MASS BALANCE AND QUALITY TESTING OF CRUDE FATTY ACIDS

Internship Report

Submitted for the partial fulfilment of the degree of

Bachelor of Technology
In
Chemical Engineering

Submitted By
Ishita Pant
0901CM201019

UNDER THE SUPERVISION AND GUIDANCE OF
Dr. Shourabh Singh Raghuwanshi
Assistant Professor
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 2024 – May 2024

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DECLARATION BY THE CANDIDATE

I hereby declare that the work entitled **"MASS BALANCE AND QUALITY TESTING OF CRUDE FATTY ACIDS"** is my work, conducted under the supervision of **Dr. Shourabh Singh Raghuwanshi, Assistant Professor, 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.

Ishita Pant

0901CM201019

Date: 24/5/24

Place: Gwalior

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

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To whomsoever it may concern

This is to certify that ***Ms. Ishita Pant*** Student of ***B.Tech. (Chemical)*** of **MITS GWALIOR (MP)** has undergone Summer Internship with us from 12/01/2024 to 11/05/2024.

We found her sincere and hardworking and she took keen interest in learning the job connected with our Chemical Operations.

We wish her success in all her future endeavours.

For **GODREJ CONSUMER PRODUCTS LIMITED,**

(AJAY PASRIJA),
DGM (P. & A.).

PLAGIARISM CHECK CERTIFICATE

This is to certify that I, a student of B.Tech. in the **Department of Chemical Engineering** have checked my complete report entitled **"MASS BALANCE AND QUALITY TESTING OF CRUDE FATTY ACIDS"** 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 ..9%.. which is within the specified limit (30%).

The full plagiarism report along with the summary is enclosed.

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ABSTRACT

This report encapsulates the comprehensive experiences and technical insights gained during my internship at Godrej Consumer Products Limited, Malanpur, focusing on various aspects of chemical engineering processes. The primary objective of my internship was to conduct a detailed Mass Balance and quality check for crude fatty acids. This involved analysing the input and output streams, understanding the chemical reactions involved, and optimizing the process for efficiency and sustainability. In addition to this core project, I also had the opportunity to study other integral plants within the facility, including the Fatty Acid Distillation Plant, Sweet water Evaporation Plant, Sweet Water Treatment Plant. I also gained hands on experience of testing of various materials in the Quality assurance lab.

These studies & experience provided a broader understanding of the interrelated processes and the overall production workflow. The exposure to real-world industrial operations, combined with the hands-on application of theoretical knowledge, significantly enhanced my practical skills, and deepened my appreciation for the complexities of chemical engineering in an industrial setting. This report documents the methodologies, findings, and recommendations from my Mass Balance study, along with an overview of the operational principles of the associated plants.

Key Words: Fatty acid, Crude fatty acid, Distilled fatty acid, Fat splitting plant, Fatty acid distillation plant.

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Ishita

Ishita Pant

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ACRONYMS

GCPL	Godrej Consumer Products Ltd.
CP	Chemical Plant
FSP	Fat Splitting Plant
FADP	Fatty Acid Distillation Plant
SWTP	Sweet Water Treatment Plant
SWEP	Sweet Water Evaporation Plant
CFA	Crude Fatty Acid
DFA	Distilled Fatty Acid
SW	Sweet Water
PKFAD	Palm Kernel Fatty Acid Distillate
H.P. Steam	High Pressure Steam
AV	Acid Value
IV	Iodine Value
SV	Saponification Value

NOMENCLATURE

N	Normality
B	Blank Value
V	Volume
W	Weight of sample

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CHAPTER 1: INTRODUCTION

The chemical industry plays a crucial role in the global economy, providing essential raw materials and products for various sectors. Within this vast industry, crude fatty acids hold significant importance due to their diverse applications in food, cosmetics, pharmaceuticals, and biodiesel production. Ensuring the quality and efficient production of crude fatty acids is essential for meeting industry standards and consumer expectations. The processes of mass balancing and quality testing are integral to optimizing production and maintaining high standards. This project focuses on a detailed analysis of these processes in the context of crude fatty acids, aiming to enhance understanding and improve practices within the production framework.

Crude fatty acids are derived from natural sources such as animal fats and vegetable oils. These fatty acids are essential building blocks in the manufacturing of soaps, detergents, and various other chemical products. The production process involves several stages, including extraction, refining, and purification. Each stage must be meticulously managed to ensure that the final product meets the desired quality standards. The complexity of the process necessitates a robust system for tracking material flow and ensuring quality at every step.

The primary objective of this project is to perform a comprehensive mass balance analysis and quality testing of crude fatty acids. Mass balance analysis involves quantifying the inputs and outputs in the production process, ensuring that all material is accounted for and that any discrepancies are identified and addressed. Quality testing, on the other hand, involves assessing various chemical and physical properties of crude fatty acids to ensure they meet industry specifications. By achieving these objectives, the project aims to optimize production efficiency and enhance product quality, contributing to the overall success of the production process, and to achieve that we need to understand the full process of obtaining crude fatty acids and learn about its basic parameters. By achieving these objectives, the project aims to optimize production efficiency and enhance product quality, contributing to the overall success of the production process, and to truly achieve that we need to understand the full process of obtaining crude fatty acids and learn about its basic parameters. We also need to understand the GCPL, Malanpur plant working in order to truly achieve our goal.

The process by which crude fatty acids are obtained is called fat splitting, and in GCPL, Malanpur this process takes place in fat splitting plant, which consists of a 43 m long splitter or autoclave, which is the main unit of the plant, where splitting takes place, the splitting process is continuous and the method which is used here for fat splitting is known as

Colgate-Emery Process, which is highly efficient and inexpensive too. For the process to be efficient we need to maintain the autoclave pressure and temperature.

1.1. Chemical Plant III

GCPL, Malanpur consists of three chemical plants, CP I, CP II, CP III. These Chemical plants are used to produce Crude Fatty Acids, their distillation (DFA), and glycerine recovery. They differ in the technology used to produce DFA. Further the DFAs from the different chemical plants are blended in the blending section to obtain the desired properties required for soapmaking.

Chemical plant III consists of 3 units as: -

- Fat Splitting Plant (FSP III)
- Fatty Acid Distillation Plant (FADP III)
- Sweet Water Evaporation Plant (SWEP III)

1.1.1. FSP III

Fat splitting is generally defined as the process of obtaining fatty acids from triglycerides by using water at high temperature and high pressure or by catalysing the action of water at relatively low temperature. The main objective of fat splitting is to obtain a maximum of fatty acids and glycerol.

This plant consists of one splitting column of 43m height, a Reboiler is attached to it.

- KEY EQUIPMENTS
  - Oil feed pump.
  - Water feed pump
  - Autoclave
- CRITICAL SUB SYSTEM
  - Degasifier

- Reboiler
- High pressure steam generator

Table 1: FSP III - Critical Process Parameter

Autoclave Pressure	52-55 kg/cm²
Autoclave Temperature.	255-265°C
Steam Pressure	60 kg/cm²

Table 2:FSP III - Utility Consumption

PARAMETER	CONSUMPTION
60 Kg/cm² STEAM	25.2 MT/Day
10 Kg/cm² STEAM	2.7 MT/Day
POWER	2700 KW/Day

Table 3:FSPIII - Analysis Plan

SAMPLE	ANALYSIS	FREQUENCY
OIL	FFA/AV, SV, IV & M/V	ONCE/DAY
CFA	AV, SV (if required)	EVERY 2 HR
SWEET WATER	% Glycerine	ONCE/SHIFT

1.1.2. FADP III

The FADP is designed to eliminate the impurities and the un-split fat from the crude fatty acids, by means of distillation in steam current under high vacuum.

The plant uses a process mainly consisting of three stages:

1st stage : Removal of dissolved air and moisture in a CFA dryer.

2nd stage : Removal of low boiling impurities by pre-evaporation in pre-cut column at lower temperature and vacuum condition.

3rd stage : Removal of the unsplit fat, by stripping of the fatty acids with steam in the main still (distiller).

The result of this process consists in the improvement of colour, odour, and stability of fatty acid.

- KEY EQUIPMENT
  - Dryer
  - Precut Tower
  - Distiller column
- CRITICAL SUB SYSTEM
  - Preheater
  - Strainer/filter DFA Scrubber
  - LFA Scrubber
  - DFA Receiver
  - Reboiler
  - Vacuum System
  - Thermic Fluid Heating System

Table 4: FADP III – Critical Process Parameter

Temp in CFA Dryer	80 °C-90°C
Temp. In Precut Tower	185°C-190°C
Temp. In Precut Reboiler	Minimum 200°C
Vacuum in Precut & Distiller	The Absolute Pressure in Pre-Cut Tower Should Be Below 15 Mm Hg and in Distiller It Should Be Below 5 Mm Hg.

Table 5: FADP III - Analysis Plan

SAMPLE	ANALYSIS	FREQUENCY
CFA	AV, IV	Once/Day
DFA	AV, COLOR, ODOUR, & IV (If required)	Every 2 Hr.
LFA	AV/COLOR	Once/Shift

1.1.3. SWEP III

The sweet water coming out of the FSP III is first sent to CP II for treatment (as CP III does not have a Sweet Water Treatment Plant) and then bring back to CP III for evaporation.

