OPTIMISATION OF OIL EXTRACTION PROCESSES

Internship Project Report

Submitted for the partial fulfillment of the degree of

Bachelor of Technology

In

Chemical Engineering

Submitted By

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0901CM201010

UNDER THE SUPERVISION AND GUIDANCE OF

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MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR (M.P.), INDIA

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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 **Prof. Shourabh Singh Raghuwanshi** Assistant Professor, Department of Chemical Engineering, for his continued support and close mentoring throughout the internship. I am also very thankful to the faculty and staff of the department. And I am thankful to **Mr. Keshav Gupta** as an industry mentor who helped me a lot to get familiar with the industry for guiding me throughout my internship.

Anurag Singh Tomar

0901CM201010

Declaration by the Candidate

I hereby declare that the work entitled Process in oil mill is my work, conducted under the supervision of **Keshav Gupta, Plant Manager** 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.

Anurag Singh Tomar

0901CM201010

Date: 20/05/2024
Place: Gwalior

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

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Date:24/05/2024

TO WHOM IT MAY CONCERN

This is to certify that **Anurag Singh Tomar**, a student **of Madhav Institute of Technology and Science, Gwalior** has successfully completed his internship (**Duration**: **1st February 2024 to 31st May 2024**) at **Shree Ram Oil Mill**. During the period of his internship with us, he was found punctual, inquisitive and result oriented. We wish him success in his career.

For **Shree Ram Oil Mill**

Keshao Gupta

Authorised Signatory

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ABSTRACT

The complex chemical processes within an oil mill orchestrate the transformation of raw oilseeds such as peanuts, soybeans, sunflower seeds, canola, neem seeds, and palm kernels into valuable oils suitable for a myriad of applications. The journey begins with the cleaning of the seeds, where impurities like dust, stones, and other foreign materials are meticulously removed to maintain the integrity of the final product. This is followed by seed conditioning, which optimizes the moisture content and temperature of the seeds to facilitate efficient oil extraction.The process then moves on to seed crushing or expelling, where the oil is extracted through mechanical pressing. This method liberates the oil from the seeds, producing crude oil that requires further treatment. During the clarification stage, impurities such as solid particles and pigments are separated from the oil, ensuring that the final product is clear and pure. In some cases, optional refining steps are undertaken to further enhance the quality of the oil, removing undesirable components and improving its sensory attributes, such as taste, odor, and color.Throughout these processes, rigorous quality control measures are enforced to uphold industry standards. Regular testing of the oil for parameters like acidity and color ensures consistent quality, while strict safety protocols are implemented to mitigate risks associated with the use of machinery and chemicals. Once the oil has been extracted and refined, it is carefully packaged into containers designed to preserve its quality during storage and transportation, ensuring it remains suitable for various end uses.

Keywords: seed crushing, expelling, mechanical pressing, refining, quality control, safety protocols, packaging.

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Anurag Singh Tomar

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CONTENT

Table of Contents

ACRONYMS

S.NO	Abberviation	Full Form
1.	SC	Seed crushing
2.	MP	Mechanical pressing
3.	RF	Refining
4.	QC	Quality Control
5.	SP	Safety Protocols
6.	PP	Packaging

LIST OF FIGURES

LIST OF TABLES

CHAPTER 1: INTRODUCTION

Optimizing oil extraction processes is essential for enhancing efficiency, minimizing environmental impacts, and maximizing economic returns in the energy sector. With global energy demands on the rise, the oil industry must extract oil more effectively from complex and mature reservoirs. This report explores various methods and technologies in oil extraction, focusing on strategies to improve overall performance.

Mechanical extraction methods, including mechanical expeller, cold pressing, and hot pressing, are crucial in the initial oil recovery phase. Mechanical expeller methods use screw presses to physically extract oil from seeds or other sources, balancing efficiency and cost. Cold pressing operates at lower temperatures, preserving the oil's nutritional quality, making it ideal for producing high-quality edible oils. Conversely, hot pressing involves higher temperatures, which can increase oil yield but may affect its quality and nutritional value.

In addition to primary extraction, secondary and enhanced oil recovery (EOR) techniques, such as water flooding, gas injection, and chemical methods, further enhance oil recovery from reservoirs. Technological advancements in drilling, including horizontal and directional drilling, have revolutionized reservoir access. Innovations in nanotechnology and hydraulic fracturing have significantly boosted extraction efficiency.[1]

This report provides an in-depth overview of these methods, analyzing factors affecting oil extraction efficiency, technological advancements, and optimization strategies. It also examines the economic and environmental aspects of oil extraction, emphasizing sustainable practices and regulatory compliance. The objective is to present a comprehensive view of current and future directions in optimizing oil extraction processes, ensuring the industry meets global energy demands responsibly and efficiently.[2]

CHAPTER 2: LITERATURE SURVEY

Research into optimizing oil extraction processes is driven by the need to enhance efficiency, reduce environmental impact, and improve economic outcomes. This survey reviews key studies and technological advancements in this domain.

