



## DESIGN AND THERMAL ANALYSIS OF SUBMERGED ARC FURNACE SYSTEM FOR FERRO ALLOY PLANT

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### Abstract :

Mechanical use of electrical vitality began with the advancement of the dynamo machine by Werner von Siemens. Electric curve heaters have been utilized for a long time both for the liquefying of scrap press (open bend heaters) and for decrease forms (submerged circular segment heaters). In the event of the submerged circular segment heater (SAF), metal and diminishing specialist are bolstered to the heater consistently from the best with the goal that the terminals are covered in the blend and the bend is submerged. The heater is named submerged-circular segment heater since the curve is submerged. The most well-known physical course of action comprises of a round shower with three vertical terminals masterminded in a triangle. Six anode heaters with roundabout or rectangular showers are additionally utilized however they are less normal.

### I INTRODUCTION

Submerged circular segment heaters have discovered their application in excess of 20 distinctive fundamental mechanical regions, for example, Ferro composite, synthetic industry, lead, zinc, copper, stubborn, titanium oxide, reusing, phosphorus and so

forth. An ordinary schematic chart of a submerged circular segment heater for ferro chrome generation alongside material adjust

The expanding interest for Ferro composites and deoxidation specialists in steel making in the start of the twentieth century prompted the advancement of the main submerged circular segment heater. The development of the principal SAF was begun in 1905. This 1.5 MVA unit was introduced in Horst Ruhr, Essen, Germany for the creation of calcium carbide. It was effectively charged in 1906 and depended on DC (coordinate current) innovation.

From that point forward countless (both with DC and AC based heaters) have been dispatched with differing applications. Today, the lion's share of submerged bend heaters depend on AC (substituting current) based ideas.

### 1.1 Rule and attributes of SAF

The rule of a traditional SAF is electric opposition warming. Electric vitality is changed over into warmth and decrease vitality by utilizing the opposition (R) of the weight or the liquid slag, once



in a while, fortified by the electrical obstruction of a curve between the slag and cathode. The vitality is transmitted to the heater hearth via carbon cathodes. The intensity of the heater is the result of the hearth opposition and the square of the terminal current. Along these lines, a restricted expanding cathode current may result in a generally extensive expanding load.

Normal for the procedure in SAF is that the cathode infiltrates through the crude material descending up in the hearth over the metal pool. Regularly the slag enters into this coke bed, however not to the extent to be in contact with the tip of the cathode. The electric warmth for purifying is produced in the quick neighborhood of the terminal tip where the real piece of the voltage drop is

The essential condition for the power contribution to the heater is given by the condition  $P = 3E \cos \phi$ ,  $I = 3RI^2$ , where  $P$  is the power,  $E$  the face voltage amongst transformer and heater hearth,  $I$  is the anode current and  $R$  the ohmic hearth opposition. With respect to the power factor the

A regular SAF with slag task includes a round or rectangular formed heater shell with isolated tap gaps for slag and metal. For a few procedures the slag and metal is tapped through one tap opening and isolated downstream by means of course throwing or skimmers. The heater shell is hard-headed lined and – if extra shell cooling is required by the procedure – water cooled by an uncommon sidewall cooling framework. The shell base is normally cooled by constrained air ventilation. The anodes are devoured by the heater shower. The self heating anodes with

concentrated. The warmed coke bed has a high electric and warm conductivity contrasted and the chilly charge. Therefore just a minor piece of the current goes out from the anode flanks. The coke bed additionally leads the warmth to the refining zones from the terminal. Response gases from the refining zone, fundamentally CO (carbon mono oxide) gas, go upwards through the plummeting crude materials halfway preheating them emitting its sensible warmth and mostly causing strong state decrease of the higher iron oxides. In any case, the thickness of the zone where materials are warmed to response temperature is small to the point that the gas does not have adequate maintenance time to give a broad decrease. 10 % to 20 % pre-decrease is typical in chilly charge activity.

housings or prebaked cathodes are occasionally reached out by new pieces. The anode is semi consequently slipped into the shower with the heater at full electric load and without any interferences of the heater activity.