In this plant Gly % is increased in the sweet water. First the heat of the condensate discharge from the first effect is used to heat the feed sweet water which then enters in all the chambers & level is maintained by LIC. Vacuum system with barometric condenser is provided in third chamber. Sweet water gets boiled in the chambers & entered in the next chamber. When the desired vacuum & temperature achieved in the third chamber, Crude glycerine transferred into the storage tank and the evaporated water is collected in a tank which is further used for Fat splitting.

The temperature and pressure maintained inside 3 stage evaporators are:

Table 6: SWEP III - Process Parameter

EVAPORATION CHAMBER	**TEMPERATURE**	**PRESSURE**
1st	129°C	2.5 bar
2nd	118°C	1.1 bar
3rd	69°C	100mB

1.2. Fat splitting process

Fat splitting is a process to produce fatty acid & glycerine from fats & vegetable oil. To get triglycerides, the corresponding crude fatty acids, and crude glycerol dissolved in the surplus water, the splitting or hydrolysis procedure is carried out.

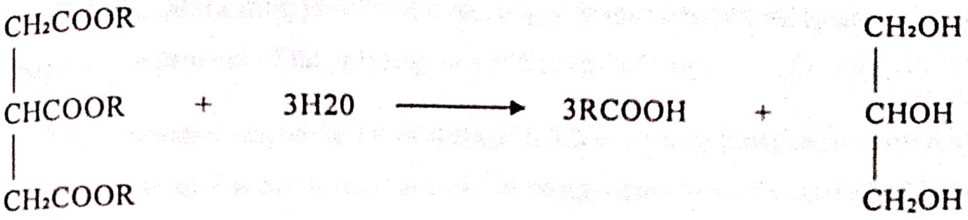
The main objective of fat splitting is to obtain a maximum of fatty acids and glycerol. Since the reaction is reversible, it is necessary to remove either glycerol or the fatty acid to shift the equilibrium. The reaction of fat splitting, whatever be the process employed obeys the following general rules:

1. The greater the proportion of free fatty acids in the fat to be hydrolysed, the shorter will be the induction period. The period during which the hydrolysis rate is depressed is known as induction period.

2. The higher the reaction temperature and the more the advanced the process, the less necessary the stirring.

3. The rate of hydrolysis is augmented by the raising of temperature and using catalyst, proportionally to its quantity.

4. The concentration of glycerol in the sweet fluids is the only factor that determines the degree of hydrolysis at equilibrium, regardless of the kind of fat to be divided. The reaction is as follows:



$$\begin{array}{l} CH_2COOR \\ | \\ CHCOOR \\ | \\ CH_2COOR \end{array} + 3H20 \longrightarrow 3RCOOH + \begin{array}{l} CH_2OH \\ | \\ CHOH \\ | \\ CH_2OH \end{array}$$

Triglyceride Water Fatty Acid Glycerol

1.2.1. Methods of Fat Splitting

There are four known methods of fat splitting: -

- Twitchell process

  In 1890, Ernest Twitchell developed an acid splitting method using a sulphonate of phenyl stearic acid. Improved by Petrov with water-soluble sulphonic acid from petroleum oils, the process requires pre-treatment of fats and distillation for purification. It is simple, inexpensive, and adaptable for small-scale operations.

- Batch autoclave process

  The batch autoclave process splits higher-grade stock into light-colored fatty acids using 2-4% catalyst (zinc, magnesium, or calcium oxides) and zinc dust for color improvement. Steam agitation raises the pressure to 1135 kPa. After processing, fatty acids are treated with mineral acid and washed.

- Continuous process

  The Colgate-Emery process, a continuous counter-current, high-pressure fat-splitting method, is highly efficient, achieving up to 99% splitting without a catalyst. Fat is introduced at the bottom and water at the top (40-50% of fat weight).

High temperatures (250-260°C) and pressure enable rapid hydrolysis and phase separation.

- Enzymatic process

Fats and oils can hydrolyse in the presence of natural enzymes. Fat splitting using lipolytic enzymes had been carried out in experimental trials. However, due to its high cost and lengthy reaction time, this technique is now of questionable value. At temperatures range of 26-45°C for a period of 48-72 h, about 98% splitting is possible.

1.3. Fat splitting process at FSP III

At CP III the fat splitting process is continuous, & the method used is known as Colgate-Emery process. The process of fat splitting of CP III is as follows: -

- The Pretreated vegetable oil is storage tanks is directly pumped through pump to the heat exchanger of Fat Splitting Plant of CP III and from there the heated oil is de-aerated in a degasifier.
- The de-aerated oil is passed through a filter, and again pumped to a 10 Kg heat exchanger, and the preheated oil enters the splitting vertical column continuously from the bottom. It enters through a spray ring, which breaks the fat into fine particle.
- After going through the fat-water face and the hot sweet water, it is heated as it moves forward and is eventually heated to a temperature of 250 to 260 degrees Celsius by direct high-pressure steam sparging. At this temperature, the hydrolysis reaction starts and propagate as fat travels upwards.

The process heated process water for splitting is charged from the top of the column through specially designed spray coils, from where the process water is sprayed in droplets and travels downwards for taking part in splitting. To achieve a high degree of splitting, several injection sites are used to inject high-pressure steam.

Sweet water, or glycerine and water, is recovered from the bottom of the splitting tower, while the converted fatty acid is collected from the top. The response happens in an anti-current fashion.

After being separated and exiting at a temperature of 175 to 180 degrees Celsius, the fatty acid is dried in a specially made CFA dryer. The liquid fatty acid is then passed through a specially made heat exchanger, where the hot product and feed oil are heated together. Lastly, the crude fatty acid is vacuum-sealed and moved to a fatty acid distiller.

CHAPTER 2: LITERATURE SURVEY

The research article explores the efficient separation of saturated fatty acids (SFAs) from high free fatty acid crude palm oil using methanol crystallization. This method is highlighted for its efficiency, low cost, stability, and ease of recovery. The study involved preparing free fatty acids (FFAs) through hydrolysis and then optimizing methanol crystallization with varying ratios of fatty acids to methanol (1:5 to 1:25 g/mL), temperatures (-20°C to 5°C), and times (4 to 30 hours). Methanol crystallization was found to be the most effective and simplest technique compared to others like adsorption chromatography and enzymatic splitting. The study concludes that methanol is an ideal crystallization solvent for separating SFAs due to its high efficiency and cost-effectiveness, with recommendations for future improvements in purification and processing techniques. [1]

The study investigates continuous hydrolysis of canola, camelina, and algal oils to produce free fatty acids (FFAs), a crucial step in biofuel production. Using a continuous counter current reactor and CFD modelling, the research optimizes reaction conditions, finding that a reaction temperature of 260°C and a 4:1 water-to-oil ratio yield the highest FFA production (89-93%). Preheating reactants significantly enhances efficiency. This method proves superior to traditional batch hydrolysis, demonstrating high conversion rates and energy efficiency, making it suitable for industrial applications. [2]

The paper "Measuring Material Efficiency: A Review of the Historical Evolution of Indicators, Methodologies, and Findings" reviews the development of material efficiency indicators over three decades. It highlights the importance of increasing material efficiency to reduce resource depletion and environmental impacts. Key indicators discussed include material intensity of use, economy-wide material flow accounting, and consumption-based material footprint. Methodological advancements such as multi-regional input-output analysis and life cycle impact assessment have improved understanding of material flows. The paper proposes a generalized framework for constructing relevant indicators and emphasizes the need for problem-oriented, policy-relevant metrics. [3]

The research "Calculation of Mass Balance of Crude Oil Tank (COT) at PT. XAZ" examines the mass balance of oil, water, and sand in the crude oil processing system. Initial crude palm oil (CPO) with impurities and high water content is filtered and stored in the COT, which reduces Non-Oil Solids (NOS) and manages temperature. The study highlights the importance of mass balance for optimizing COT efficiency, improving processing design, and enhancing quality control. Regular maintenance, including sludge and water removal, is recommended for maintaining efficient oil separation. These insights aim to improve crude oil processing techniques for more efficient production and higher quality crude palm oil. [4]

The document provides an in-depth discussion on the quality control of fats and oils, emphasizing the importance of predicting and monitoring their quality to ensure high-quality products. Key quality parameters evaluated include fatty acid composition, relative density, refractive index, viscosity, color, odor and taste, saponification value, iodine value, unsaponifiable matter, acid value, smoke, flash and fire points, peroxide value, thiobarbituric acid reactive substances, para-anisidine value, volatile matter, metal ions, trans-fatty acids, carotenoids, chlorophylls, synthetic antioxidants, and adulterants. [5]

Oxidation of lipids is highlighted as a significant issue affecting flavor, aroma, nutritional quality, and texture. Predictive and indicator tests are used to measure oxidation, including the Active Oxygen Method (AOM), Oxidative Stability Index (OSI), iodine number, and oxygen bomb test for predictive purposes, while peroxide value, TBA test, anisidine value, hexanal value, headspace profile, free fatty acids, Kreis test, ultraviolet spectrophotometry, fluorescence, chromatographic methods, sensory evaluation, Schaal oven test, Rancimat method, and oxygen absorption are used as indicator tests. [5]

The document underscores that lipid oxidation, often leading to rancidity, produces chemicals responsible for off-flavors and aromas, and that understanding this process is crucial for minimizing undesirable effects in fat-containing products. [5]

CHAPTER 3: COMPANY PROFILE

3.1. About GCPL

Godrej Consumer Products Limited (GCPL) is a leading Indian consumer goods company with a diverse portfolio that spans personal care, home care, and hair care products. Established in 2001 as a part of the Godrej Group, a prominent Indian conglomerate, GCPL has grown to become a global player, with a significant presence in emerging markets such as Asia, Africa, and Latin America. The company's product range includes well-known brands like Goodknight, Cinthol, Godrej Expert, and Godrej No. 1, which cater to the everyday needs of millions of consumers.

