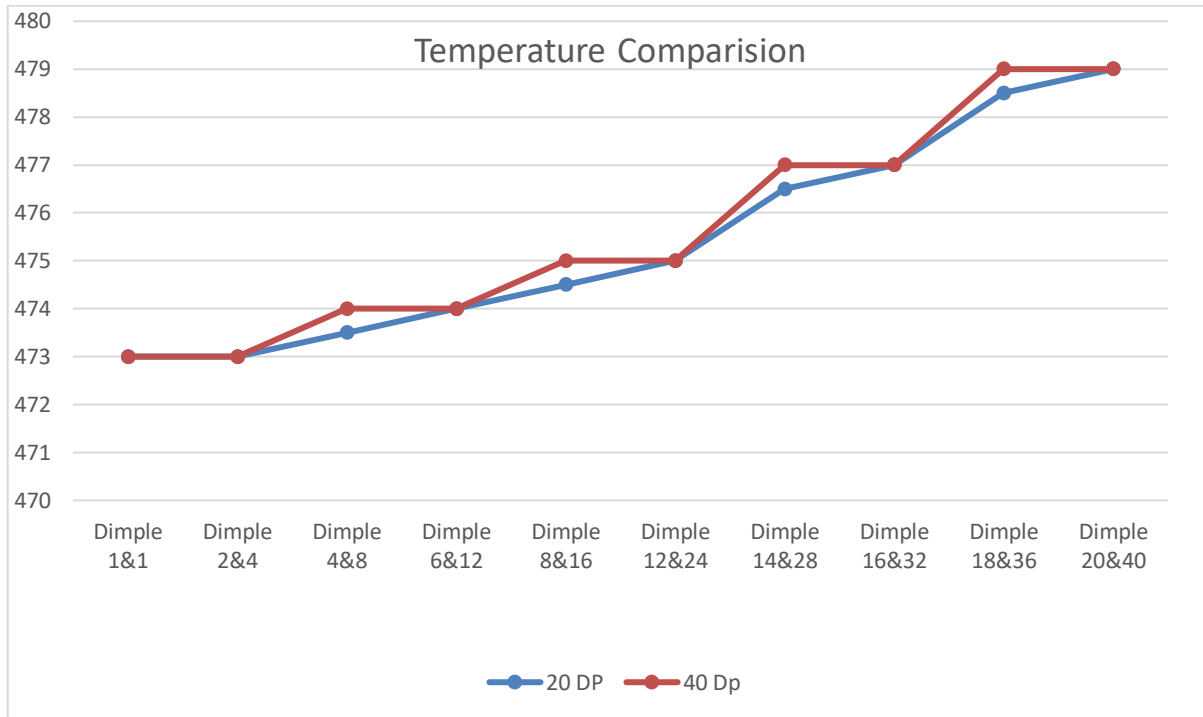
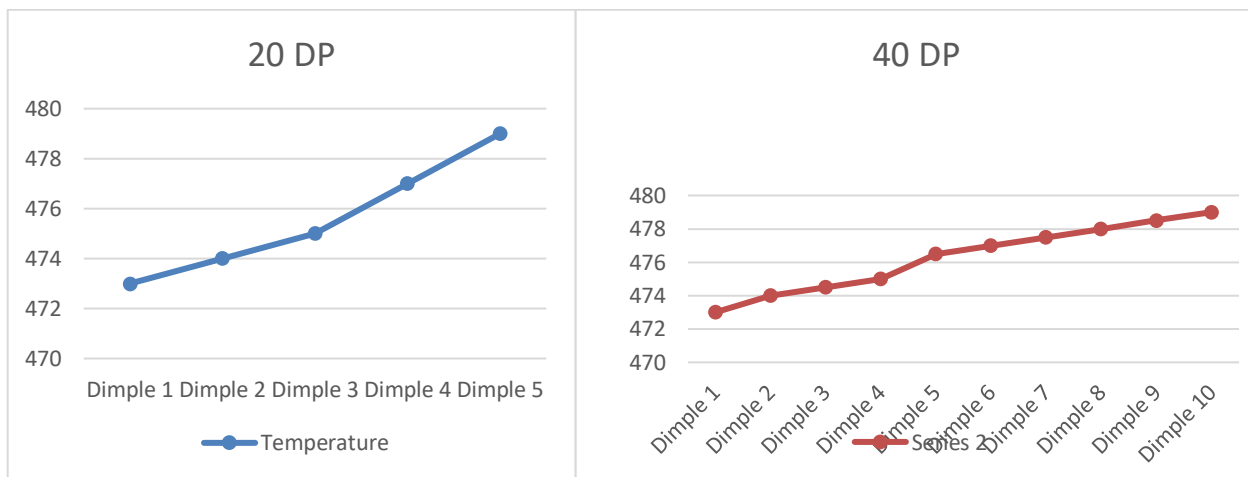