The anode section congregations contain all offices to hold, slip, and control the infiltration into the shower. All terminal activities are performed powerfully. The electric power is regularly provided from the heater transformer by means of high flow lines, water cooled adaptable transport tubes at the cathodes and the contact braces to the anodes. In the event that the procedure creates off gas which contains a specific measure of CO, the heater is ordinarily planned as a deterred heater compose and the gas is gathered and used for promote applications,



for example, control age, warming, pumping, steam age, and so on.

## II PORTRAYAL OF THE PROJECT

### 2.1 Traditional DC heaters

The DC heaters are for the most part of roundabout sort and the electric vitality is changed over into warm predominantly by the circular segment, which is built up between the anode tip and the slag shower. The best terminal is associated as the cathode and the conductive base framework is associated as the anode. An ordinary heater with open slag shower activity includes for the most part 1 to 3 slag tap openings and 1 to 2 metal tap gaps at a lower rise. The heater requires propelled cooling game plans in the rooftop and side divider region because of the way that the fluid slag temperature is in coordinate contact with the recalcitrant material and in light of the radiation warmth of the bend. The headstrong idea is generally planned deliberately to embrace these forceful conditions. The anode is devoured by the heater procedure. The prebaked anodes are occasionally stretched out by new pieces. Regular ideas apply anode arm to control the terminal. The mechanical capacities and the electrical power exchange standards are like the customary AC based terminal segments.

Additionally DC heaters can be planned as a shut heater compose and the CO can be gathered. The vitality utilization can be improved because of joined cathode development controller with thyristor start controller and high anode speed. DC cathode

segment framework as a rule permits slipping and nipling under full power (giving augmented power-on time). Fast variable focal point gadget is basic for most extreme working time. In DC heaters typically wise sustaining game plan is expected to expand throughput and hard-headed life. Alternate highlights of a DC heater incorporate the accompanying.

The DC heater is typically working with an open curve, which purifies the material inside a brief span. The material can be charged through the empty cathode framework straightforwardly into the circular segment. Typically the circular segment is moving at the tip of the terminal. Accordingly, it is additionally down to earth to charge the material specifically around the terminal tip. In a few heaters it is conceivable to heap up a side divider insurance layer with the charged material. Most procedures, where the slag is overheated don't permit this sort of side divider assurance. By and large it very well may be expressed that the general vitality utilization of a DC heater is higher in contrast with an AC heater because of the accompanying.

## III TARGET OF THE PROJECT

The target of this venture work is to effectively build up an outline of a component. The component is to be dependable, basic, financially savvy and for all intents and purposes attainable. The point of this system is to give strength to the item on unbanked bends, to empower included edge speed bends in correlation regions. This framework is likewise expected to improve comfort as the side



power felt taking a turn is nearly less in the framework.

The strategy received to utilize standard and by and by utilized segments in outline as opposed to plan all segments from ground up. The upside of this strategy is that, you don't need to invest crazy sum and energy in testing the honesty of each part as they have officially demonstrated their value in true applications.

### 3.1 Summary of abilities

Like any product it is constantly being created to incorporate new usefulness. The subtle elements underneath intend to plot the extent of capacities to give a review instead of giving particular points of interest on the individual usefulness of the item.

Catia Elements is a product application inside the CAID/CAD/CAM/CAE classification, alongside other comparable items as of now available.

Catia Elements is a parametric, include based demonstrating engineering fused into a solitary database rationality with cutting edge run based outline capacities. The capacities of the item can be part into the three primary heading of Engineering Design, and Optimization. This information is then archived in a standard 2D generation drawing or the 3D standard ASME illustrations.

### 3.2 Engineering Design

Catia Elements offers a scope of instruments to empower the age of a total computerized portrayal of the item being planned. Notwithstanding the general geometry devices there is additionally the capacity to create geometry of other incorporated outline trains, for example, mechanical and standard work and finish wiring definitions. Instruments are additionally accessible to help synergistic advancement.

Various idea configuration apparatuses that give in advance Industrial Design ideas would then be able to be utilized in the downstream procedure of building the item. These range from applied Industrial outline portrays, figuring out with point cloud information and far reaching freestyle surface apparatuses.