GCPL is committed to innovation, sustainability, and inclusive growth, focusing on creating high-quality products that enhance the lives of its customers. By leveraging its deep market understanding and extensive research and development capabilities, GCPL continues to expand its reach and influence, maintaining a strong foothold in the fast-moving consumer goods (FMCG) sector. The company's dedication to corporate social responsibility and ethical business practices further solidifies its reputation as a trusted and respected name in the industry.

3.2. Vision

Godrej Consumer Products Limited (GCPL) envisions being a leading emerging markets company by delighting consumers with innovative and sustainable products and services. The company aims to outperform and create lasting value through an agile and high-performance culture, while remaining deeply committed to ethics, people, and the planet.

3.3. Mission

Godrej Consumer Products Limited (GCPL) has a mission to enhance the quality of life for its consumers by offering superior, innovative products and services. The company aims to create value for all stakeholders, including customers, employees, shareholders, and the community, while maintaining a strong focus on sustainability and social responsibility. GCPL strives to be a leading consumer goods company by leveraging its heritage of trust and commitment to innovation and excellence.

3.3. GCPL, Malanpur

Godrej Consumer Products Limited, Malanpur is a part of the Godrej group and first manufacturing location outside Vikhroli (Mumbai) in the stable of GCPL for manufacturing toilet soap & stearic acid. The unit is located at Malanpur, Bhind, M.P. on the Gwalior - Etawah highway, nearly 30 km away from the historic city Gwalior.

GCPL, Malanpur is one of the largest soap integrated plants in India, its annual turnover is 1000 crore. The Unit is certified with ISO 9002, ISO 14001, & it is the first soap manufacturing company to get ISO 14001 certification in India.

GCPL and Malanpur have adopted the principle of TQM. Ideas like technology and development, rural development, sports and cultural activities, SGA, Kaizen, technology and development, and 5-S have become ingrained in the culture of GCPL, Malanpur.

GCPL uses SAP manufacturing software. The purpose of a systems applications products audit is to examine the security and data integrity of a computer system. Systems Applications Products is the abbreviation for SAP. Users of the system can access a soft real-time business application. It is thought to be very adaptable and has a user interface. Security and data integrity are the two primary areas of concern in a SAP audit. The unit is built on 76 acres of land, with 25 acres reserved for plantation, which makes GCPL Malanpur one of the greenest plants in the area.

The unit consists of various plants which includes 3 Chemical plants, and each of the chemical plants consists of the Fat Splitting Plant, Fatty Acid Distillation Plant, Sweet Water Treatment Plant, & Sweet Water Evaporation Plant. There are two plants for Soap Manufacturing known as New & Old Soap Plant, also there are many other plants like water treatment plant, residue treatment plant, and much more.

The main products which are being manufactured in the GCPL, malanpur are: -

- Godrej No.1 Variants (Sandal, Aloe vera, Lime, Coconut)
- Cinthol
- Godrej Fresh Glow
- Godrej Expert Rich Crème

Other products of GCPL, Malanpur are crude glycerin, distilled fatty acids.

CHAPTER 4 : PROBLEM FORMULATION

Problem formulation for : -

Mass Balancing and Quality Testing of Crude Fatty Acids at GCPL, Malanpur.

4.1. Context

Crude fatty acids are a crucial raw material for GCPL's personal care and household products. Streamlining production efficiency and maintaining rigorous quality control are essential for:

Cost Reduction: Minimizing waste and maximizing yield of crude fatty acids can significantly reduce production costs.

Product Quality Assurance: Consistent quality of crude fatty acids is vital for downstream processing and ensuring the final products meet consumer expectations.

Environmental Sustainability: Reducing UFM and optimizing resource utilization contribute to a more environmentally responsible production process.

4.2. Specific Issues and Uncertainties

- Mass Balance Optimization:
  - Quantify the current conversion rate of raw materials to crude fatty acids.
- Quality Control Enhancement
  - Evaluate the current quality control procedures for crude fatty acids at various production stages.
  - Determine if the produced crude fatty acids consistently meet established quality standards (e.g., acid value, iodine value).
  - Identify any variations in quality parameters that could affect downstream processing or final product quality.

4.3. Research Questions

- **Mass Balance:**
  - What is the current conversion rate of raw materials to crude fatty acids in the GCPL Malanpur production process?
  - What is the percentage of UFM generated during the process?

- What are the potential causes of UFM?

➤ ***Quality Control:***

- Do the produced crude fatty acids meet the established quality standards set by GCPL?
- Are there any significant variations in quality parameters (e.g., acid value, iodine value) at different stages of the production process?

This project focuses on understanding the efficiency and effectiveness of the current crude fatty acid production process at GCPL Malanpur. By analyzing mass balance and quality control aspects, the project aims to identify areas for improvement that can benefit both production costs and product quality.

CHAPTER 5 : METHODOLOGY

5.1. Mass Balance Analysis

- **Data Collection:**
  - We need to collect the production data to perform mass balance on Crude fatty acids, the data will include the flowrates of feed (input) and production (output).
  - Yield of crude fatty acids produced for a shift.
  - Amounts of waste streams generated during the process (e.g., sweet water).
- **Calculations and Analysis:**
  - Employ mass balance calculations to determine the following: -

    Loss of triglyceride

    Percentage conversion of raw materials to crude fatty acids.

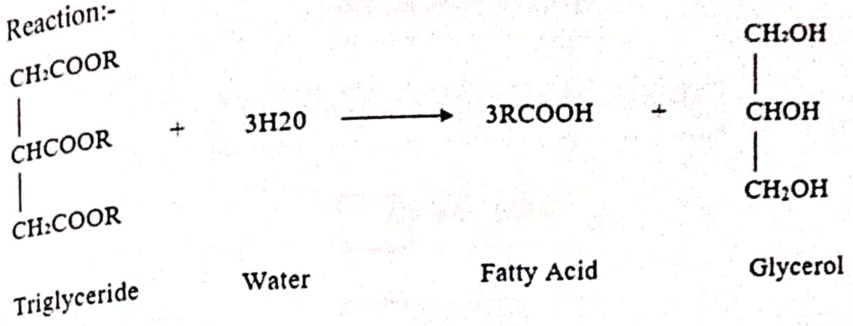
5.2. Quality Control Evaluation

- **Analytical Techniques:**
  - Utilize established analytical methods to evaluate the quality of the collected crude fatty acid samples according to relevant specifications. These techniques include:
  - Acid value (determining free fatty acid content)
  - Iodine value (assessing degree of unsaturation)
  - Saponification value (measuring the total fatty acid content)
- **Data Analysis and Comparison:**
  - Analyse the quality control data for each sample.
  - Compare the obtained results with established quality standards for crude fatty acids relevant to GCPL's production processes.
  - Identify any deviations from the standards and assess their potential impact on downstream processing or final product quality.

5.3. Mass balance on crude fatty acids

- Process : Hydrolysis, Splitting of triglycerides into fatty acids & glycerol with the help of water and high pressure steam.

- Reaction:-



$$\begin{matrix} \text{CH:COOR} \\ | \\ \text{CHCOOR} \\ | \\ \text{CH:COOR} \end{matrix} + 3H20 \longrightarrow 3RCOOH + \begin{matrix} \text{CH:OH} \\ | \\ \text{CHOH} \\ | \\ \text{CH}_2\text{OH} \end{matrix}$$

- Feed

  Oil (PKFAD)

  Water

  High Pressure Steam

- Output

  Crude Fatty Acid

  Sweet water (Crude Glycerol)

- Accumulation

  No accumulation but losses in terms of waste, if some accumulation in the splitter occur it means that there is some problem.

The mass balance for fat splitting process is calculated in terms of flowrate or at any instance as the process is continuous.

