**Thermodynamic Process Simulation**

LAB 2

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Aim

*This report aims to analyze thermodynamic processes using MATLAB, addressing two specific questions. The primary objectives are as follows:*

1. *To develop a MATLAB code for calculating the heat discarded to a river by a central power plant operating at a rated power of 800,000 kW with a thermal efficiency of 70% of the maximum possible value. The calculations involve steam generation at 585 K and heat dissipation to a river at 295 K.*
2. *To create a MATLAB code for determining the change in entropy during the quenching process of a 40 kg steel casting at 450 ℃ in 150 kg of oil at 25 ℃. The specific heat capacities of steel and oil are provided, and the analysis includes calculating the entropy changes for the casting, the oil, and their combined system.*

*Through these MATLAB implementations, the aim is to enhance understanding and provide efficient tools for the analysis of thermodynamic systems, offering insights into energy processes and aiding in system optimization.*

Top of Form

Methodology

1. ***Central Power Plant***

*A central power plant, with a rating of 800,000 kW, operates with a thermal efficiency of 70% of the maximum possible value. Steam is generated at 585 K, and heat is discarded to a river at 295 K. The objective is to calculate the amount of heat discarded to the river at the rated power.*

*The MATLAB analysis of the central power plant reveals valuable insights into its thermal efficiency and heat dissipation mechanisms. The calculated heat discarded to the river at the rated power provides a quantitative measure of the plant's energy losses. The methodology employed, which includes the determination of maximum possible work, offers a comprehensive understanding of the plant's performance. The code allows for quick and accurate assessment, aiding in the identification of potential areas for improvement in energy utilization and efficiency.*

1. ***Quenching Process***

*A 40 kg steel casting at 450 ℃ is quenched in 150 kg of oil at 25 ℃. The specific heat capacities of steel and oil are given. The goal is to determine the change in entropy for (a) the casting, (b) the oil, and (c) both combined.*

*The MATLAB analysis of the quenching process showcases the change in entropy for both the steel casting and the quenching oil. The individual entropy changes provide a detailed view of the thermodynamic behavior during the cooling process. The total change in entropy for both components combined reflects the overall entropy change in the system. This information is crucial for understanding the energy exchanges during the quenching process, helping in the design and optimization of heat treatment procedures.*

Conclusions:

*The MATLAB codes provided in this report facilitate the calculation of heat discarded by a central power plant and the change in entropy during the quenching process of a steel casting in oil. These detailed calcul**ations contribute to a comprehensive understanding of thermodynamic processes, aiding in the analysis and optimization of energy systems.*

Results:

*1.Eff = 0.3470*

*The amount of heat given to the system is*

*Q\_in = 2.3054e+06*

*The amount of heat discarded to the river is*

*Q\_out = 1.5054e+06*

*2. The final temperature of the system is*

*T\_final = 319.6690 Kelvin*

*Entropy of casting is*

*delS1 = -16.3266*

*Entropy of oil is*

*delS2 = 26.1335*

*Total entropy of the system is*

*S\_total = 9.8069*

Appendix:

Q1:

clear all

clc

Pow = 800000 ; % kW

T\_h = 585 ; %K

T\_l = 295 ; %K

n= 0.7 ;

Eff = n\*(1-T\_l/T\_h) % Second Law

Q\_in = Pow/Eff %kW

Q\_out = Q\_in - Pow %kW

Q2:

clc

Cp\_Steel = 0.5 %kJ/kg\*K

Cp\_oil = 2.5 %KJ/kg\*K

m\_steel = 40; %kg

m\_oil = 150;

T1 = 450 + 273.15; %K

T2 = 25+273.15; %K

% Energy Balance ;delQ = 0

T\_final = (m\_steel\*Cp\_Steel\*T1 + m\_oil\*Cp\_oil\*T2)/(m\_steel\*Cp\_Steel + m\_oil\*Cp\_oil);

%Casting S = m\*cp\*ln(t2/t)

delS1 = m\_steel\*Cp\_Steel\*log(T\_final/T1)

%Oil

delS2 = m\_oil\*Cp\_oil\*log(T\_final/T2)

%Total Entropy

S\_total = delS2+delS1 %KJ/Kg\*K