STUDY OF FUNDAMENTAL OF APPLIED CHEMISTRY

Term paper

Submitted as Pre-Requirement for the Partial Fulfillment of +2Science degree

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RECOMMENDATION LETTER

This is to certify that the term paper report entitled "**STUDY OF FUNDAMENTAL OF APPLIED CHEMISTRY**" submitted as pre-requirement for the partial fulfilment of **"+2ScienceDegree"** Of **Orient College** is prepared by **Dipshan Sharma** as approved by this department.

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Sincerely,
Dipshan Sharma.
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ABBREVIATION

ABSTRACT

Applied chemistry is the branch of chemistry that deals with the practical application of chemical knowledge to solve **real-world problems**. It encompasses a wide range of fields including **materials science, environmental science, biochemistry, and chemical engineering**. The goal of applied chemistry is to improve the **quality of life** by **developing new materials**, understanding and mitigating **environmental problems**, creating new drugs, and optimizing **industrial processes**. The field of applied chemistry is constantly evolving and has a broad impact on many aspects of our daily lives. For example, the development of new **catalysts** in chemical engineering has led to more **efficient** and **environmentally friendly** industrial processes, while research in materials science has led to the creation of stronger and more **durable materials** for use in various industries.

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INTRODUCTION

Applied chemistry is the branch of chemistry that deals with the practical application of chemical knowledge to solve problems in various fields such as medicine, agriculture, industry, and the environment. It involves the use of chemical principles, techniques and methods to develop new materials, products, and processes or to improve existing ones. It encompasses the use of chemical knowledge for the benefit of human kind. It involves the use of chemical knowledge to develop new materials, products, and processes, as well as to improve existing ones. Some examples of applied chemistry include the development of new drugs and medical treatments, the production of new materials for use in electronics and construction, and the creation of more efficient and environmentally-friendly industrial processes. So, applied chemistry plays a vital role for the betterment of human life

Chemical Industry and Its Importance

The chemical industry is a sector of the economy that produces a wide range of chemical products, including basic chemicals, specialty chemicals, and consumer goods. These products are used in a variety of industries, such as agriculture, construction, manufacturing, and healthcare.

A suitable example of the chemical industry is the production of fertilizers. Fertilizers are chemical compounds that are added to soil to improve crop growth and yield. The chemical industry produces a wide range of fertilizers, including nitrogen-based fertilizers, phosphorous-based fertilizers, and potash-based fertilizers. These fertilizers are used in agriculture to improve crop growth and increase food production. The chemical industry also produces other products such as pesticides, herbicides, and fungicides which are used in agriculture for pest and disease control.

Another example is the production of plastic, which is widely used in many sectors such as packaging, construction and automotive industry. The chemical industry produces a wide range of plastics, including polyethylene, polypropylene, and polyvinyl chloride, which are used to make a wide variety of products, including packaging materials, construction materials, and automotive parts.

Overall, the chemical industry plays an important role in many areas of society, and its products are used in a wide range of industries and applications.

Importance of Chemical Industry:-

- Importance in agriculture
- Importance in environment
- Importance in hygiene and health
- Importance in sustainable energy solutions
- Importance on food
- Importance in painting and coating
- Importance in petro-chemistry
- Importance in pharmaceutical
- Importance in the construction industry
- Importance in the automobile industry

Stages in producing a new product

The chemical industry is a vital sector that produces a wide range of products that are essential to modern life, such as materials, chemicals, and energy. It is able to survive by constantly innovating and adapting to changing market conditions and customer needs through Research and Development, cost control, efficiency improvement, diversification, and sustainability. The chemical industry also has to comply with regulations related to safety and environmental protection, and must manage and mitigate potential hazards associated with its operations.

The process of producing a new product in the chemical industry typically involves several stages, including:-

Stage 1: Research and Development (R&D)

This is the initial stage of product development where ideas are generated, research is conducted, and prototypes are created. R&D helps to identify the

feasibility, market potential, and technical requirements of a new product. In the chemical industry, R&D often involves the synthesis and characterization of new chemical compounds, as well as the optimization of existing ones.

Stage 3 : Design and Engineering

In this stage, the product is designed and engineered, taking into consideration the research and development findings, customer requirements, and production constraints. The design and engineering process includes creating detailed specifications, blueprints, and models of the product. In the chemical industry, this stage may involve developing processes for the production of the chemical compound on a large scale.