- Overview of the fat splitting process at FSP III

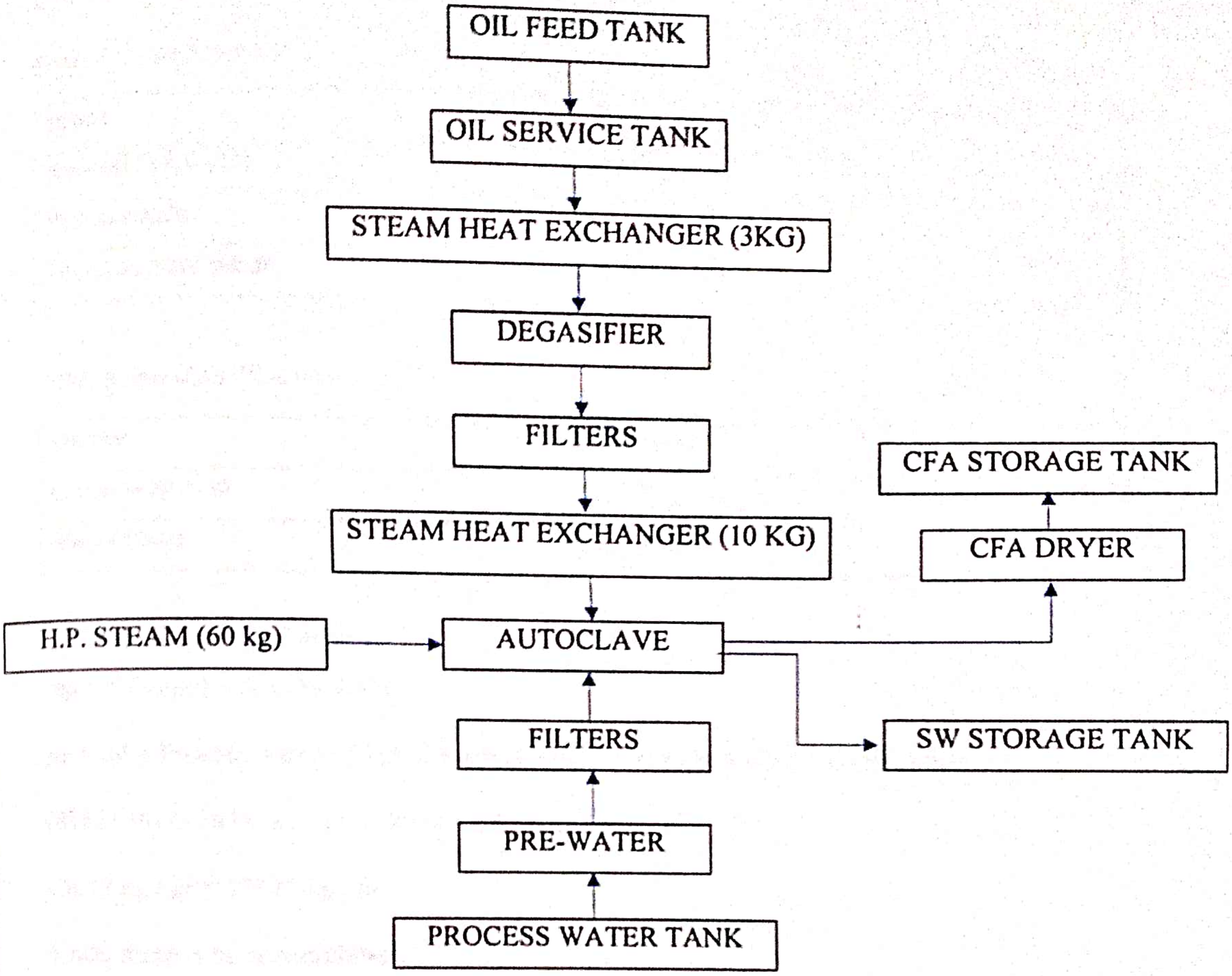


Figure 1: Block Diagram of FSP III

- **Mass balance of CFA in terms of flowrate**

Data Collected in the month of February.

Table 7:Feed Flowrate

Input	**Flowrate**
Raw oil (PKFAD)	8962 kg / hr
Process water	3612 kg / hr
High pressure steam	1038 kg / hr

Table 8: Product Flowrate

Output	**Flowrate**
Crude fatty acid	8912 kg / hr
Sweet water	3812 kg / hr

- Overall Material Balance: -

Input = Output + Accumulation

Raw oil + Process water + High pressure steam = Crude fatty acid + Sweet water

(8962+3612+1038) kg / hr = (8912 + 3812) kg / hr +(0)

13612 kg / hr = 12724 kg / hr

Since, there is no accumulation.

Therefore, Total mass entering the system must be equal to the total mass leaving the system.

i.e. Input = Output

But our calculations states that there are some losses.

So,

Total Loss = (13612-12724) kg / hr

= 888 kg / hr

Vapour loss = (Process water + H.P. Steam) – (Sweet water)

= (3612+1038) kg / hr - (3812) kg / hr

= 838 kg / hr

Now,

Loss percentage = ((888 – 838) / 888) * 100

= 5.6 %

- **Mass Balance of CFA at an instance**

Data collected in the month of April

Table 9: Feed Flowrate

Input	**Flowrate**
Raw oil (PKFAD)	7970 kg / hr
Process water	3799 kg / hr
High pressure steam	912 kg / hr

Table 10: Product Flowrate

Output	**Flowrate**
Crude fatty acid	7920 kg / hr
Sweet water	4680 kg / hr

For an instant: -

Table 11: Instant Feed

Input	**Quantity**
Raw oil (PKFAD)	2.22 kg
Process water	1.05 kg
High pressure steam	0.25 kg

Table 12: Instant Product

Output	Quantity
Crude fatty acid	2.2 kg
Sweet water	1.3 kg

- Overall Material Balance: -

Input = Output + Accumulation

Raw oil + Process water + High pressure steam = Crude fatty acid + Sweet water

(2.22+1.05+0.25) kg = (2.2 + 1.3) kg +(0)

3.52 kg = 3.5kg

Since, there is no accumulation.

Therefore, Total mass entering the system must be equal to the total mass leaving the system.

i.e. Input = Output

But our calculations states that there are some losses.

So,

Loss = (3.52 - 3.5) kg

= 0.02 kg

Now,

Loss percentage = ((3.52 – 3.5) /3.52) * 100

= 0.5 %

The process is efficient.

5.4. Quality Analysis of CFA

- **For AV**

APPARATUS:

1. Conical flask
2. Burette
3. Weighing balance
4. Hot plate

REAGENTS:

1. Neutral methanol
2. Phenolphthalein indicator solution
3. Standard aqueous Sodium hydroxide solution of N/2

PROCEDURE:

Mix the melted fat thoroughly before weighing. Weigh accurately 1.5-2gm of oil or fat in a conical flask. Add 50 ml of neutral alcohol and 1 ml of phenolphthalein indicator solution. Boil the mixture for about 5 min and then titrate while as hot as possible with standard N/20, shaking vigorously during titration. Note the reading when color just changes to pink

FORMULA USED:

ACID VALUE (56.1*N*V)/W

CALCULATIONS:

Data:

Weight of CFA sample (W) = 0.205 grams

Volume of 0.1 N NaOH solution used (V) = 18.3 mL

Normality of NaOH solution (N) = 0.1 N

Conversion factor (56.1 mg KOH / meq)

AV = (V x N x 56.1) / W

= (18.3 mL x 0.1 N x 56.1 mg KOH / meq) / 0.205 grams AV = 49.2 mg KOH/g

- **For IV**

APPARATUS:

1. Conical flask
2. Burette
3. Weighing balance
4. Hot plate
5. Pipette
6. Measuring Cylinder

REAGENTS:

1. Potassium iodide solution:
2. Starch solution
3. Standard sodium thiosulphate solution:
4. Standard potassium chromate solution:
5. Wijs solution
6. Chloroform solution

PROCEDURE:

Take appropriate quantity of oil or fat in 500ml iodine flask. Add quantity sufficient of chloroforms solution and 10ml of wijs solution to the flask. Replace the glass stopper after wetting it with potassium iodide solution. Allow it to stand in dark for 30min in case of non-drying and semi drying oils and one hour in case of drying oils. Carry out blank test simultaneously under same experimental condition. After standing, add 10ml of potassium iodide solution and 100ml of distilled water. Titrate the liberated iodine with standard N/10 sodium thiosulphate solution until solution is straw yellow. Add ml of starch solution and continue titration until blue colour formed disappears.

FORMULA USED:

IODINE VALUE = 12.69*(B-S) *N/W

OR

IV = (V x N x 126.9 x 100) / (W x Sample weight)

CALCULATIONS:

Data:

Weight of CFA sample (W) = 0.321 grams

Volume of 0.1 N sodium thiosulfate solution used (V) = 15.7 mL

Normality of sodium thiosulfate solution (N) = 0.1 N

IV = (15.7 mL x 0.1 N x 126.9 x 100) / (0.321 grams x 100 grams/sample)

IV = 60.8 g I2/100 g sample

- **For SV**

APPARATUS

1. SV flask
2 Burette
3. Pipette
4. Reflux Condenser
5. Weighing balance
6. Hot plate

REAGENTS:

1. Alcoholic potassium hydroxide solution
2. Phenolphthalein indicator solution

3. Standard hydrochloric solution 0.5N

4. Standard sodium carbonate solution 0.5N

PROCEDURE

Melt the sample and weigh accurately about 1.5 to 2 gms in a conical flask with standard joint. Add 25 ml of alcoholic potassium hydroxide solution and connect the reflux air condenser to the flask. Heat the flask on the electric hot plate for not more than 1 hr. Boil the sample gently but steadily until it is totally saponified, as shown by the lack of any greasy debris and the appearance of clear liquid. After the flask and condensed have cooled, wash down the inside of the condenser with about 10ml of hot neutralize ethyl alcohol. Add about 1ml of phenolphthalein indicator solution and titrate it with standardized N/2 hydrochloric acid At the same time, prepare and conduct a blank decision.

