RECOVERY OF PARACETAMOL AND ACETIC ACID FROM WASTE WATER GENERATED FROM PARACETAMOL SYNTHESIS

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ABSTRACT

An improved process for the synthesis of paracetamol. p-aminophenol is acetylated in aqueous medium to produce a crude aqueous reaction mixture and paracetamol product is recovered by crystallization from an aqueous system comprising the reaction mixture. According to the improvement, paracetamol recovered by filtration and the filtrate containing acetic acid & dissolved paracetamol. The filtrate(as a solvent) as a required amount send to the reactor for paracetamol synthesis and excess amount filtrate store in a storage tank for distillation. According to that, required amount filtrate used as a solvent from 2nd batch to 12th batch, finally total filtrate goes to distillation to recovery acetic acid and distilled residue goes to another storage tank for neutralization and after filtration, the filtrate as inffluent goes the solar panel for evaporation and collected a small scale residue from solar panel goes to incineration.

KEYWORDS: Recovery, paracetamol, paracetamol synthesis, acetic acid, waste water.

I. INTRODUCTION

Paracetamol was first synthesized in 1878 by Morse, and introduced for medical usage in 1883.However, due to misinterpretation of its safety profile, it enjoyed only limited use until the1950s, when the chemically similar, and up until then preferred analgesic, phenacetin was with-drawn because of renal toxicity. Paracetamol is now probably the most commonly used drug worldwide, available over the counter, used in almost all ages, and forming Step 1 of the WHO analgesic ladder. First-line treatment for pain and pyrexia, it plays an important role in multimodal analgesia,1,2and is considered to possess a generally excellent safety profile except in significant overdose, with few drug interactions. Oral and rectal administration can produce analgesia within 40 min, with maximal effect at 1 h, but large variations in bio-availability (ranging from 63 to 89% for oral, and24 to 98% for rectally administered preparations)can make the onset and duration of action unpredictable. The introduction of its i.v. administered formulation within the last decade not only over-comes this issue of bioavailability that limits its speed of onset, but its ease of use when internal administration is not possible has also cemented its position within virtually every anesthetic/preoperative pain management plan. The onset of analgesia after i.v. paracetamol occurs within 5min, peaking at 40–60 min, and lasting 4–6 h.3 high a dose can result in liver failure. It appears to be safe during pregnancy and when breastfeeding. In those with liver disease, it may still be used, but in lower doses. It is classified as a mild analgesic. It does not have significant anti-inflammatory activity and how it works is not entirely clear.

II. OBJECTIVE:

- Recovery of paracetamol from discarded influent
- Recovery of acetic acid as 70% - 80% from discarded influent
- Reduction in influent generation and treatment cost

III. MATERIAL AND METHODS:

Apparatus & instruments

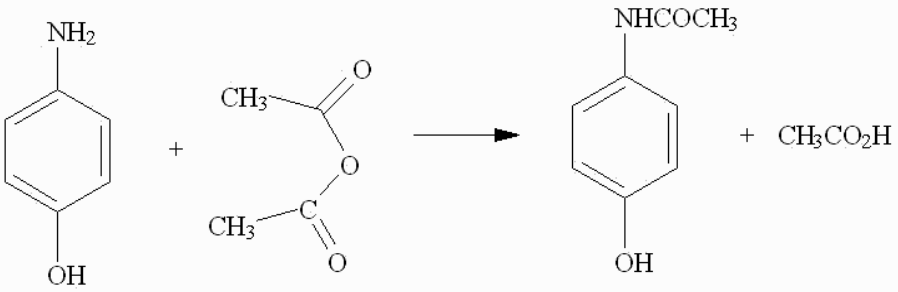
- Preparing N-(4-hydroxyphenyl)ethanamide - Paracetamol
- Two 50 cm3 conical flasks
- Magnetic stirrer
- One 100 cm3 beaker
- Tripod and gauze
- Bunsen Burner
- Thermometer (-1 0 "C to 11 0 "C)
- Buchner flask, funnel and filter papers
- Melting point apparatus
- Glass rod or magnetic stirrer
- One 10 cm3 and one 50 cm3 measuring cylinder
- Clamp and stand
- Access to oven and fume cupboard
- Ice and water supply
- Water pump
- Eye protection
- **Chemicals :** 4-Aminophenol , Ethanoic anhydride , Solvent DM water

Acetylation Reaction:

