DESIGN OF PROCESS EQUIPMENT FOR EFFICIENCY AND RELIABILITY : OPTIMIZED ENGINEERING

Internship Report

Submitted for the partial fulfillment of the degree of

Bachelor of Technology

In

Chemical Engineering

Submitted By

Akash Ojha

0901CM201005

UNDER THE SUPERVISION AND GUIDANCE OF

Prof. Anish P. Jacob

Assistant Professor And Coordinator

Department of Chemical Engineering

माधव प्रौद्योगिकी एवं विज्ञान संस्थान, ग्वालियर (म.प्र.), भारत
MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR (M.P.), INDIA
Deemed to be University
(Declared under Distinct Category by Ministry of Education, Government of India)
NAAC ACCREDITED WITH A++ GRADE

January-May 2024

DECLARATION BY THE CANDIDATE

I hereby declare that the work entitled **"Design Of Process Equipment for Efficiency and Reliability : Optimized Engineering"** is my work, conducted under the supervision of **Prof. Anish P. Jacob , Assistant Professor and Coordinator ,** during the session Jan-May 2024. The report submitted by me is a record of bonafide work carried out by me.

I further declare that the work reported in this report has not been submitted and will not be submitted, either in part or in full, for the award of any other degree or diploma in this institute or any other institute or university.

Akash Ojha

0901CM201005

Date: 24-05-2024
Place: Gwalior

This is to certify that the above statement made by the candidates is correct to the best of my knowledge and belief.

Guided By:

Prof. Anish P. Jacob
Assistant Professor and Coordinator
Chemical Engineering
MITS, Gwalior

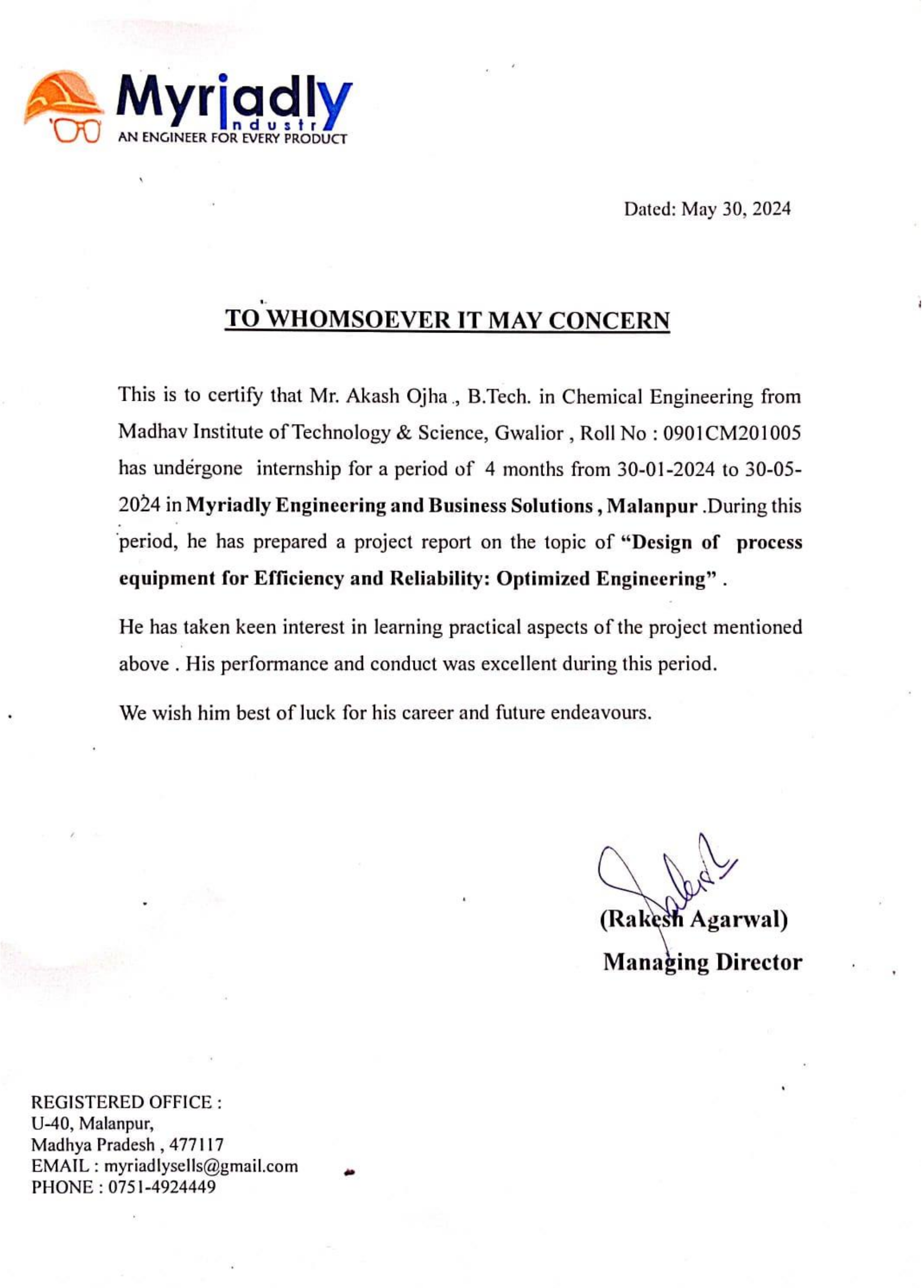
Departmental Project Coordinator

Prof. Shivangi Sharma
Assistant Professor
Chemical Engineering
MITS, Gwalior

Approved by Coordinator

Prof. Anish P. Jacob
Assistant Professor and Coordinator
Chemical Engineering
MITS, Gwalior

INTERNSHIP CERTIFICATE



Myriadly
AN ENGINEER FOR EVERY PRODUCT

Dated: May 30, 2024

TO WHOMSOEVER IT MAY CONCERN

This is to certify that Mr. Akash Ojha ., B.Tech. in Chemical Engineering from Madhav Institute of Technology & Science, Gwalior , Roll No : 0901CM201005 has undergone internship for a period of 4 months from 30-01-2024 to 30-05-2024 in **Myriadly Engineering and Business Solutions , Malanpur** .During this period, he has prepared a project report on the topic of **"Design of process equipment for Efficiency and Reliability: Optimized Engineering"** .

He has taken keen interest in learning practical aspects of the project mentioned above . His performance and conduct was excellent during this period.

We wish him best of luck for his career and future endeavours.

(Rakesh Agarwal)
Managing Director

REGISTERED OFFICE :
U-40, Malanpur,
Madhya Pradesh , 477117
EMAIL : myriadlysells@gmail.com
PHONE : 0751-4924449

PLAGIARISM CHECK CERTIFICATE

This is to certify that I am a student of B.Tech. in **Chemical Engineering** have checked my complete report entitled **"Design Of Process Equipment for Efficiency and Reliability : Optimized Engineering"** for similarity/plagiarism using the "Turnitin" software available in the institute.

This is to certify that the similarity in my report is found to be 16 % which is within the specified limit (20%).

The full plagiarism report along with the summary is enclosed.

Akash Ojha

0901CM201005

Checked & Approved By:

Prof. Anish P. Jacob
Turnitin Coordinator
Chemical Engineering
MITS, Gwalior

ABSTRACT

The efficient separation and energy transfer in chemical processing industries heavily rely on the optimal design of distillation columns and heat exchangers. This project focuses on the comprehensive design, analysis, and optimization of these critical components to enhance process efficiency, cost-effectiveness, and sustainability. For the distillation column, the project encompasses the selection of suitable column type, tray or packing design, application of McCabe-Thiele to determine the ideal number of steps and Fenske-Underwood-Gilliland methods, and evaluation of column diameter and height. The design process integrates thermodynamic data, mass and energy balances, and consideration of factors like feed composition, desired product purity, and operational constraints. Parallelly, the heat exchanger design addresses the thermal energy management crucial for the distillation process. The project involves selecting the appropriate type of heat exchanger, such as shell-and-tube or plate heat exchanger, and performing detailed thermal and hydraulic calculations. Key design aspects include heat duty,material compatibility, fouling effects, pressure drop, and total heat transfer coefficient. The optimisation of the design seeks to optimise heat recovery, reduce energy usage, and guarantee safety and mechanical integrity. By integrating both the distillation column and heat exchanger designs,The final design will be evaluated for energy efficiency, cost implications, and environmental impact, ensuring adherence to industry standards and regulatory requirements. The outcomes will contribute to the development of more sustainable and economically viable chemical processing systems.

Keywords

Distillation column, heat exchanger, design optimization, process efficiency, chemical processing, thermal management, simulation, sustainability.

ACKNOWLEDGEMENT

The full semester internship has proved to be pivotal to my career. I am thankful to my institute **Madhav Institute of Technology and Science** to allow me to continue my disciplinary/ interdisciplinary internship as a curriculum requirement, under the provisions of the Flexible Curriculum Scheme (based on the AICTE Model Curriculum 2018), approved by the Academic Council of the institute. I extend my gratitude to the Director of the institute**, Dr. R. K. Pandit** and Dean Academics, **Dr. Manjaree Pandit** for this.

Guidance and co-operation are valuable for fulfilling and furnishing any kind of work. Similarly, I am dearly thankful to the Management for giving me this prestigious opportunity to learn from the field knowledge based on the theoretical aspects and also for guiding me during the ongoing training period.

I am sincerely thankful to my faculty mentors. I am grateful to the guidance of **Anish P. Jacob**, Assistant Professor and Coordinator , **Department of Chemical Engineering**, for his continued support and close mentoring throughout the internship. I am very thankful to the faculty and staff of the department. And I am thankful to **Mr. Rakesh Agarwal** as an industry mentor who helped me a lot to get familiar with the industry for guiding me throughout my internship.

Akash Ojha

0901CM201005

CONTENT

Table of Contents

ACRONYMS

NTP	Normal Temperature and Pressure
LMTD	Logarithmic Mean Temperature Difference
ID	Internal Diameter
OD	External Diameter
UPV	Unfired Pressure Vessels
IPA	Isopropyl Alcohol
MOC	Material of construction
SS-304	Stainless steel 304
SS-316	Stainless steel 316

NOMENCLATURE

Xf	mole fraction of feed
Xd	mole fraction of distillate
Xw	mole fraction of bottom
M	molecular weight of the vapor
Z	compressibility factor
R	gas constant
G	mass flow rate of vapor
h_i	inside fluid film coefficient, W/m^2°C
h_{od}	outside dirt coefficient (fouling factor), W/m^2 "C
h_{id}	inside dirt coefficient, W/m2°C
k_w	thermal conductivity of the tube wall material, W/m°C
d_o	tube outside diameter, m.
d_i	tube inside diameter, m.
L	length of tube
W_c	total condensate flow
N_t	total number of tubes in the bundle
N_r	average number of tubes in a vertical tube row.
ΔT_{Im}	log mean temperature difference
T_1	inlet shell side fluid temperature
p	internal or external pressure (design or test condition)
T_2	outlet shell side fluid temperature
t	shell thickness (before adding corrosion allowance)
t_1	inlet tube side temperature
t_2	outlet tube-side temperature

Di	internal dia of shell
K_1	coefficient depending upon the shape factor.
K_2	coefficient based on the length of the vessel's vibration cycle
p_w	N/m2, the minimum wind pressure must be utilised for calculating moments
V_w	maximum wind speed recorded in the area during the worst weather, in km/h
f	allowable stress at design temperature
W_s	wt of the shell
W_i	wt of insulation
W_l	wt of the liquid supported
W_a	wt of all attachments

LIST OF FIGURES

LIST OF TABLES

CHAPTER 1: INTRODUCTION

The design and optimization of process equipment are pivotal in achieving high performance and reliability in chemical and industrial processes. This project aims to develop advanced methodologies for the design of key process equipment, focusing on maximizing efficiency, ensuring operational reliability, and minimizing costs. By integrating principles of chemical engineering, thermodynamics, and materials science, the project seeks to enhance the overall process performance through innovative engineering solutions. Heat exchangers and distillation columns are examples of process equipment that fundamental components in numerous industrial applications, including petrochemical refining, pharmaceuticals, food processing, and environmental management. These units must be meticulously designed to handle complex chemical reactions, phase separations, and thermal energy transfers under varying operational conditions. The challenges lie in balancing competing factors such as energy efficiency, material compatibility, mechanical strength, and economic feasibility.[3]

The core goal of this of this project is to maximise the design of distillation columns and heat exchangers, ensuring they operate at peak efficiency and reliability. The approach involves a detailed analysis of the process requirements, selection of appropriate design methodologies, and rigorous testing through simulation and modeling. Key aspects of the column design include the determination of the optimal number of stages, tray or packing configurations, column dimensions, and energy integration strategies. Similarly, for heat exchangers, the focus is on selecting the suitable type (e.g., shell-and-tube, plate), performing thermal and hydraulic calculations, and optimizing heat transfer efficiency while minimizing pressure drops and fouling.[3]

1.1 Design Considerations

Safety: Ensuring the safety of personnel and the environment is paramount. This involves adherence to safety standards and regulations, incorporating safety features, and conducting risk assessments.

Efficiency: Designing for optimal performance and energy efficiency to reduce operational costs and environmental impact.

Reliability and Maintenance: Selecting robust materials and designing for easy maintenance and repair to ensure long-term reliability and minimal downtime.

Scalability and Flexibility: Ensuring the design can accommodate future expansions or modifications with minimal disruption[3]

1.2 Design of Distillation Column

One essential piece of machinery for breaking down liquid mixtures into their component parts based on variations in boiling points is a distillation column. It operates on the principle of repeated vaporization and condensation cycles, which progressively enrich the concentration of the desired components in the respective output streams. As the mixture heats up, the components with varying boiling points separate; the more volatile ingredients vaporise and rise, while the less volatile ingredients stay liquid and sink. Pharmaceuticals to produce high-purity substances, Chemical Manufacturing to purify chemicals and solvents, Food and Beverage: To distil alcoholic beverages and essential oils, and Petrochemical and Refining: To separate crude oil into fractions like petrol, diesel and kerosene. Distillation columns' construction and functionality are critical for process efficiency, product quality, and energy consumption. By optimizing parameters such as column height, diameter, reflux ratio, and internal design, engineers can enhance separation performance, reduce costs, and improve safety and sustainability in industrial processes.[2]

1.3 Design of Heat Exchanger

Heat exchangers are biases that use heat transfer to dynamically transport fluids at different temps. These biases can be widely applied in both everyday and industrial settings, for example, in steam generators in thermal power plants, distillers in the chemical sector, and evaporators and condensers.A key component of engineering is heat exchanger design, which entails selecting materials, geometry, and operating conditions carefully to achieve effective heat transfer between two fluids while taking maintenance needs, pressure drop, and temperature gradients into account.