Fig:5.7: temperature variant for both 20dp&40dp

5.3.3 Temperature variation for sepearate pipes (20dt&40dt)



5.4 INLET FACE OF THE PIPE

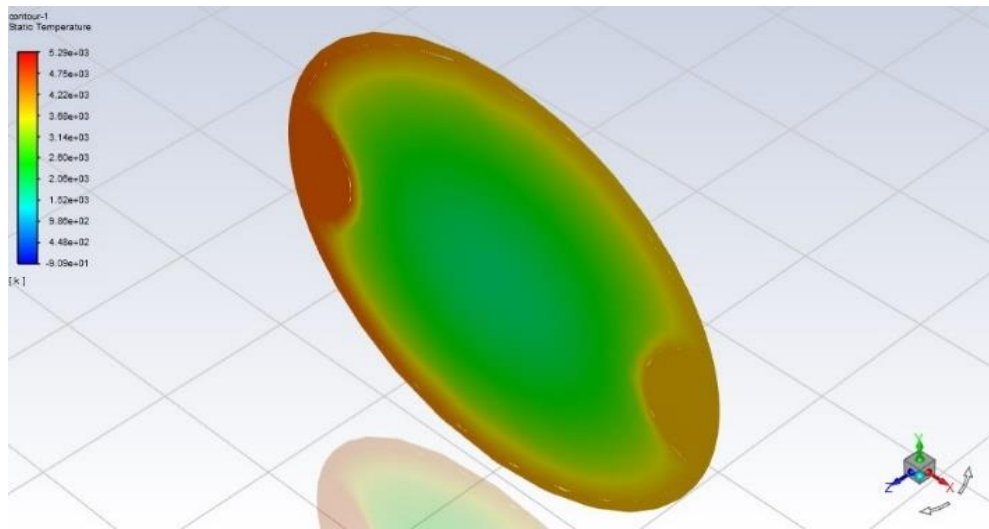


Fig:5.8:20dimple pipe inlet

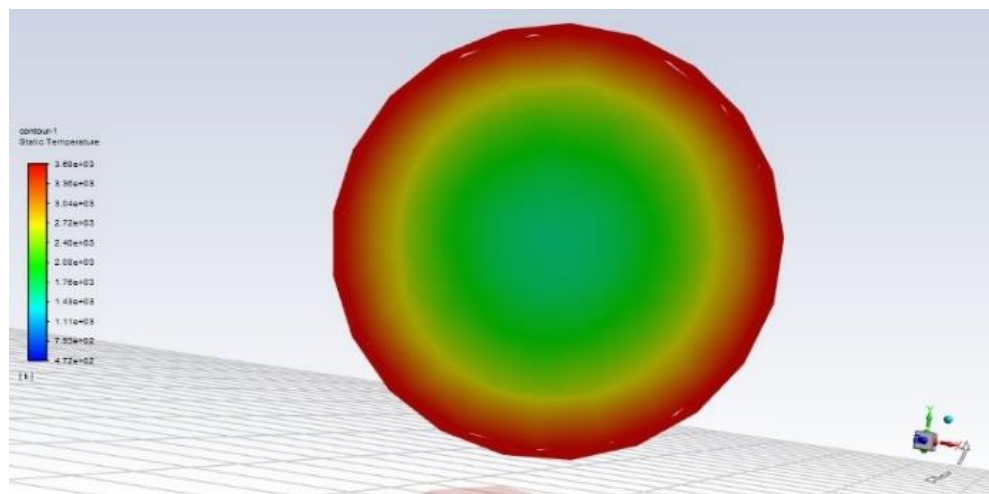


Fig:5.9:40dimple pipe inlet

Here, the temperature is measured by the front face (inlet) there will be a slight change in temperature difference between the both dimple tubes. The red colored area discusses about high temperature, while comparing both as shown in fig 5.8 & 5.9 .Fig 5.8 has temperature abnormal because of the less number of dimples had been provided, but for fig 5.9 the temperature is high at the edges of the pipe, as compared with circumferences middle region has less temperature due to the presence of more dimples ,The presence of static temperature is different as given at the both of fig 5.8 &fig 5.9 .Temperature is given as 473K

at the inlet of the dimple tube(DT) or dimple pipe(DP).