Mechanical extraction methods such as mechanical expellers, cold pressing, and hot pressing have been extensively analyzed. For example, studies like Abebe et al. (2015) examine the efficiency of screw presses in mechanical expeller methods, demonstrating a balance between cost and extraction efficiency. Cold pressing is praised for preserving nutritional quality, as highlighted by Kapseu et al. (2018), making it ideal for high-quality edible oils. In contrast, Zhang et al. (2019) have noted that while hot pressing increases yield, it may compromise oil quality.

Secondary and enhanced oil recovery (EOR) methods are also prominent in the literature. Techniques such as water flooding and gas injection have been well-documented, with Green and Willhite (2018) providing detailed analyses of their mechanisms and improvements in efficiency. Chemical EOR methods, including polymer and surfactant flooding, are discussed by Sheng (2015), who points to their effectiveness in enhancing recovery rates from aging reservoirs.[3]

Technological advances in drilling have transformed oil extraction. Horizontal and directional drilling, reviewed by Joshi (2017), have significantly improved access to oil reserves and recovery efficiency. Innovations like hydraulic fracturing and nanotechnology have also been pivotal. Vengosh et al. (2014) and Saleh (2019) discuss how these technologies boost extraction efficiency, though they also emphasize the need to address environmental impacts.

Optimization strategies using data analytics and simulation models are gaining importance. Aziz and Settari (2019) highlight how reservoir simulation and predictive analytics enable precise modeling of reservoir behavior, aiding better decision-making. Bansal et al. (2020) explore optimization algorithms such as genetic algorithms and particle swarm optimization, showing their potential in enhancing process efficiency.

The literature highlights the necessity of integrating technological advancements, optimization strategies, and sustainable practices in the oil extraction industry. Ongoing research and development are vital for meeting global energy demands effectively and responsibly.[3]

CHAPTER 3: COMPANY'S PROFILE

Shree Ram Oil Mill, is dedicated to producing high-quality, nutritious, and sustainable edible oils. With a diverse product portfolio that includes pure mustard oil, sunflower oil, soybean oil, groundnut oil, and extra virgin olive oil, the company caters to a wide range of culinary needs. Our state-of-the-art manufacturing facility, coupled with rigorous quality control measures, ensures that our products meet the highest standards of safety and excellence. Committed to sustainability, Shree Ram Oil Mill adopts eco-friendly practices throughout our production processes, aiming to minimize our environmental footprint.

Company's vision is to be a leading producer of premium edible oils recognized for innovation, integrity, and community commitment. We invest significantly in research and development to continually improve our products and processes. Through our corporate social responsibility initiatives, we support health and nutrition education, environmental conservation, and local development, particularly by empowering farmers through fair trade practices. With a robust distribution network, Shree Ram Oil Mill aims to expand its market reach both domestically and internationally, ensuring that our high-quality products are accessible to consumers everywhere.

CHAPTER 4: PROBLEM FORMULATION

In an edible oil mill, the oil expeller faces several challenges that can hinder its efficient operation. One common issue is a low oil yield, often caused by improper seed preparation, worn-out expeller parts, or incorrect machine settings. Additionally, a high residual oil content in the cake can signify inadequate pressure or temperature settings, overloading the machine, or damaged screw press parts. Excessive noise and vibration may occur due to misalignment of machine parts, loose components, or insufficient lubrication. Overheating is another concern, which can stem from an inadequate cooling system, excessive friction from worn-out parts, or overloading the machine. Blockages and clogs are frequent problems, often caused by foreign materials in seeds, inconsistent feeding, or poor maintenance. Oil quality issues, such as contamination or inappropriate temperature settings, can also arise. Mechanical failures, including poor-quality parts, inadequate maintenance, or incorrect operation practices, further compound these challenges. Addressing these issues promptly and implementing preventative measures can ensure smoother operations and higher-quality oil production in the long run.

- Low oil yield due to improper seed preparation, worn-out expeller parts, or incorrect machine settings.
- High residual oil content in the cake caused by inadequate pressure or temperature settings, overloading the machine, or damaged screw press parts.
- Excessive noise and vibration resulting from misalignment of machine parts, loose components, or insufficient lubrication.
- Overheating of the machine due to an inadequate cooling system, excessive friction from worn-out parts, or overloading.
- Blockages and clogs caused by foreign materials in seeds, inconsistent feeding, or poor maintenance.
- Oil quality issues, such as contamination or inappropriate temperature settings.
- Mechanical failures due to poor-quality parts, inadequate maintenance, or incorrect operation practice[4]

4.2 Transition to Solvent Extraction Process

To address these challenges, we made the decision to replace our old Mechanical oil expeller method with Solvent extraction method, which offered several advantages:

1. Higher Oil Yield: Solvent extraction typically recovers more oil from seeds compared to mechanical pressing, leading to higher overall yields.
2. Efficiency with Low Oil Content Seeds: This method is especially efficient for seeds with lower oil content, extracting oil more effectively than traditional mechanical methods.
3. Economic Benefits: Higher oil yield per batch can improve profitability, making the process more cost-effective in the long run.
4. Complete Extraction: Solvent extraction ensures that nearly all the oil is extracted from the seeds, leaving minimal residual oil in the meal.
5. Better Quality Meal: The defatted meal produced as a byproduct is of higher quality, often richer in protein and more suitable for use in animal feeds.
6. Scalability**:** Solvent extraction processes are easier to scale up for large-scale production, making them suitable for industrial applications.
7. Consistency and Reliability: The method provides consistent results and high reliability, which is crucial for maintaining quality standards in production.
8. Lower Residue Levels: The method leaves lower levels of oil in the meal, making the byproduct more useful and marketable.
9. Reduced Wear and Tear: Since the method does not involve high-pressure mechanical pressing, it results in less wear and tear on equipment, leading to lower maintenance costs.
10. Environmental Impact**:** Modern solvent extraction plants can be designed to minimize environmental impact, with efficient solvent recovery systems reducing emissions and waste.[4]