The primary goal of heat exchanger design is to maximize heat transfer while minimizing energy consumption, cost, and environmental impact. Design considerations vary depending on the specific application and the characteristics of the fluids involved.[4]

CHAPTER 2: LITERATURE SURVEY

Rajendra , Syed Sameer, Dr. Mallikarjun.C.Math,Rangu P. proposed in this research paper that Engineers are frequently requested to boost productivity and streamline procedures. These requests might be made in order to overcome capital constraints, boost probability, or increase throughput. For these reasons, it is necessary to constantly improve the procedures that include heat transfer equipment. This research presents a way for enhancing the performance of shell and tube heat exchangers by increasing the surface area for heat transfer through the use of grooved tubes and rough surfaces. Heat transfer is accelerated by the externally grooved surface of the tube (fins) due of the increased surface area. Additionally, this research offers strategies for increasing turbulence within heat exchanger tubes through the use of inserts. Any heat exchanger's primary function is to transfer heat from hot to cold fluids and lower the temperature of hot water by transferring its heat to the cold water. Heat exchangers are used in the majority of devices that operate on thermal principles as a result. Although heat can naturally be transferred between two substances at differing temperatures, heat exchangers speed up this process, which makes them crucial to industries. One of the most widely used heat exchangers in use today is the shell and tube type, which is the one chosen for this project.[8]

Karl Kolmetz , Dr. Wai Kiong Ng Siang Hua Lee, Tau Yee Lim proposed in this research paper design of a distillation tower is typically created in two stages: the mechanical design and the process design Calculating the necessary stream flows and number of theoretical stages is the goal of the process design. Reflux rate, side draws, and heat duties (number of pump arounds, condenser, and reboiler) are examples of steam flows that may be necessary. Determining the height, diameter, and internal structure of the columns and tower is the aim of the mechanical design. Numerous Engineering Procurement and Construction (EPC) companies have developed "cook book" methods to expedite the process and complete mechanical designs. It is frequently possible to optimize "cook book" designs for better operations, maintenance, and profitability. The life cycle cost, which includes the plant's initial capital cost as well as its running and maintenance costs for the first ten years, is the most effective method of evaluating profitability. Reliability is a component of life cycle cost that is crucial to consider when developing any equipment for a process plant. Increased ROI is significantly impacted by improved reliability. When developing distillation equipment, there are a few things to take into account: 1. Select the right distillation equipment for the parameters of the operation. 2. Appropriate equipment choice for anticipated run duration 3. Appropriate process management approach to attain stable operations 4. Potential for fouling, corrosion, and polymerization 5. Safety, chemical stability, and thermal stability 6. Dependability of maintenance, accessibility, and ease of repair .[7]

Haiyan Tan , Lin Cong described the most popular type of separation machinery in the petrochemical sector is distillation columns. Due to its intricate structure, the classic mechanism modeling approach is typically challenging to adapt to online optimization and control, and popular simplified models result in glaring inaccuracies. Thus, we apply the theory of gas-liquid equilibrium to Using an analysis of the gas-liquid mass transfer process on each column tray, create a nonlinear dynamic model that represents the distillation process. The structure of the suggested model is far simpler than that of the conventional mechanism model, and it is capable of correctly capturing the nonlinear aspects of the distillation process. As such, the model presents a new angle on model-based methods in distillation columns, particularly in situations when effective online models are needed. Two distillation case studies involving benzene and toluene.[10]

S.H. Jamshak,Mr. Dev Anand,S.B. Akshay, S. Arun ,J. Prajeev, Prajeesh Prabhakaran redesigning a system in this reasearch involves making changes to its current architecture to minimize its drawbacks and enhance its functionality to achieve the desired increase in output. for creating a new heat exchanger that is designed to replace the current conventional heat exchanger. The main drawbacks of conventional heat exchangers are their high cost, increased room requirement, and challenging maintenance. Since the liquids in a plate heat exchanger spread out over the plate, they are exposed to a larger surface area, which gives it a significant advantage over a normal heat exchanger. Its particular shape makes it ideal for heat transmission between liquids at low pressure. The plate creates a very large surface area that makes it feasible to investigate the substance of the plate and convey information quickly.[9]

CHAPTER 3: COMPANY PROFILE

"**Myriadly Engineering & Business Solutions Pvt. Ltd**." are committed to offering the chemical and pharmaceutical industries engineering and business solutions. To the best of our knowledge, we offer engineering solutions for the chemical and pharmaceutical industries. We customise every product to meet the needs of our customers. Our motive is to provide finest quality services to the industries. Our products are manufactured as per Indian and International standards.

Our Company has achieved desired growth in last 4 years due to appreciation and goodwill that customers have showered on it from all over the India .Issued objected to severe testing & quality checks before dispatch under various stages as Raw .

material Inspection:- Inspection of raw material has to be done as per requirement &schedule fixed.

Inspection during production:- Inspection of the molding, fabrication, galvanizing & machining has to be done to minimize the rejection & quality production.

Pre dispatch Inspection:- A pre dispatch inspection has to be done after assembly or production of the products to ensure proper fitment of all the accessories.

Drawings & Test Certificates:- All the Drawings & Test Certifications will be provided with the machine. The also provide Engineers to commission the machine.

All our products that include hastelloy coating, glove box,labscale reactors, halar coating, heat exchanger and hastelloy coating heat exchanger are of international standards and undergo stringent quality checks before they reach the end user [1]

VISION

Our unreality is to be global leaders in furnishing wide and ready access to daedal artificial results of high quality norms. A one stop result for all artificial conditions, we cast to make a brand that will be reverse to quality, luxury and trustability.[1]

MISSION

Our thing is to be a ground between all Pharma and Chemical companies and their indulgence diligence while in parallel, develop youthful gift to work as freelancers alongside [1]

PRODUCTS :

1. Condensor

Fig 3.1 : Condenser [1]

A condenser is a device used to convert vapor or gas to liquid. In various contexts, it can be found in refrigeration systems, distillation processes, and even in laboratory setups. Essentially, it removes heat from a substance, causing it to condense into a liquid state. [1]

2. Nutshe Filter

Fig 3.2 : Nutshe filter [1]

Nutshe Filter is a feature-rich tool designed to help users streamline their online experience. It allows you to customize your browsing by filtering out unwanted content, such as ads, trackers, and unwanted scripts. With Nutshe Filter, you can enjoy faster and cleaner browsing while enhancing your online privacy and security. [1]

3. Dust Collector

Fig 3.3 Dust collector [1]

A dust collector is a device used to remove dust and other airborne particles from industrial processes or environments. It typically consists of a blower, filter, and a dust removal system. Dust collectors are essential for maintaining air quality and ensuring worker safety in various industries such as woodworking, metalworking, and manufacturing. They come in different types and sizes depending on the specific application and volume of dust produced. [1]

4. Vaccum Ejector System

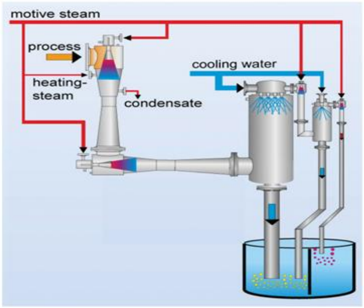


Fig 3.4 : Vaccume ejector system [1]

A vacuum ejector system is a device used to create a vacuum by removing air or gas from a sealed chamber or system. It works by using a high-pressure fluid, typically steam or compressed air, to create a suction effect, pulling the air or gas out of the chamber. These systems are commonly used in industries such as manufacturing, packaging, and food processing for tasks like lifting, conveying, and holding materials. [1]

5. Glove Box

Fig 3.5 : Glove box [1]

A glove box, also known as a glovebox or a glove compartment, is a sealed container that allows manipulation of objects in a controlled atmosphere. It typically consists of a clear, transparent chamber with built-in gloves that enable users to handle materials inside the box without exposing them to the external environment. Glove boxes are commonly used in scientific research, pharmaceuticals, semiconductor manufacturing, and other industries where sensitive materials must be handled in a controlled environment, such as inert gases or a vacuum, to prevent contamination or reactions with moisture or oxygen. They come in various sizes and configurations, ranging from small, benchtop units to large, walk-in chambers, and may include features like gas purifiers, antechambers for introducing materials, and built-in monitoring systems for maintaining desired conditions. [1]

6. LabScale Reactor

Fig 3.6 : labscale reactor [1]

MOC- Connection corridor – SS304, SS316, Hastelloy- Non Connection corridor – SS304 CAPACITY – 500 ml to 50Liter DESIGN PRESSURE – FV to 100 Kg/ cm2 project

TEMPERATURE –- 40 Deg C to 250 Deg C Consistence – 20 mm to 100 mm factors- FLP Panel – Heating System – Chilling System MAGNETIC punch. [1]

7. Hastelloy Coating Heat Exchanger

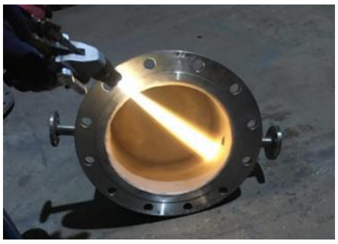


Fig 3.7 : Hastelloy coating heat exchanger [1]

Hastelloy is a high-performance alloy known for its exceptional corrosion resistance, making it ideal for heat exchangers in demanding environments. The coating enhances its durability and resistance to harsh chemicals and high temperatures, ensuring longevity and efficiency in industrial processes. [1]

VESSELS AND TANKS

Vessels and tanks are containers used to store liquids, gases, or solids in various industries such as chemical processing, oil and gas, pharmaceuticals, and food production. They come in different shapes and sizes, ranging from small drums to large cylindrical or spherical tanks. Vessels and tanks are typically made of materials like stainless steel, carbon steel, or fiberglass, and they can be equipped with features like insulation, agitators, and pressure or temperature control systems depending on their intended use. [1]

HEAT EXCHANGER

Heat exchangers made of pipes and shells correlate to a group of leaders. The fluid that has to be either heated or cooled is contained in one set of these leads. The leaders that are being heated are covered with the alternative fluid.. [1]

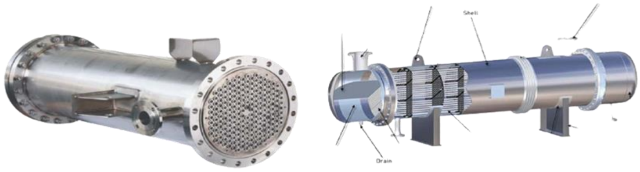


Fig 3.8 : Heat exchanger [1]

CHAPTER 4 : PROBLEM FORMULATION

In whole chemical engineering curriculum, I have found that heat exchanger holds much importance in most of the industries. It is not used only in chemical plant but also has uses in other mechanical works. Designing of unit operation equipments are first step to achieve the desired results. If the equipment has not designed properly it can led dangerous situati on. Several past accidents such as chernoboyl accident is an example of equipment failure that caused loss of live sand property. Moreover economic design of an equipment is the secondary factor that needs to be fulfilled.

PROBLEM 1. Design of distillation column for isopropyl alcohol and water solution .

IPA water solutions 60% IPA and 40% water separate them via distillation column at feed rate

rate 3000 lit/ hr at atm temperature ,pressure is 1 atm .

Solution :-

Feed rate = 3000 lit/hr

IPA = 60 %

Water = 40 %

Top product = 88%

Bottom product = 12%

Pressure = 1 Atm

PROBLEM 2.

Design a shell-and-tube heat exchanger to cool 5000 kg/hr of isopropyl alcohol (IPA) from 80°C to 40°C using cooling water entering at 20°C. The allowable pressure drop for IPA is 0.5 bar, and the desired overall heat transfer coefficient is 500 W/m^{2}K. Assume the thermal conductivity of IPA is 0.17 W/mK, its density is 785 kg/m^3, and its specific heat capacity is 2.44 kJ/kg°C.

PROBLEM 3.

33.4 deg API oil has viscosity of 1.0 centipose at 180 deg Fahrenheit and 2.0 centipoise at 100 deg Fahrenheit. 49,600IB/hr of oilleaves a distilling column at 359 deg. Fahrenheit and is to be utilized in an absorption process at 100 deg farhenheit. Cooling will be attained by water from from 90 to 120 deg Fahrenheit . pressure drop allowance of 10 psi amy be utilized in both streams along with a merged dirt factor of 0.005. Available for the service from a discontinued operation in a 36 inch, inner dia. 2-4 exchanger having 454 1 inch , outer diameter 11BMG tubes 12’0’’ long and laid out on 1(1/4) inch square pitch .Six tube passes and baffles with vertical cut are positioned in the bundle.

CHAPTER 5 : METHODOLOGY

Designing a distillation column involves several detailed steps, including defining the separation requirements, selecting operating conditions, and determining the column specifications

Designing a distillation column :

1. Define the Separation Requirements :

Feed Composition and Flow Rate : Identify the composition and flow rate of the feed stream.

Desired Products and Purities : Specify the desired composition and purity of the top (distillate) and bottom products.

2. Determine Thermodynamic Data :

Vapor-Liquid Equilibrium Data : Obtain or calculate the equilibrium data (K-values or relative volatilities) for the components in the mixture.

Thermodynamic Models : Choose appropriate thermodynamic models (e.g., Raoult's Law, Antoine Equation) for predicting equilibrium data.

3. Select Operating Conditions :

Operating Pressure : Choose the operating pressure based on the boiling points of the components and the pressure drop considerations.

Reflux Ratio : Determine the reflux ratio, typically starting with a minimum reflux ratio calculated using the Fenske-Underwood-Gilliland method.

4. Perform Stage Calculations :

Minimum Number of Stages : Use the Fenske equation to determine the minimum number of theoretical stages required for the desired separation.

Actual Number of Stages : Apply the Gilliland correlation to find the actual number of stages needed, considering the chosen reflux ratio.

5. Design the Column Internals :

Tray or Packing Type : Decide between trays (sieve, valve, or bubble cap) and packing (random or structured).

Tray Spacing and Diameter : Calculate the column diameter and tray spacing based on vapor and liquid traffic.

6. Mass and Energy Balances :

Component Mass Balance : Perform a component balance around the distillation column to ensure the consistency of feed, distillate, and bottoms.

Energy Balance : Calculate the reboiler and condenser duties based on the latent heat of vaporization and the flow rates.

7. Sizing and Mechanical Design :

Column Diameter : Calculate the diameter based on vapor and liquid flow rates, ensuring that velocities are within acceptable limits to avoid flooding or weeping.

Height of the Column : Determine the height based on the number of stages and tray spacing or packing height.

Auxiliary Equipment : Size the reboiler, condenser, and other associated equipment.

8. Perform Hydraulic Analysis :

Flooding and Weeping : Check the column design for flooding and weeping conditions.

Pressure Drop : Ensure the pressure drop across the column is within acceptable limits.

9. Control and Instrumentation :

Control Strategies : Design control systems to maintain product purity, reflux ratio, and other critical parameters.

Instrumentation : Specify the required instrumentation for monitoring and controlling the process variables.

10. Cost Estimation and Economic Analysis :

Capital and Operating Costs : Estimate the capital costs for the column and associated equipment and the operating costs, including utilities and maintenance.

Economic Feasibility : Perform a detailed economic analysis to ensure the project is financially viable.

Here is an example calculation for a simple binary distillation column design:

1. Minimum Reflux Ratio :

Use the Underwood equations to determine the minimum reflux ratio.

2. Number of Theoretical Stages :

Use the Fenske equation:

$$N_{min}=\log\alpha_{avg}\log\left(X_B X_D\cdot 1-X_D 1-X_B\right)$$

3. Actual Number of Stages :

Apply the Gilliland correlation to determine the actual number of stages:

- Find the fractional stages increase using Gilliland's method.
- Assume the final result gives $N\approx 7N\approx 7$.

4. Column Diameter :

Use the vapor and liquid flow rates to calculate the column diameter ensuring the velocities are appropriate.

5. Reboiler and Condenser Duties :

Calculate the heat duties based on the latent heat of vaporization and flow rates.

Designing a heat exchanger involves several critical steps to ensure efficient heat transfer between fluids while meeting operational and safety requirements. Here is a detailed guide to approach the design of a heat exchanger:

We have used kern’s Method to solve our heat exchanger problem.the advantage associated with this method is that it is easy to apply and accurate enough for design calculation.

Design of Heat Exchanger :

Process Requirements : Identify the hot and cold fluids, their flow rates, inlet and outlet temperatures.

1. Heat Duty : Calculate the total amount of heat to be transferred.

2. Choose the Type of Heat Exchanger

Common Types : Shell-and-tube, plate, air-cooled, double-pipe, etc.

Selection Criteria : Based on the fluids, required heat transfer rate, pressure drops, space constraints, maintenance, and cost.

3. Calculate Heat Transfer Requirements :

Heat Duty (Q) :

$$Q=\dot{m}\cdot C_p\cdot \Delta T$$

Log Mean Temperature Difference (LMTD) :

$$\Delta T_{\text{lm}}=\ln\left(\Delta T_2\Delta T_1\right)\Delta T_1-\Delta T_2$$

Overall Heat Transfer Coefficient (U) :

Depends on the nature of fluids, flow arrangement, fouling factors, and material of construction. Typical values can be obtained from references or initial estimates.

