International Journal of Advances in Engineering and Management (IJAEM)
Volume 3, Issue 9 Sep 2021, pp: 74-77 www.ijaem.net ISSN: 2395-5252

Transient Analysis of Al2585 Alloy by Using Fem with Different Eco Friendtly Quenchants

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Submitted: 30-08-2021 Revised: 03-09-2021 Accepted: 05-09-2021

ABSTRACT:
Heat dissipation is very important process because heating in an conserving way to modify a metal component properties to cater the end users requirement. Significant work had been done on altering the mechanical properties of the metal components and little on the fundamental of the process, which is the heat transfer between the quench media and metal component. Selection of the quench media plays vital role to improve mechanical properties and micro structure. In this research author choose different eco friendly cooling media i.e. cow urine, water, distilled water, soap nut solution, shikakai nut solution and engine oil (unused). Experimentation has been carried out to find the heat dissipation rate of different media. Also ANSYS soft ware has been used to correlate the results. Lastly, it is concluded that there is a good agreement between experimental results with ANSYS soft ware.

Key words: Al alloy, Ansys work bench soft ware, Heat dissipation, Finite Element, Quench media.

I. INTRODUCTION:

In this paper studied different cooling media with its thermal properties on heated specimen with above cooling media and heat transfer rate that is rapid heat transfer occurred with different media and compared with these results practical applications. Therefore ANSYS workbench can produce the accurate result and it helps us save the time and money to analyze the problems. So instead of wasting time and money, the best alternative solution is by doing the simulation. Therefore we can easily find the best cooling media (faster cooling rate) temperature distribution history by using Ansys Workbench.

1.0 HEAT TRANSFER ANALYSIS

1.1 Heat Transfer:

Heat transfer is the analysis of thermal energy transport within a medium or between neighboring media as a result of a spatial variation in temperature through molecular interaction, fluid motion, and electro-magnetic waves. The theory of energy conservation, when applied to a control volume or a control mass, states that the amount of the flow of energy equals the flow of energy. The work performed on the device, as well as the energy collected and converted within the system, are all zero. Conduction, convection, and radiation are the three most common forms of heat transfer. Heat transfer is used in a variety of fields, including the construction of thermal and nuclear power plants, as well as heat engines, steam turbines, condensers, and other heat exchangers.

1.2 Unsteady state Analysis:

To this point, we've only looked at conductive heat transfer problems with temperatures that are constant over time. However, in many implementations, temperatures change over time, necessitating an understanding of the temperature version's entire time history. In metallurgy, for example, the warmth treating technique can be regulated to affect the characteristics of the treated materials immediately. Metals can be melted and made more ductile by annealing (slow cooling). Quenching (rapid cooling) on the other hand, will harden the tension boundary and increase electricity. The overall unsteady equation is needed to describe this brief behavior:

$$\frac{1}{\alpha}\frac{\partial T}{\partial \tau} = \frac{\partial^2 T}{\partial x^2} + \frac{\partial^2 T}{\partial y^2} + \frac{\partial^2 T}{\partial z^2} + \frac{q}{k}$$

Where, α = k/ρc is the thermal diffusivity. Without any heat era and thinking about spatial version of temperature only in x-direction, the above equation reduces to:

$$\frac{1}{\alpha}\frac{\partial T}{\partial \tau} = \frac{\partial^2 T}{\partial x^2}$$

We need boundary conditions in x-route and one initial situation for the above equation. As the name suggests, boundary conditions are often detailed alongside an object's bodily boundary; however, they may also be internal – for example, a regarded temperature gradient at an inner line of symmetry.

1.3 Biot and Fourier numbers:

The inner temperature gradients within the body may be very small and insignificant in certain short problems. However, the temperature at a given location, or the average temperature of an object, can change dramatically over time. We should be mindful that this may be the case for large thermal diffusivity.

$$\text{Biot number} = \frac{(T_i - T_s)}{(T_s - T_\infty)} = \frac{hL}{k}$$

It's possible to think of the Biot quantity as a ratio because it's dimensionless. Bi is the ratio of internal to external flow resistance. When the Biot number is low, the inner temperature gradients are low, and a transient problem can be solved using the "lumped thermal potential" method. The expectation of a single mass-averaged temperature for the object under consideration is known as the lumped potential assumption.

$$\ln\frac{T(t)-T_\infty}{T_i-T_\infty} = -\frac{hA_s}{\rho c V}t$$

Taking the exponents of each sides and rearranging,

$$\frac{T(t)-T_\infty}{T_i-T_\infty} = e^{-bt}$$

$$b = -\frac{hA_s}{\rho c V}$$

II. TRANSIENT HEAT ANALYSIS OF CONDUCTION

Problems by written as: **using ANSYS Software Tool**

2.1 ANSYS Software Introduction:

ANSYS is a computer-aided engineering software program developed in the United States. In a variety of disciplines, such as finite detail evaluation, structural evaluation, computational fluid dynamics, explicit and implicit techniques, and heat transfer, ANSYS publishes engineering evaluation tools at some stage. Temperature distribution in a solid cylinder is investigated.

