

## Match Maker/ Pharmaceutical Process Innovations/ 20 March 2025

# A cost effective and green process for the synthesis of p-Aminophenol (PAP) from p- Chloronitrobenzene (PCNB)

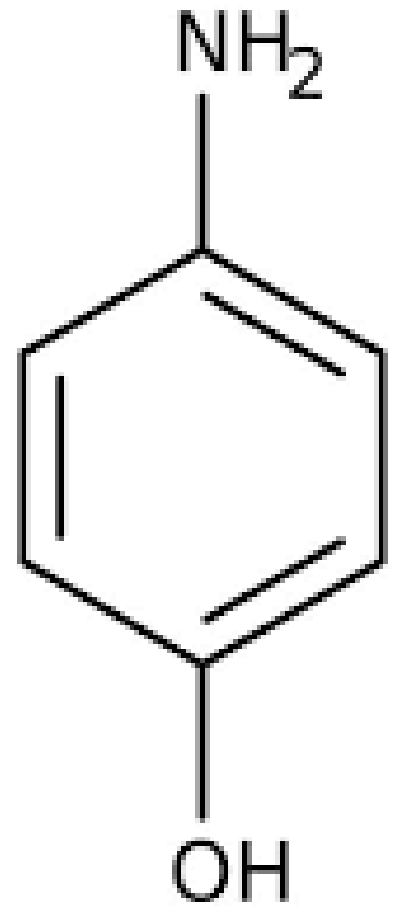
**Lead Inventor: Dr. Sanjay Kamble**

Organization: CSIR-NCL

TechEx.in Case Manager: Pradnya Aradhye (pradnya@ventercenter.co.in)

# What is p-Aminophenol (PAP)?

- p-Aminophenol (4-aminophenol), with the chemical formula C<sub>6</sub>H<sub>7</sub>NO, is an organic compound used as an intermediate in the **production of analgesics and antipyretics (paracetamol)** and a developer in black-and-white film, a precursor in hair dye formulations.
- Production of p-Aminophenol is included in Production Linked Incentive (PLI) Scheme from the Government of India.
- EXIM Data Price: 1.5–2.5 \$/Kg (Country of origin: China)