4. Heat Exchanger Sizing :

Heat Transfer Area (A) :

$A = Q\ /U*LMT$

5. Design the Shell-and-Tube Heat Exchanger :

Tube Side Design:

Determine tube material, diameter, length, and arrangement (triangular or square pitch).

Calculate the number of tubes required:

Shell Side Design :

Decide on the shell diameter, baffle spacing, and type.

Calculate shell-side heat transfer coefficient and pressure drop.

6. Perform Thermal and Hydraulic Calculations :

Heat Transfer Coefficients :

$$U1=h_h1+h_c1+R_w+R_f$$

Pressure Drop :

Calculate pressure drops on both the shell and tube sides using suitable correlations.

7. Mechanical Design :

Material Selection : Based on fluid properties, temperature, pressure, and corrosion considerations.

Stress Analysis : Ensure the design withstands operational pressures and temperatures.

8. Check for Fouling and Maintenance :

Fouling Factors : Include fouling resistances in the overall heat transfer coefficient.

Maintenance Access : Ensure the design allows for easy cleaning and maintenance.

9. Economic Analysis

Cost Estimation: Calculate the capital cost and operational cost.

Economic Feasibility : Evaluate the design from a cost-benefit perspective.

CHAPTER 6 : RESULT AND DISCUSSION

All the problems have been solved with the conditions provided.

Problem 1.

Design Parameters : feed rate of column is 3000 lit/ hr at atm temperature ,pressure is 1 atm IPA water solutions 60% IPA and 40% water separate them via distillation column .

Design Outcomes:

Number of theoretical stages = 12

Reflux ratio = 3

Column height = 9.2 meter

Column diameter = 1.01 meter

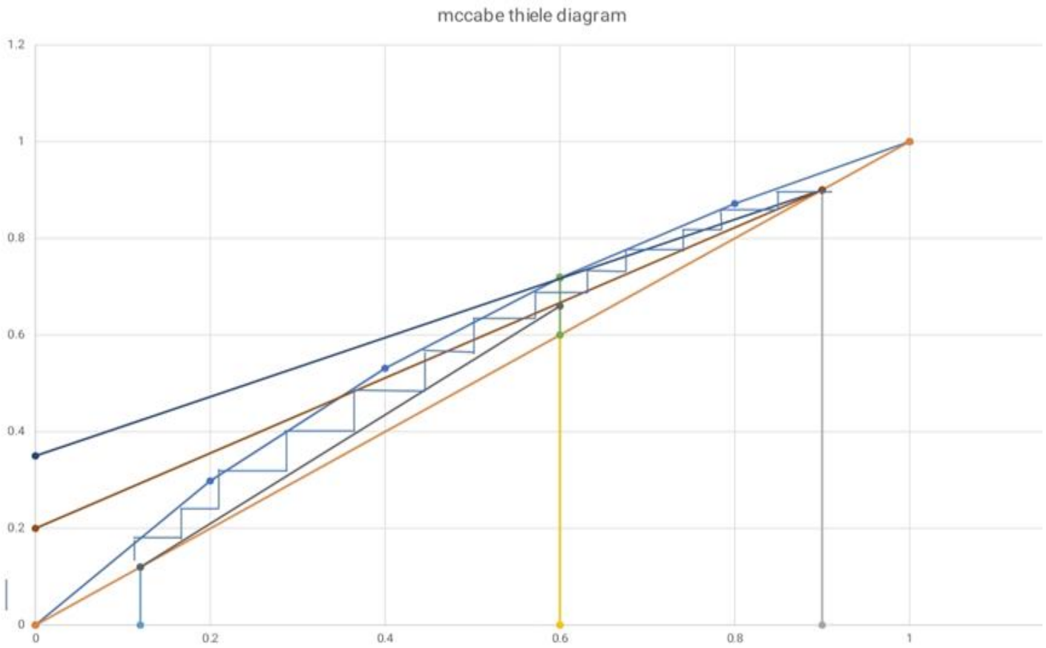


Fig 6.1 : McCabe thiele diagram

Discussion

The distillation column design meets the desired separation specifications with manageable deviations. The design is economically viable and incorporates necessary safety measures, though further optimization and pilot testing are recommended**.**

Problem 2.

Design Parameters :

Shell and tube heat exchanger to cool 5000kg/hr of IPA from 80 deg.C To 40 deg.C Using cooling water 20 deg.C. pressure drop of IPA is 0.5 bar ,desired overall heat transfer coefficient is 500 w/m^{2}K.Heat capacity is 2.44 kJ/kg^{0}C.

Design outcomes :

LMTD = 34.46

Temps. of hot fluid inlet = 80^{0}C

Temps. of hot fluid outlet = 40^{0}C

Temps. of Cold fluid inlet = 20^{0}C

Temps. of Cold fluid outlet = 24^{0}C

Overall coefficient = 202.86

Area = 1.610 m^2

Design overall coefficient = 450

Discussion :

The heat transfer rate indicating that the heat exchanger is operating efficiently. This surplus suggests that the design has a built-in safety margin, enhancing reliability.

Problem 3.

Design Parameters :

33.5 deg API oil, viscosity of 1.0 centipose , 180 deg Fahrenheit and 2.0 centipoise at 100 deg Fahrenheit. 49,600IB/hour of oilleaves a distilling column at 358 deg. Fahrenheit Cooling will be accomplished by water from from 90 to 120 deg Fahrenheit . pressure drop allowance of 10 psi amy be mixedwith a combined dirt factor 0.004 and applied in both streams .

Design outcomes :

LMTD = 72.15 deg Fahrenheit

Clean overall coefficient = 101.385 Btu/hr*ft^{2}deg. fahrenhiet

Design overall coefficient = 73.151 Btu/hr*ft^{2}deg. Fahrenhiet

Area = 1426.28 ft^2

Dirt factor = 0.00380 hr*ft^2* deg. Fahrenhiet/Btu

Discussion :

The design exhibits significant underperformance regarding heat transmission and an excessive drop in pressure. Addressing these issues through design optimization, regular maintenance, and prototype testing will be crucial for achieving the desired performance. Future work should focus on experimental validation and exploring innovative materials and configurations to enhance overall efficiency and reliability.

6.1 The physical and chemical characteristics of different constituents

Name	Formula	Molecular weight	Boiling point
IPA	C3H8O	60.1 g/mol	82.3 deg. C
Water	H2O	18 g/mol	100 deg C
Oxygen	O2	31.999	-183
Air	……	28.851	-194.5
Hydrogen	H2	2.016	-252.7

6.2 IPA Plants in India

Company	Capacity	Sales
DFPCL	70,000 TPA	87%

6.3 Preliminary cost of materials

Material	Cost
IPA	45 per lit
Hydrogen	1830-6100 inr/40 L Cylinder

CHAPTER 7 : CONCLUSION

The design of distillation columns and heat exchangers is paramount in achieving efficient and reliable separation and thermal management in industrial processes. in chemical engineering , designing equipment like heat exchanger , distillation column involves considering factors like heat transfer rates, material compatibility, pressure drops,energy efficiency for distillation columns, the focus is on optimizing tray design, packing materials, and column height to maximize separation efficiency and throughput while minimizing energy consumption. heat exchanger design emphasizes selecting the appropriate type (such as shell-and-tube or plate), materials, and configuration to ensure effective heat transfer, durability, and ease of maintenance. through thorough analysis, simulation, and iterative refinement, we have crafted a heat exchanger design that meets the specified requirements and optimizes performance. by leveraging advanced computational tools and engineering principles, we have achieved a design that not only enhances heat transfer rates but also ensures operational reliability and longevity both require careful consideration of process conditions, material properties, and safety standards. successful design and implementation of these critical components lead to enhanced operational performance, energy efficiency, and overall process sustainability.

CHAPTER 8 : ACHIEVED OUTCOMES AND SOCIETAL RELEVANCE

8.1 Achieved Outcomes

1. Created innovative distillation column designs for improved efficiency.

2. Analyzed process vessel designs for safety and efficiency .

3. Evaluated heat exchanger performance for energy savings .

4. Implimented robust safety protocols into the distillation column and heat exchanger design

8.2 Societal relevance

1. Efficient design of heat exchangers can lead to significant energy savings in industrial processes by optimizing heat transfer rates. This results in less energy being used, less money spent on operations, and less of an influence on the environment due to less carbon emissions.

2. Properly designed distillation columns and heat exchangers can minimize the environmental footprint of industrial activities by optimizing resource usage and reducing waste generation. This contributes to sustainability efforts and helps mitigate the impact of industrial operations on local ecosystems and communities.

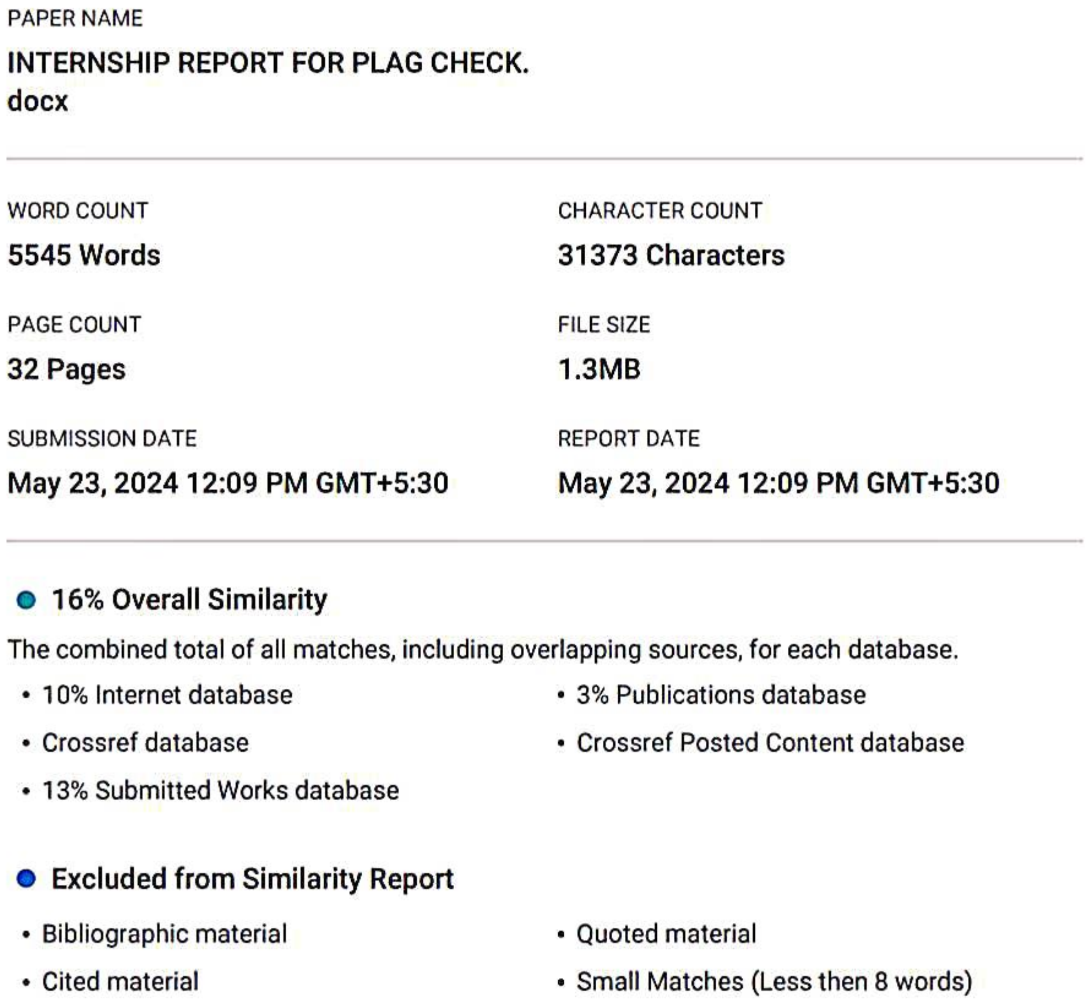
3. Distillation columns and heat exchangers are essential components in the efficient utilization of resources such as water, chemicals, and raw materials in various industrial processes. By maximizing resource efficiency and minimizing losses, these design considerations contribute to the sustainable management of finite resources and promote responsible stewardship of natural resources.

4. Well-designed distillation columns and heat exchangers prioritize safety and health considerations ,assuring the defence of communities, the environment, and labourers against potential risks related to industrial processes.This includes mitigating risks of chemical exposure, fire, and explosions through proper design, maintenance, and operation of equipment.

REFERENCES

1. Myriadly Engineering and Business results.
2. Kister, HenryZ. Distillation Design New York McGraw- Hill, 1992. Publish.
3. Wikipedia,. ' Methanol '.N.p., 2015. trap. 13Oct. 2014.
4. McCabe, Warren L, Julian C Smith, and Peter Harriott. Unit Operations Of Chemical Engi- neering.Boston McGraw- Hill, 2005. publish.
5. Steed,P.K. Heat And Mass Transfer New Delhi Tata McGraw- Hill, 2011. Publish
6. Unit operations of Chemical Engineering, WarrenL. McCabe JulianC. Smith Peter Harriot.
7. Process Heat Transfer, DQ Kern, McGRAW-HILL Edition
8. Mehendale, S. S., A. M. Jacobi, and R. K. Shah. "Fluid flow and heat transfer at microand meso-scales with application to heat exchanger design." (2009): 17
9. Singh, K. P., & Soler, A. I. Mechanical Design of Heat Exchangers: And Pressure Vessel Components. Springer Science & Business Media(2013).
10. Seader, J.D. and Ernest J. Henley, "Separation Process Principle"s, John Wiley, 1998

TURNITIN PLAGIARISM REPORT



PAPER NAME

**INTERNSHIP REPORT FOR PLAG CHECK.
docx**

WORD COUNT	CHARACTER COUNT
5545 Words	**31373 Characters**
PAGE COUNT	FILE SIZE
32 Pages	**1.3MB**
SUBMISSION DATE	REPORT DATE
May 23, 2024 12:09 PM GMT+5:30	**May 23, 2024 12:09 PM GMT+5:30**

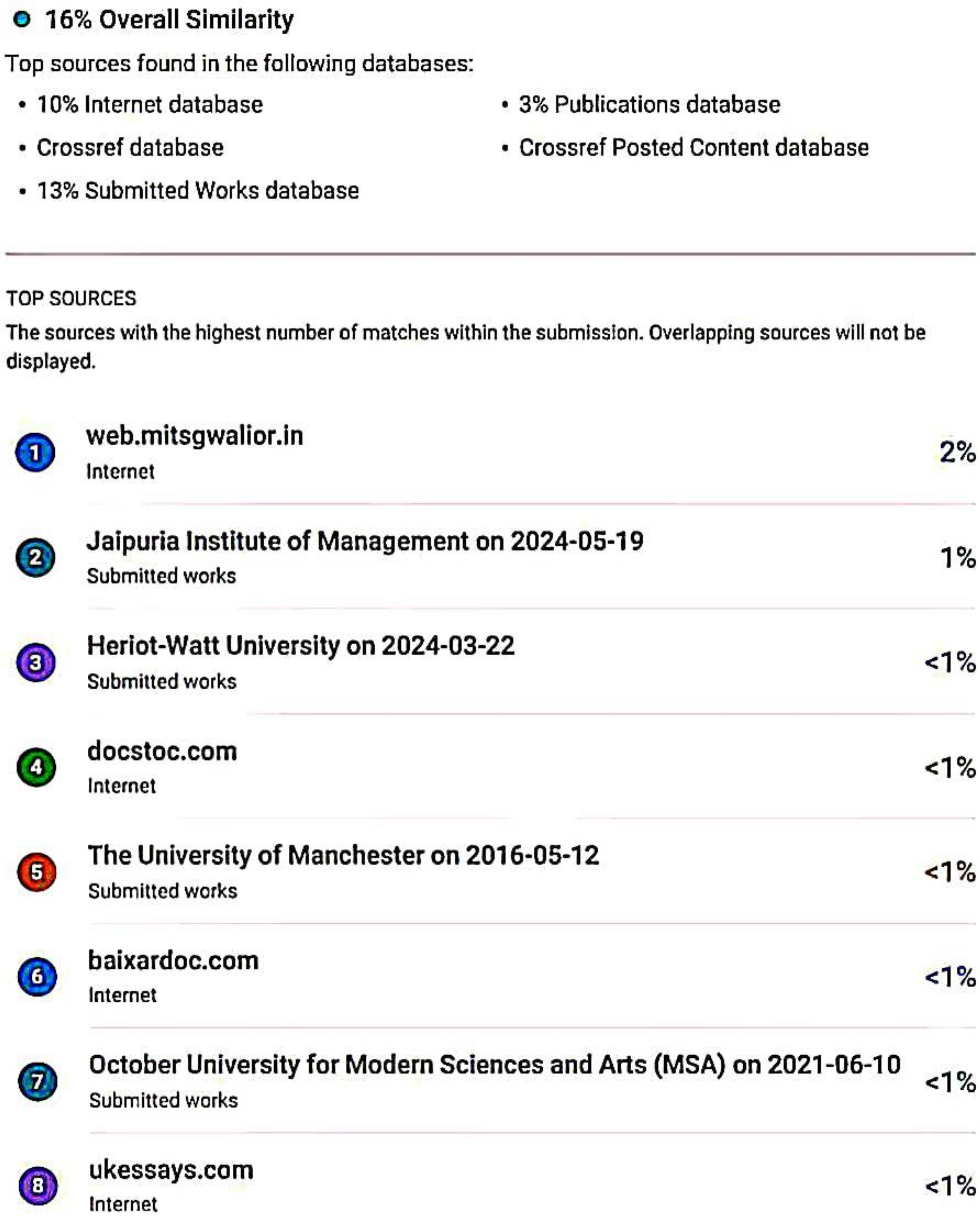
● **16% Overall Similarity**

The combined total of all matches, including overlapping sources, for each database.