## IV OUTLINE METHODOLOGY OF SUBMERGED ARC FURNACE SYSTEM

### 4.1 Introduction to CATIA

CATIA (Computer Aided Three-dimensional Interactive Application) is a multi-stage CAD/CAM/CAE business programming suite created by the French organization Dassault Systems. Written in the C++ programming dialect, CATIA is the foundation of the Dassault Systems item lifecycle administration programming suite. CATIA contends in the top of the line CAD/CAM/CAE showcase with Cero Elements/Pro and NX (Unigraphics).



The 3D CAD framework CATIA V5 was presented in 1999 by Dassault Systems. Supplanting CATIA V4, it spoke to a totally new plan device indicating essential contrasts to its ancestor. The UI, now highlighting MS Windows format, takes into account the simple joining of basic programming bundles, for example, MS Office, a few realistic projects or SAPR3 items (contingent upon the IT condition).

The idea of CATIA V5 is to carefully incorporate the total procedure of item improvement, including the main draft, the Design, the format and finally the generation and the get together. The workbench Mechanical Design is to be tended to in the Context of this CAE instructional class.

## V EXAMINATION OF SUBMERGED ARC FURNACE SYSTEM

### 5.1 Procedure for FE Analysis Using ANSYS:

The examination of the Submerged Arc Furnace System for Ferro Alloy Plant is finished utilizing ANSYS. For contend get together isn't required, is to completed by applying minutes at the flow of the liquid area along which pivot we have to say. Settling area is base legs.

according to the need/reasonable imperatives are to be connected on the part.

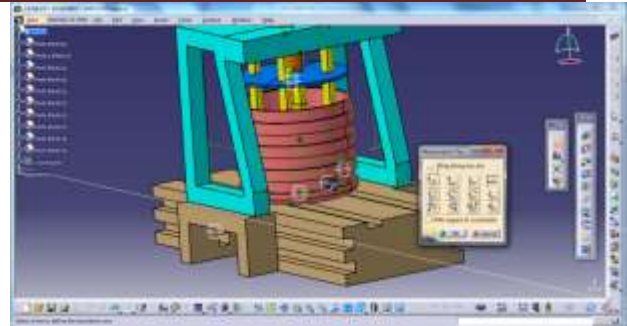


Fig: 5.1: Using Manipulate Command

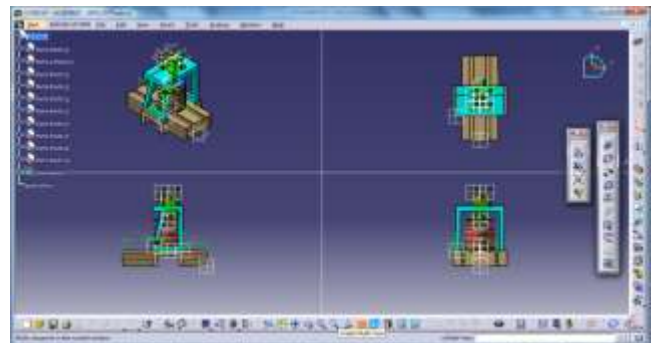


Fig: 5.2: Using Multi View Command

### 5.2. Meshing:

Work age is the act of creating a polygonal or polyhedral work that approximates a geometric space. The expression "lattice age" is frequently utilized reciprocally. Regular uses are for rendering to a PC screen as limited component examination or computational liquid elements. The info display frame can change enormously however normal sources are CAD, NURBS, B-rep and STL (document design). The field is exceedingly interdisciplinary, with commitments found in arithmetic, software engineering, and designing.

Three-dimensional lattices made for limited component examination need to comprise of tetrahedral, pyramids, crystals or hexahedra. Those



utilized for the limited volume technique can comprise of subjective polyhedral. Those utilized for limited contrast techniques more often than not have to comprise of piecewise organized varieties of hexahedra known as multi-square organized lattices.