2.2 ANSYS - Transient Thermal Analysis - Problem Solving Steps:

1. Create Analysis System
2. Attach Geometry
3. Apply Mesh Controls/Preview Mesh
4. Establish Analysis Settings
5. Define Initial Conditions
6. Apply Heat Flux
7. Solve

Table 1. Composition Al 2585 alloy % weight

Cu	Mg	Si	Fe	Mn	Ni	Zn	Pb	Sn	Al
10	0.3	2	0.7	0.5	0.5	0.1	0.01	0.01	Rest

S. No	QM	Time (in m -sec) to drop temperature to 100°C		
		Experimental	Analytical	Simulated
1	CU	3.5	3.6	3.3
2	TW	5.0	5.2	5.3
3	DW	5.5	5.3	5.4
4	SN	6.3	6.7	6.5
5	Shi N	7.0	6.9	6.7
6	EO	10.0	9.9	9.8

Table2. Experimental and simulated results

III. HEAT TRANSFER RESULTS OF TRANSIENT CONDUCTION ANALYSIS:

3.1 Heat Distribution in Solid Cylinder:

Fig. 1 shows the variant of temperature with time for various warmness source parameters for a stable cylinder. We take a solid cylinder and then applied a consistent warmth flux of 9200W/m^2 on all the faces for 30 seconds with an initial temperature of 22 ^{0}C.

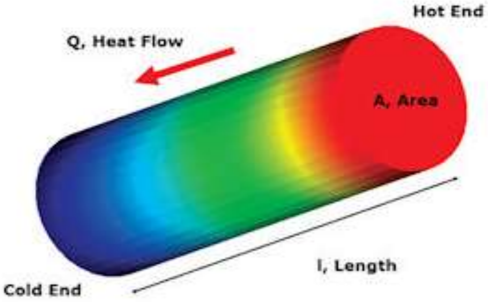

Fig: 1 Heat flow solid cylinder

3.2. Cow urine Quenchant

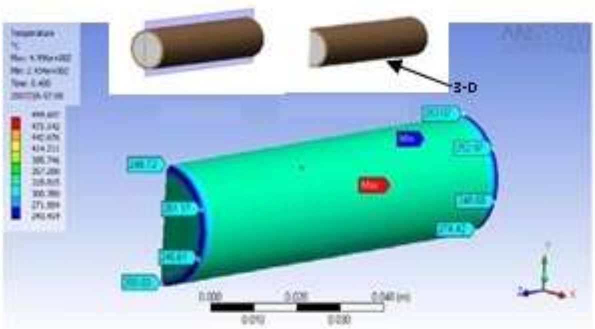

Fig 2. Result for 530 ºC Al alloy bar and 100 ºC at time step 3.3 m-second.

3.3. TW & DW Quenchants

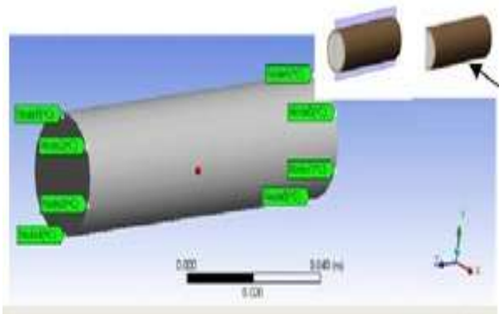

Fig 3. Result for 530 ºC Al alloy bar and 100 ºC at time step 5.2 m-second.