- 10% Internet database
- Crossref database
- 13% Submitted Works database
- 3% Publications database
- Crossref Posted Content database

● **Excluded from Similarity Report**

- Bibliographic material
- Cited material
- Quoted material
- Small Matches (Less then 8 words)



● 16% Overall Similarity

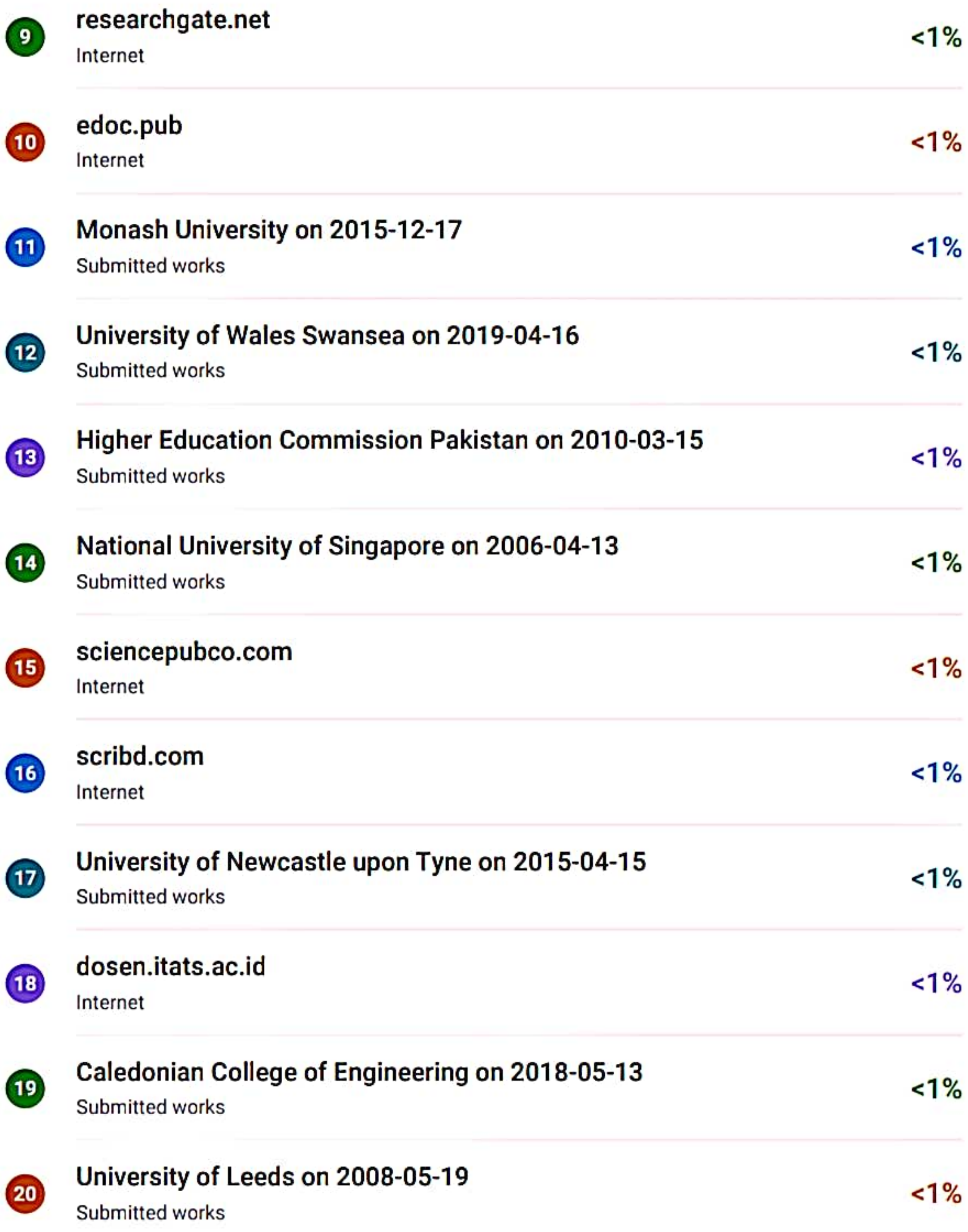
Top sources found in the following databases:

- 10% Internet database
- 3% Publications database
- Crossref database
- Crossref Posted Content database
- 13% Submitted Works database

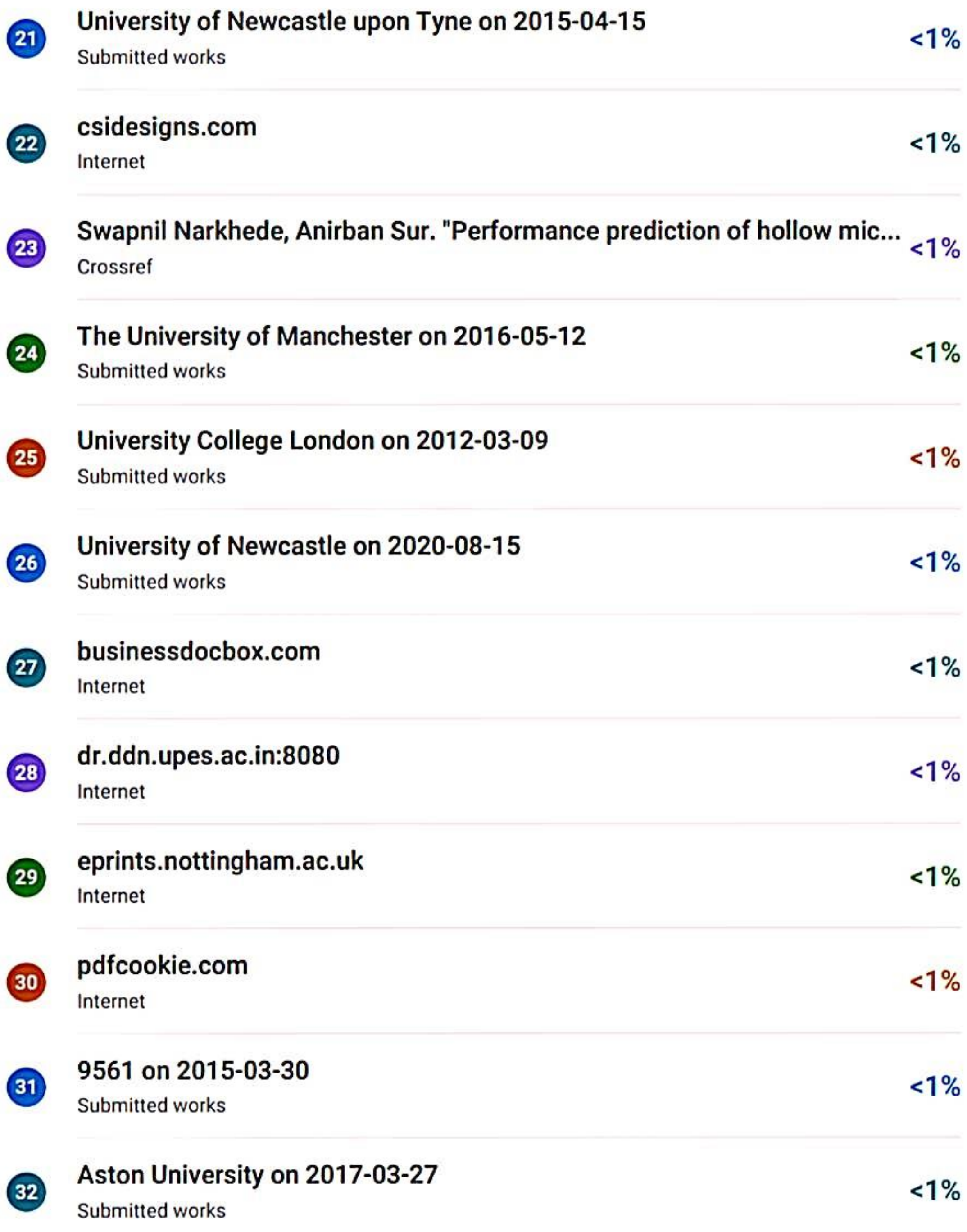
TOP SOURCES

The sources with the highest number of matches within the submission. Overlapping sources will not be displayed.

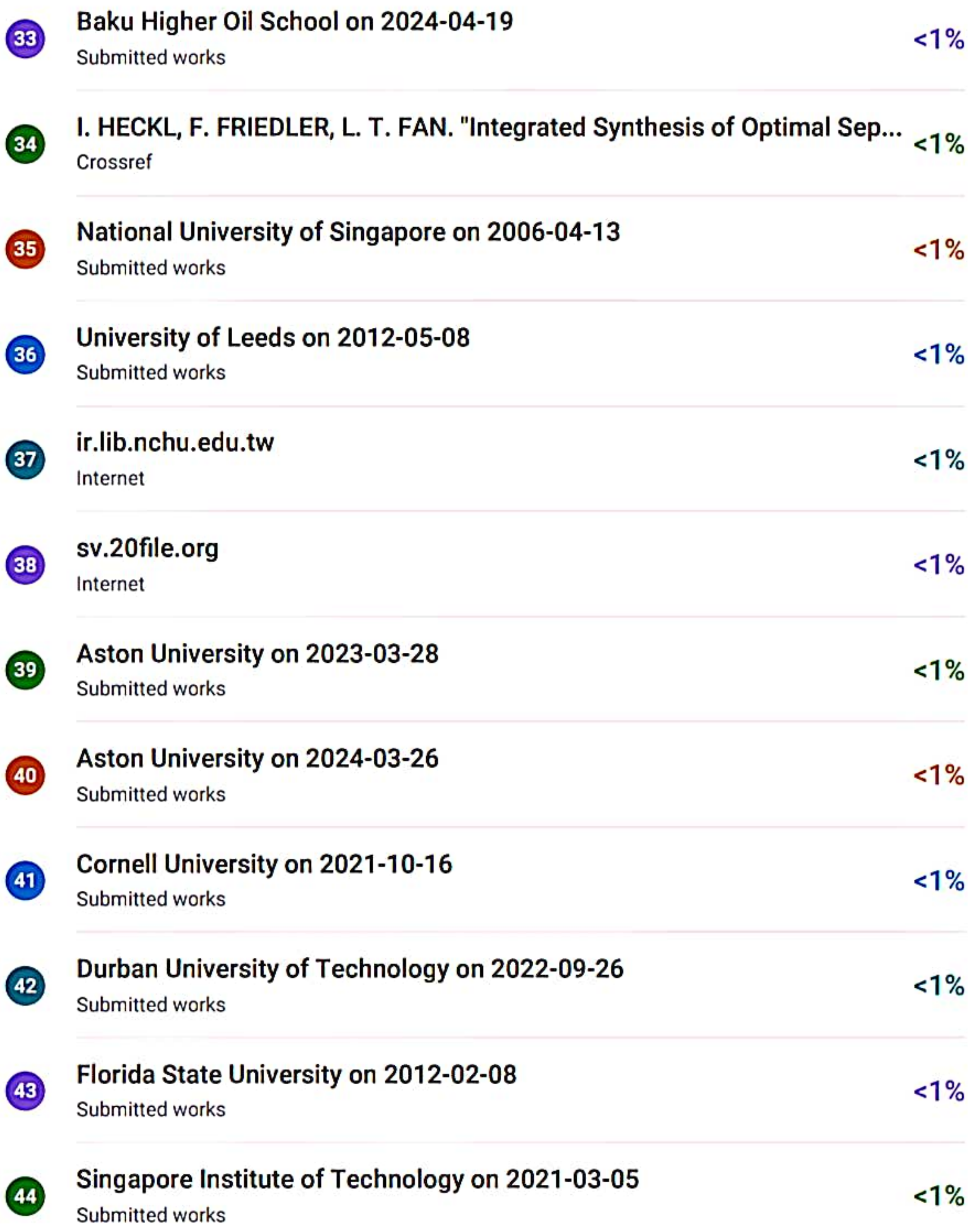
①	**web.mitsgwalior.in** Internet	2%
②	**Jaipuria Institute of Management on 2024-05-19** Submitted works	1%
③	**Heriot-Watt University on 2024-03-22** Submitted works	<1%
④	**docstoc.com** Internet	<1%
⑤	**The University of Manchester on 2016-05-12** Submitted works	<1%
⑥	**baixardoc.com** Internet	<1%
⑦	**October University for Modern Sciences and Arts (MSA) on 2021-06-10** Submitted works	<1%
⑧	**ukessays.com** Internet	<1%



