UDYOG

➢ INTRODUCTION

Coronavirus disease (COVID-19) is caused by SARS-COV2 and represents the causative agent of a potentially fatal disease that is of great global public health concern. The virus was first identified in Wuhan City, China. Person-to-person transmission of COVID-19 infection led to the isolation of patients that were subsequently administered a variety of treatments. COVID-19 has led to a situation of Global quarantine and shutdown. No official cure of COVID-19 has yet been found out, though patients are being treated via broad-spectrum antiviral drugs. Through this Problem, we will step into the shoes of a chemical engineer and try to appreciate the role being played by us in such a situation.

➢ PROBLEM STATEMENT

A Pharmaceutical company PFZ Ltd. has been successful in developing a drug for COVID-19. The drug has an active ingredient, 'X,' which is responsible for its therapeutic action. You are a chemical engineer working in PFZ Ltd., and you are tasked with designing a process to scale up production of X based on Laboratory data. The active ingredient 'X' is isolated from a chemical P. The chemical P is synthesized from substrate S according to the reaction given below:

$$S\ (aq) \xrightarrow{ENZYME\ (E),\ rate-constant\ (k)} P\ (aq) \qquad \Delta H = -418.6\ kJ/kmol.$$

Batch Kinetics:

$$\frac{d[P]}{dt} = -\frac{d[S]}{dt} = \frac{k[E_o][S]}{K_m+[S]} \qquad \text{OR} \qquad t = \frac{[S_o]-[S]+K_m \ln\frac{[S_o]}{[S]}}{k[E_o]}$$

K_m= 0.01M, k = 6 hr^{-1}, $[E_o]$ = Initial Enzyme concentration should be kept at 1% of Initial substrate concentration i.e. $[S_o]$. The reaction can be assumed to be completed when 95% of the initial substrate has been converted to P.

1000L batch reactor vessels are available in the plant for carrying out the reaction. The active chemical X constitutes at most 0.1% of the total product P formed. And it is desired that the plant should produce five kmoles of X per day.

Restrictions:

The Enzyme works optimally in the pH range of 7.0 to 8.0; other than this range, the enzyme gets denatured, and no conversion takes place. The product obtained is heat-sensitive, hence ideally, a temp of 25 ^{o}C to 35 ^{o}C must be maintained in the reactor vessel at all times. The value of $[S_o]$ should be kept below 10 M to allow for homogenous mixing and cooling.

Properties of X:

- Heat Sensitive
- Polar Molecule
- Hydrophilic
- Contains Aromatic Ring
- Symmetrical organic molecule

➢ CHALLENGE TO THE PARTICIPANTS:

1) Design a process suitable for meeting the requirements of the plant. The process design should constitute No. of reactor vessels used, Amount of substrate taken in each vessel, operation time, Method to keep pH within the suitable range, Method to keep the temperature constant in the suitable range and Operation cost/ Plant set up Cost. Make appropriate assumptions if necessary, and state them. Show the required calculations.

2) Come up with an idea to isolate compound X from the product mixture P based on the Properties of X with suitable justification. Give Description of the Process.

3) [**BONUS MARKS**] – Currently, there is a situation of Global quarantine due to the pandemic outbreak of COVID-19. Hence many Travel restrictions have been imposed globally. Additionally, there is a very high demand for the Drug, while the Plant output supply is limited. Now you have been tasked with giving your inputs on the initial supply points of the drug. In which countries will you make the drug available first, and why? Give a Brief strategy to supply the drugs to the supply points presuming drug is sensitive to temperature changes, moisture, sunlight, Oxygen in the air, and keeping in mind the quarantine restrictions while Maximising profits to required cost ratio.

➢ HINTS:

- For Temperature Calculation assumes that the heat resistance offered by the reaction mixture and reactor vessel is negligible; hence all the heat evolved from the reaction is to be removed directly.
- For the costs of equipment, visit any authorized vendor sites and provide the due source. For operation costs, take assumptions and mention them with credible sources (if any).
- For the Supply Chain part, you can visit this site to track no. cases present worldwide: https://www.worldometers.info/coronavirus/

➢ RULES AND EVALUATION: -

- You can participate in a group of **at most 3** members. More than three is strictly not allowed.
- Abstract needs to be submitted in **one page** only. You can add charts, infographics, and flowchart by mentioning the credible source. The font size will be 12, font will be "Arial". The team name and team member's name should be mentioned at the top of the abstract.
- The deadline for Abstract Submission will be **31st March 2020 9:00 PM** strictly. Hardly in unforeseen circumstances, it will be allowed till *1st April 2020 9:00 AM* but delay from **31st March 2020 9:00 PM** will lead you to heavy penalty of marks.
- You need to mail your abstracts on osmoze@itbhu.ac.in in PDF format. The filename of PDF should be "Osmoze_Udyog_Abstract_<Team Name>.
- The shortlisted teams will receive a mail on 31st March upon clearing abstract round. In round 2, you will have to submit the solution by making a PPT. It should be again mailed to osmoze@itbhu.ac.in . The filename of the PPT should be "Osmoze_Udyog_PPT_<Team Name>.
- The deadline of PPT submission will be **5th April 2020 11:59 AM**. Any changes in the scheduled deadline if made, will be communicated to you, unless you are made to follow this deadline strictly. The PPT should not contain more than 10 slides (including introduction & thankyou slide).
- You need to very clearly state all the assumptions and methods of calculation used. The PPT will be evaluated on how well you have approached and analyze the problem, how much the solution is feasible in practical terms and how much practically innovative the designed processes and the strategies are.
- You are advised to strictly adhere to all the rules mentioned here. Violating the rules will lead you to pay heavy penalty of marks.
- You can contact to any of the coordinators if you have any query/doubts regarding the event structure, evaluation and the problem statement.

UDYOG

OSMOZE
Sharing Sapience Crossing Channels

EVENT COORDINATOR:

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