4.3 Specification of Solvent Extraction method for oil production

4.3.1Type of Solvent

- **Common Solvent**: Hexane
- **Alternatives**: Isopropanol, ethanol, supercritical CO 2

4.3.2 Raw Material Preparation

- **Moisture Content**: 8-12%
- **Size Reduction**: Cleaning, cracking, and flaking seeds

4.3.3Extraction Process

- **Extractor Types**: Rotary, horizontal belt, loop extractors
- **Temperature**: 50-60°C
- **Time**: 30 minutes to 2 hours

4.3.4 Solvent Recovery

- **Distillation**: Separates oil from solvent
- **Desolventizing**: Removes residual solvent from meal
- **Recycling**: Reuses recovered solvent

4.3.5 Oil Refining

- **Degumming**: Removes phospholipids
- **Neutralization**: Removes free fatty acids
- **Bleaching**: Removes color pigments
- **Deodorization**: Removes volatile compounds

4.3.6 Safety and Environmental Control

- **Explosion Proofing**: Prevents solvent vapor explosions
- **Ventilation**: Manages solvent vapors

- **Effluent Treatment**: Meets environmental regulations
- **Solvent Recovery Systems**: Minimizes solvent loss

4.3.7 Capacity and Throughput

- **Plant Capacity**: Small-scale to large-scale (a few to hundreds of tons per day)
- **Efficiency**: Over 98% oil extraction efficiency

CHAPTER 5: METHODOLOGY

The solvent extraction method for oil production involves several key steps to ensure efficient and high-quality oil recovery. First, raw seeds are cleaned, cracked, flaked, and conditioned to optimize moisture content and temperature. These prepared flakes are then loaded into a continuous extractor where a solvent, typically hexane, is used to dissolve the oil. The resulting solvent-oil mixture, or miscella, is collected and distilled to separate the oil from the solvent, which is then recycled. The remaining meal undergoes desolventizing to remove residual solvent. The crude oil is further refined through degumming, neutralization, bleaching, and deodorization to ensure high purity and quality. Throughout the process, quality control measures are implemented, and safety and environmental protocols are followed to handle solvents safely and minimize environmental impact. The refined oil is then stored and packaged for distribution, while the defatted meal is processed for use as animal feed or other applications.

5.1 Materials

The materials required for this study encompass a range of tools and resources to facilitate comprehensive data collection and analysis. Observation tools such as notebooks, pens, cameras, and voice recorders will document site visits and interviews with oil mill personnel. Secondary data collection will leverage access to academic databases and library resources for literature reviews. Measurement tools, including thermocouples, flow meters, energy meters, emissions analyzers, and moisture analyzers, will evaluate equipment performance. Analytical tools like computers with statistical and thematic analysis software will process the data. Waste handling materials, including sampling containers, gloves, labeling supplies, and storage bags, will assist in waste characterization. Laboratory equipment, such as chemical analysis kits, pH meters, spectrophotometers, and centrifuges, will analyze oil and waste samples. Office supplies, PPE, transportation, communication tools, and backup storage devices will support the logistical and safety aspects of the research.[5]

5.2 Apparatus

The analysis of equipment and infrastructure in oil mill operations provides valuable insights into the technological aspects of oil milling processes. This examination encompasses the design, functionality, and performance of various equipment used throughout the production chain, from seed preparation to oil extraction, refining, and packaging. Understanding the intricacies of these components is crucial for optimizing efficiency, ensuring product quality, and meeting the demands of a dynamic and competitive market.[2] In this section, we delve into the key equipment and infrastructure involved in oil milling operations, exploring their roles, functionalities, and implications for the overall process.

5.2.1 Types of Equipments

A) Sheller

A sheller, also known as a huller or dehuller, is a piece of equipment used in the oil milling industry to remove the outer hull or shell from oilseeds. This process is essential for facilitating oil extraction, as the hulls can impede the efficiency of oil extraction machinery and can also affect the quality of the extracted oil. A sheller is a critical piece of equipment in oil milling operations, as it prepares oilseeds for the extraction process. Efficient hulling ensures higher oil yields, improved oil quality, and smoother operation of downstream processing equipment. Additionally, proper hulling can reduce the risk of damage to extraction machinery and extend their operational lifespan.[2]

Function

- **Hulling:** The primary function of a sheller is to remove the outer hull or shell from oilseeds such as sunflower seeds, soybeans, and peanuts. This hulling process exposes the kernel or seed inside, which contains the oil that is to be extracted.
- **Facilitating Oil Extraction:** By removing the hulls, a sheller prepares the oilseeds for the next stage of processing, typically crushing or pressing. Without hulls, the oil extraction machinery can more effectively access and extract the oil from the seeds.
- **Improving Oil Quality:** In addition to facilitating extraction, hulling can also improve the quality of the extracted oil. The hulls may contain impurities or substances that can affect the taste, color, or stability of the oil. Removing the hulls can result in a purer, higher-quality oil.