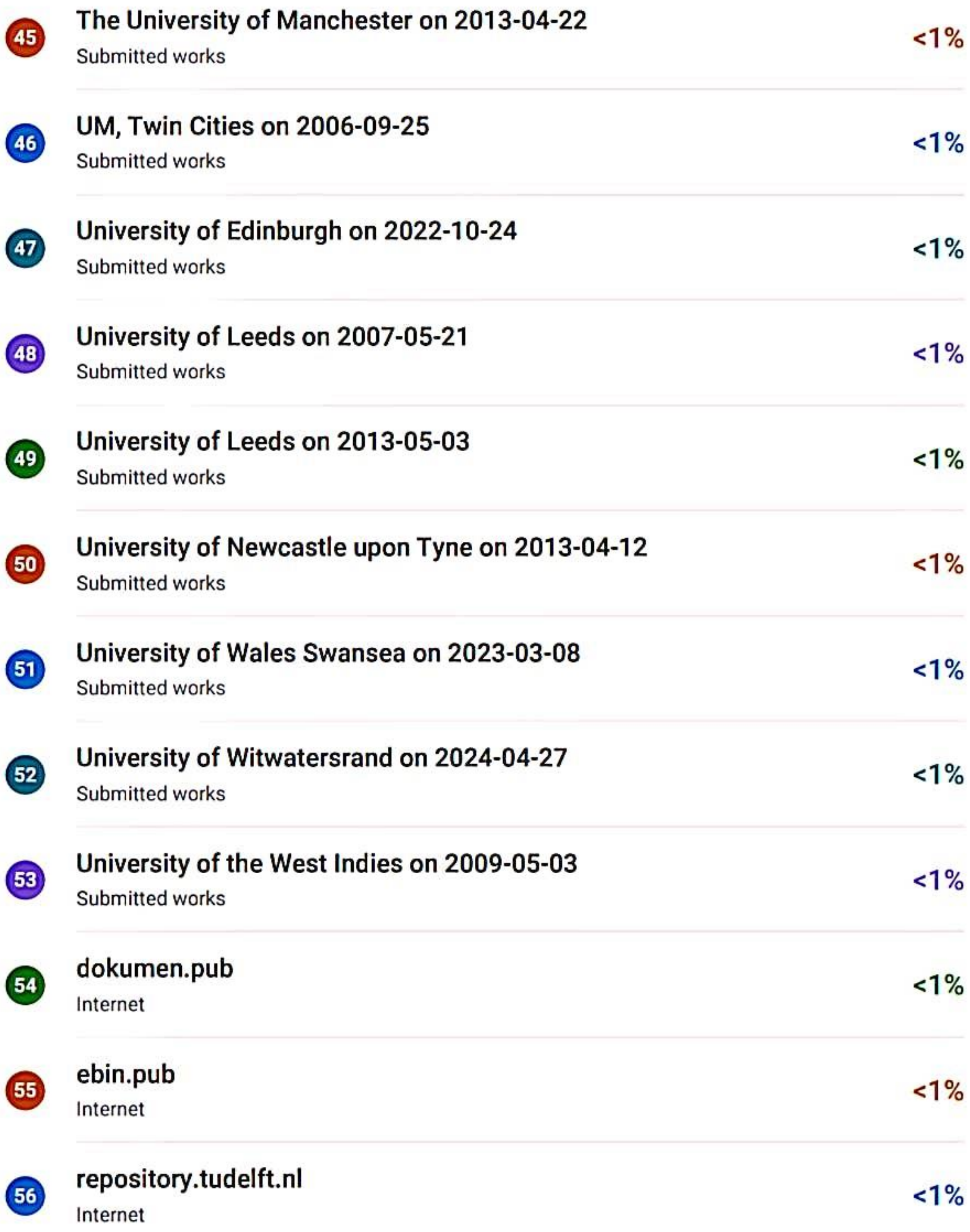
9	**researchgate.net** Internet	<1%
10	**edoc.pub** Internet	<1%
11	**Monash University on 2015-12-17** Submitted works	<1%
12	**University of Wales Swansea on 2019-04-16** Submitted works	<1%
13	**Higher Education Commission Pakistan on 2010-03-15** Submitted works	<1%
14	**National University of Singapore on 2006-04-13** Submitted works	<1%
15	**sciencepubco.com** Internet	<1%
16	**scribd.com** Internet	<1%
17	**University of Newcastle upon Tyne on 2015-04-15** Submitted works	<1%
18	**dosen.itats.ac.id** Internet	<1%
19	**Caledonian College of Engineering on 2018-05-13** Submitted works	<1%
20	**University of Leeds on 2008-05-19** Submitted works	<1%



21	University of Newcastle upon Tyne on 2015-04-15 Submitted works	<1%
22	csidesigns.com Internet	<1%
23	Swapnil Narkhede, Anirban Sur. "Performance prediction of hollow mic... Crossref	<1%
24	The University of Manchester on 2016-05-12 Submitted works	<1%
25	University College London on 2012-03-09 Submitted works	<1%
26	University of Newcastle on 2020-08-15 Submitted works	<1%
27	businessdocbox.com Internet	<1%
28	dr.ddn.upes.ac.in:8080 Internet	<1%
29	eprints.nottingham.ac.uk Internet	<1%
30	pdfcookie.com Internet	<1%
31	9561 on 2015-03-30 Submitted works	<1%
32	Aston University on 2017-03-27 Submitted works	<1%



33	**Baku Higher Oil School on 2024-04-19** Submitted works	<1%
34	**I. HECKL, F. FRIEDLER, L. T. FAN. "Integrated Synthesis of Optimal Sep...** Crossref	<1%
35	**National University of Singapore on 2006-04-13** Submitted works	<1%
36	**University of Leeds on 2012-05-08** Submitted works	<1%
37	**ir.lib.nchu.edu.tw** Internet	<1%
38	**sv.20file.org** Internet	<1%
39	**Aston University on 2023-03-28** Submitted works	<1%
40	**Aston University on 2024-03-26** Submitted works	<1%
41	**Cornell University on 2021-10-16** Submitted works	<1%
42	**Durban University of Technology on 2022-09-26** Submitted works	<1%
43	**Florida State University on 2012-02-08** Submitted works	<1%
44	**Singapore Institute of Technology on 2021-03-05** Submitted works	<1%

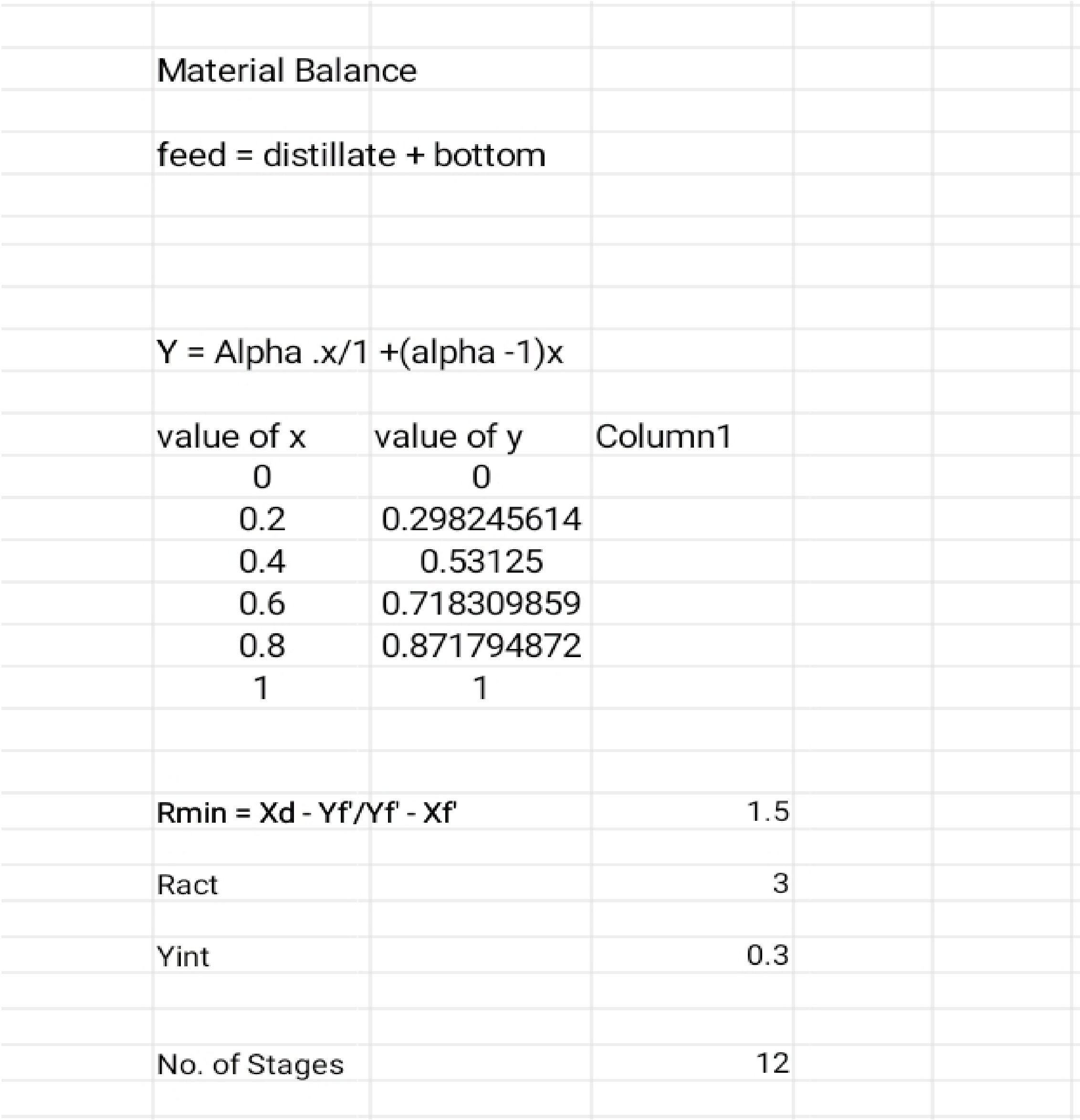


45	**The University of Manchester on 2013-04-22** Submitted works	<1%
46	**UM, Twin Cities on 2006-09-25** Submitted works	<1%
47	**University of Edinburgh on 2022-10-24** Submitted works	<1%
48	**University of Leeds on 2007-05-21** Submitted works	<1%
49	**University of Leeds on 2013-05-03** Submitted works	<1%
50	**University of Newcastle upon Tyne on 2013-04-12** Submitted works	<1%
51	**University of Wales Swansea on 2023-03-08** Submitted works	<1%
52	**University of Witwatersrand on 2024-04-27** Submitted works	<1%
53	**University of the West Indies on 2009-05-03** Submitted works	<1%
54	**dokumen.pub** Internet	<1%
55	**ebin.pub** Internet	<1%
56	**repository.tudelft.nl** Internet	<1%

APPENDIX SECTION

1 . Appendix A

Problem 1



Material Balance

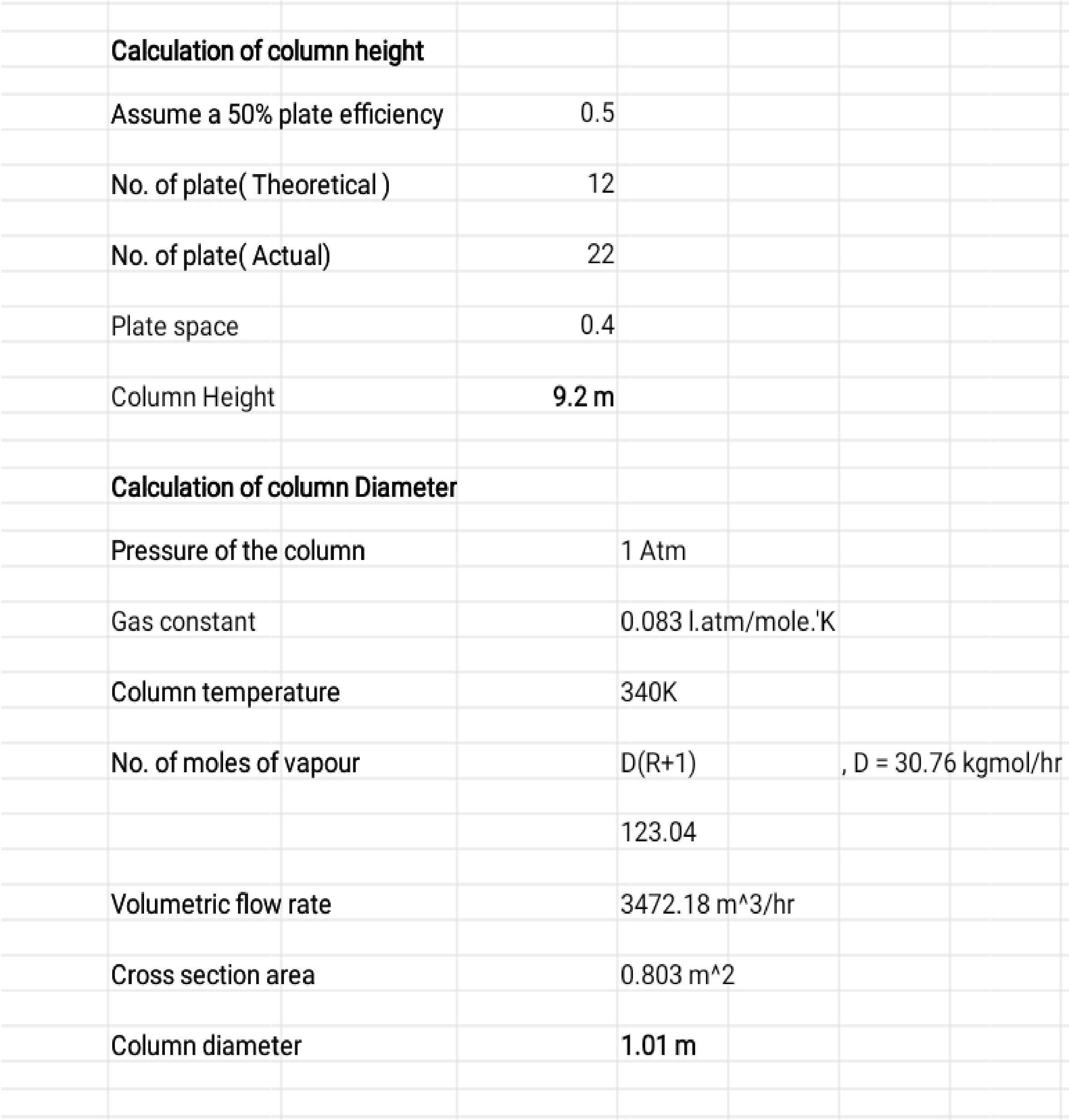
feed = distillate + bottom

Y = Alpha .x/1 +(alpha -1)x

value of x	value of y	Column1
0	0	
0.2	0.298245614	
0.4	0.53125	
0.6	0.718309859	
0.8	0.871794872	
1	1	