3.4. Soap Nut & Shi Nut Quenchants

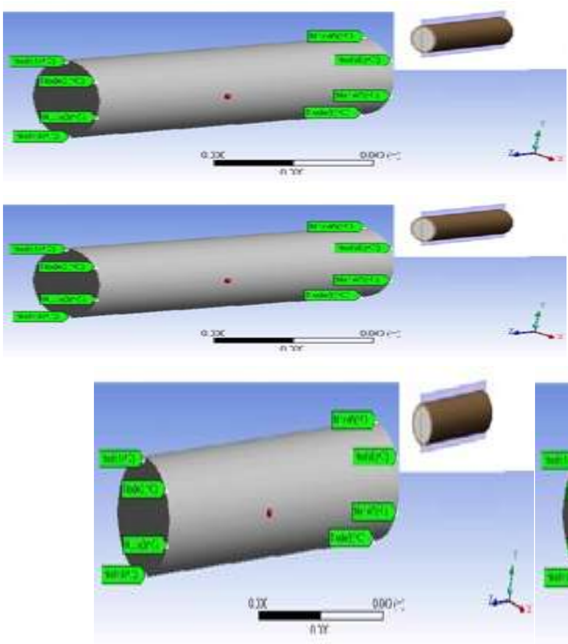

Fig.4. Result for 530 ºC Al alloy bar and 100 ºC at time step 6.7 m-second.

3.5. Engine oil Quenchant

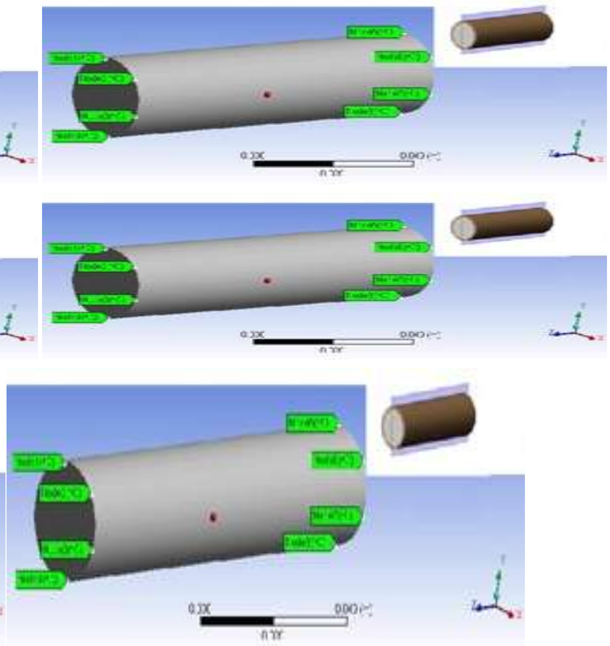

Fig.5. Result for 530 ºC Al alloy bar and 100 ºC at time step 9.8 m-second.

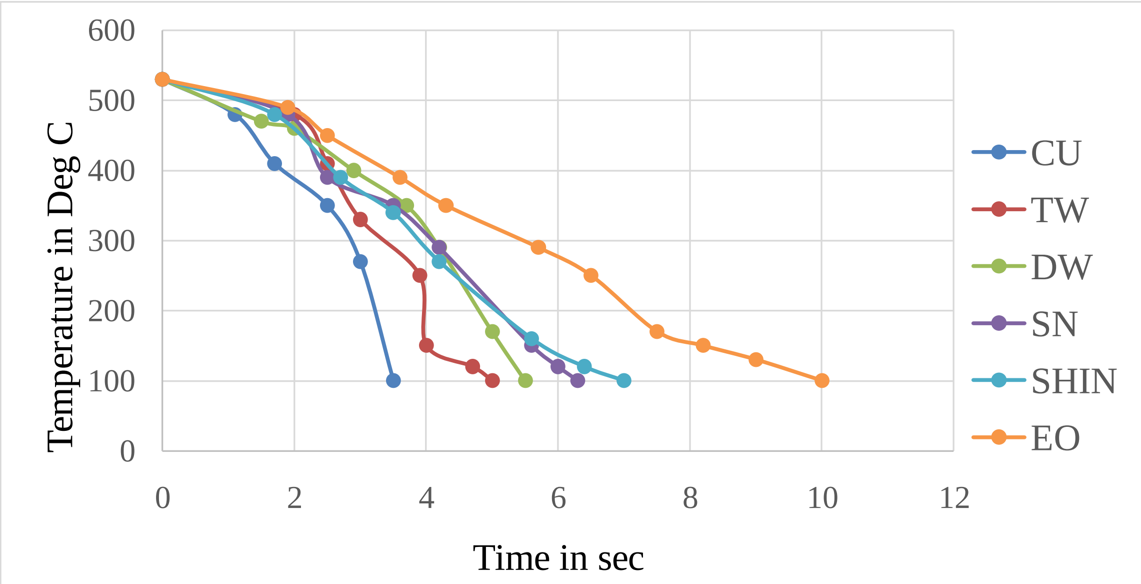

Fig .6. Cooling curves quenching in CU, Water, TW, SN, Shi N, EO

IV. CONCLUSION:

In this investigation experiments have been conducted to find the temperature distribution within the cooling media. Showed the same result experimental and simulated shown table 2.

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