Industrial Engineering Journal
ISSN: 0970-2555
Volume : 52, Issue 5, May : 2023

MANUFACTURING OF PHENOL BASED LIQUID DISPERSING AGENT BY CHANGING THE TRANSFER POLICY

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Abstract

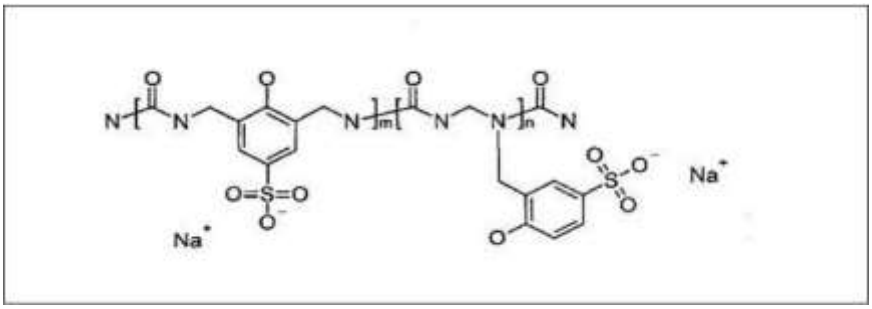
We are proposing a method which could decrease the production time of the process which will eventually result in decrease in energy consumptions and cycle time as well as it will increase the production. Our method proposes that by changing some transfer policies which includes increasing the number of reactors and tanks used to produce the product which will make it cheaper and even easier to handle during the production.

INTRODUCTION

This phenolic thermosetting resin is produced by condensing formaldehyde with phenolsulfonic acid and urea to fo rm a polymer consisting of several repeating units associated with phenolsulfonic acid and methylene (-CH,-). determined by the number of units. It is an excellent dispersant and superplasticizer that can be used in the concr ete and cement industry. Phenolic resins are often brittle, and Bakelite was one of the first plastics to be widely use d in the consumer market.

Systematic Name: - Benzenesulfonic acid, hydroxy- polymer with Formaldehyde, phenol, urea and sodium salt.

Structure:-



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RESEARCH METHODOLOGY

Mass balance, also known as mass balance, is the application of conservation of mass to the analysis of objects. By thinking about what goes in and out of the body, it is possible to identify large flows that would be unknown or dif ficult to measure without this technique.

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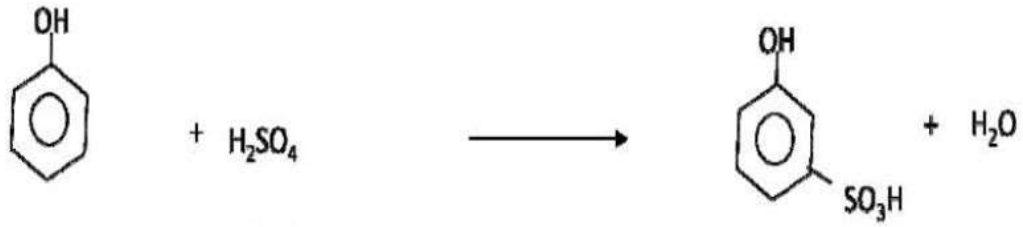
The exact rules used in the analysis of
depend on the details of the problem, but everything changes when it comes to conservation of mass, so the proble m cannot go away or be created by itself.

Therefore, the mass equation is widely used in engineering and environmental analysis. For example, mass balance theory is used to design chemical reactors, examine alternative methods for producing chemicals, and model infec tious diseases and other processes in the body.Reaction Wise Mass Balance

- **Sulphonation**



The following raw materials are used for this reaction: -

- Phenol – 270 kgs
- Sulphuric Acid (98%) – 325 kgs
- Water – 230 kgs
- Urea – 205 kgs
- Formaldehyde (37%) – 447 kgs
- Caustic soda (50%) – 130 kgs

For the 2nd time, the same components are used except Urea and Sulphuric Acid: -

- Phenol – 195 kgs
- Water – 135 kgs
- Formaldehyde (37%) – 135 kgs
- Caustic soda (50%) – 150 kgs

The total yield obtained from the reaction mass balance is 8189 litres.

