Applicant: Catalysta Industries Pvt. Ltd

Inventors:

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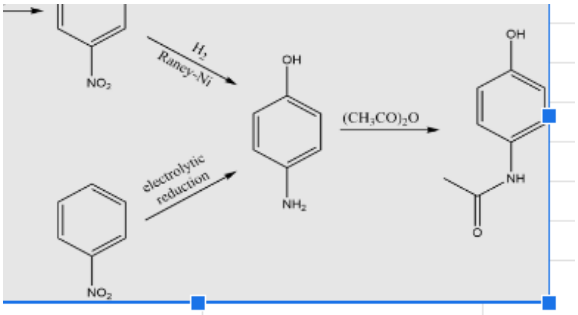
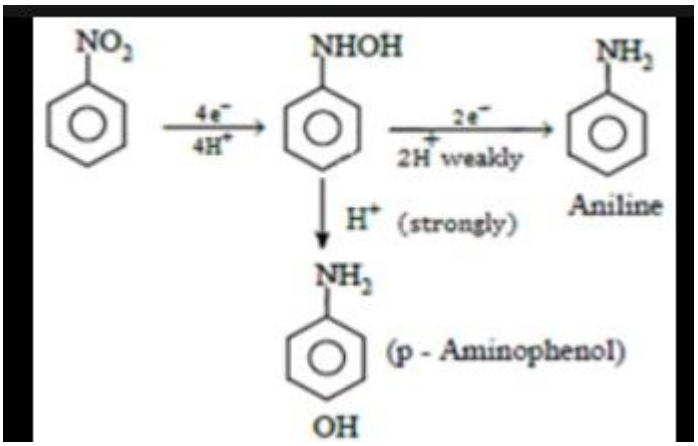
Chemical Formula: C8H9NO2 (HOC6H4NHCOCH3)

Chemical Name: Acetaminophen

Chemical synthesis routes:

- **Lab scale reaction that will be scaled up:**
  We will be using nitrobenzene electrolytic reduction to make our required drug.





(This is a half part of the reaction. It is the formation of Hydroxy Aniline, which is a good part of the reaction and also tells us what reaction condition we need to follow.)

The reaction at the bottom will be our primary industrial production process over other responses available.

Raw materials:
Major raw materials includes nitrobenzene, Sulphuric Acid, Ammonia and Acetic anhydride. Some other requirements will be mainly for the reduction process via the electrolytic process.
Other Information:

So, the reaction will be a continuous process that is highly efficient, as mentioned in the paper. Implementing the reaction is complex but requires less manpower than other industrial reactions. The min cost to set up this plant is around 30 crore, and the minimum economic size is 300 TPM. Also, this reaction provides an excellent margin profit, covering many drawbacks of setting up this industrial process. We don't have any solid wastes but liquid effluents that must be handled.

By- Products of the reactions include dilute acetic acid and aniline, which can be used in other production processes, but currently, we are not planning to use these.

Regarding the reaction condition, each step has its own condition, which is mentioned in the last paragraph. The main purification steps include Crystallization and evaporation concentrator, which results in purity exceeding 99% above the FDA guidelines. Also, yield can reach as high as 90 % on a lab scale, and on a large scale, it can reach up to 75%, which is considered good enough for a plant to continue working on significant profit margins.

A few brief steps with reaction conditions are:

1)After displaced air 8～12 minutes, be heated to 180 ℃ and pass into H_2, to hydrogen partial pressure be 1.0MPa, reacted 6 hours, make oil of mirbane be converted into p-aminophenol.

2)After the reaction of the above step finishes, while hot with reacting liquid filtering, separate solid-phase catalyst and reaction solution

3)The reaction solution that leaches distills under 0.05～0.1MPa pressure in 40～100 ℃, steams by product aniline and part water.

4)The reaction solution of isolated aniline in the 4th step is cooled to 30～50 ℃, and the acylating agent, acetic anhydride, is 1.0:1.0 that acetic anhydride.