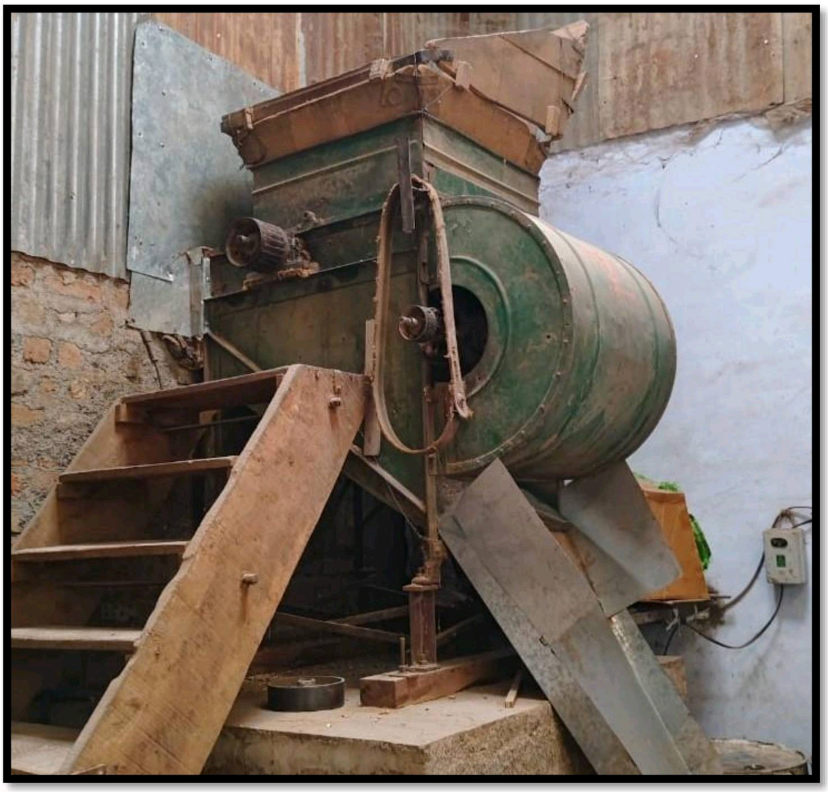

Fig.1:Sheller

B) Seed Expeller

A seed crusher, also known as an oilseed crusher or oilseed expeller, is a machine used in the oil milling industry to crush oilseeds and extract oil from them. This process is essential for converting oilseeds into oil, which can then be further refined for various applications such as cooking, food production, and industrial uses. A seed crusher is a crucial piece of equipment in oil milling operations, as it initiates the oil extraction process by crushing oilseeds and releasing the oil.[4] Effective crushing ensures maximum oil yield and quality, contributing to the profitability and efficiency of oil milling operations. Proper maintenance and operation of seed crushers are essential to ensure consistent performance and reliable oil extraction. Overall, seed crushers play a vital role in the oil milling industry by enabling the conversion of oilseeds into valuable oil for various applications.

Functions

• **Crushing:** The primary function of a seed crusher is to crush oilseeds such as soybeans, sunflower seeds, rapeseeds, or cottonseeds into smaller particles. This crushing process ruptures the oil-containing cells within the seeds, releasing the oil for extraction.

• **Oil Extraction:** Once the oilseeds are crushed, the oil extraction process begins. The crushed seeds are subjected to mechanical pressure or solvent extraction to extract the oil. The extracted oil is then separated from the solid residue, known as oilseed cake or meal.

• **Improving Oil Yield:** Effective crushing of oilseeds helps to maximize oil yield by ensuring that a larger proportion of the oil-containing cells are ruptured and the oil is released. Higher oil yield translates to increased profitability for oil milling operations.