FORMULA USED:

SAPONIFICATION VALUE = 56.1*(B-S) N/W

CALCULATION:

Data:

Weight of CFA sample (W) = 1.35 grams

Volume of distilled water used in sample titration (V) = 18.7 mL

Volume of distilled water used in blank titration (B) = 20.2 mL

Normality of KOH solution (N) = 0.5 N

SV = (56.1 x 0.5 N x (20.2 mL - 18.7 mL)) / 1.35 grams

SV = 189.3 mg KOH/g sample

CHAPTER 6 : RESULTS & DISCUSSION

1. The mass balance is done for CFA, and we found that there are around 5 % loss of the feed oil, which is due to the low conversion rate of triglycerides into CFA.

2. The calculated AV of the sample was 49.2 mg KOH/g, which falls within the typical acceptable range (50-160 mg KOH/g) for most CFAs.

The calculated IV of the sample was 60.8 g I2/100 g sample, which also falls within the typical acceptable range (40-140 g I2/100 g sample) for most CFAs.

The calculated SV of the sample was 189.3 mg KOH/g sample, which also falls within the typical acceptable range (180-200 mg KOH/g.) for most CFAs.

CHAPTER 7 : CONCLUSION

In conclusion, my internship at GCPL, Malanpur proved to be an invaluable experience. I gained significant knowledge and skills in the fat splitting & distillation processes. I am particularly grateful for the opportunity to be a part of CP III Team, I learned about various processes and operations, and gained hand on experience in operating the plant mimics and testing . This experience equipped me with valuable knowledge in applying analytical techniques for CFA quality assessment, understanding the importance of established quality control standards, and appreciating the influence of intended use on desired CFA properties. Additionally, I gained insights into mass balance calculations and their role in tracking material flow throughout production. These learnings will be instrumental in my future endeavours, particularly when working with or analysing fatty acid-based materials. .The knowledge and experience I gained during this internship will be highly beneficial as I move forward in my career.

CHAPTER 8 : ACHIEVED OUTCOMES & SOCIETAL RELEVANCE

8.1. Achieved Outcomes

1. Performed mass balancing on crude fatty acid, and learned about process optimization.

2. Analysed and learned about quality parameters of CFA.

3. Learned about various processes and operations.

8.2. Societal Relevance

The findings from this internship project hold relevance for society in several ways:

1.Improved Quality of CFA-based Products: By ensuring consistent and high-quality CFAs through effective quality control measures, GCPL Malanpur can contribute to the production of better end products across various industries.

2. Responsible Manufacturing Practices: The emphasis on mass balance calculations highlights the importance of resource efficiency and minimizing waste in the production process. This aligns with the growing societal focus on sustainable manufacturing practices.

3.Consumer Safety and Satisfaction: Consistent quality control in CFA production helps ensure the safety and effectiveness of final products containing these materials. This translates to consumer confidence and satisfaction with the performance of these products.

REFERENCES

[1] A.-A. W. Japir, J. Salimon, D. Derawi, B. H. Yahaya, M. Bahadi, S. Al-Shuja'a, and M. R. Yusop, "A highly efficient separation and physicochemical characteristics of saturated fatty acids from crude palm oil fatty acids mixture using methanol crystallisation method," *OCL*, vol. 25, no. 2, p. A203, 2018

[2] W.-C. Wang, T. L. Turner, L. F. Stikeleather, and W. L. Roberts, "Exploration of process parameters for continuous hydrolysis of canola oil, camelina oil and algal oil," *Chemical Engineering and Processing*, vol. 57–58, pp. 51–58, 2012.

[3] C. Zhang, W.-Q. Chen, and M. Ruth, "Measuring material efficiency: A review of the historical evolution of indicators, methodologies and findings," *Journal of Cleaner Production*, vol. 192, pp. 409-425, Aug. 2018. DOI: 10.1016/j.jclepro.2018.04.192.

[4] A. Barus, M. Hutagalung, I. Rachmiadji, Yanto, Hariyanto, N. Nelza, and D. C. S. Purba, "Calculation of Mass Balance of Crude Oil Tank (COT) at PT. XAZ," *International Journal of Computer Sciences and Mathematics Engineering*, vol. 1, no. 2, pp. 101-109, 2022.

[5] "Quality Control of Fats and Oils," in Food Analysis and Quality Control, Module 32, Paper No. 11, *Inflibnet Centre*

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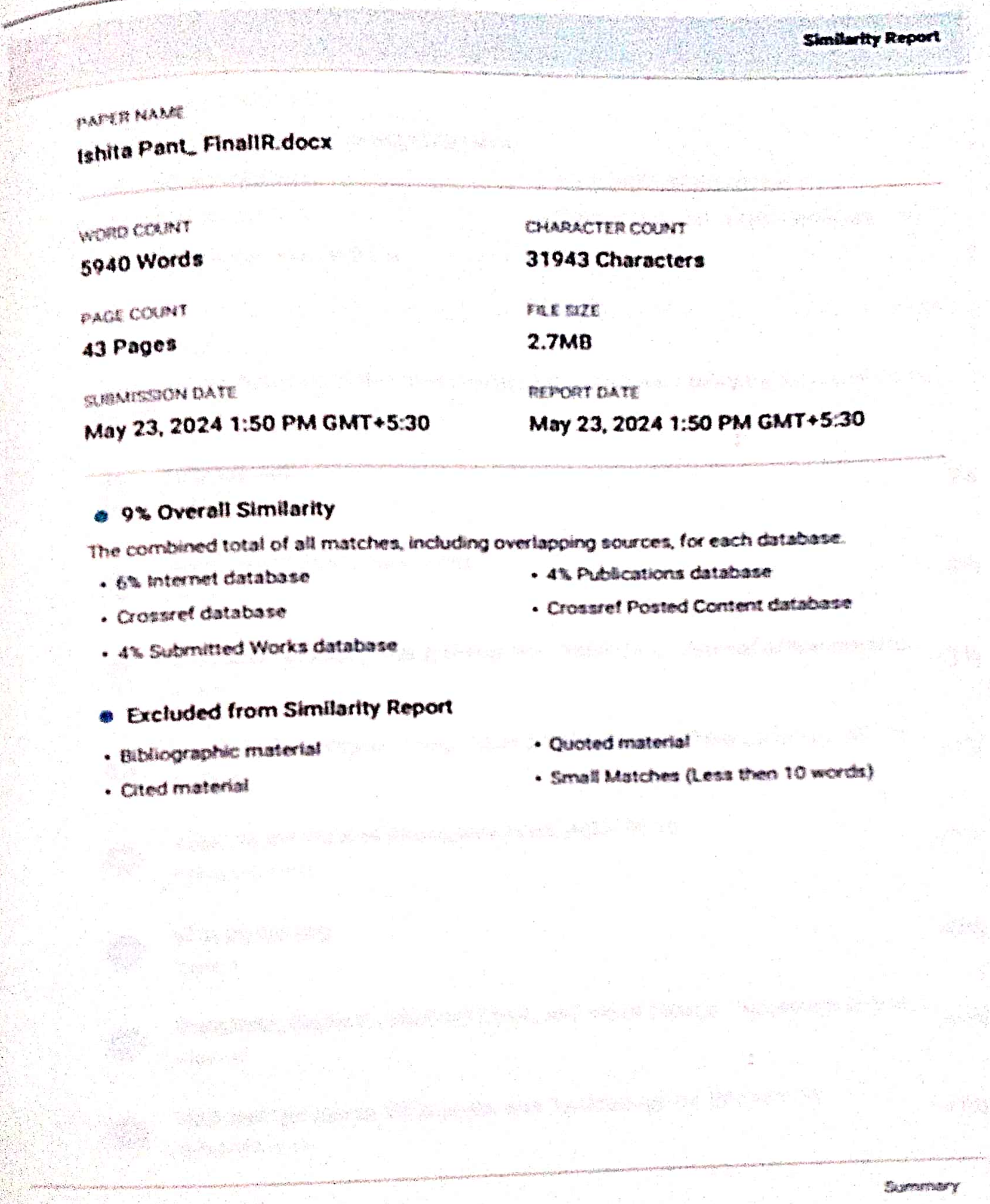