5) In this step, it is 15ml that the 4th reaction solution obtained of step is carried out evaporation concentration to the reaction solution volume, is cooled to 0 ℃～5 ℃, and crystallization filters, and the crystallization obtained is paracetamol, and the yield of paracetamol is 72%. The crystalline mother solution returns to the reactor and recycles.

During the reduction process, one needs to remember that the solution must be highly acidic to avoid the aniline residual product, or else we will end up with low efficient process and will not be able to sustain much.

About the electrode:

4-aminophenol was electrochemically detected with the VMSF/ITO electrode, so we will use the same electrode. Some basic info for electrodes:

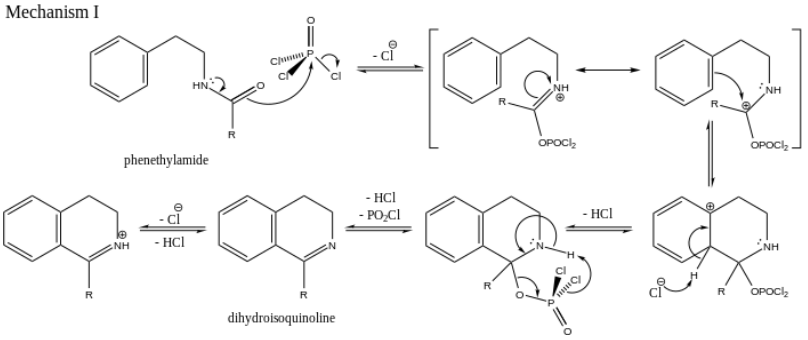
Transmission electron microscopy (TEM) was utilized to characterize the VMSF initially grown on the ITO electrode. In Fig. 1A, it can be observed that the VMSF exhibits uniform and well-aligned pores, each with a diameter ranging from 2 to 3 nm and an overall porosity of approximately 16.7%. Notably, the VMSF structure remains intact without any signs of cracking. Fig. 1B presents a cross-sectional view TEM image of the VMSF, revealing a thickness of around 83 nm. This structure aligns with previous reports, confirming the presence of a vertically and regularly arranged nanochannel structure in the VMSF material.

- **Alternative approach:**

  So, this reaction is a plant-based way to reach our required product, but only a little data is available in the report. Also, this reaction has excellent potential due to its uniqueness in the process. This is produced from **Para-Hydroxy acetophenone Hydrazine**.

  Raw materials include the component itself, and acetic anhydride is a significant part. Its efficiency is higher than many other processes. It is a continuous process and is mainly automated in the industry, but the plant setup cost is very high, reaching up to 300 crores; hence not very diversified.

  The reaction is not direct. It has an alternative approach, which is called the Bischler-Napieralski reaction.



This reaction depicts a primary reaction mechanism as the direct reaction is not for public view.

Many alternative approaches are available, like the phenol route PNCB route, and steps and other information are listed publicly. Still, our primary focus won't be on these steps as they have been used for a long while, but those mentioned above are new to the industry and show promising results.

References:

1) Google patent:https://patents.google.com/patent/CN103113254A/en
2) ScienceDirect: https://www.sciencedirect.com/science/article/abs/pii/S1566736709001289
3) dsir source: https://www.dsir.gov.in/sites/default/files/2019-12/tsr131.pdf
4) DriveLink: https://drive.google.com/drive/folders/1Fn4FNy-pX30lmwPLXeF_6e13ndFcW9VJ?usp=sharing

List the contributions of each author:

- Author 1 did a large part in describing the primary reaction and the alternative approach to reach the desired product.
- Author 2 writes about reaction conditions and electrodes that are to be used. He also gave Proof reading of the report, mentioning the minute details.
- Authors 3 and 4 worked on the yield, efficiency, and other parameters necessary to finalize the reaction.

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