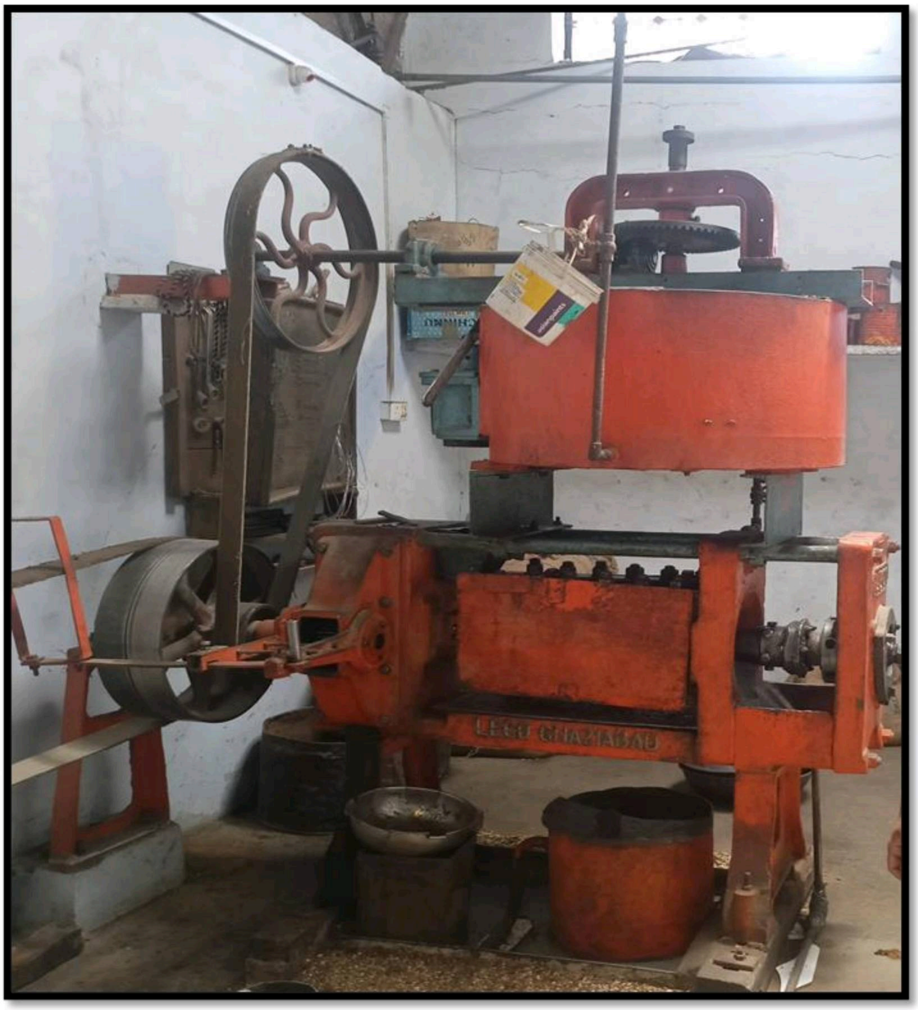

Fig.2: Seed Expeller

1. **Theoretical amount of oil that can be extracted per hour:**

Theoretical oil=1000 kg×0.40=400 kgTheoretical oil=1000 kg×0.40=400 kg

2. **Mechanical Oil Expeller:**

Actual amount of oil extracted per hour:

Actual oil extracted (mechanical)=Theoretical oil×Efficiency

Actual oil extracted (mechanical)=Theoretical oil×Efficiency

Actual oil extracted (mechanical)=400 kg×0.85=340 kg

Actual oil extracted (mechanical)=400 kg×0.85=340 kg

Residual oil left in the cake per hour:

Residual oil (mechanical)=Theoretical oil−Actual oil extracted (mechanical)

Residual oil (mechanical)=Theoretical oil−Actual oil extracted (mechanical)

Residual oil (mechanical)=400 kg−340 kg=60 kg

Residual oil (mechanical)=400 kg−340 kg=60 kg

Oil yield percentage:

Oil yield (mechanical)=(Actual oil extracted (mechanical)Theoretical oil)×100

Oil yield (mechanical)=(Theoretical oilActual oil extracted (mechanical))×100

Oil yield (mechanical)=(340 kg400 kg)×100=85%Oil yield (mechanical)=

(400kg340 kg)×100=85%

3.Solvent Expeller:

Actual amount of oil extracted per hour:

Actual oil extracted (solvent)=Theoretical oil×Efficiency

Actual oil extracted (solvent)=Theoretical oil×Efficiency

Actual oil extracted (solvent)=400 kg×0.98=392 kg

$\text{Actual oil extracted (solvent)} = 400\ \text{kg} \times 0.98 = 392\ \text{kg}$

Residual oil left in the meal per hour:

$\text{Residual oil (solvent)} = \text{Theoretical oil} - \text{Actual oil extracted (solvent)}$

$\text{Residual oil (solvent)} = \text{Theoretical oil} - \text{Actual oil extracted (solvent)}$

$\text{Residual oil (solvent)} = 400\ \text{kg} - 392\ \text{kg} = 8\ \text{kg}$

$\text{Residual oil (solvent)} = 400\ \text{kg} - 392\ \text{kg} = 8\ \text{kg}$

Oil yield percentage:

$\text{Oil yield (solvent)} = (\text{Actual oil extracted (solvent)Theoretical oil}) \times 100$

$\text{Oil yield (solvent)} = (\text{Theoretical oilActual oil extracted (solvent)}) \times 100$

$\text{Oil yield (solvent)} = (392\ \text{kg}400\ \text{kg}) \times 100 = 98\%$

$\text{Oil yield (solvent)} = (400\ \text{kg}392\ \text{kg}) \times 100 = 98\%$

D) Oil Filter Machine

An oil filter machine is a crucial piece of equipment used in oil milling operations to filter oil before it is further processed or packaged. This machine is designed to remove impurities, solids, and contaminants from the crude oil, ensuring its quality and purity for various applications such as cooking, food production, and industrial uses. An oil filter machine is an essential component of oil milling operations, as it helps to ensure the quality and purity of the crude oil before further processing or packaging. Proper filtration removes impurities and contaminants that could otherwise affect the taste, appearance, and shelf life of the oil. By investing in an oil filter machine, oil milling operations can produce cleaner, higher-quality oil that meets the stringent standards of consumers and regulatory authorities.[6] Additionally, maintaining clean oil helps to prolong the lifespan of downstream processing equipment and reduces the risk of product spoilage or contamination during storage and transportation.