- In the 50 cm3 Conical flask, 2.6 ml DM Water of required quantity is taken from source
- Para amino Phenol powder (Batch qty, 3.00 g) is charged into the Reactor directly through Pneumatic conveying system .
- Then heating is applied to heat the mass up to 40^{o}C.
- Acetic Anhydride (Predetermined Qty , 2.89 g) is taken in Receiver from Storage Tank or receiver
- Acetic Anhydride charging is started at slow rate by monitoring temperature.
- Apply Steam to the Jacket, the reaction will take place for 50 minutes
- After the reaction stop Steam heating and apply Cooling from Cooling Unit.
- The total mass is allowed to cool upto 40^{o}C.
- After cooling the Product, stop Cooling and apply Chilling from Chiller Until 15^{o}C.
- Reaction mass will get crystallize. The by-product Acetic Acid is formed.

Note: In a series of consecutive twelve (12) batches DM water is used in First Batch and rest 11batches used ML (Crude) from the previous batch as per quantity required. The Excess ML (Crude) is collected for the Distillation Unit for distillation to recovery Acetic Acid and dissolved paracetamol.

REACTION:



p-aminophenol
material used: 2.1 g

acetic anhydride: MW =102
material used: 2.0 mL
density: 1.10 g/mL

Note: The quality of p-aminophenol is of sufficient that Norit treatment should not be necessary.

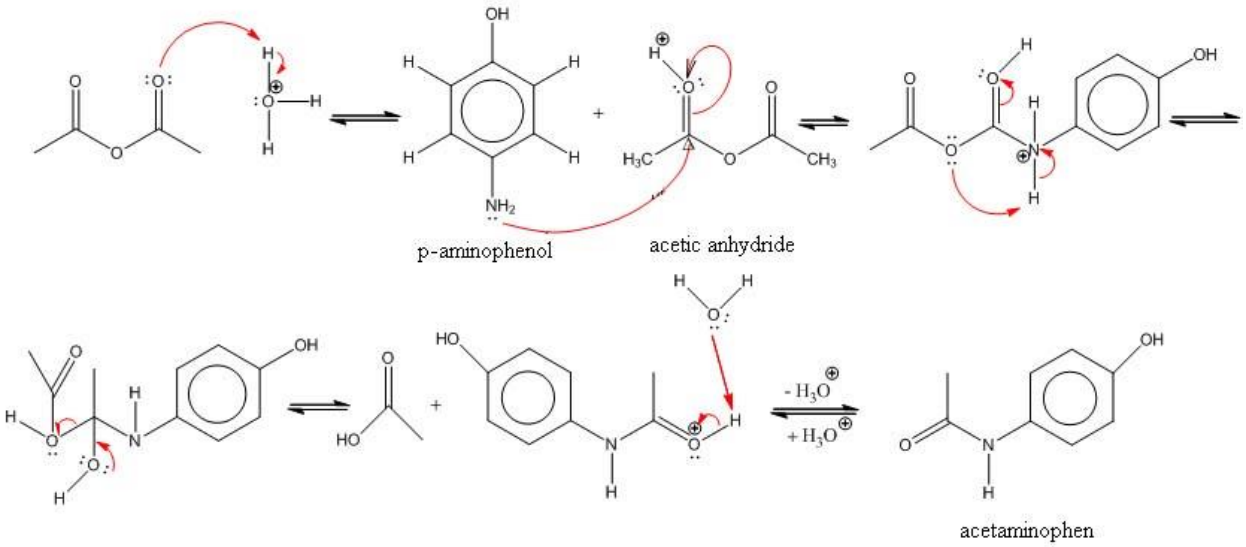
para -amino phenol: C6H7NO, MW 109,

Acetic anhydride: C4H6O3, MW 102,

Aceetic acid, CH3COOH, MW 60,

Paracetamol, C8H9NO2,MW151.16

REACTION MECHANISM:



FILTRATION:

- Drop the reaction mass into centrifuge machine or filter
- Spin dry 20 min
- Collect mother liquor , ML to storage tank for next batch uses as solvent, excess ml transfer to distillation.
- Washed water collect to separated storage tank for distillation to collect dissolved paracetamol.
- Weigh the total reaction mass as crude paracetamol.