Stage 4: Testing and Validation

The product is tested and validated to ensure that it meets the desired performance and safety specifications. This includes laboratory testing, field testing, and simulation testing. In the chemical industry, this stage may include testing the chemical compound for purity, stability, and potential environmental or health hazards.

Stage 5: Scale-up and Manufacturing

After successful testing and validation, the product is scaled up for mass production. The chemical industry, this stage may include setting up the necessary equipment and infrastructure, such as reactors and distillation columns, as well as hiring and training personnel.

Stage 6: Quality Control and Safety

The final stage of production is quality control and safety, where the chemical industry has to ensure the product is safe to use, and meet the required standards.

This includes regular testing of the product during production and monitoring of the production process to ensure it is safe and compliant with relevant regulations.

Stage 6: Marketing and Distribution

After the production process, the product needs to be marketed and distributed to the target market. This includes identifying target customers, creating marketing strategies, and building distribution channels to reach the customers.

Economics of Production

The basic function of any company for existence is to make a profit. Without profit, it cannot do other socially desirable activities such as providing continuing employment, paying money for local social service through rates and local taxes and providing money for national activities through corporate taxes. Therefore, when a company considers establishing a new manufacturing plant, it must carefully consider the economic aspect of the plant.

Simply for any production, we can consider a number of inputs and outputs of the manufacturing plant. The key inputs are the raw materials, energy and supportive service. The supportive services include all employees with labour, laboratory services (quality-control) and security with fire services. The key output is the major product with other by-products including released energy. Generally, the energy is trapped as a steam of high temperature and pressure which can be recycled to run electrical generators, pumps and others. The by-products will be purified followed by further processing to get other product which can be sold to make money. Moreover, it can be more economic to change the conditions in the production of the major products so that by-products are suppressed. A considerable number of factors are involved in the production of a chemical ranging from the supply and storage of raw materials to the storage and selling of the finished product. In between these steps, we consider firstly all the complex and expensive equipment for carrying out the chemical process, separating and purifying the product and secondly the people who operate the plant and carry out maintenance work to

keep this process in operation. A simple way of combining information on these various cost factors into a useful economic model is the cost table. We can split the cost of production into two, fixed cost and variable cost which are presented below:

Types of costs and their examples

Fixed costs	Variable costs
Labour	Raw materials
Maintenance	Energy
Safety	Packaging
Laboratory services	Transport
Management	License
Depreciation	Patents

Cash flow in production cycle

The cash flow in the production cycle is a crucial aspect for any company as it determines the time it takes to convert raw materials into cash. The term "cash conversion cycle" is often used to refer to the period between the purchase of raw materials and the collection of revenue from the sale of the finished product. The production process can be a long and costly endeavor, taking several years to bring a product to market. During this time, the company incurs expenses as it transforms raw materials into a finished product. These expenses can be financed either through profits generated in previous years or by borrowing money from a bank. Regardless of the method used, it is important for the company to consider the expenses involved and weigh them against the potential profits that the product is expected to generate.

Running a Chemical Plant

A chemical plant is an industrial facility that produces chemicals on a large scale. These plants utilize specialized equipment, units, and technology in the manufacturing process. Some examples of the types of chemicals produced in chemical plants include polymers, pharmaceuticals, food and beverage products, power plant materials, natural gas processing chemicals, and water and wastewater treatment chemicals.

There are a variety of scientific principles that are utilized in the chemical industry, including chemistry, thermodynamics, reaction mechanisms, process design, mechanical design, economics, and unit operations and processes.

When it comes to the operation of a chemical plant, there are several key considerations. One important aspect is **market and sales**, which helps to justify the operation of the industry. Another important aspect is the **method of production**, which includes the **chemical reactions, flow diagrams, and materials requirements** involved in the manufacturing process. Additionally, chemical engineering problems such as **manufacturing** and **economics** must be taken into account.

Despite the complexity of the manufacturing process, a chemical plant can be easily managed with a small team of workers. Temperature and pressure changes can be constantly monitored through instruments connected to computers, and computer programming can be used to control pumps, heaters, and other equipment to ensure optimal performance and control over the quality of the final product.

Designing A Chemical Plant

Designing a chemical plant is a complex process that involves several different stages and a variety of different considerations. The following are some key points to keep in mind when designing a chemical plant:

- **Market and sales:** The first step in designing a chemical plant is to understand the market for the products that will be produced. This includes

assessing demand, identifying potential customers, and understanding the competitive landscape. This information is used to justify the investment in the plant and to inform decisions about the scale and scope of the facility.