Rmin = Xd - Yf'/Yf' - Xf'	1.5
Ract	3
Yint	0.3
No. of Stages	12

Fig A.1 : solution of problem 1

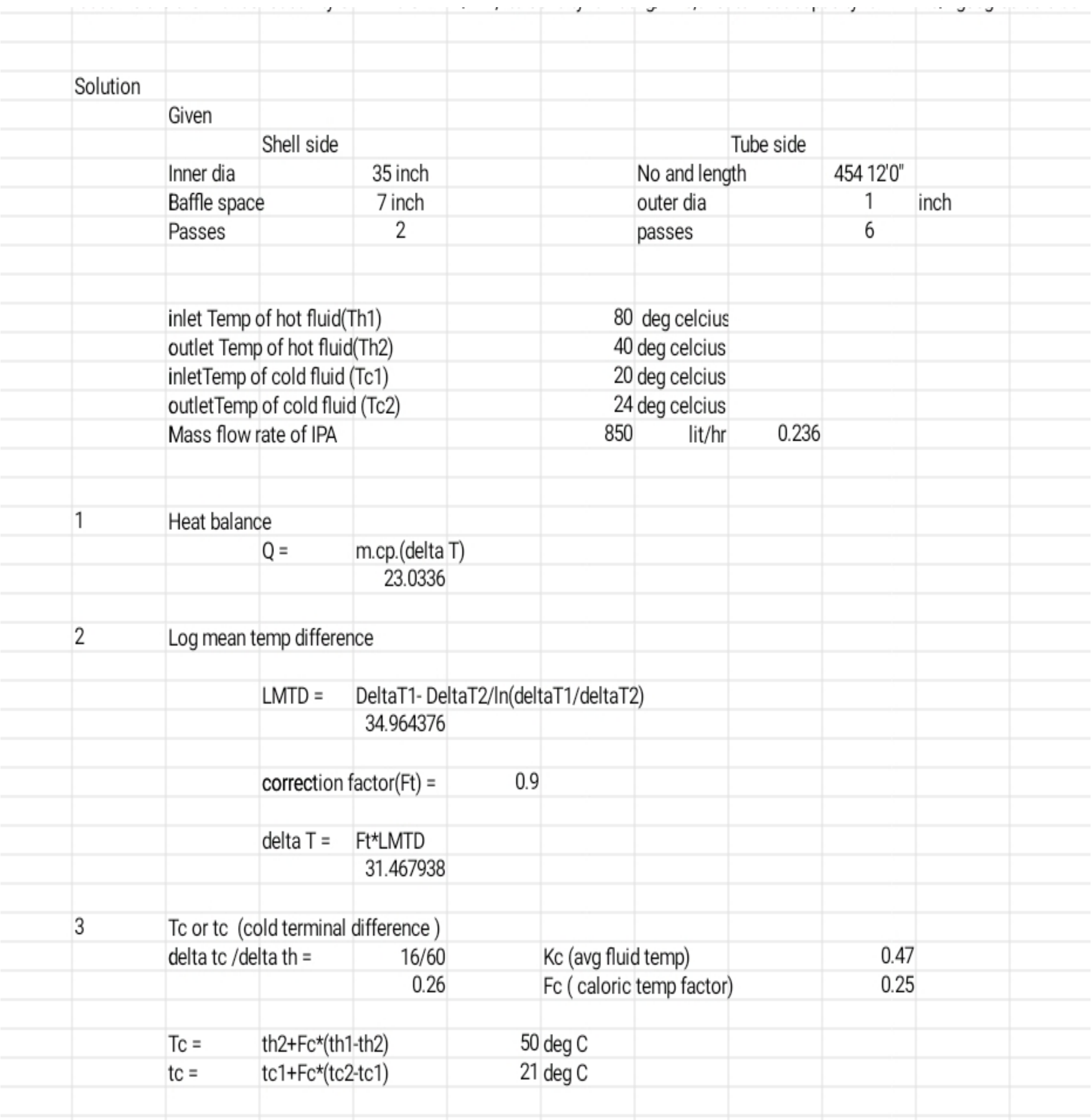


Calculation of column height			
Assume a 50% plate efficiency	0.5		
No. of plate(Theoretical)	12		
No. of plate(Actual)	22		
Plate space	0.4		
Column Height	**9.2 m**		
Calculation of column Diameter			
Pressure of the column		1 Atm	
Gas constant		0.083 l.atm/mole.'K	
Column temperature		340K	
No. of moles of vapour		D(R+1)	, D = 30.76 kgmol/hr
		123.04	
Volumetric flow rate		3472.18 m^3/hr	
Cross section area		0.803 m^2	
Column diameter		**1.01 m**	

Fig A.2 : solution of problem 1

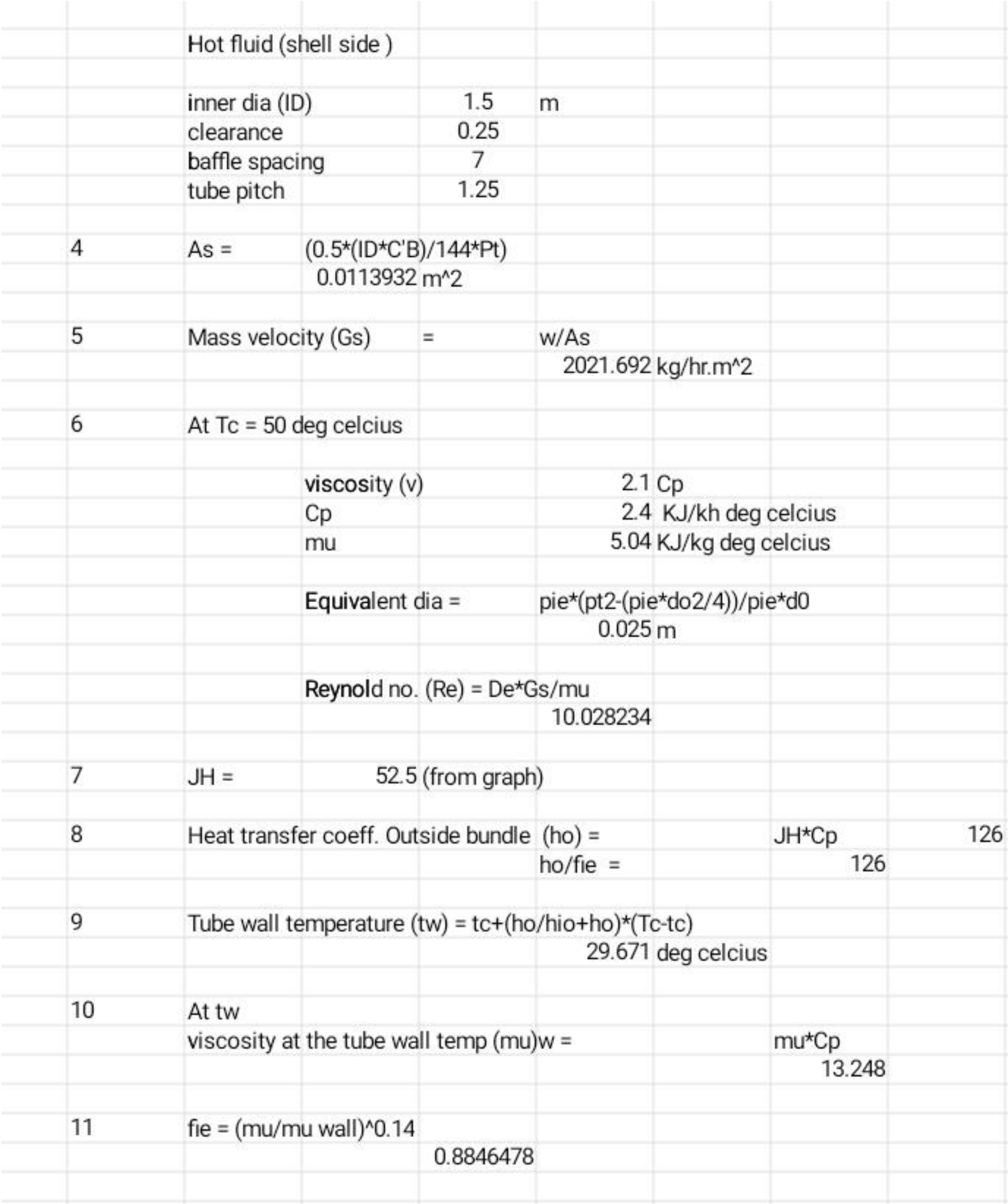
2 . Appendix B

Problem (2 and 3)



Solution									
	Given								
		Shell side					Tube side		
	Inner dia		35 inch			No and length		454 12'0"	
	Baffle space		7 inch			outer dia		1	inch
	Passes		2			passes		6	
	inlet Temp of hot fluid(Th1)				80	deg celcius			
	outlet Temp of hot fluid(Th2)				40	deg celcius			
	inletTemp of cold fluid (Tc1)				20	deg celcius			
	outletTemp of cold fluid (Tc2)				24	deg celcius			
	Mass flow rate of IPA				850	lit/hr	0.236		
1	Heat balance								
		Q =	m.cp.(delta T)						
			23.0336						
2	Log mean temp difference								
		LMTD =	DeltaT1- DeltaT2/ln(deltaT1/deltaT2)						
			34.964376						
		correction factor(Ft) =		0.9					
		delta T =	Ft*LMTD						
			31.467938						
3	Tc or tc (cold terminal difference)								
	delta tc /delta th =		16/60		Kc (avg fluid temp)			0.47	
			0.26		Fc (caloric temp factor)			0.25	
	Tc =	th2+Fc*(th1-th2)		50	deg C				
	tc =	tc1+Fc*(tc2-tc1)		21	deg C				

Fig B.1 : solution of problem 2



Hot fluid (shell side)

inner dia (ID) 1.5 m
clearance 0.25
baffle spacing 7
tube pitch 1.25

4 As = (0.5*(ID*C'B)/144*Pt)
0.0113932 m^2

5 Mass velocity (Gs) = w/As
2021.692 kg/hr.m^2

6 At Tc = 50 deg celcius

viscosity (v) 2.1 Cp
Cp 2.4 KJ/kh deg celcius
mu 5.04 KJ/kg deg celcius

Equivalent dia = pie*(pt2-(pie*do2/4))/pie*d0
0.025 m

Reynold no. (Re) = De*Gs/mu
10.028234

7 JH = 52.5 (from graph)

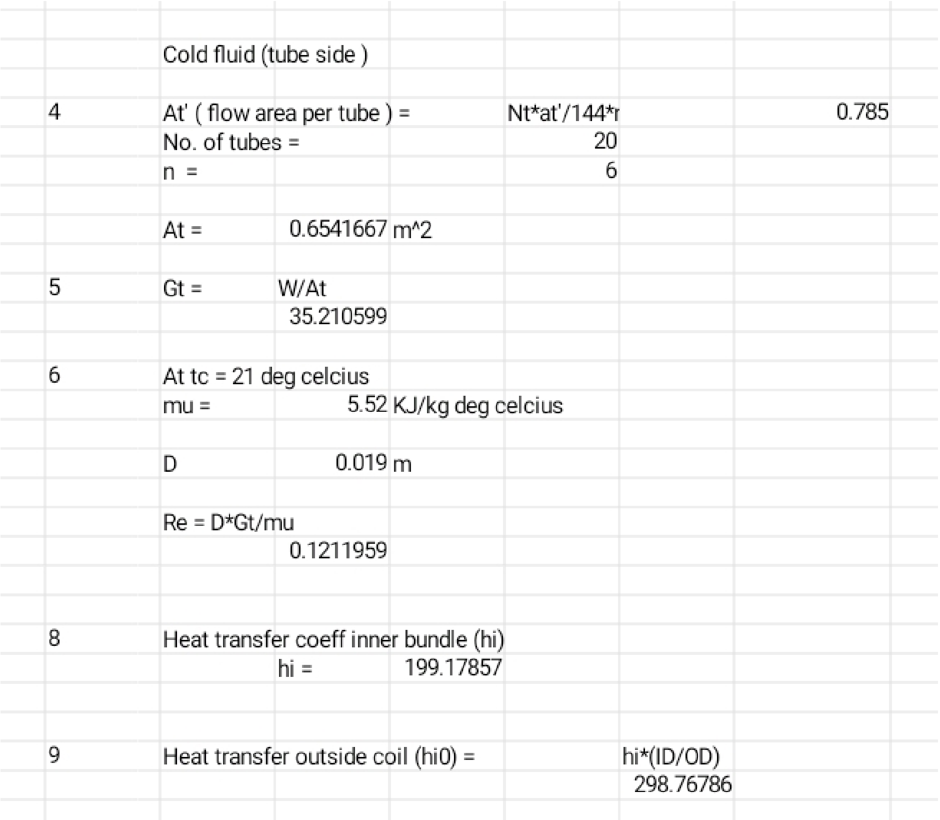
8 Heat transfer coeff. Outside bundle (ho) = JH*Cp 126
ho/fie = 126

9 Tube wall temperature (tw) = tc+(ho/hio+ho)*(Tc-tc)
29.671 deg celcius

10 At tw
viscosity at the tube wall temp (mu)w = mu*Cp
13.248

11 fie = (mu/mu wall)^0.14
0.8846478

Fig B.2 : solution of problem 2



Cold fluid (tube side)

4 At' (flow area per tube) = Nt*at'/144*r 0.785

No. of tubes = 20

n = 6

At = 0.6541667 m^2

5 Gt = W/At

35.210599

6 At tc = 21 deg celcius

mu = 5.52 KJ/kg deg celcius

D 0.019 m

Re = D*Gt/mu

0.1211959

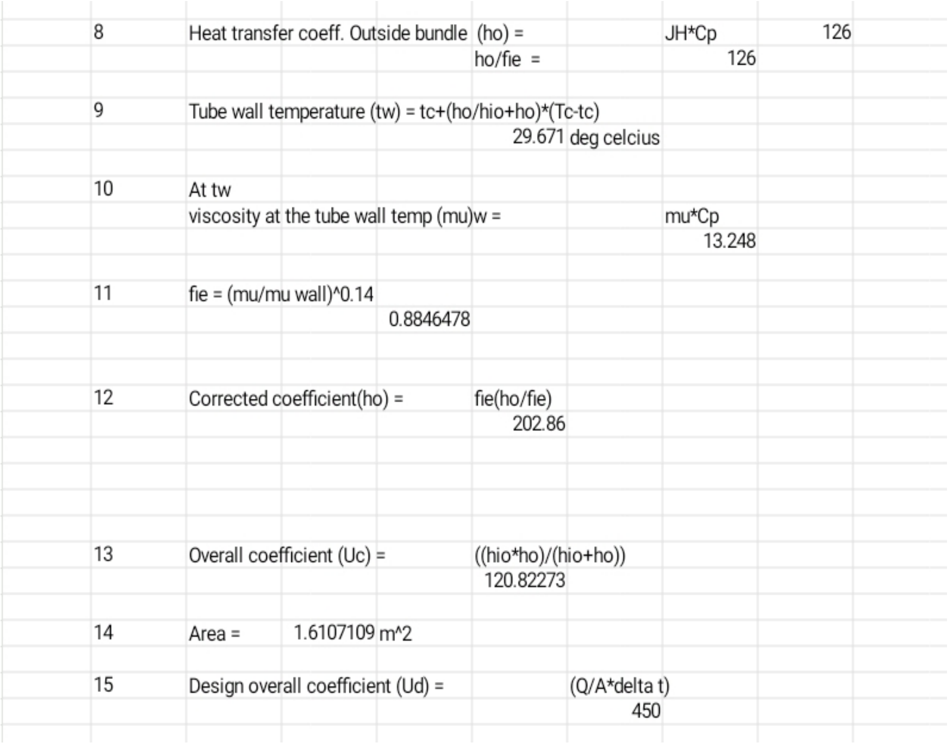
8 Heat transfer coeff inner bundle (hi)