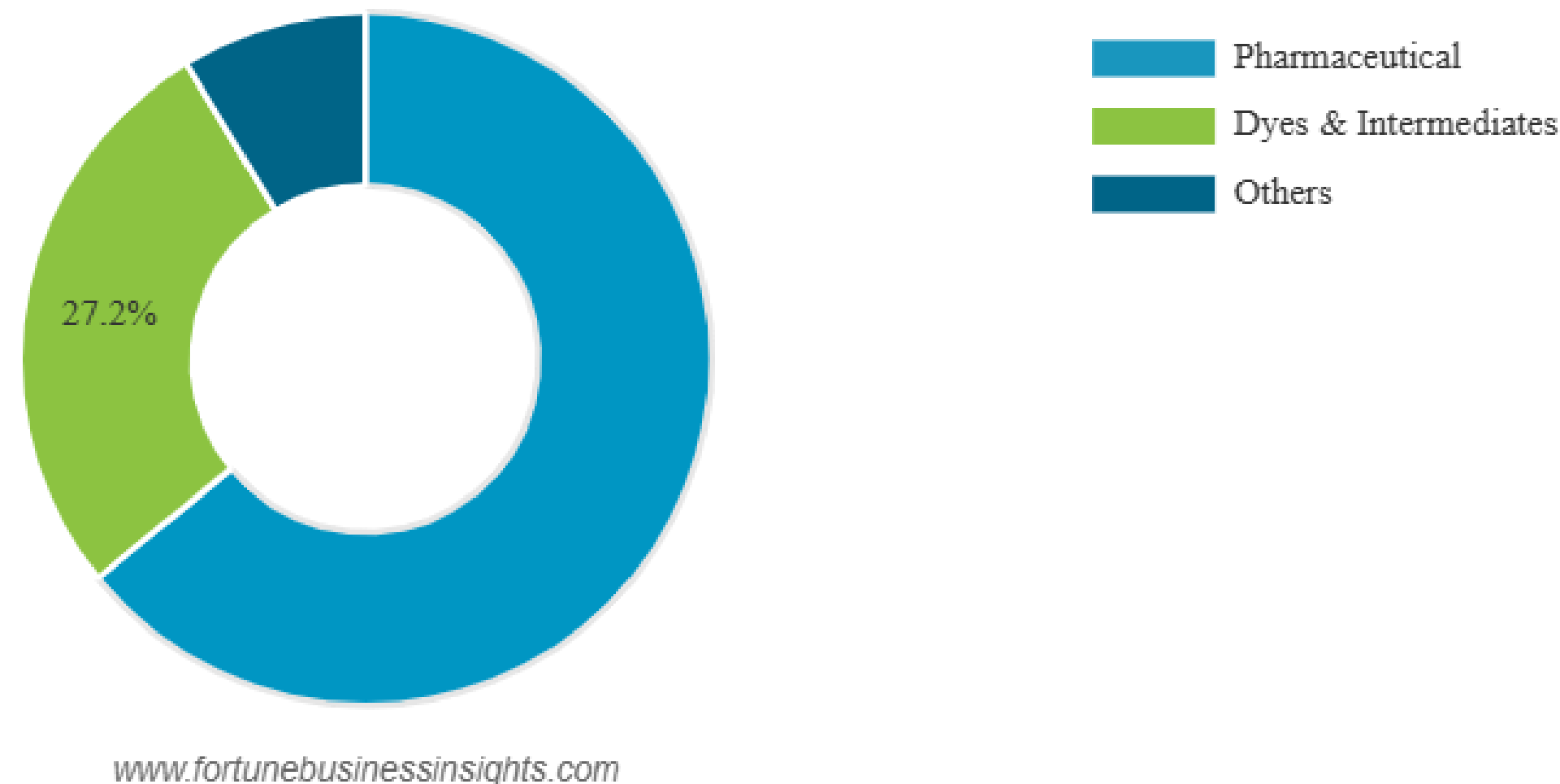
# Market Opportunities

Global Para Aminophenol Market Share, By End-use Industry, 2023

The global para aminophenol market size was valued at USD 620 million in 2023. Source: Fortune Business Insights

## Industry

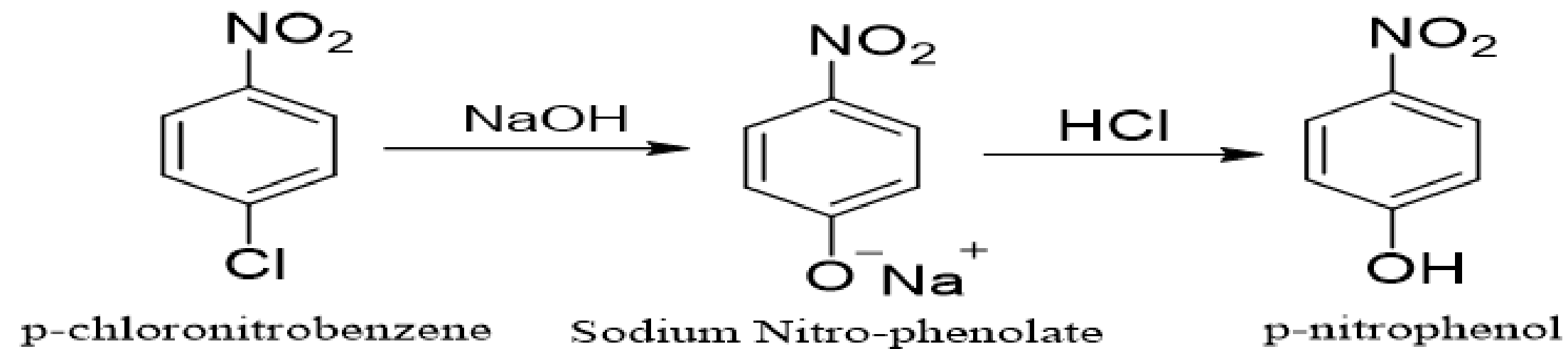
Innovator : El Du Pont de Nemours and Co  
US Patent No. 2,765,342.  
Priority date: 22 Oct 1952