5.5 OUTLET FACE OF THE PIPE

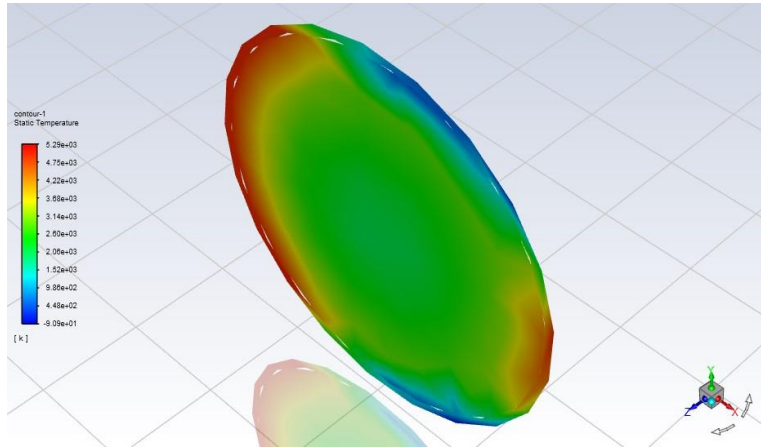


Fig:5.10 :20dimple pipe outlet

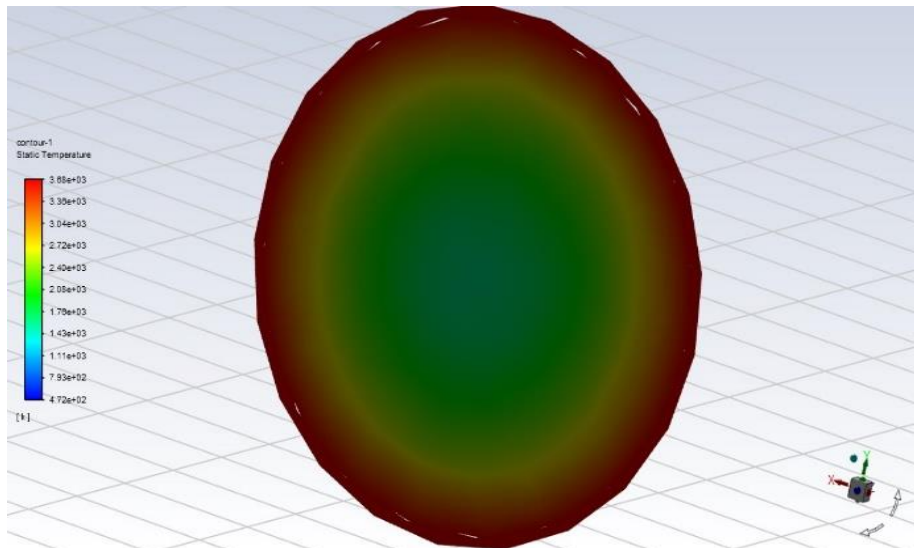


Fig:5.11: 40dimple pipe outlet

Here, the temperature is measured by the back face (outlet) there will be a slight change in temperature difference between the both dimple tubes. The red coloured area discusses about high temperature, while comparing both as shown in fig 5.10 & 5.11. Fig 5.10 has temperature abnormal because of the less number of dimples had been provided, but for fig 5.11 the temperature is high at the edges of the pipe, as compared with circumferences middle region has less temperature due to the presence of more dimples ,The presence of

static temperature is different as given at the both of fig 5.10 & 5.11. Temperature is given as 479K at the outlet of the dimple tube(DT) or dimple pipe(DP). And therefore for fig 5.10 & 5.11 temperature is not presenting properly and also the outlet temperature is not going to reduce but it's getting a slight increase by the outlet side of the pipe but compared with both the pipes fig 5.10 & 5.11 temperature is constantly flowing through the pipe only for fig 5.11 . back flow turbulent viscosity ratio 10, back flow hydraulic diameter 0.0615m.