Lattice is a basic piece of the PC helped building (CAE) recreation process. The work impacts the precision, union and speed of the arrangement. Besides, the time it takes to make a work demonstrate is regularly a critical part of the time it takes to get results from a CAE arrangement. Along these lines, the better and more mechanized the cross section instruments, the better the arrangement. From simple, programmed lattice to a profoundly created work, ANSYS gives a definitive arrangement. Intense mechanization capacities facilitate the underlying cross section of another geometry by keying off material science inclinations and utilizing shrewd defaults so a work can be acquired upon first attempt. Also, clients can refresh quickly to a parameter change, making the handoff from CAD to CAE consistent and supporting in advance plan. Once the best outline is discovered, fitting advancements from, ANSYS give the adaptability to deliver networks that range in intricacy from unadulterated hex lattices to exceedingly point by point Hybrid cross sections.

Fig.5.3: Nodal Temperature

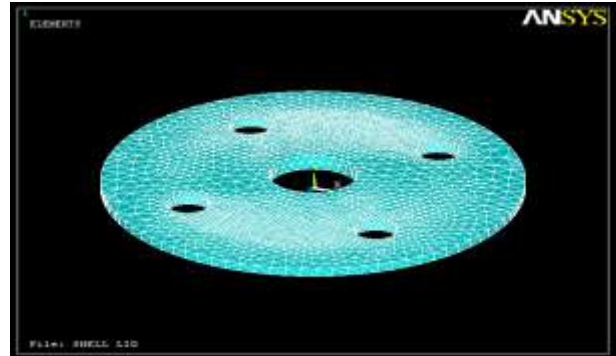


Fig.5.4. Meshing SHELL LID

**VI DISCOURSE ON ANALYSIS RESULT**

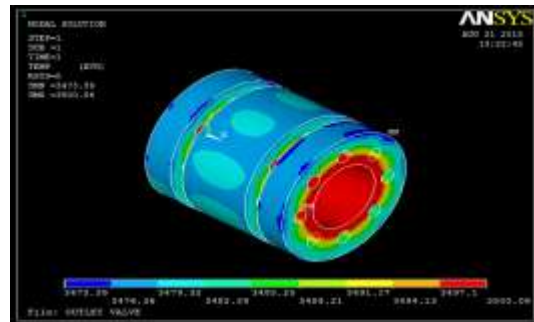


Fig: 6.3: Nodal Temperature of OUTLET VALVE

**VII End**

It very well may be seen from the above outcome that, our goal to examine the warm compelled by thermodynamic improvement which has been fruitful. This venture is made with the outlines, that it gives adaptability in task. This outline has made the more attractive and prudent.

As appeared above figures the Nodal Temperature of the entire plan is coincided and tackled utilizing Ansys and Nodal Temperature is





1227.25. This is demonstrating to us that obviously every segment in get together is having minor entropy.

The most extreme Thermal slope is coming, this arrangement understanding with the assistance of Ansys programming so the greatest Thermal inclination is 38.98.

The most extreme Thermal motion is 5.458 is coming, this arrangement unraveling with the assistance of Ansys programming so the greatest Heat Flow is 1.121. So we can finish up our outline parameters are around rectify.

It very well may be seen from the above outcomes that, our target to outline safe and anchored for Submerged Arc Furnace System for Ferro Alloy Plant.

In this way, the outline of the Submerged Arc Furnace System for Ferro Alloy Plant instrument worked immaculately also. Every one of these actualities point to the consummation of our goal in high regard.

- "Home". worldsteel.org.
- Preston, R., American Steel. Avon Books, New York, 1991
- H. W. Beaty (ed.), Standard Handbook for Electrical Engineers, eleventh Ed., McGraw Hill, New York 1978, ISBN 0-07-020974-X pages 21.171-21.176
- Benoit Boulet, Gino Lalli and Mark Ajersch, Modeling and Control of an Electric Arc Furnace, got to 2014-05-24
- "Graphite Electrodes Solutions from GrafTech". graftech.com.
- "Cross area of electric circular segment heater". Kandi Engineering. Recovered 16 April 2016.
- "Plasma Arc Furnace"

## VIII REFERENCES

- US patent 417943
- The History of Phosphorus, Arthur Toy
- "Crucible Industries:: Our History"