PURIFICATION:

S.No.	Raw Materials	R. No.	Unit	Theoretical Weight
1.	Mother Liquor (Purified)	-	ML	~ 11.0
	Demineralized Water (DMW)	-	ML	~ 11.0
2.	Crude Paracetamol	-	g	3.87
3.	Sodium Hydroxide		g	0.037
4.	Activated Charcoal (Activated Carbon)		g	0.02
5.	Sodium Hydrosulfite		g	0.004
6.	Demineralized Water (DMW) Chilled**	-	ML	0.69

- In the Conical flask,PL(purified Liquor) / 11.0 ml DM Water of required quantity is taken from source.
- Crude paracetamol (Batch qty, 3.87 g) is charged into the Reactor directly through Pneumatic conveying system.
- Then heating is applied to heat the mass up to 91°C-93°C.

- Add sodium hydroxide (Predetermined Qty , 2.89 g) to maintain pH 5.6 -5.9.
- raise the temperature to the reaction mass to 96ºC-97ºC temperature.
- Add the AC to the reaction mass
- Apply Steam to the Jacket, maintain the temperature for 30 minutes.
- Circulate steam through sparkler filter and filtration line for 20 to 30 minutes
- Turn on the sparkler filter for approx. 40 min and coolect sample to ensure the carbon free.
- If carbon free, transfer the dissolved paracetamol to another reactor maintaining 96ºC-97ºC .
- After the reaction stop Steam heating and apply Cooling from Cooliissolev paracetamol to another reactor maintaining approx. 96ºC-97ºC and add the sodium hydrosulfite. .
- The total mass is allowed to cool upto 40ºC through water circulation.
- After cooling the Product, stop Cooling and apply Chilling from Chiller Until 15ºC.
- Reaction mass will get crystallize.

FILTRATION:

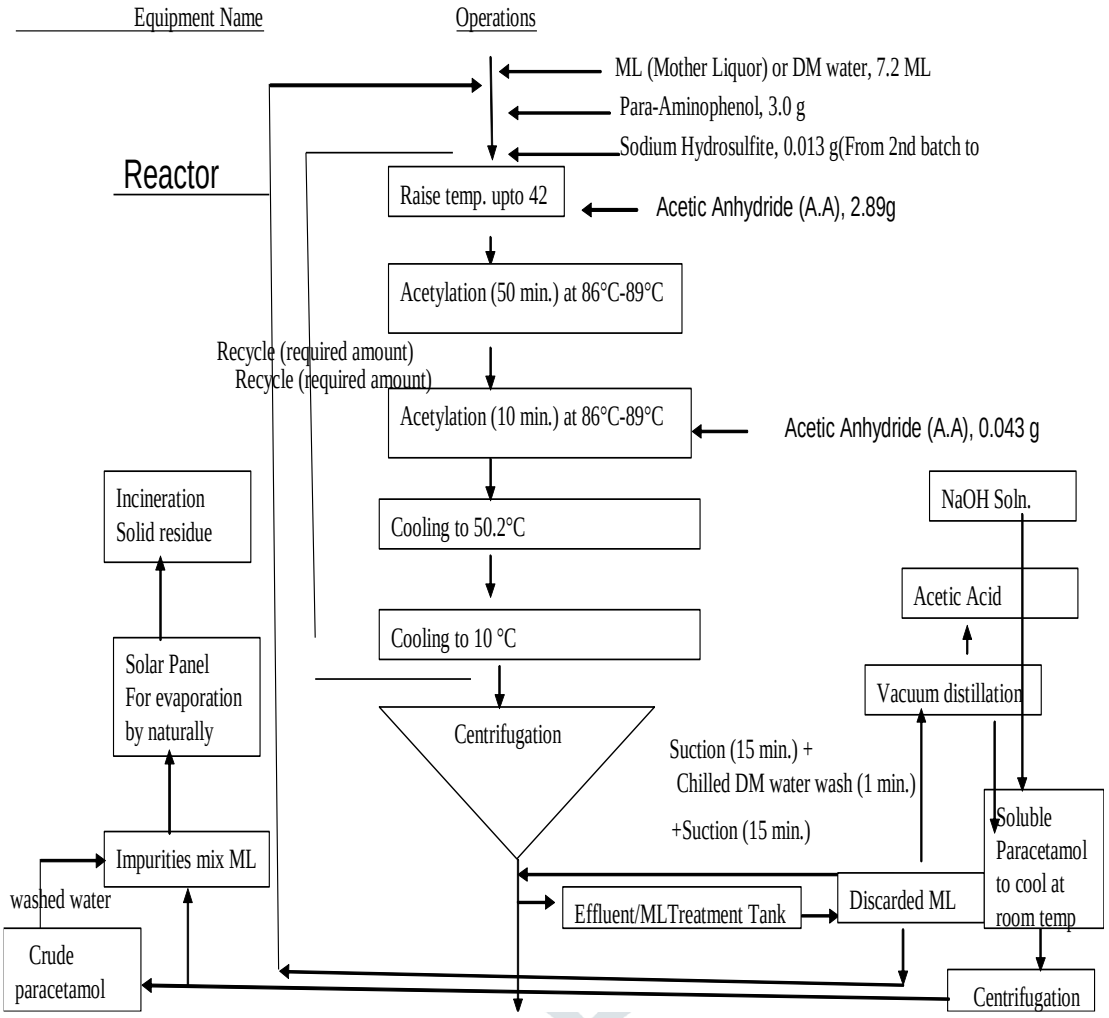
- Drop the reaction mass into centrifuge machine or filter
- spin dry 20 min
- collect mother liqour , ML to storage tank for next batch uses as solvent.
- washed water collect to separated storage tank for distillation to collect dissolved paracetamol.
- Weigh the total reaction mass as purified paracetamol.