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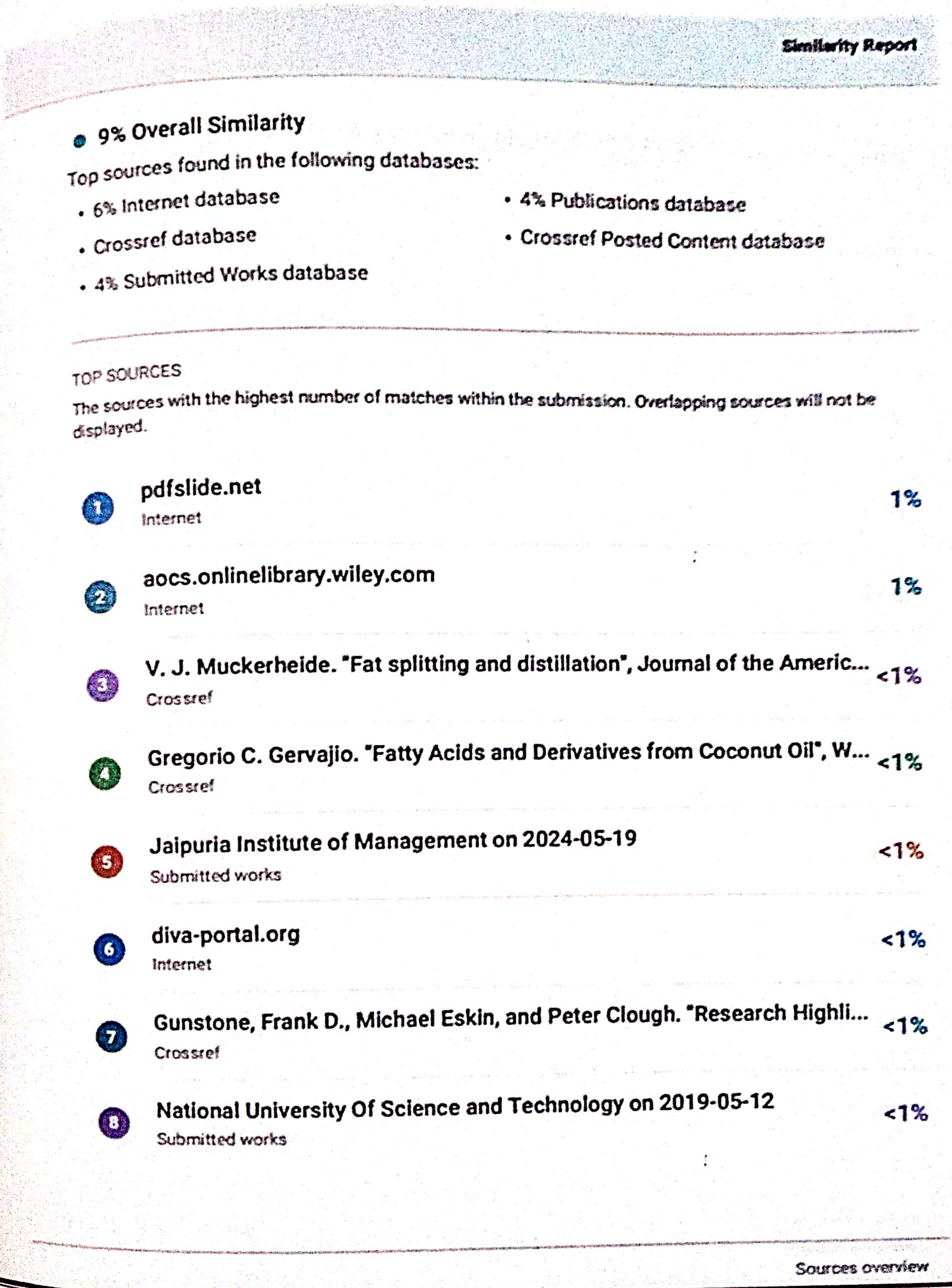

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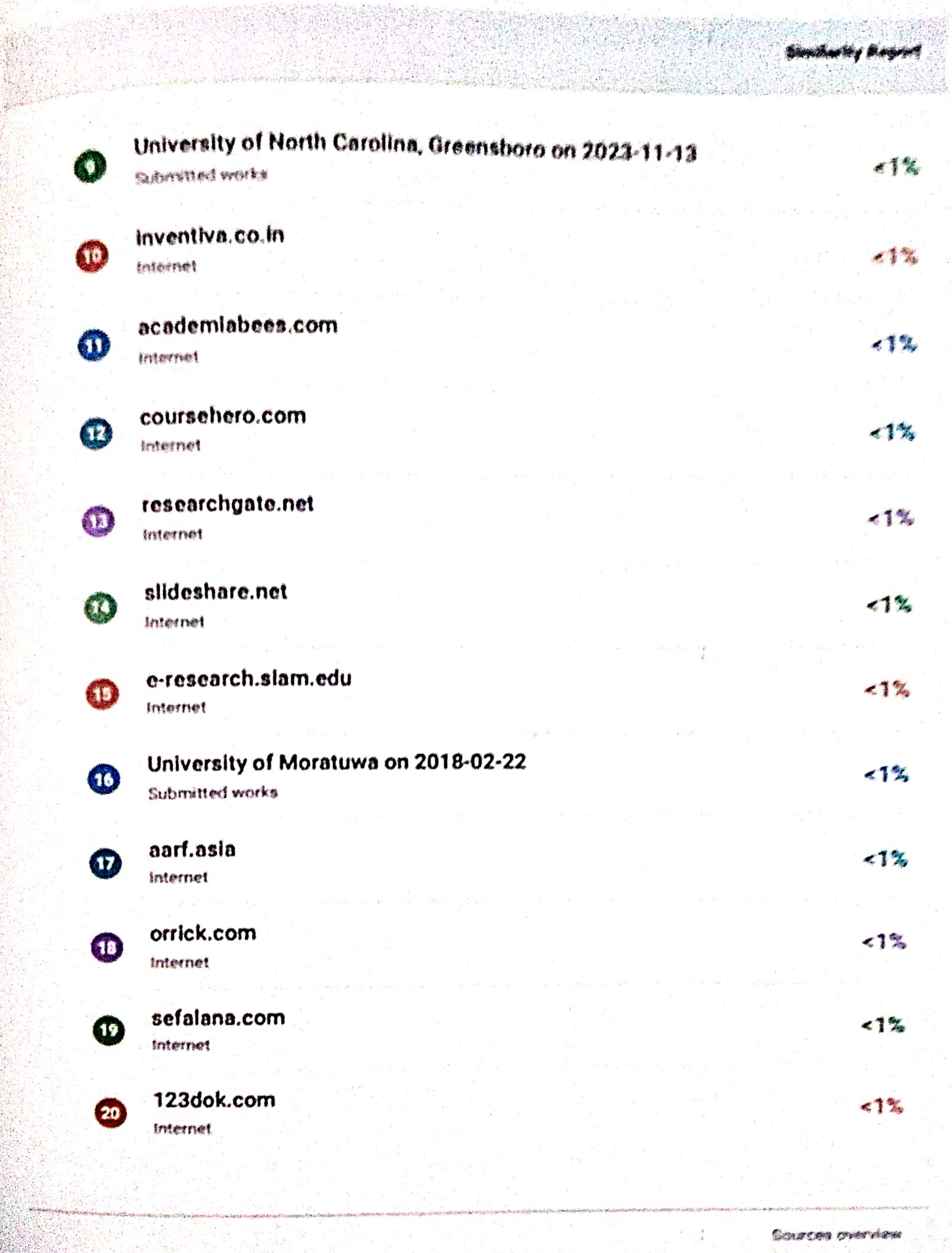

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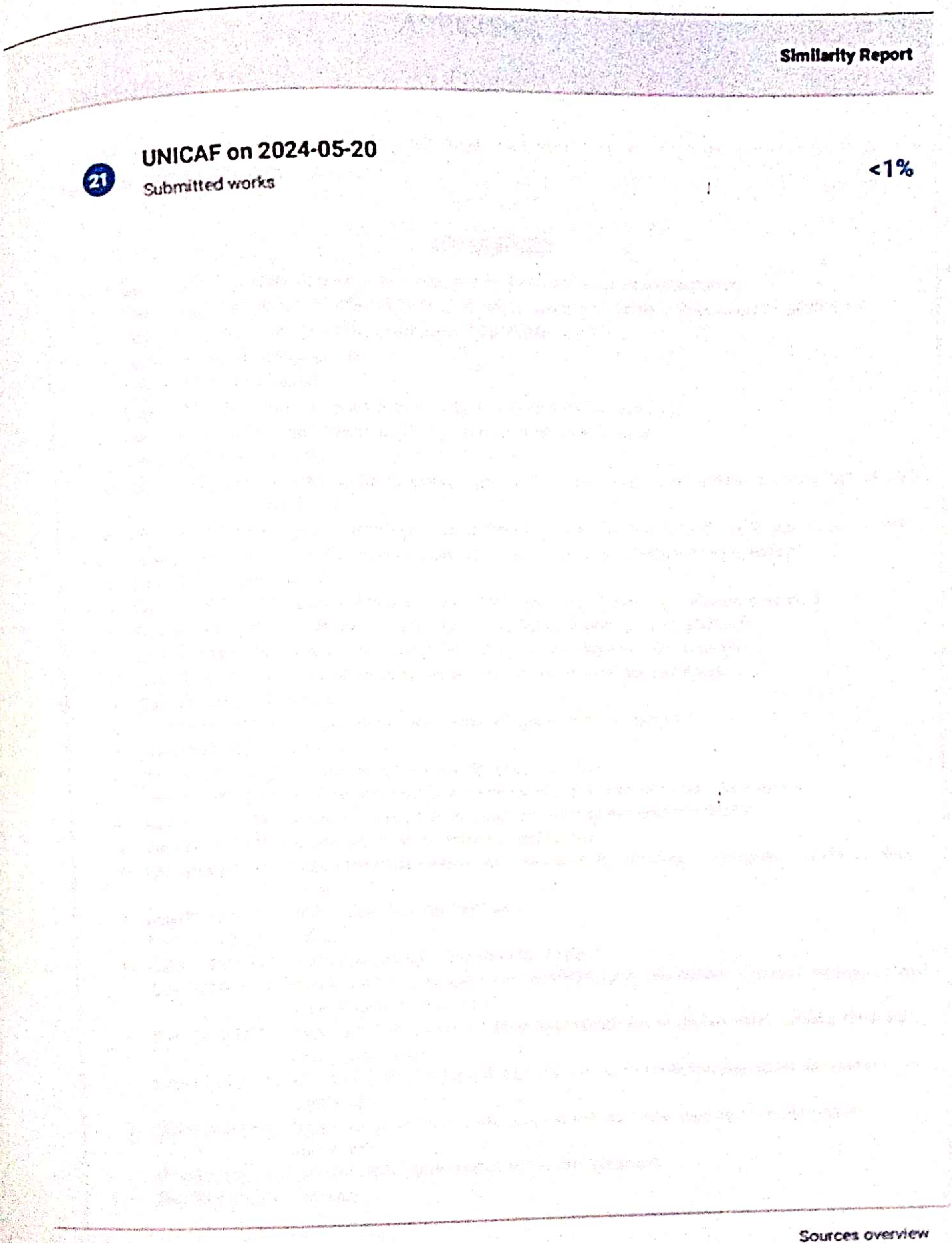