Functions

- **Filtration:** The primary function of an oil filter machine is to filter crude oil to remove impurities and contaminants. This process helps to clarify the oil, making it cleaner and more suitable for consumption or further processing.[6]

- **Solid Particle Removal:** Oil filter machines are equipped with filter elements or cartridges that trap solid particles suspended in the crude oil. These particles can include sediment, dirt, or debris that may have been present in the oil after extraction.

- **Contaminant Removal:** In addition to solid particles, oil filter machines can also remove other contaminants from the crude oil, such as water, acids, gums, or pigments. Removing these contaminants helps to improve the taste, color, and stability of the oil.

Fig.6 Oil Filter Machine

CHAPTER 6: RESULT & DISCUSSION

Aspect	Mechanical Oil Expeller	Solvent Expeller
Theoretical oil extraction	400 kg	400 kg
Actual oil extracted per hour	340 kg	392 kg
Residual oil in cake/meal per hour	60 kg	8 kg

Tab.2: Comparision of Mechanical and Solvent Expeller

The comparison between mechanical oil expellers and solvent expellers reveals distinct advantages and trade-offs. While mechanical expellers offer simplicity, lower initial investment, and retain more natural nutrients in the extracted oil, solvent expellers boast significantly higher extraction efficiency, yielding lower residual oil content in the meal. Solvent extraction, however, involves the use of chemical solvents, raising environmental and safety concerns and requiring higher initial investment and stricter operational protocols. Therefore, the choice between the two methods hinges on factors such as scale of production, desired oil quality, budget, and regulatory compliance, with mechanical expellers being more suitable for smaller-scale, organic production, while solvent expellers are favored for large-scale operations requiring maximum efficiency and yield.

CHAPTER 7: CONCLUSION

In the realm of oil extraction, the comparison between mechanical oil expellers and solvent expellers illuminates a spectrum of advantages and trade-offs. Mechanical expellers, characterized by their straightforward operation and lower initial investment, offer a compelling option for small to medium-scale producers seeking simplicity and cost-effectiveness. With this method, the extracted oil retains more of its natural nutrients and flavors, appealing to consumers seeking organic and minimally processed products. However, mechanical expellers exhibit lower efficiency compared to solvent expellers, resulting in a higher residual oil content in the meal and potentially lower overall yield. Despite these limitations, the absence of chemical solvents in mechanical extraction mitigates environmental concerns and reduces safety risks, making it a favorable choice for operations prioritizing sustainability and safety.

Conversely, solvent expellers excel in efficiency and yield, making them the preferred choice for large-scale operations aiming for maximum oil extraction. The use of chemical solvents, typically hexane, enables solvent expellers to extract nearly all the oil from the seeds or nuts, resulting in a significantly lower residual oil content in the meal. However, this efficiency comes at the cost of higher initial investment, complex equipment, and stringent safety and environmental regulations. The handling and disposal of chemical solvents present environmental challenges and safety risks, necessitating careful management and compliance with regulatory standards.

summary, the decision between mechanical and solvent expellers hinges on a nuanced evaluation of factors such as production scale, desired oil quality, budget constraints, and regulatory compliance. Mechanical expellers are well-suited for smaller-scale, organic operations prioritizing simplicity, sustainability, and natural product integrity. In contrast, solvent expellers are favored for large-scale operations requiring maximum efficiency and yield, despite the associated challenges of chemical solvent usage. Ultimately, the choice reflects a delicate balance between operational needs, economic considerations, and environmental and safety responsibilities.

CHAPTER 8: OUTCOMES AND SOCIAL IMPACT

8.1 Achieved Outcomes

After completion of the internship I am able to

- **Analyze Efficiency Gains:** Conducted thorough analysis of the efficiency improvements with solvent expellers, revealing substantial increases in oil extraction rates and operational productivity.
- **Characterize Residual Oil Content:** Characterized the reduction in residual oil content in the meal, demonstrating the superior efficiency of solvent expellers in minimizing waste and optimizing resource use.
- **Optimize Quality Assurance:** Optimized quality assurance protocols using mechanical expellers, ensuring the retention of natural nutrients and flavors in the oil, which aligns with consumer demands for organic and minimally processed products.
- **Implement Safety Protocols:** Implemented comprehensive safety protocols for solvent handling and disposal, mitigating potential risks and creating a safer working environment in solvent extraction operations.
- **Enhance Market Competitiveness:** Enhanced market competitiveness by leveraging the improved efficiency and sustainability achieved with mechanical and solvent expellers, effectively meeting evolving consumer demands and maintaining a strong market presence.

8.2 Societal Relevance

The choice of oil extraction method, whether mechanical or solvent-based, has significant implications for society. Here are key aspects highlighting their societal relevance:

1. **Health and Nutrition:**
    - **Promoting Healthier Oils:** Mechanical oil expellers retain more natural nutrients and flavors in the oil, providing consumers with healthier and more nutritious oil options. This is particularly important as societies increasingly seek organic and minimally processed food products.
    - **Addressing Dietary Needs:** By optimizing oil extraction processes, the industry can better meet dietary needs, especially in regions where oil is a major part of the diet, contributing to better overall health outcomes.