CHAPTER 6

SUMMARY AND CONCLUSION

6.1 SUMMARY

Thermal heat exchange for different situations by using of a SS304 steel pipe with different type of circumstance, consists of two pipes. One pipe has prepared dimples of the number is 20 and length of the pipe from Top to bottom is 1m in length with respect that configuration of dimple, depth is 10mm and diameter is 20mm. Distance between dimple to dimple is 200mm and exactly center point at dimple to dimple that means 100mm length a dimple is placed Helical like wise all numbers of dimples is 20. And as like the steel pipe, another pipe also made to compare the both pipes but for that One, where number of dimples is increased, it consists of 40dimples. Therefore Here dimple to dimple 100mm and Helical length of the dimple has 50mm. For this both pipes has CFD analysis is taken by using a software name called ANSYS SOFTWARE. CFD images were taken by various types of situations. And also for experimental work we used RMS digital multimeter and Thermocouple K type wire for measuring the temperature of each and every point of the dimple.

Warm hotness exchange for various circumstances by utilizing of a SS304 steel pipe with various sort of situation, comprises of two lines. One line has arranged dimples of the number is 20 and length of the line from Top to base is 1m long with deference that setup of dimple, profundity is 10mm and width is 20mm. Distance between dimple to dimple is 200mm and precisely focus point at dimple to dimple that implies 100mm length a dimple is set Helical like wise all quantities of dimples is 20. Furthermore, as like the steel pipe, another pipe likewise made to look at the two lines however for that one, where number of dimples is expanded, it comprises of 40dimples. Hence Here dimple to dimple 100mm and Helical length of the dimple has 50mm. For this the two lines has spictures were taken by different sorts of circumstances. And furthermore for exploratory work we utilized RMS advanced multimeter and Thermocouple K type wire for estimating the temperature of each and every point of the dimple.

6.2 CONCLUSION

The mathematical examinations were performed to contrast the strain drop around the dimpled tube. From the similar investigation of strain drop forms versus stream course, the pneumatic stress diminishes with the increment... of Reynolds number as a result of the .expansions in the stream section region in the diffuser and the strain misfortunes increments because of the presence of the dimples that make distribution and vortices causes to build the misfortunes. Speed reproductions are used to concentrate on the speed profile attributes in a dimpled tube during the fierce stream. It is observed that the air close to the dimples region is blended in with the extra air that streaming around the dimpled cylinder and improves the appropriations of the speed that implies more distracting speed parts. This reality prompts upgrade the stream blending through the diffuser region. The distribution and the unrelated speed part force close to the dimples. region increment as the Reynolds. number increment. In the stream course, it tends to be seen that with the .increment. of Reynolds.. number, the speed profile diminishes. At the power source, the speed circulation increments. as the Reynolds.. number increments and the tension. rate .diminishes. with the .increment of Reynolds.. number. The expansion in Reynolds. number upsets the stream and makes more swirl stream and distribution.