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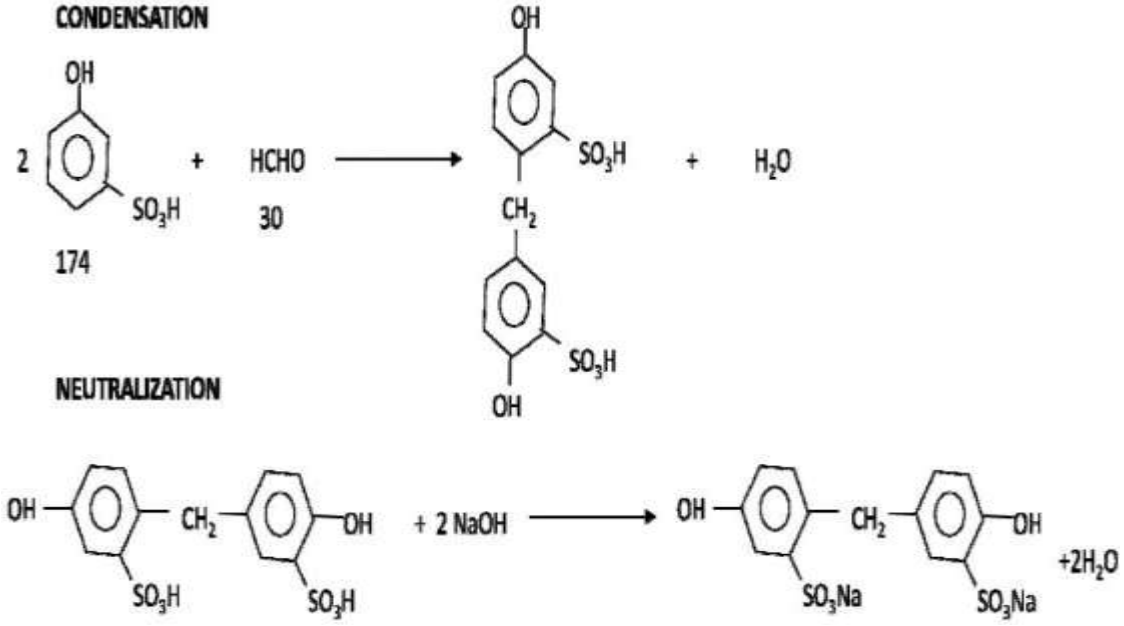
- **Condensation and Neutralization**



- Take 1 mole of Phenol (M.W. = 94) + 1.15 mol of Sulphuric acid
- (M.W.=98) in a clean and dry reactor. Heat it to 102 to 105 °C. And maintain for 3 hrs. The product obtain is 1 mole of Phenol Sulphonate (M.W.= 174) + 1 mol of water (M.W.=18).
- Add 1.2 mole of Urea (M.W.=60) into it at 65 -70 °C.
- Add 2.20 mole of formaldehyde (M.W.= 30) into it at 75-80 °C. The Product obtain is 1 mole of Phenol sulphonate formaldehyde condensate (M.W.= 204) + 1 mole of Urea formaldehyde condensate (M.W. = 89) + 1 mol of water (M.W.=18).
- The 1 mole of Phenol sulphonate formaldehyde condensate (M.W.=174) is self polymerise to give one polymer of molecular weight 714 + 1 mole of Urea formaldehyde condensate (M.W. = 89)) is self polymerise to give one polymer of molecular weight 312 .
- Now, add 2 mole of Phenol + 2 mole of formaldehyde to obtain 1 mole of Phenol formaldehyde condensate (M.W.= 124), Which polymerise to give molecular weight 248.
- Finally, the product is neutralised with 3 mol of Caustic soda. The product obtained is 1 mole of Sodium salt of Phenol sulphonate formaldehyde condensate + 1 mole of Urea formaldehyde condensate + 1 mole of Phenol formaldehyde condensate + 1 mole of water.
- Total Molecular of product is Approx. 1450.

• List of processes and equipment's used for proposed process

1. Equipment's: -
   - Glass-Lined reactor:
     Glass lined Reactors (GLR's) have a glass (enamel) coating on the product wetted surfaces to provide high levels of chemical resistance to said surfaces.

   - Chilling Plant:
     Water chiller is a refrigeration machine which produces chilled water (Approx. 7°C-12°C).
     The primary function of a chiller is to lower the temperature of water to such value such that it can be used for producing cooling effect.