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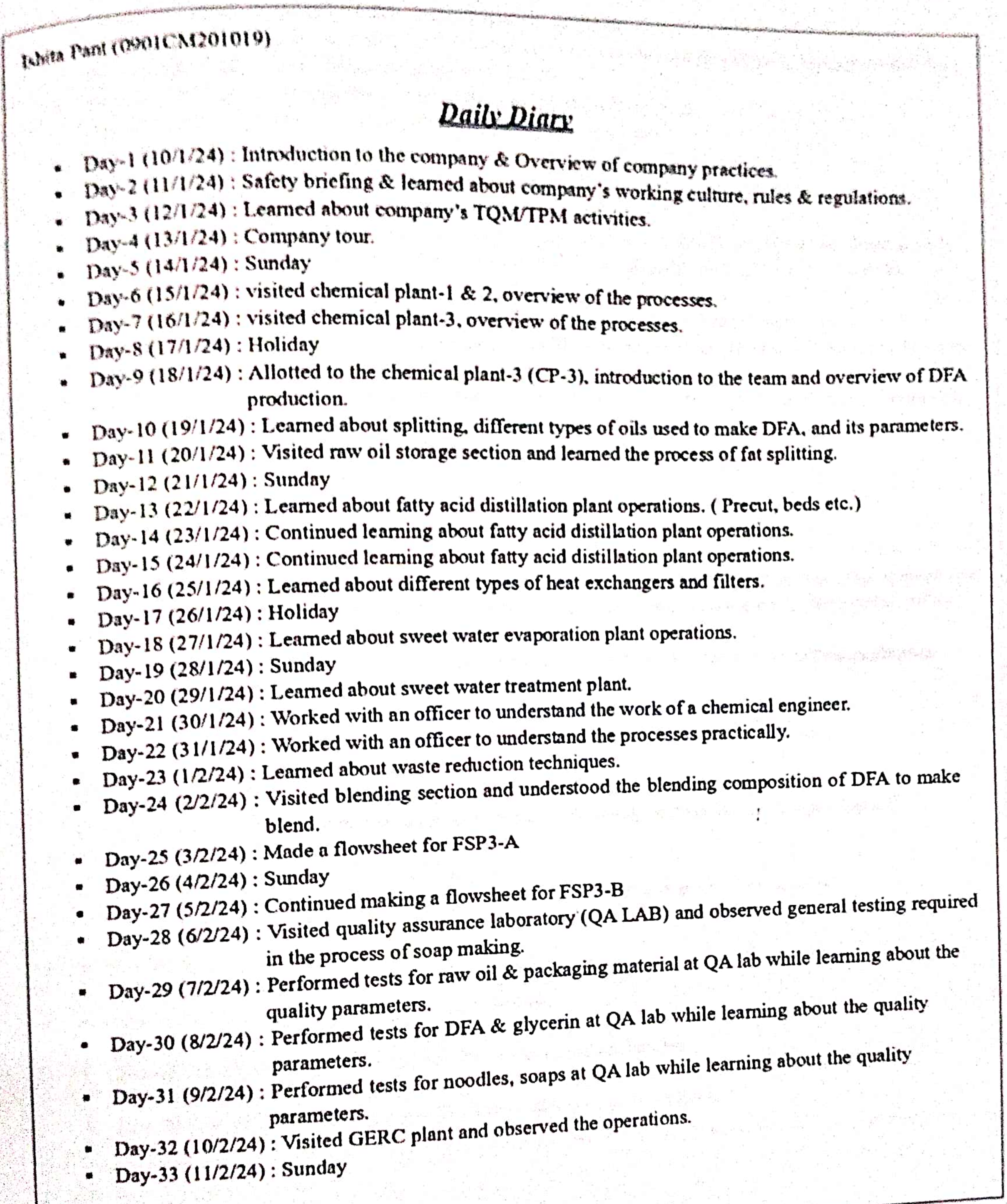
APPENDIX

- Daily Diary



Ishita Pant (0901CM201019)

Daily Diary

- Day-1 (10/1/24) : Introduction to the company & Overview of company practices.
- Day-2 (11/1/24) : Safety briefing & learned about company's working culture, rules & regulations.
- Day-3 (12/1/24) : Learned about company's TQM/TPM activities.
- Day-4 (13/1/24) : Company tour.
- Day-5 (14/1/24) : Sunday
- Day-6 (15/1/24) : visited chemical plant-1 & 2, overview of the processes.
- Day-7 (16/1/24) : visited chemical plant-3, overview of the processes.
- Day-8 (17/1/24) : Holiday
- Day-9 (18/1/24) : Allotted to the chemical plant-3 (CP-3), introduction to the team and overview of DFA production.
- Day-10 (19/1/24) : Learned about splitting, different types of oils used to make DFA, and its parameters.
- Day-11 (20/1/24) : Visited raw oil storage section and learned the process of fat splitting.
- Day-12 (21/1/24) : Sunday
- Day-13 (22/1/24) : Learned about fatty acid distillation plant operations. (Precut, beds etc.)
- Day-14 (23/1/24) : Continued learning about fatty acid distillation plant operations.
- Day-15 (24/1/24) : Continued learning about fatty acid distillation plant operations.
- Day-16 (25/1/24) : Learned about different types of heat exchangers and filters.
- Day-17 (26/1/24) : Holiday
- Day-18 (27/1/24) : Learned about sweet water evaporation plant operations.
- Day-19 (28/1/24) : Sunday
- Day-20 (29/1/24) : Learned about sweet water treatment plant.
- Day-21 (30/1/24) : Worked with an officer to understand the work of a chemical engineer.
- Day-22 (31/1/24) : Worked with an officer to understand the processes practically.
- Day-23 (1/2/24) : Learned about waste reduction techniques.
- Day-24 (2/2/24) : Visited blending section and understood the blending composition of DFA to make blend.
- Day-25 (3/2/24) : Made a flowsheet for FSP3-A
- Day-26 (4/2/24) : Sunday
- Day-27 (5/2/24) : Continued making a flowsheet for FSP3-B
- Day-28 (6/2/24) : Visited quality assurance laboratory (QA LAB) and observed general testing required in the process of soap making.
- Day-29 (7/2/24) : Performed tests for raw oil & packaging material at QA lab while learning about the quality parameters.
- Day-30 (8/2/24) : Performed tests for DFA & glycerin at QA lab while learning about the quality parameters.
- Day-31 (9/2/24) : Performed tests for noodles, soaps at QA lab while learning about the quality parameters.
- Day-32 (10/2/24) : Visited GERC plant and observed the operations.
- Day-33 (11/2/24) : Sunday

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- Day-34 (12/2/24) : Project assigned by mentor to perform material balance for a splitter of FSP-3. Learned about material balance.
- Day-35 (13/2/24) : Attended a safety training session for freshers.
- Day-36 (14/2/24) : Again, worked with the operators to understand the processes & operations of CP-3.
- Day-37 (15/2/24) : Continued learning material balance
- Day-38 (16/2/24) : Collected data required to perform material balance.
- Day-39 (17/2/24) : Started doing mass balance with mentor's help.
- Day-40 (18/2/24) : Sunday
- Day-41 (19/2/24) : Continued doing material balance.
- Day-42 (20/2/24) : Continued doing material balance.
- Day-43 (21/2/24) : CP-3 plant shutdown because a vacuum line collapsed. Observed the situation and became the part of the team to do root cause analysis (RCA) for the situation.
- Day-44 (22/2/24) : Learned about root cause analysis and assisted the team.
- Day-45 (23/2/24) : Continued working on the RCA of the collapsing of the vacuum line.
- Day-46 (24/2/24) : Continued working on the RCA of the collapsing of the vacuum line & found the cause.
- Day-47 (25/2/24) : Sunday
- Day-48 (26/2/24) : Completed material balance and shown to the mentor, made correction as suggested.
- Day-49 (27/2/24) : Visited old soap manufacturing plant and observed the processes.
- Day-50 (28/2/24) : Studied about different types of machinery used in soap plant.
- Day-51 (29/2/24) : Studied about different types of machinery used in soap plant.
- Day-52 (1/3/24) : Learned the process of making soap.
- Day-53 (2/3/24) : Observed finishing line and collected data about total waste.
- Day-54 (3/3/24) : Sunday
- Day-55 (4/3/24) : Cleared some queries about the waste production and deduction, and other queries too.
- Day-56 (5/3/24) : Visited new soap plant, which is fully automated unlike the old plant, observed the processes and differences.
- Day-57 (6/3/24) : Continued observing and understanding the plant process as its little complicated.
- Day-58 (7/3/24) : Learned about bar feel and studied about that.
- Day-59 (8/3/24) : Celebration of women's day in the company, attended the event.
- Day-60 (9/3/24) : worked in QA Lab to find reason behind bar feel, performed tests.
- Day-61 (10/3/24) : Sunday
- Day-62 (11/3/24) : continued working in the laboratory.
- Day-63 (12/3/24) : Reported the progress to my mentor and given viva for the things I learned.
- Day-64 (13/3/24) : On leave due to fever.
- Day-65 (14/3/24) : On leave due to fever.
- Day-66 (15/3/24) : Learned about the reason behind bar feel and some of its solution.
- Day-67 (16/3/24) : Mentor told to perform energy balance on heat exchanger.
- Day-68 (17/3/24) : Sunday
- Day-69 (18/3/24) : Leave due to flovol hiring drive at college.
- Day-70 (19/3/24) : Started learning energy balance.
- Day-71 (20/3/24) : continued learning energy balance.
- Day-72 (21/3/24) : Collected data and started doing energy balance.
- Day-73 (22/3/24) : Showed energy balance to mentor. Today also visited water treatment plant.
- Day-74 (23/3/24) : Learned about safety valves and setting in the plant.