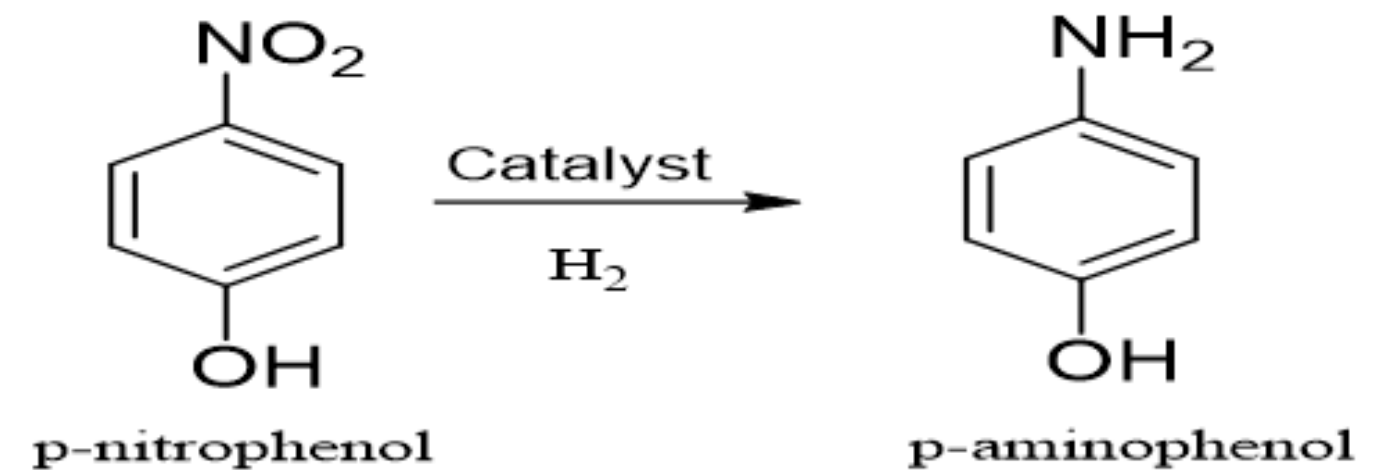
**Several players:** Glentham Life Sciences Ltd. (England), Wego Chemical Group (U.S.), Central Drug House (India), Taixing Yangzi Pharm Chemical Co., Ltd. (China), Haihang Industry (China), Hefei TNJ Chemical Industry Co., Ltd. (China), Valiant Organics Ltd. (India), SEQENS Group (France), Jayvir Dye Chem (India), Parachem Fine & Specialty Chemicals (U.S.), BHARAT CHEMICALS (India), Sadhana Nitro Chem Limited (India)