hi = 199.17857

9 Heat transfer outside coil (hi0) = hi*(ID/OD)

298.76786

Fig B.3 : solution of problem 2



8 Heat transfer coeff. Outside bundle (ho) = JH*Cp 126

ho/fie = 126

9 Tube wall temperature (tw) = tc+(ho/hio+ho)*(Tc-tc)

29.671 deg celcius

10 At tw

viscosity at the tube wall temp (mu)w = mu*Cp

13.248

11 fie = (mu/mu wall)^0.14

0.8846478

12 Corrected coefficient(ho) = fie(ho/fie)

202.86

13 Overall coefficient (Uc) = ((hio*ho)/(hio+ho))

120.82273

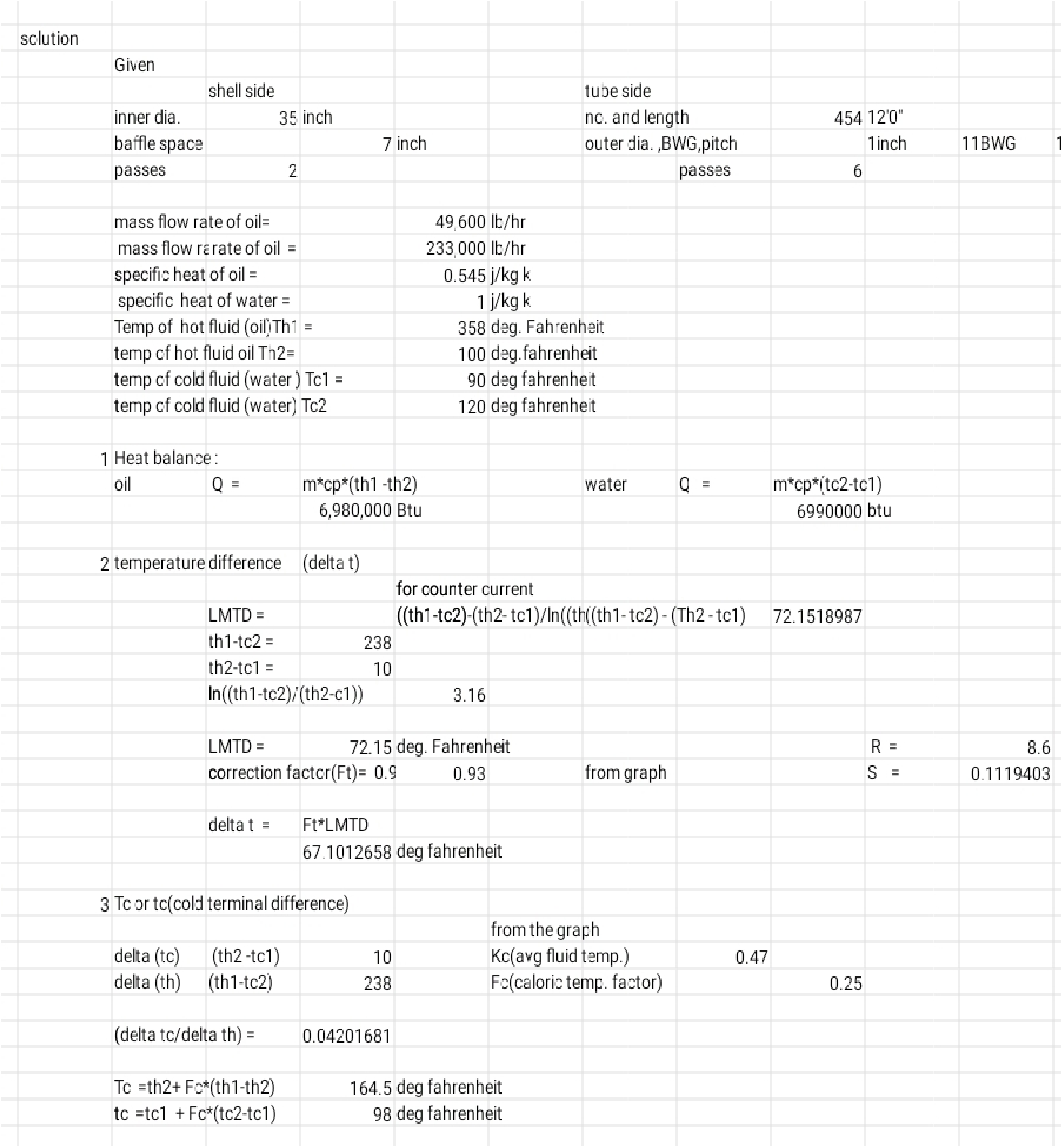
14 Area = 1.6107109 m^2

15 Design overall coefficient (Ud) = (Q/A*delta t)

450

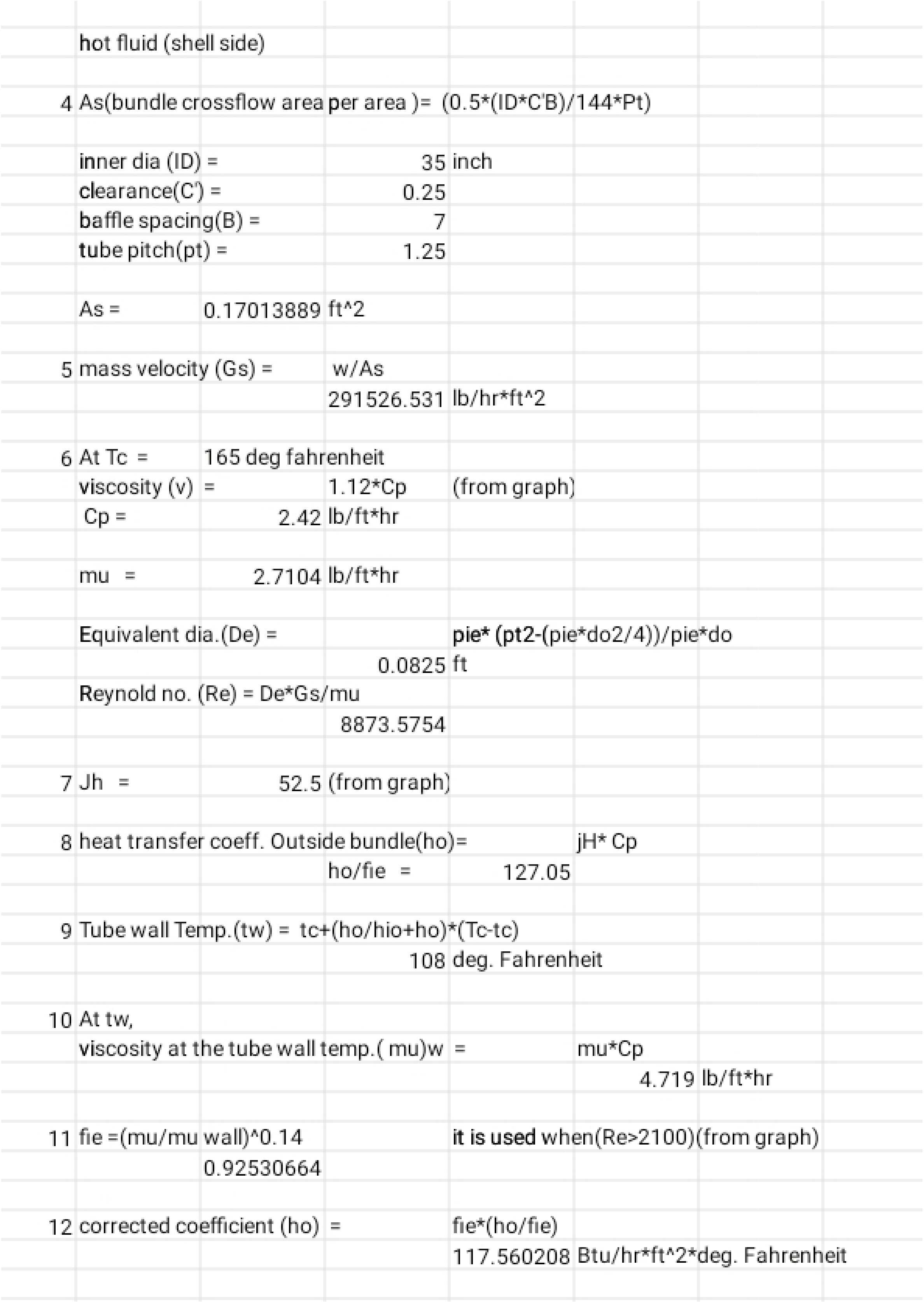
Fig B.4 : solution of problem 2

Solition of problem 3



solution											
	Given										
		shell side				tube side					
	inner dia.	35	inch			no. and length		454	12'0"		
	baffle space		7	inch		outer dia. ,BWG,pitch			1inch	11BWG	1
	passes	2					passes	6			
	mass flow rate of oil=			49,600	lb/hr						
	mass flow ra	rate of oil =		233,000	lb/hr						
	specific heat of oil =			0.545	j/kg k						
	specific heat of water =			1	j/kg k						
	Temp of hot fluid (oil)Th1 =			358	deg. Fahrenheit						
	temp of hot fluid oil Th2=			100	deg.fahrenheit						
	temp of cold fluid (water) Tc1 =			90	deg fahrenheit						
	temp of cold fluid (water) Tc2			120	deg fahrenheit						
1	Heat balance :										
	oil	Q =	m*cp*(th1 -th2)			water	Q =	m*cp*(tc2-tc1)			
			6,980,000	Btu				6990000	btu		
2	temperature difference		(delta t)								
				for counter current							
		LMTD =		((th1-tc2)-(th2- tc1)/ln((th((th1- tc2) - (Th2 - tc1)				72.1518987			
		th1-tc2 =	238								
		th2-tc1 =	10								
		ln((th1-tc2)/(th2-c1))		3.16							
		LMTD =	72.15	deg. Fahrenheit					R =	8.6	
		correction factor(Ft)= 0.9		0.93		from graph			S =	0.1119403	
		delta t =	Ft*LMTD								
			67.1012658	deg fahrenheit							
3	Tc or tc(cold terminal difference)										
					from the graph						
	delta (tc)	(th2 -tc1)	10		Kc(avg fluid temp.)		0.47				
	delta (th)	(th1-tc2)	238		Fc(caloric temp. factor)			0.25			
	(delta tc/delta th) =		0.04201681								
	Tc =th2+ Fc*(th1-th2)		164.5	deg fahrenheit							
	tc =tc1 + Fc*(tc2-tc1)		98	deg fahrenheit							

Fig B. 5 : solution of problem 3



hot fluid (shell side)

4 As(bundle crossflow area per area)= (0.5*(ID*C'B)/144*Pt)

inner dia (ID) = 35 inch
clearance(C') = 0.25
baffle spacing(B) = 7
tube pitch(pt) = 1.25

As = 0.17013889 ft^2

5 mass velocity (Gs) = w/As
291526.531 lb/hr*ft^2

6 At Tc = 165 deg fahrenheit
viscosity (v) = 1.12*Cp (from graph)
Cp = 2.42 lb/ft*hr

mu = 2.7104 lb/ft*hr

Equivalent dia.(De) = pie* (pt2-(pie*do2/4))/pie*do
0.0825 ft
Reynold no. (Re) = De*Gs/mu
8873.5754

7 Jh = 52.5 (from graph)

8 heat transfer coeff. Outside bundle(ho)= jH* Cp
ho/fie = 127.05

9 Tube wall Temp.(tw) = tc+(ho/hio+ho)*(Tc-tc)
108 deg. Fahrenheit

10 At tw,
viscosity at the tube wall temp.(mu)w = mu*Cp
4.719 lb/ft*hr

11 fie =(mu/mu wall)^0.14 it is used when(Re>2100)(from graph)
0.92530664

12 corrected coefficient (ho) = fie*(ho/fie)
117.560208 Btu/hr*ft^2*deg. Fahrenheit

Fig B. 6 : solution of problem 3

cold fluid (tube side)

4 at'(flow area per tube) = 0.455 inch^2 (from graph)

At(flow area of tube) = Nt*at'/144*n
no. of tubes = 454
n = 6

At = 0.23908565 ft^2

5 Gt = w/at
974546.159 lb/hr*ft

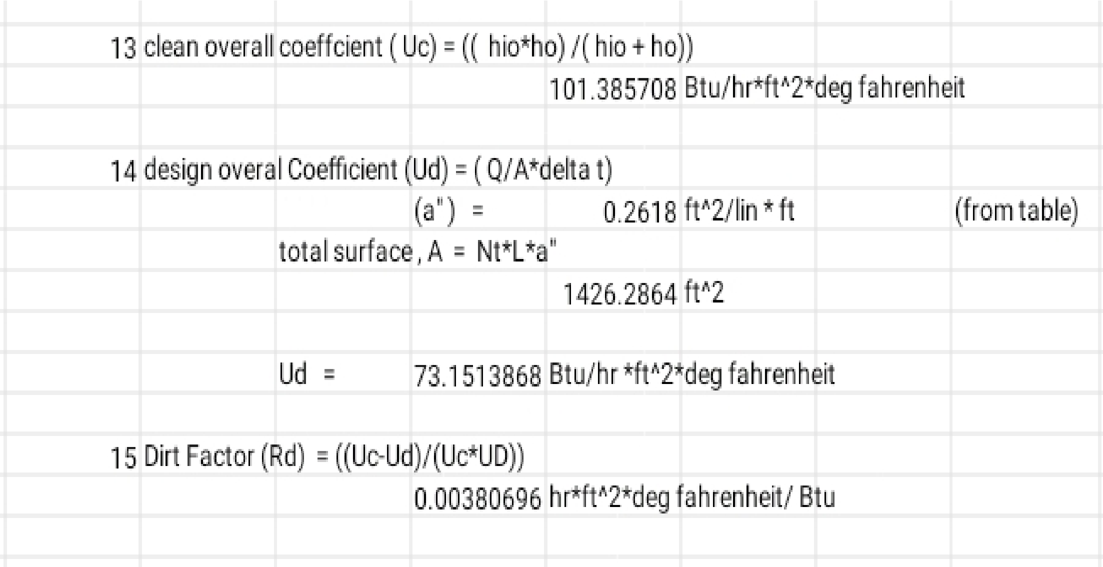
6 At tc = 98 deg fahrenheit
mu = 0.73*Cp
1.7666 lb/ft*hr

D = o.76/12
D = 0.06333333 ft (from table)
Re = D*Gt/v/ mu
34937.8788

8 heat transfer coefficient inner bundle (hi) = (0.023*(Gs^0.8)*(k^0.67)*(cp^0.33))/((D^0.2)*(mu^0.470))
969.6 Btu/hr*ft^2*deg fahrenheit

9 heat transfer coeff. outside coil (hio) = hi*(ID/OD)
736.896

Fig B.7 : solution of problem 3



13 clean overall coeffcient (Uc) = ((hio*ho) /(hio + ho))
101.385708 Btu/hr*ft^2*deg fahrenheit

14 design overal Coefficient (Ud) = (Q/A*delta t)
(a") = 0.2618 ft^2/lin * ft (from table)
total surface , A = Nt*L*a"
1426.2864 ft^2

Ud = 73.1513868 Btu/hr *ft^2*deg fahrenheit

15 Dirt Factor (Rd) = ((Uc-Ud)/(Uc*UD))
0.00380696 hr*ft^2*deg fahrenheit/ Btu

Fig B.8 : solution of problem 3

3 . Appendix C

Design of Vessel

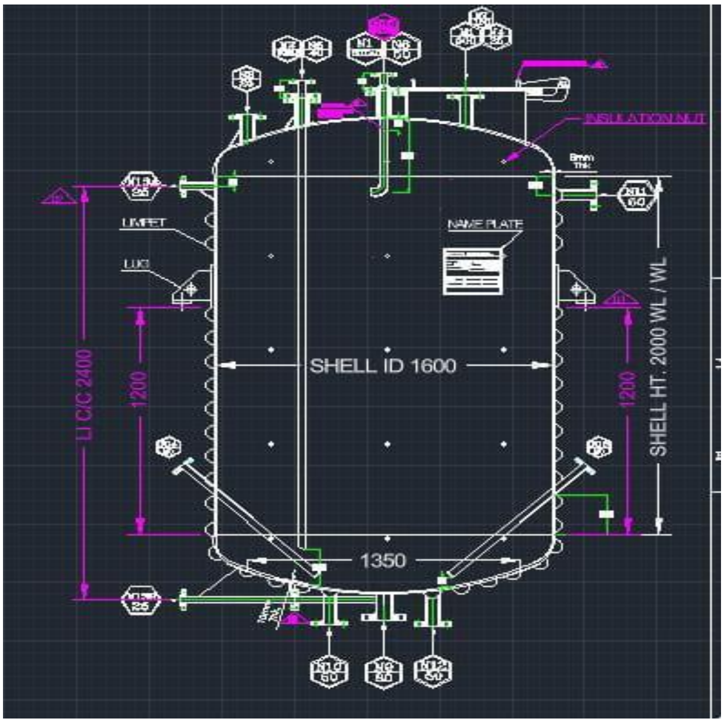


Fig C.1 : vessel elevation view

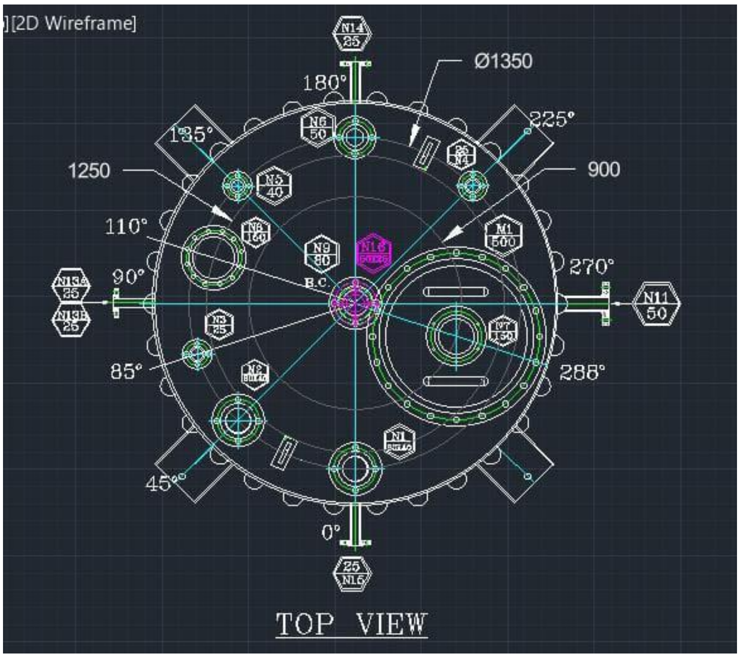


Fig C.2 : vessel top view

<u>4 . Apeendix D</u>

DAILY DIARY

Industry : - Myriadly Engineering and Business Solutions

Joining Date :- 30 Jan.