Note: In a series of consecutive twelve (12) batches ML (Purified)/DM water is used in First Batch and rest 11batches used ML (purified) from the previous batch as per quantity required. After 12 batches, purified ml to be purified by using activated carbon and sodium hydrosulfite. if no activated for use, total purified ml transfer to distillation unit to collect dissolved paracetamol.

DRYING

- Purified paracetamol transfer to dryer to dry at 90oC for 45 minutes and collect.

METHODOLOGY



IV. RESULT AND DISCUSSION

Experimental paracetamol and acetic acid sent to ACI pharmaceuticals,in Bangladesh for test, All testing parameters of paracetmol and acetic acid meet as per specifications, as a result paracetamol quality is good and the percentage of acetic acid is 72%.

V. REFERENCES

1."Paracetamol " University of oxford centre for suicide research . 25 march 2013. archived from the original on 20 march2013, rretrived 20 april 2013.

2."International listing for paracetamol" archived from the original on 06 january 2016. Retrived 11 january 2016.

3.Advanced practical medicinal chemistry by ashutush kar;new age international (p) ltd publishers(2004). page no. 88

4.Martindale,The Complete Drug Reference, ed. S. C. Sweetman, Pharmaceutical paraceetamool product Press, London, 37th ed., 2011, volume A, p. 112.

5.A. C. Moffat, M. D. Osselton, and B. Widdop (eds), Clarke's Analysis of Drugs and Poisons, Pharmaceutical Press, London, 4th ed., 2011, volume 2, pp. 1856-1858.

6. G. G. Graham, M. J. Davies, R. O. Day, A. Mohamudally, and K. F. Scott, Inflammopharmacology2013, 21, 201-232.

7.J. A. Hinson, D. W. Roberts, and L. P. James, Handbook of Experimental Pharmacology, Adverse Drug reactions, Springer, Berlin, 2010, chapter 12, 369-405. doi:10.1007/978-3-642-00663-0_12

8.The Merck Index. An Encyclopedia of Chemicals, Drugs, and Biologicals, Merck and Co., Whitehouse Station NJ, 14th ed., 2006, p. 9 and p. 78.

9. A. I. Vogel, Vogel's Textbook of Practical Organic Chemistry, Longman Scientific & Technical, New York, 5th ed., 1989, Experiment 6.109, p. 985.

10. Agreda, victor H, and Joshep R. Zoeller (eds). Acetic Acid and its derivatives. CRC press,1992. ISBN 0824787927.

11. Acetic Acid. *NIST*. Retrieved April 3, 2018.
12. Geoffrey Martin, *Industrial and Manufacturing Chemistry, Part 1, Organic* (London: Crosby Lockwood, 1917), 330–331.
13. Helmut Schweppe, "Identification of dyes on old textiles," *J. Am. Inst. Conservation* 19(1) (1979): 14–23. Retrieved April 3, 2018.
14. R. E. Jones and D. H. Templeton, "The crystal structure of acetic acid." *Acta Crystallogr*. 11(7) (1958): 484–487.
15. James M. Briggs, Toan B. Nguyen, and William L. Jorgensen, "Monte Carlo simulations of liquid acetic acid and methyl acetate with the OPLS potential functions," *J. Phys. Chem.* 95 (1991): 3315-3322.