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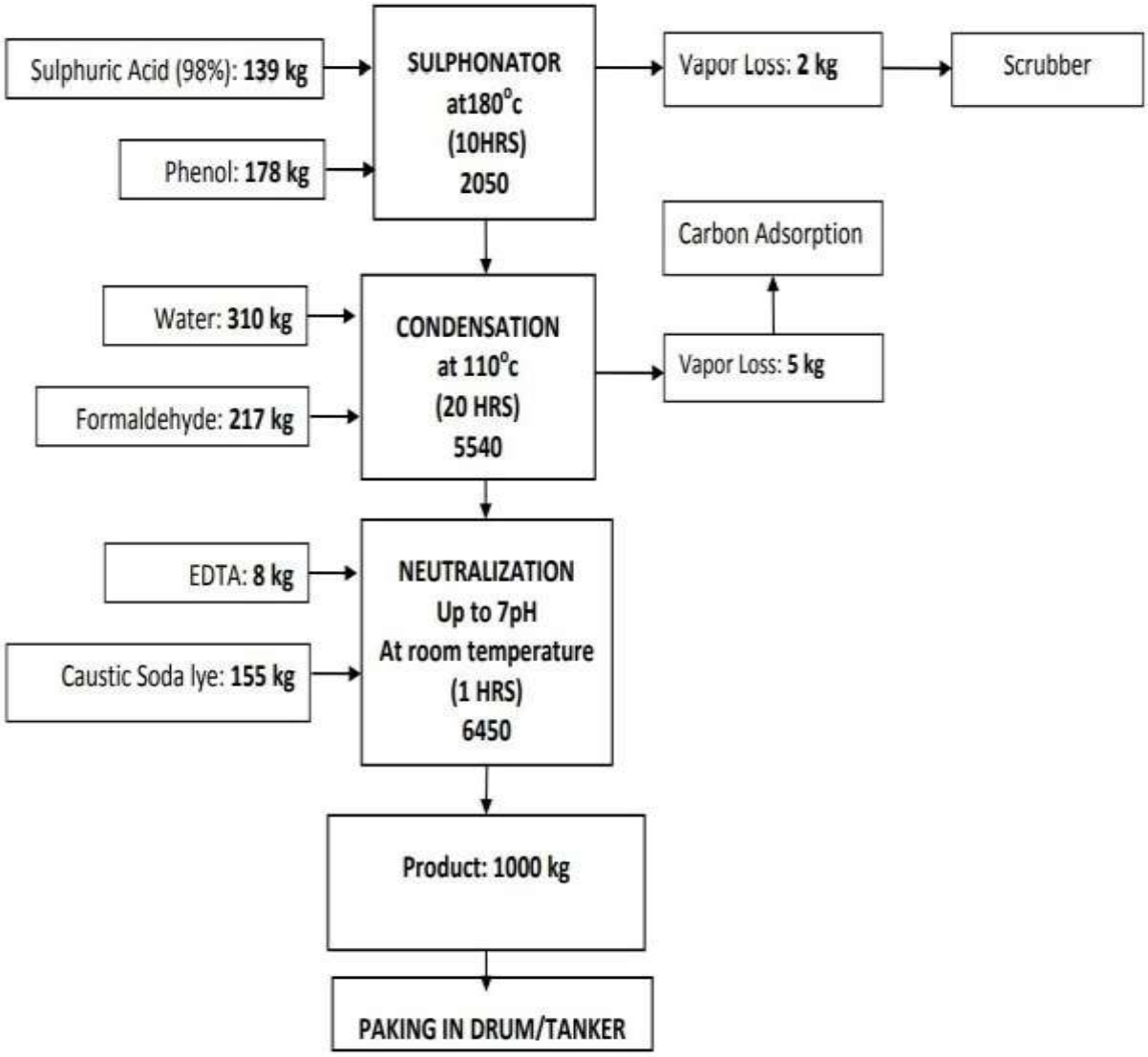
2. Process: -
   - We study the manufacturing process and tried to improve the process but there is no waste produced in the process.
   - Hence, waste reduction is not possible.
   - The selection of inter stage transfer policy to transfer product intermediates from one stage to another is also very important in scheduling decisions.
   - The purpose of using storage tanks is to increase the plant availability by reducing the idle time of process units.
   - We applied the time optimization methods to see if the production time can be reduced.
   - We used Gantt chart to determine best design by applying different transfer policies.
   - The different transfer policies are mentioned below.
     a. Zero wait Transfer Policy
     b. No Intermediate Storage Policy
     c. Unlimited Storage Policy

PLUG FLOW DIAGRAM



1) Zero wait Transfer Policy
2) No Intermediate Storage Policy
3) Unlimited Storage Policy

Zero wait transfer policy (ZWTP)

- The usually referred transfer policies are zero wait (ZW) where the nature of the intermediate product demands its immediate transfer to the next stage.
- This policy requires the product intermediates to be transferred from one stage to the next as soon as they are produced as shown in Figure 1.
- This procedure could produce idle time between process stages as shown by shaded area in Figure 1.
- The idle time represents the time during which the stage remains idle or not in use.
- The idle time between stages has been shown using shaded area in Figure 1.