Date :- 06-02-2024

Entry – 1 pm

Workshop

Sheet storage area

- SS-316-red
- SS-304-green
- Hastelloy-yellow

Buffing Area

- Flag wheel – 4 types
- Wire brush
- Buff

Red powder – flag wheel

Yellow powder – wire brush

Green powder – buff

Exit – 4 PM

Date – 08-02-2024

Entry – 1 PM

Workshop

- Material rejection area
- Pipe storage area

Machines

- Drill
- Compressor
- Crain machine
- Blasting machine
- Centrifuge pump
- Welding machine

Exit – 4 PM

Date – 10-02-2024

Entry – 1 PM

Topic – Design of distillation column

Isopropyl alcohal and water

IPA water solution

60% IPA

40% water

Separate via distillation column

Feed rate = 3000 lit/hr at atm temp. , pressure 1 atm

Exit – 3 PM

Date :- 15-02-24

Industry visit Entry – 12 PM

Practice solving problem on excel

Exit :- 4 PM

Date :- 16-02-24 to 29-02-24

Practice to draw graph on excel

Solved the problem given on design of distillation column

Solved similar problems on design of distillation column

Date :- 01-03-24 to 11-03-24

Solved the height and diameter of column

Solved solution on Excel

Found product rate , bottom rate , feed rate and reflux rate .

Next work :- Design of heat exchanger for flow rate 850 lit/hr.

Date :- 15-03-24

Industry visit

Date – 16-03-24 to 23-03-24

Solved the problem on design of heat exchanger

Date :- 28-03-24

Industry visit

Date :- 30-03-24

Solved problem on excel.

Date – 01-04-24

Industry visit

Date -02-04-24 to 08-04-24

Solved the second problem on design of heat Exchanger

Date :- 09-04-24

Industry visit

Date :- 10-04-24

Solved problem on excel

Date :- 11 – 04 – 2024

Industry Visit

Date :- 12-04-2024 to 20-04-2024

Solved similar questions of design of heat exchanger

Q= WC(T1-T2)

Cp= m*Cp*DeltaT

LMTD = deltaT1-deltaT2/ln(deltaT1/deltaT2)

Area required (Q) = UAdeltaTlm

Date 21-04-24 to 25-04-24

Study about AutoCAD and its tools

AutoCAD is a computer-aided design (CAD) software used for creating 2D and 3D drawings. Its functions include drawing and editing geometric shapes, adding annotations, creating precise measurements, generating 3D models, and collaborating with other users through file sharing and markup tools.

AutoCAD offers a comprehensive set of tools for drawing, editing, and annotating designs. Some of the key tools include:

Drawing Tools: These tools allow users to create various geometric shapes such as lines, circles, rectangles, and polygons.

Editing Tools: Tools like Move, Copy, Rotate, and Scale enable users to modify and manipulate objects within their designs.

Annotation Tools: These tools are used to add text, dimensions, leaders, and other annotations to the drawing for clarity and documentation.

Layer Management: AutoCAD allows users to organize objects into layers, making it easier to control visibility and manage complex drawings.

Dimensioning Tools: Dimensioning tools help users accurately measure distances, angles, and other geometric properties within the drawing.

3D Modeling Tools: AutoCAD offers a range of tools for creating and editing 3D models, including extrusion, lofting, and Boolean operations.

Collaboration Tools: Features like file sharing, markup tools, and cloud storage integration facilitate collaboration among team members working on the same project.

Date 26-04-24 to 30-04-24

Designed a vessel on AutoCAD .

Date 01-05-24

Industry Visit .

Date 02-05-24 to 10-05-24

Designed a distillation column on AutoCAD .

Date 11-05-24

Industry visit

Date 12-05-24 to 14-05-24

Made Final internship Report

Date 15-05-24

Professional Development Evaluation .

Date 16-05-24

Industry Off

Date 17-05-24

Industry visit.

FORTNIGHTLY PROGRESS REPORT (FPR)

MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR
(A Govt. Aided UGC Autonomous Institute Affiliated to RGPV Bhopal)
NAAC Accredited with A++ Grade

FORTNIGHTLY PROGRESS REPORT (FPR) FROM INDUSTRY MENTOR

Name of student	xxxxxxxxxxxxx Akash Ojha		Department Chemical	xxxx Engineering	
Industry/Organization	xxxxxxxxxxxxxx Myriadly Eng.		Date/Duration 14 Days	DD/MM/YR -DD/MM/YR 01-02-24-14-02-24	
Criterion	**Poor**	**Average**	**Good**	**Very Good**	**Excellent**
Punctuality/Timely completion of assigned work			✓		
Learning capacity/Knowledge up gradation				✓	
Performance/Quality of work			✓		
Behaviour/Discipline/Team work			✓		
Sincerity/Hard work			✓		
Comment on nature of work done/Area/Topic	Design of distillation column of IPA and water.				
OVERALL GRADE (Any one)	**POOR/AVERAGE/[✓ GOOD]/VERY GOOD/EXCELLENT**				
Name of Industry Mentor	Mr. Rakesh Agrawal Sir.				
Signature of Industry Mentor					

Receiving Date	**xxxx** 15-02-2024	**Name of Faculty Mentor**	**xxx** Prof. Anish P. Jacob	**Sign**	**xxx**

MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR

(A Govt. Aided UGC Autonomous Institute Affiliated to RGPV Bhopal)

NAAC Accredited with A++ Grade

FORTNIGHTLY PROGRESS REPORT (FPR) FROM INDUSTRY MENTOR

Name of student	Akash Ojha		Department	Chemical Engineering	
Industry/Organization	Myriadly Engineering and Business Solutions		Date/Duration	15/02/2024 -29/02/2024	
Criterion	**Poor**	**Average**	**Good**	**Very Good**	**Excellent**
Punctuality/Timely completion of assigned work			✓		
Learning capacity/Knowledge up gradation				✓	
Performance/Quality of work				✓	
Behaviour/Discipline/Team work			✓		
Sincerity/Hard work				✓	
Comment on nature of work done/Area/Topic	Designing g Disttilation Column.				
OVERALL GRADE (Any one)	**POOR/AVERAGE/GOOD/[✓ VERY GOOD]/EXCELLENT**				
Name of Industry Mentor	Mr. Rakesh Agrawal				
Signature of Industry Mentor					

Receiving Date	01-03-24	**Name of Faculty Mentor**	Prof. Anish P. Jacob	**Sign**	

MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR
(A Govt. Aided UGC Autonomous Institute Affiliated to RGPV Bhopal)
NAAC Accredited with A++ Grade

FORTNIGHTLY PROGRESS REPORT (FPR) FROM INDUSTRY MENTOR

Name of student	Akash Ojha		Department	Chemical Engineering	
Industry/Organization	Myriadly Engineering and Business Solutions		Date/Duration	01/03/2024 -15/03/2024	
Criterion	**Poor**	**Average**	**Good**	**Very Good**	**Excellent**
Punctuality/Timely completion of assigned work			✓		
Learning capacity/Knowledge up gradation				✓	
Performance/Quality of work				✓	
Behaviour/Discipline/Team work				✓	
Sincerity/Hard work			✓		
Comment on nature of work done/Area/Topic	Designing of Heat Exchangers				
OVERALL GRADE (Any one)	**POOR/AVERAGE/GOOD/[✓ VERY GOOD]/EXCELLENT**				
Name of Industry Mentor	Mr. Rakesh Agrawal				
Signature of Industry Mentor					

Receiving Date	18-03-24	**Name of Faculty Mentor**	Prof. Anish P. Jacob	**Sign**	

MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR
(A Govt. Aided UGC Autonomous Institute Affiliated to RGPV Bhopal)
NAAC Accredited with A++ Grade

FORTNIGHTLY PROGRESS REPORT (FPR) FROM INDUSTRY MENTOR

Name of student	Akash Ojha	Department	Chemical Engineering
Industry/Organization	Myriadly Engineering and Business Solutions	Date/Duration	16/03/2024 -31/03/2024

Criterion	**Poor**	**Average**	**Good**	**Very Good**	**Excellent**
Punctuality/Timely completion of assigned work			✓		
Learning capacity/Knowledge up gradation			✓		
Performance/Quality of work			✓		
Behaviour/Discipline/Team work			✓		
Sincerity/Hard work			✓		

Comment on nature of work done/Area/Topic	Design of Heat exchanger.
OVERALL GRADE (Any one)	**POOR/AVERAGE/[✓ GOOD]/VERY GOOD/EXCELLENT**
Name of Industry Mentor	Mr. Rakesh Agrawal
Signature of Industry Mentor	

Receiving Date	01-04-24	**Name of Faculty Mentor**	Prof. Anish P. Jacob	**Sign**	Anish

MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR
(A Govt. Aided UGC Autonomous Institute Affiliated to RGPV Bhopal)
NAAC Accredited with A++ Grade

FORTNIGHTLY PROGRESS REPORT (FPR) FROM INDUSTRY MENTOR

Name of student	Akash Ojha	Department	Chemical Engineering
Industry/Organization	Myriadly Engineering and Business Solutions	Date/Duration	01/04/2024 - 15/04/2024

Criterion	**Poor**	**Average**	**Good**	**Very Good**	**Excellent**
Punctuality/Timely completion of assigned work			✓		
Learning capacity/Knowledge up gradation			✓		
Performance/Quality of work			✓		
Behaviour/Discipline/Team work			✓		
Sincerity/Hard work			✓		

Comment on nature of work done/Area/Topic	Distillation column Heat Exchange design.
OVERALL GRADE (Any one)	**POOR/AVERAGE/[✓ GOOD]/VERY GOOD/EXCELLENT**
Name of Industry Mentor	Mr. Rakesh Agrawal
Signature of Industry Mentor	

Receiving Date	16-04-24	**Name of Faculty Mentor**	Prof. Anish P. Jacob	**Sign**	Anish

MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR
(A Govt. Aided UGC Autonomous Institute Affiliated to RGPV Bhopal)
NAAC Accredited with A— Grade

FORTNIGHTLY PROGRESS REPORT (FPR) FROM INDUSTRY MENTOR

Name of student	Akash Ojha	Department	Chemical Engineering
Industry/Organization	Myriadly Engineering and Business Solutions	Date/Duration	16/04/2024 - 30/04/2024

Criterion	Poor	Average	Good	Very Good	Excellent
Punctuality/Timely completion of assigned work			✓		
Learning capacity/Knowledge up gradation			✓		
Performance/Quality of work			✓		
Behaviour/Discipline/Team work			✓		
Sincerity/Hard work			✓		

Comment on nature of work done/Area/Topic	Design of heat exchanger and distillation column.
OVERALL GRADE (Any one)	**POOR/AVERAGE/[✓ GOOD]/VERY GOOD/EXCELLENT**
Name of Industry Mentor	Mr. Rakesh Agrawal
Signature of Industry Mentor	

Receiving Date	01-05-24	**Name of Faculty Mentor**	Prof. Anish P. Jacob	**Sign**	Anish

MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR
(A Govt. Aided UGC Autonomous Institute Affiliated to RGPV Bhopal)
NAAC Accredited with A++ Grade

FORTNIGHTLY PROGRESS REPORT (FPR) FROM INDUSTRY MENTOR

Name of student	XXXXXXXXXXXXX Akash Ojha	Department Chemical	XXXX Engineering.
Industry/Organization	XXXXXXXXXXXXXXX Chemically Industry and Eng. for every prod.	Date/Duration	DD/MM/YR -DD/MM/YR 01-05-24 - 15-05-24

Criterion	Poor	Average	Good	Very Good	Excellent
Punctuality/ Timely completion of assigned work			✓		
Learning capacity/Knowledge up gradation			✓		
Performance/Quality of work			✓		
Behaviour/Discipline/ Team work			✓		
Sincerity/Hard work			✓		

Comment on nature of work done/Area/Topic	Design of Distillation column And Heat Exchanger.
OVERALL GRADE (Any one)	**POOR/AVERAGE/[✓ GOOD]/VERY GOOD/EXCELLENT**
Name of Industry Mentor	Mr. Rakesh Agrawal
Signature of Industry Mentor	

Receiving Date	XXXX 17-05-24	**Name of Faculty Mentor**	XXX Prof. Anish P. Jacob	**Sign**	XXX

DECLARATION BY THE CANDIDATE

I hereby declare that the work entitled **"Design Of Process Equipment for Efficiency and Reliability : Optimized Engineering"** is my work, conducted under the supervision of **Prof. Anish P. Jacob , Assistant Professor and Coordinator** , during the session Jan-May 2024. The report submitted by me is a record of bonafide work carried out by me.

I further declare that the work reported in this report has not been submitted and will not be submitted, either in part or in full, for the award of any other degree or diploma in this institute or any other institute or university.

Akash Ojha

0901CM201005

Date: 24-05-2024
Place: Gwalior

This is to certify that the above statement made by the candidates is correct to the best of my knowledge and belief.

Guided By:

24/05/24

Prof. Anish P. Jacob
Assistant Professor and Coordinator
Chemical Engineering
MITS, Gwalior

Departmental Project Coordinator

24/05/24

Prof. Shivangi Sharma
Assistant Professor
Chemical Engineering
MITS, Gwalior

Approved by Coordinator

24/05/24

Prof. Anish P. Jacob
Assistant Professor and Coordinator
Chemical Engineering
MITS, Gwalior

COORDINATOR
Chemical Engineering
MITS, Gwalior

PLAGIARISM CHECK CERTIFICATE

This is to certify that I am a student of B.Tech. in **Chemical Engineering** have checked my complete report entitled **"Design Of Process Equipment for Efficiency and Reliability : Optimized Engineering"** for similarity/plagiarism using the "Turnitin" software available in the institute.

This is to certify that the similarity in my report is found to be 16 % which is within the specified limit (20%).

The full plagiarism report along with the summary is enclosed.

Akash Ojha

0901CM201005

Checked & Approved By:

Anish 24/05/24

Prof. Anish P. Jacob
Turnitin Coordinator
Chemical Engineering
MITS, Gwalior

ACKNOWLEDGEMENT

The full semester internship has proved to be pivotal to my career. I am thankful to my institute **Madhav Institute of Technology and Science** to allow me to continue my disciplinary/ interdisciplinary internship as a curriculum requirement, under the provisions of the Flexible Curriculum Scheme (based on the AICTE Model Curriculum 2018), approved by the Academic Council of the institute. I extend my gratitude to the Director of the institute**, Dr. R. K. Pandit** and Dean Academics, **Dr. Manjaree Pandit** for this.

Guidance and co-operation are valuable for fulfilling and furnishing any kind of work. Similarly, I am dearly thankful to the Management for giving me this prestigious opportunity to learn from the field knowledge based on the theoretical aspects and also for guiding me during the ongoing training period.

I am sincerely thankful to my faculty mentors. I am grateful to the guidance of **Anish P. Jacob**, Assistant Professor and Coordinator , **Department of Chemical Engineering**, for his continued support and close mentoring throughout the internship. I am very thankful to the faculty and staff of the department. And I am thankful to **Mr. Rakesh Agarwal** as an industry mentor who helped me a lot to get familiar with the industry for guiding me throughout my internship.

Akash Ojha

0901CM201005