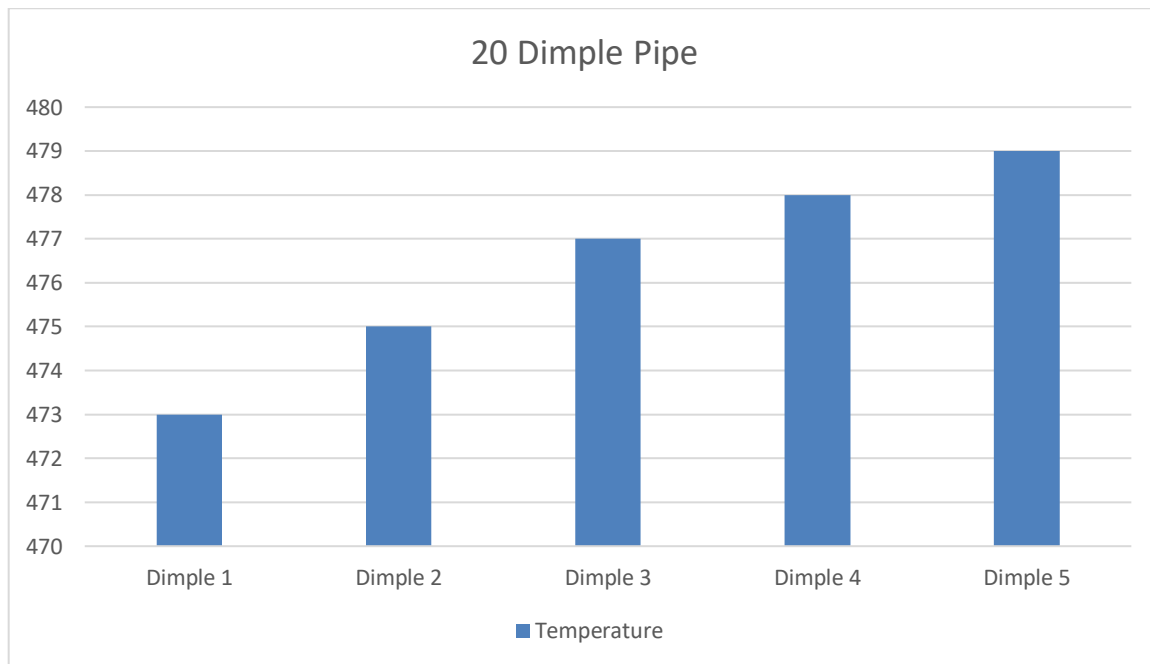


Fig:6.1 :TEMPERATURE OF 20DP Bar graph

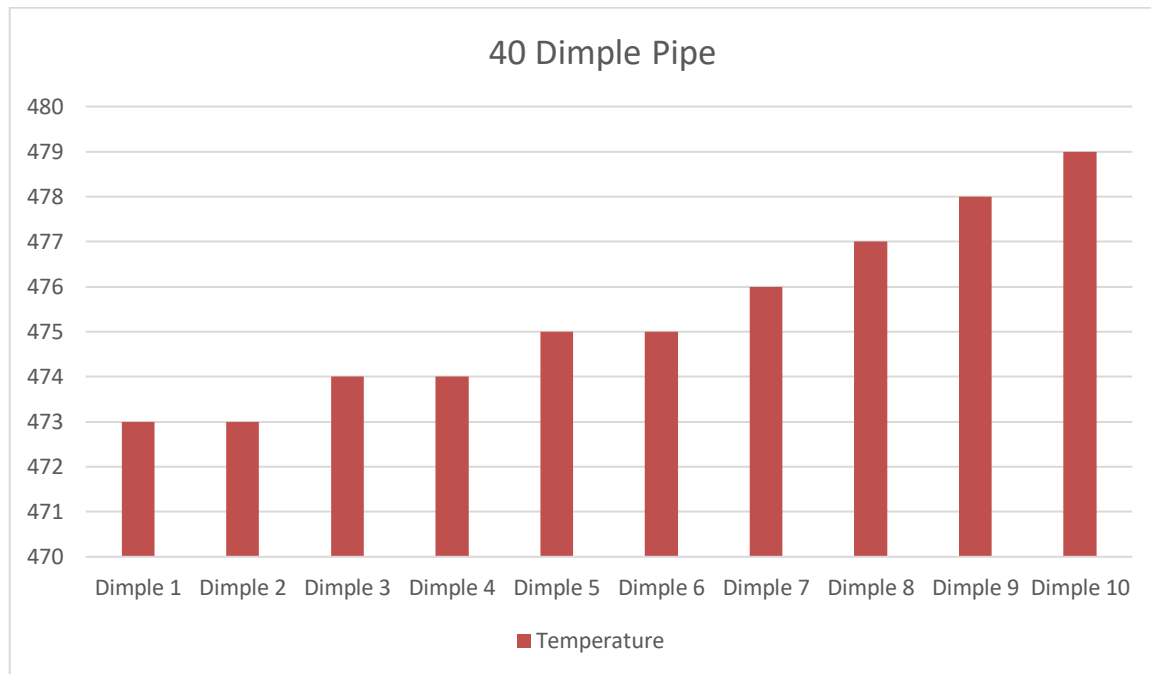


Fig:6.2:temperature of 40DP Bar graph

6.3 PLAIN PIPE

Temperature is constantly passing through the pipe and also velocity & pressure is constant at the pipe, at the end of the pipe that means outlet of the pipe contains less number of temperature in k for plain pipe (with out dimples). this is the assumption for only a plain ss304 pipe

6.4 DIMPLE PIPE

In this 20 dimple pipe temperature in inlet side contains 473K in temperature, As outlet of the pipe consists of 479k in temperature. But we have measured the temperature at the middle point of the ss304 H grade pipe. standard values for the velocity and pressure has given for pressure 0pascles provided. temperature distribution is done for this experimental work .for 20 dimple pipe it consists of 200mm for dimple to dimple dimensions.

6.5 DIMPLE PIPE

For 40 dimple pipe temperature in inlet consists of 473K in temperature, As outlet of the pipe consists of 479K in temperature. But we have measured the temperature at the middle point of the ss304 H grade pipe. standard values for the velocity and pressure has given for pressure 0pascles provided. temperature distribution is done for this experimental work .For 40 dimple pipe it consists of 100mm for dimple to dimple dimensions. Due to increase in dimples temperature is not changed on circumference of the pipe. Outlet pressure flow rate also same as the 20 dimple pipe but it has abnormal outlet

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