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- Day-75 (24/3/24) : Sunday
- Day-76 (25/3/24) : Holiday
- Day-77 (26/3/24) : Mentor assigned to do another energy balance on heat exchanger used for cooling.
- Day-78 (27/3/24) : collected data and started doing the energy balance.
- Day-79 (28/3/24) : Did an energy balance and showed to the mentor.
- Day-80 (29/3/24) : Holiday
- Day-81 (30/3/24) : On leave due to personal reasons.
- Day-82 (31/3/24) : Sunday
- Day-83 (1/4/24) : Mentor told to perform energy balance on FSP-3.
- Day-84 (2/4/24) : Collected information required to perform energy balance.
- Day-85 (3/4/24) : Collected required data from the operators.
- Day-86 (4/4/24) : Tried to perform energy balance and asked mentor for help.
- Day-87 (5/4/24) : Collected more data required for the energy balance and aske some queries.
- Day-88 (6/4/24) : Continued doing energy balance.
- Day-89 (7/4/24) : Sunday
- Day-90 (8/4/24) : Continued doing energy balance.
- Day-91 (9/4/24) : Showed the completed energy balance to mentor and made suggested corrections.
- Day-92 (10/4/24) : Worked in QA lab and learned rest of the test on soap.
- Day-93 (11/4/24) : Holiday
- Day-94 (12/4/24) : Performed test for free alkali and fatty acids, for % of glycerin in soap.
- Day-95 (13/4/24) : Performed test for alcohol insoluble matter, and total fatty matter in soap.
- Day-96 (14/4/24) : Sunday
- Day-97 (15/4/24) : Determined moisture content of soap in lab and cleared some queries related to previous test.
- Day-99 (16/4/24) : Performed test for salt % in soap and iron content in soap.
- Day-100 (17/4/24) : Holiday
- Day-101 (18/4/24) : Leave due to personal reasons till 25 april'24.
- Day-102 (19/4/24) : On leave
- Day-103 (20/4/24) : On leave
- Day-104 (21/4/24) : Sunday
- Day-105 (22/4/24) : On leave
- Day-106 (23/4/24) : On leave
- Day-107 (24/4/24) : On leave
- Day-108 (25/4/24) : On leave
- Day-109 (26/4/24) : Leave due to TCS NQT.
- Day-110 (27/4/24) : Leave due to NPTEL exam.
- Day-111 (28/4/24) : Sunday
- Day-112 (29/4/24) : Leave due to mid-evaluation of the internship in college.
- Day-113 (30/4/24) : Cleared my queries related to chemical plant-3.
- Day-114 (1/5/24) : Started working on the report to be submitted in the company.
- Day-115 (2/5/24) : Worked on the report.
- Day-116 (3/5/24) : Worked on the report.
- Day-117 (4/5/24) : Worked on the report.
- Day-118 (5/5/24) : Sunday

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FORTNIGHTLY PROGRESS REPORT (FPR) FROM INDUSTRY MENTOR

Name of student	Istita Pant		Department	chemical	
Industry/Organization	Godrej Consumer products limited		Date/Duration	10th Jan,24 - 24th Jan 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	- overview of MFG Process - General awareness about Archy.				
OVERALL GRADE (Any one)	**POOR/AVERAGE/GOOD/[✓ VERY GOOD]/EXCELLENT**				
Name of Industry Mentor	HAMID ALI				
Signature of Industry Mentor					

Receiving Date	26/1/24	**Name of Faculty Mentor**	Rakesh kumar Dubey	**Sign**	for

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FORTNIGHTLY PROGRESS REPORT (FPR) FROM INDUSTRY MENTOR

Name of student	Ishita Pant		Department	Chemical	
Industry/Organization	Godrej Consumer products limited		Date/Duration	25/1/24 - 8/2/24	
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	- Learning TPM / TQM activities - Learning of other support activities				
OVERALL GRADE (Any one)	**POOR/AVERAGE/GOOD/[✓ VERY GOOD]/EXCELLENT**				
Name of Industry Mentor	HAMID ALI				
Signature of Industry Mentor					

Receiving Date	10/2/24	**Name of Faculty Mentor**	Rakesh Kumar Dubey	**Sign**	for

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FORTNIGHTLY PROGRESS REPORT (FPR) FROM INDUSTRY MENTOR

Name of student	Ishita Pant	Department	Chemical
Industry/Organization	Godrej Consumer Products Limited	Date/Duration	9/2/24 - 23/2/24

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	Learned about Fat splitting operations
OVERALL GRADE (Any one)	**POOR/AVERAGE/GOOD/[✓ VERY GOOD]/EXCELLENT**
Name of Industry Mentor	Sanjay Nath Mathur
Signature of Industry Mentor	

Receiving Date	25/2/24	**Name of Faculty Mentor**	Dr. Saurabh Singh Raghuwanshi	**Sign**	

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FORTNIGHTLY PROGRESS REPORT (FPR) FROM INDUSTRY MENTOR

Name of student	Ishita Pant		Department	Chemical	
Industry/Organization	Godrej Consumer Products Limited		Date/Duration	24/2/24-9/3/24	
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	Learnt about operations of Fatty acid distillation plant				
OVERALL GRADE (Any one)	**POOR/AVERAGE/GOOD/[✓ VERY GOOD]/EXCELLENT**				
Name of Industry Mentor	Sanjay Nath Mathur				
Signature of Industry Mentor					

Receiving Date	11/3/24	**Name of Faculty Mentor**	Dr. Saurabh Singh Raghuwanshi	**Sign**	

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FORTNIGHTLY PROGRESS REPORT (FPR) FROM INDUSTRY MENTOR

Name of student	Ishita Pant		Department	Chemical	
Industry/Organization	Godrej Consumer Products Limited		Date/Duration	10/3/24 - 24/3/24	
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	Learnt about quality parameter				
OVERALL GRADE (Any one)	**POOR/AVERAGE/GOOD/[✓ VERY GOOD]/EXCELLENT**				
Name of Industry Mentor	Sanjay Nath Mathur				
Signature of Industry Mentor					

Receiving Date	26/3/24	**Name of Faculty Mentor**	Dr. Sourabh Singh Raghuvanshi	**Sign**	

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FORTNIGHTLY PROGRESS REPORT (FPR) FROM INDUSTRY MENTOR

Name of student	Ikshita Pant		Department	Chemical	
Industry/Organization	Godrej Consumer Products Limited		Date/Duration	25/3/24 - 8/4/24	
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	Done mass balance of Fat splitting plant				
OVERALL GRADE (Any one)	**POOR/AVERAGE/GOOD/[✓ VERY GOOD]/EXCELLENT**				
Name of Industry Mentor	Sanjay Nath Mathur				
Signature of Industry Mentor					

Receiving Date	10/4/24	**Name of Faculty Mentor**	Dr. Shaurabh Singh Raghuwanshi	**Sign**	

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FORTNIGHTLY PROGRESS REPORT (FPR) FROM INDUSTRY MENTOR

Name of student	Ishita Pant		Department	Chemical	
Industry/Organization	Godrej Consumer Products Ltd		Date/Duration	9/4/24 - 23/4/24	
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	Learnt about operations of Sweet water treatment plant				
OVERALL GRADE (Any one)	**POOR/AVERAGE/GOOD/[✓ VERY GOOD]/EXCELLENT**				
Name of Industry Mentor	Sanjay Nath Mathur				
Signature of Industry Mentor					

Receiving Date	25/4/24	**Name of Faculty Mentor**	Dr. Shaurabh Singh Raghuwanshi	**Sign**	

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FORTNIGHTLY PROGRESS REPORT (FPR) FROM INDUSTRY MENTOR

Name of student	Ishita Pant		Department	Chemical	
Industry/Organization	Godrej Consumer Products Limited		Date/Duration	29/4/24 - 8/5/24	
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	Learnt about manufacturing of soap				
OVERALL GRADE (Any one)	**POOR/AVERAGE/[✓ GOOD]/VERY GOOD/EXCELLENT**				
Name of Industry Mentor	Sanjay Nath Mathur				
Signature of Industry Mentor					

Receiving Date	10/5/24	**Name of Faculty Mentor**	Dr. Shourabh Singh Raghuwanshi	**Sign**	