# Existing Commercial Process

Step 1: Synthesis of p-nitrophenol from p-chloronitrobenzene

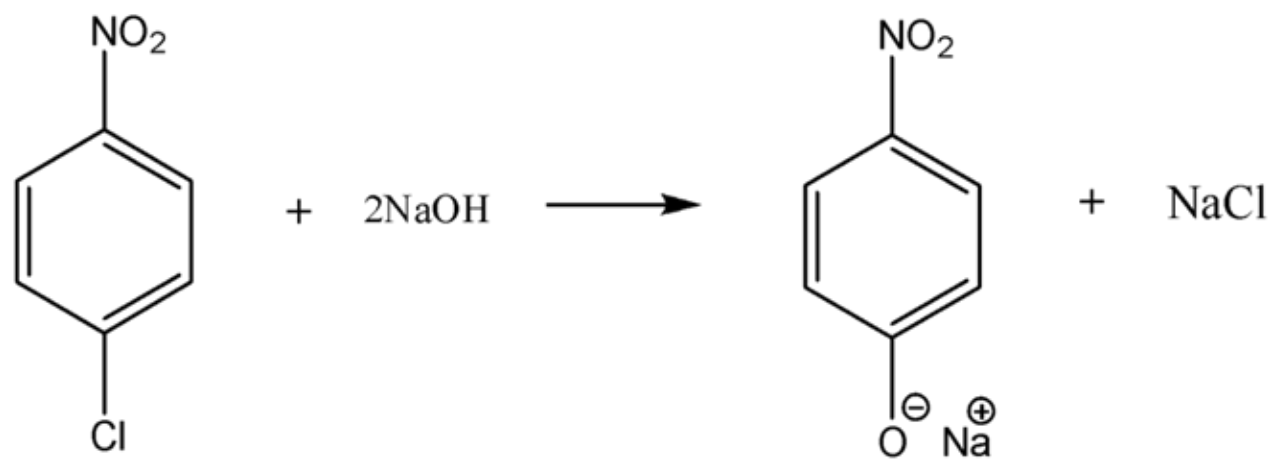


Step 2: Synthesis of p-aminophenol from p-nitrophenol.

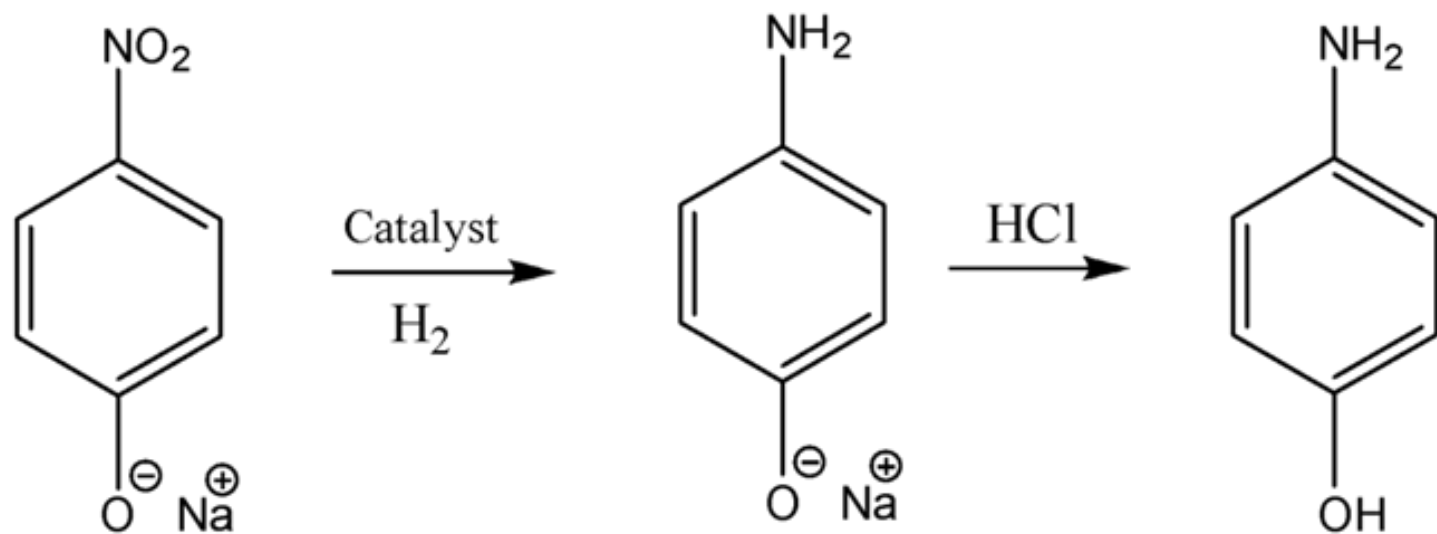


# NCL Process: Direct hydrogenation of Sodium nitrophenolate

Step 1: Synthesis of sodium-nitrophenolate from PNCB.



Step 2: Synthesis of p-aminophenol from sodium-nitrophenolate



## Process features:

- PAP productivity has increased more than 20-times compared to the conventional process owing to highly soluble Sodium-nitrophenolate in water.
- Effluent generation has been reduced by approximately 50% compared to the commercial process.
- A non-noble metal catalyst has been developed, which remains effective for multiple recycles.
- Wastewater generation minimized via recycle and reuse of alkaline water in process, therefore no waste generation.