- **Method of production:** The next step is to determine the method of production that will be used in the plant. This includes identifying the chemical reactions that will take place, developing flow diagrams to show how the materials will move through the plant, and determining the materials and equipment that will be needed.

- **Chemical engineering problems:** Once the method of production has been determined, the next step is to address any chemical engineering problems that may arise. This includes analyzing the chemical reactions taking place in the plant, assessing the economics of the operation, and identifying any potential safety hazards.

- **Design and construction:** After the chemical engineering problems have been addressed, the next step is to design the plant and its various systems. This includes developing detailed plans and specifications for the facility, selecting equipment and materials, and managing the construction process.

- **Operations and maintenance:** Once the plant is built, the final step is to establish procedures for its operation and maintenance. This includes developing protocols for monitoring and controlling the various systems, training personnel, and implementing safety procedures.

In summary, designing a chemical plant is a multi-disciplinary task that requires knowledge in market analysis, chemical reaction, flow diagrams, materials and equipment, chemical engineering, process design, mechanical design, economics, unit operation, unit process, safety and regulations, and construction

management. It's a complex process that requires the collaboration of experts from different fields such as chemical engineers, mechanical engineers, process engineers, safety engineers, economists, and construction managers, to name a few.

Factors to consider before designing a chemical plant:-

1. **Process Design:** The process design includes determining the type of chemical reactions that will take place, the flow diagrams, and the materials requirements. It also involves identifying the equipment and technology needed for the manufacturing process.

2. **Market and Sales:** The market and sales aspect of the chemical plant design involves analyzing the demand for the products and determining the justification for the industry. This includes assessing the competition and identifying potential customers.

3. **Safety:** Safety is a crucial aspect of chemical plant design. It includes designing the plant to comply with safety regulations and standards, and also ensuring that the plant is equipped with emergency shutdown systems and fire protection systems.

4. **Environmental Impact:** The environmental impact of the chemical plant must be considered during the design phase. This includes assessing the potential effects on air, water, and soil, as well as identifying any necessary pollution control measures.

5. **Cost and Economics:** The cost of the chemical plant and its economic viability must be taken into account during the design phase. This includes estimating the total cost of the project, identifying any potential cost savings, and assessing the plant's profitability.

6. **Location and Site:** The location and site of the chemical plant must be considered during the design phase. This includes identifying a suitable site with access to necessary resources, such as water, power, and transportation.

7. **Scale and Capacity:** The scale and capacity of the chemical plant must be determined during the design phase. This includes identifying the production capacity and determining the size of the plant.

8. **Maintenance and Operation:** The maintenance and operation of the chemical plant must be considered during the design phase. This includes identifying the necessary equipment and technology for maintaining the plant, as well as identifying the personnel required to operate the plant.

9. **Energy Efficiency:** The energy efficiency of the chemical plant must be considered during the design phase. This includes identifying energy-saving opportunities, such as using renewable energy sources, and assessing the overall energy consumption of the plant.

10. **Flexibility and Scalability:** The flexibility and scalability of the chemical plant must be considered during the design phase. This includes identifying opportunities for future expansion and the ability to adapt to changing market conditions.

Batch Processing System	Continuous Processing System
1. Production is carried out in batches of a specific quantity	1. Production is carried out continuously without interruption
2. Start-up and shut-down procedures are required for each batch	2. Start-up and shut-down procedures are not required
3. Equipment and processes are not in constant use	3. Equipment and processes are in constant use
4. Product quality may vary from batch to batch	4. Product quality is consistent and uniform
5. Ideal for small-scale or one-time production	5. Ideal for large-scale, high-volume production
6. Flexibility in production as different products can be produced in the same plant	6. Specialization of production and equipment is required
7. Higher labor and maintenance costs	7. Lower labor and maintenance costs
8. Higher initial investment	8. Lower initial investment
9. e.g. production of paracetamol	9. e.g. cement industry.