Figure 1. Gantt chart for three products in three stages for ZW Transfer Policy

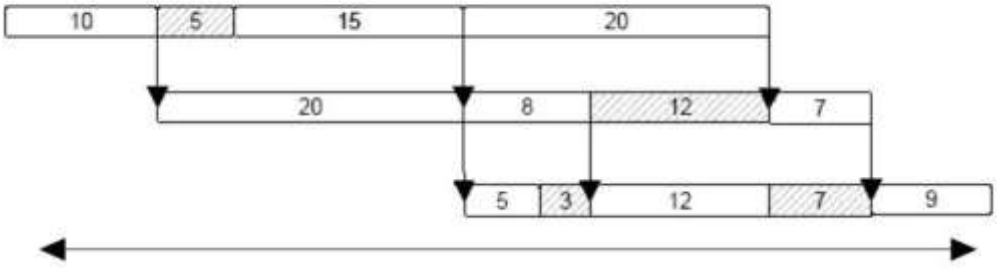


Fig. .:- Example of ZWTP

No Intermediate Storage transfer policy (NISTP)

- In this transfer policy, the flexibility is provided in terms of allowing the product intermediate to wait inside the same stage till the next stage is available to accept the product intermediate from the previous stage.
- Figure 2 represents the waiting time of an example batch process recipe shown by the shaded area.

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Figure 2 Gantt chart for four products in three stages for NIS Transfer Policy

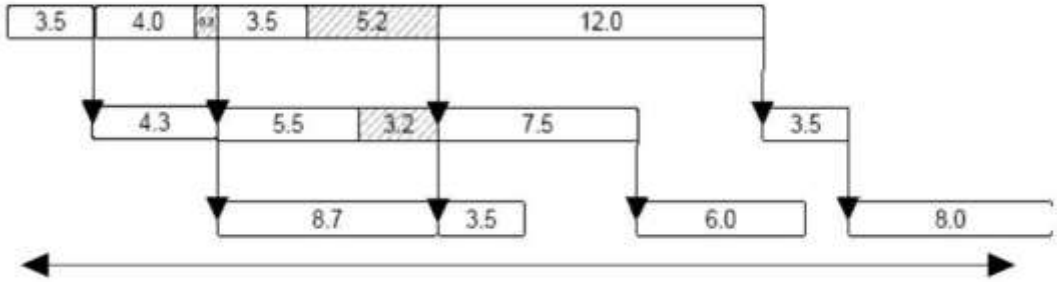

Fig. .:- Example of NISTP

Unlimited Intermediate Storage transfer policy (UISTP)

- Sometimes the nature of the product intermediate is such that they can not be held inside the same stage till the next stage is made available.
- In such a case, a storage tank is used to temporary store the product intermediate till the next stage becomes available.
- The number of storage tanks is not limited and always available whenever required.

Figure 3. Gantt chart for four products in three stages for UIS Transfer Policy

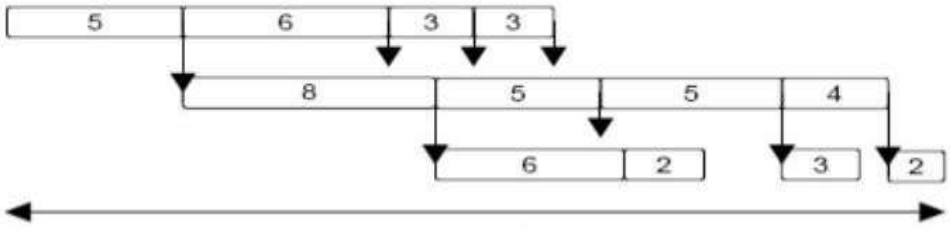

Fig :- Example of UISTP

Industrial Engineering Journal
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CONCLUSION

- As we can see in above graphical and numerical comparison our proposed design suggests less production time.
- The new production time is 2 hours less compared to company's current production time.
- This reduction in production time can be achieved by adding an additional GLR (Glass lined reactor).
- We can not use UISTP method because it requires additional storage tanks and the resulting final time is also equal to ZWTP and NISTP methods.
- Therefore, we can use either ZWTP or NISTP method.

At last, We would like to suggest some points which are given below:

- Reaction route through which product is produced includes pH maintaining and dilution step, which required huge quantity of water, Hydrochloric acid and caustic soda. Another route can be used for production of same product, so that use of such chemicals can be reduced.
- Safety training should be given to the employees as well as workers.
- Proper color code should be given to the piping system in the industry.

Industry should keep fire extinguisher at each floor to fight against the fire. Safety posters should be there on the wall of industry campus.

ACKNOWLEDGMENTS

I have taken efforts in this project. However, it would not have been possible without the kind support and help of many individuals. I would like to extend my sincere thanks to all of them. I am highly indebted to for their guidance and constant supervision as well as for providing necessary information regarding the project & also for their support in completing the project. I would like to express my gratitude towards my parents and teachers for their kind co-operation and encouragement which help me in completion of this project.

I am thankful to Assistant professor Mr. Priyeshnath Rathod for providing us guidance and the opportunity to gain theoretical knowledge. I am also thankful to Mr. Shubham Vaishanav who have also helped supported us as faculty guide and allowing me to use the R & D lab.

I am greatly indebted to all Professors, Guide, who has been continuous source of inspiration right from the conception of the report to its completion. I am also thankful to them for their timely guidance and providing a helpful environment to make this report a success.

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