## Product features:

- A stable and light brown colour
- Synthesized product PAP has purity 98-99 %
- Yield: 85%

# Who should be interested and why?

## Who

Paracetamol producing drug companies

Petrochemical Industries

## Why

Heavy reliance on China based companies with highly fluctuating costs. Therefore most of pharma companies wish to manufacture PAP in-house to enhance self-sufficiency.

Petrochemical Industries looking to diversify into chemical and pharmaceutical manufacturing. As part of this strategy, they have identified key molecules used in the pharmaceutical industry as Key Starting Materials (KSM), with p-Aminophenol (PAP) being one of them.(starting material PNCB)

# Current status

## Technology Status :

- Status of the technology – TRL 4
- Demonstrated at 0.5 Kg scale

## Patent Status :

- Patent coverage: India
- Priority date: 2023
- Status: India: Filed No: 202311061153

# VALUE PROPOSITION OF NCL PROCESS

- Using non-Nobel metal catalyst (Nickel based), recyclable multiple times.
- More product is formed in reactor of same volume resulting in better productivity per reactor volume
- Yield 85–90%
- 98–99% purity, can be improved further
- Can get colourless product
- Water is used as solvent and can be recycled
- Estimated Raw Material Cost is comparable to landed cost → 2 \$ /kg of product synthesized



# Team & Organization



## Dr Sanjay Kamble

Senior Principal Scientist  
CEPD Division

National Chemical Laboratory, Pune.

- Areas of expertise:
  - Process intensification
  - Conversion of biomass into valuable chemicals
  - Depolymerisation of plastics
  - Process development and scale-up, and the treatment of industrial using advanced oxidation processes (AOPs).
- Awards and Honours:
  - NCL RF-CIPLA Hamied award (2019,2020,2021 & 2022)
  - FMASc by Maharashtra Academy of Sciences, 2016
  - CSIR Young Scientist Award by CSIR, Government of India, 2010
- Life fellow of Indian Chemical Society (LM 8440) by Indian Chemical Society

## About the Institute

CSIR-NCL is a science and knowledge based research, development and consulting organization. It is internationally known for its excellence in scientific research in chemistry and chemical engineering as well as for its outstanding track record of industrial research involving partnerships with industry from concept to commercialization.

## Process Development Group @ CSIR-NCL

Key assets and strengths of the team:

- Well-equipped laboratories facilities, Pilot plant facility viz Fixed bed reactor FBR (500 gm capacity); Agitated thin film dryer (ATFD), Short path distillation (SPD), High pressure reactor (10 Lit capacity), continuous distillation assembly, Stirred batch reactor ( 500 ml to 100 Lit) advanced analytical instruments.
- Strong collaborations with academia, industries, and research organizations.
- A significant number of patents and technology transfers to industries.
- Focus on translational research to address industrial and societal challenges.
- Strong track record of developing scalable technologies for industrial applications
- Best commercialized technology Award for the “Continuous Process for Production of Paracetamol” during year 2023-24.

# Infrastructure and Analytical facilities



ATFD



SPDU



High Pressure Reactor 10 L



Continuous Plug flow Reactor



Reactive Distillation facility



Fixed Bed Reactor



Wastewater Treatment facility

# Industry collaborations: Process Development Group



# Next Steps

- CSIR-NCL has developed lab scale process for the preparation of PAP.
- Developed downstream processing methodology for purification of PAP.
- Impurity profiling of PAP has been established.
- Looking forward for Industrial partners who are interested in Know-how transfer or sponsoring further technology advancement and scale-up or licensing the technology as-is basis, where-is basis.

## Seeking

Industrial partners interested in technology licensing

Industrial partners interested in sponsoring further technology advancement and scale-up

Industrial partners interested in raising 3rd party funds for a collaborative project.

Industry interested in tapping scientist capabilities as an expert/consultant.



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