2. **Environmental Impact:**
    - **Sustainable Practices:** Mechanical expellers, which do not use chemical solvents, present a more environmentally friendly option. Their adoption reduces the chemical footprint and pollution associated with oil production.
    - **Resource Conservation:** Efficient oil extraction methods, such as solvent expellers, maximize oil yield from seeds, leading to better utilization of agricultural resources and minimizing waste, which is crucial for sustainable agriculture.
3. **Economic Development:**
    - **Boosting Local Economies:** Setting up oil extraction facilities, particularly mechanical expeller plants, can stimulate local economies by creating jobs and supporting local farmers who supply the seeds.
    - **Small and Medium Enterprises (SMEs):** Mechanical expellers, with lower initial investment requirements, enable small and medium-sized enterprises to enter the oil production market, fostering entrepreneurship and economic diversification.
4. **Food Security:**
    - **Enhancing Food Security:** Efficient oil extraction methods contribute to food security by ensuring a steady and reliable supply of cooking oils, which are staple ingredients in many diets around the world.
    - **Supporting Agricultural Sectors:** By providing a reliable market for oilseeds, oil extraction industries support agricultural sectors, ensuring farmers have a stable income and encouraging sustainable farming practices.
5. **Social Equity:**
    - **Empowering Communities:** By making technology accessible, especially mechanical expellers, communities can be empowered to produce their own oil, reducing dependence on imported oils and enhancing self-sufficiency.
    - **Fair Trade Practices:** Encouraging fair trade practices in the oil extraction industry can ensure that farmers and workers receive fair compensation, contributing to social equity and reducing poverty.

6. **Public Health and Safety:**
   - **Minimizing Chemical Exposure:** Mechanical expellers eliminate the need for chemical solvents, reducing the risk of exposure to hazardous substances for workers and consumers, thereby promoting public health and safety.
   - **Regulatory Compliance:** Adopting methods that comply with strict environmental and safety regulations ensures the protection of public health and the environment.

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5. Rosenthal, A., Pyle, D.L., & Niranjan, K. (1996). "Aqueous and Enzymatic Processes for Edible Oil Extraction." Enzyme and Microbial Technology, 19(6), 402-420.
6. Gunstone, F.D. (2011). "Vegetable Oils in Food Technology: Composition, Properties and Uses." John Wiley & Sons.
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FPRs (If Applicable)

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FORTNIGHTLY PROGRESS REPORT (FPR) FROM INDUSTRY MENTOR

Name of Student	Anurag Singh Tomar		Department	Chemical Engineering	
Industry/Organization	Shree Ram Oil Mill		Date/Duration	1/02/2024 – 15/02/2024	
Criterion	**Poor**	**Average**	**Good**	**Very Good**	**Excellent**
Punctuality/Timely Completion of Assigned Work		✓			
Learning capacity/Knowledge Up Gradation				✓	
Performance/Quality of Work					✓
Behavior/Discipline/Teamwork				✓	
Sincerity/Hard work			✓		
Comment on Nature of Work Done/Area/Topic	In the present time Analyzing the process and importance of safety and cleaning equipment.				
OVERALL GRADE (Anyone)	**POOR/AVERAGE/GOOD/VERY GOOD/EXCELLENT** ✓ (EXCELLENT)				
Name of Industry Mentor	Mr. Keshav Gupta				
Signature of Industry Mentor	Keshav Gupta (signature)				

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FORTNIGHTLY PROGRESS REPORT (FPR) FROM INDUSTRY MENTOR

Name of Student	Anurag Singh Tomar		Department	Chemical Engineering	
Industry/Organization	Shree Ram Oil Mill		Date/Duration	16/02/2024 – 02/03/2024	
Criterion	**Poor**	**Average**	**Good**	**Very Good**	**Excellent**
Punctuality/Timely Completion of Assigned Work		✓			
Learning capacity/Knowledge Up Gradation				✓	
Performance/Quality of Work			✓		
Behavior/Discipline/Teamwork				✓	
Sincerity/Hard work		✓			
Comment on Nature of Work Done/Area/Topic	In the present time learning about the entire oil extraction process from oilseeds. This includes understanding the machinery involved, such as crushers, expellers, and oil refining equipment.				
OVERALL GRADE (Anyone)	**POOR/AVERAGE/GOOD/VERY GOOD/EXCELLENT** (✓ VERY GOOD)				
Name of Industry Mentor	Mr. Keshav Gupta				
Signature of Industry Mentor	Keshav Gupta				

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FORTNIGHTLY PROGRESS REPORT (FPR) FROM INDUSTRY MENTOR

Name of Student	Anurag Singh Tomar		Department	Chemical Engineering	
Industry/Organization	Shree Ram Oil Mill		Date/Duration	02/03/2024 – 17/03/2024	
Criterion	**Poor**	**Average**	**Good**	**Very Good**	**Excellent**
Punctuality/Timely Completion of Assigned Work			✓		
Learning capacity/Knowledge Up Gradation				✓	
Performance/Quality of Work			✓		
Behavior/Discipline/Teamwork			✓		
Sincerity/Hard work				✓	
Comment on Nature of Work Done/Area/Topic	In the present time learning importance of boiler and assembling boiler and I can assure that he is getting better day by day.				
OVERALL GRADE (Anyone)	**POOR/AVERAGE/GOOD/VERY GOOD/EXCELLENT**				
Name of Industry Mentor	Mr. Keshav Gupta				
Signature of Industry Mentor	Keshav Gupta				