Environmental Impact of The Chemical Industry

The chemical industry has a significant impact on the environment. The production and use of chemicals can lead to the release of pollutants into the air, water, and soil, which can have negative effects on human health and the natural environment. Some of the main environmental impacts of the chemical industry include:

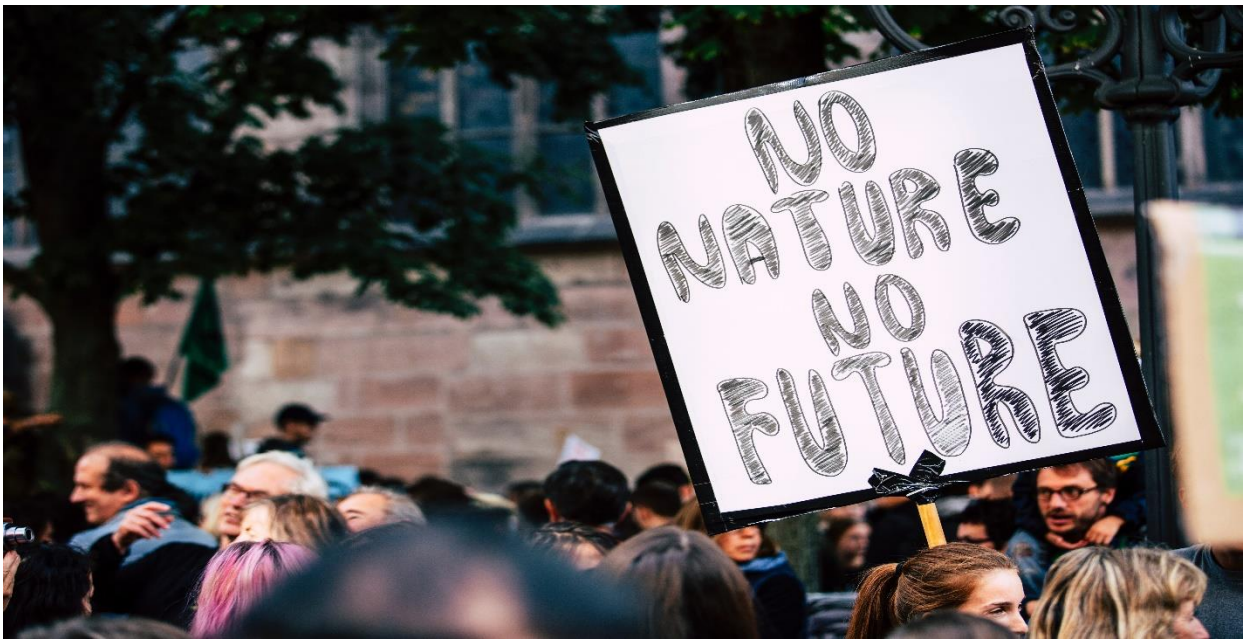
Air pollution: The chemical industry releases a variety of pollutants into the air, including volatile organic compounds (VOCs), particulate matter, and nitrogen

oxides. These pollutants can contribute to smog and acid rain, and have been linked to respiratory and cardiovascular health problems.

Water pollution: Chemicals used in the production of industrial chemicals can contaminate water sources, such as rivers and lakes. These pollutants can harm aquatic life and make the water unsafe for human consumption. In addition, chemical spills and leaks can also occur, leading to the release of harmful chemicals into the water.

Soil pollution: The chemical industry can also pollute the soil through the release of chemicals and waste products. These pollutants can make the soil toxic for plants and animals, and can also contaminate the food chain.

Climate change: The chemical industry is a significant contributor to climate change. The production and use of chemicals generates greenhouse gas emissions, which contribute to global warming and climate change.



Hazardous waste: The chemical industry generates large amounts of hazardous waste, which can be toxic, flammable, or reactive. If not properly managed, this waste can pose a risk to human health and the environment.

Overall the chemical industry has a wide range of environmental impacts, which can have serious consequences for human health and the natural environment. Therefore, it is important to minimize these impacts through the use of cleaner production methods, safer chemicals, and effective waste management practices.

In conclusion, the **study of fundamental of applied chemistry** is crucial for understanding the principles and concepts that govern the chemical industry. From the design and operation of chemical plants to the environmental impacts of the industry, a thorough understanding of applied chemistry is necessary for making informed decisions and developing sustainable practices. We have learned about the different types of chemical plants, their method of production and the chemical engineering problems that arise in the manufacturing process. We have also discussed the environmental impact of the chemical industry and the importance of considering these impacts in the design and operation of chemical plants. Overall, this term paper has provided a comprehensive overview of the fundamental principles of applied chemistry and their practical applications in the chemical industry.