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FORTNIGHTLY PROGRESS REPORT (FPR) FROM INDUSTRY MENTOR

Name of Student	Anurag Singh Tomar		Department	Chemical Engineering	
Industry/Organization	Shree Ram Oil Mill		Date/Duration	18/03/2024 – 1/04/2024	
Criterion	**Poor**	**Average**	**Good**	**Very Good**	**Excellent**
Punctuality/Timely Completion of Assigned Work			✓		
Learning capacity/Knowledge Up Gradation				✓	
Performance/Quality of Work					✓
Behavior/Discipline/Teamwork			✓		
Sincerity/Hard work				✓	
Comment on Nature of Work Done/Area/Topic	Learning the process of assembling boiler and impact of boiler on the production unit of oil mill and right now his performance is good and learning fast.				
OVERALL GRADE (Anyone)	**POOR/AVERAGE/GOOD/VERY GOOD/EXCELLENT**				
Name of Industry Mentor	Mr. Keshav Gupta				
Signature of Industry Mentor	Keshav Gupta				

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FORTNIGHTLY PROGRESS REPORT (FPR) FROM INDUSTRY MENTOR

Name of Student	Anurag Singh Tomar		Department	Chemical Engineering	
Industry/Organization	Shree Ram Oil Mill		Date/Duration	2/4/2024 – 17/4/2024	
Criterion	**Poor**	**Average**	**Good**	**Very Good**	**Excellent**
Punctuality/Timely Completion of Assigned Work				✓	
Learning capacity/Knowledge Up Gradation				✓	
Performance/Quality of Work				✓	
Behavior/Discipline/Teamwork			✓		
Sincerity/Hard work				✓	
Comment on Nature of Work Done/Area/Topic	Learning the process of assembling boiler and impact of boiler on the production unit of oil mill and right now his performance is good.				
OVERALL GRADE (Anyone)	**VERY GOOD**				
Name of Industry Mentor	Mr. Keshav Gupta				
Signature of Industry Mentor					

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FORTNIGHTLY PROGRESS REPORT (FPR) FROM INDUSTRY MENTOR

Name of Student	Anurag Singh Tomar		Department	Chemical Engineering	
Industry/Organization	Shree Ram Oil Mill		Date/Duration	18/4/2024 – 1/5/2024	
Criterion	**Poor**	**Average**	**Good**	**Very Good**	**Excellent**
Punctuality/Timely Completion of Assigned Work				✓	
Learning capacity/Knowledge Up Gradation				✓	
Performance/Quality of Work				✓	
Behavior/Discipline/Teamwork			✓		
Sincerity/Hard work				✓	
Comment on Nature of Work Done/Area/Topic	In present time analyzing the process and importance of Mechanical expeller or Screw Process.				
OVERALL GRADE (Anyone)	**VERY GOOD**				
Name of Industry Mentor	Mr. Keshav Gupta				
Signature of Industry Mentor	Keshav Gupta				

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FORTNIGHTLY PROGRESS REPORT (FPR) FROM INDUSTRY MENTOR

Name of Student	Anurag Singh Tomar		Department	Chemical Engineering	
Industry/Organization	Shree Ram Oil Mill		Date/Duration	1/5/2024 – 15/5/2024	
Criterion	**Poor**	**Average**	**Good**	**Very Good**	**Excellent**
Punctuality/Timely Completion of Assigned Work				✓	
Learning capacity/Knowledge Up Gradation				✓	
Performance/Quality of Work				✓	
Behavior/Discipline/Teamwork			✓		
Sincerity/Hard work				✓	
Comment on Nature of Work Done/Area/Topic	Learning about the entire process of Oil filtration and packaging of the product.				
OVERALL GRADE (Anyone)	**VERY GOOD**				
Name of Industry Mentor	Mr. Keshav Gupta				
Signature of Industry Mentor					

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FORTNIGHTLY PROGRESS REPORT (FPR) FROM INDUSTRY MENTOR

Name of Student	Anurag Singh Tomar		Department	Chemical Engineering	
Industry/Organization	Shree Ram Oil Mill		Date/Duration	16/5/2024 – 29/5/2024	
Criterion	**Poor**	**Average**	**Good**	**Very Good**	**Excellent**
Punctuality/Timely Completion of Assigned Work				✓	
Learning capacity/Knowledge Up Gradation				✓	
Performance/Quality of Work				✓	
Behavior/Discipline/Teamwork			✓		
Sincerity/Hard work				✓	
Comment on Nature of Work Done/Area/Topic	Understanding about the entire process of contamination prevention and quality maintenance.				
OVERALL GRADE (Anyone)	**VERY GOOD**				
Name of Industry Mentor	Mr. Keshav Gupta				
Signature of Industry Mentor	Keshav Gupta				