Nature of Invention: Process design

Applicant: ChemiEvolve Industries

Inventors: Adarsh Pal, Raj Patel, Manas Dhakad, Akash Kumar Gupta

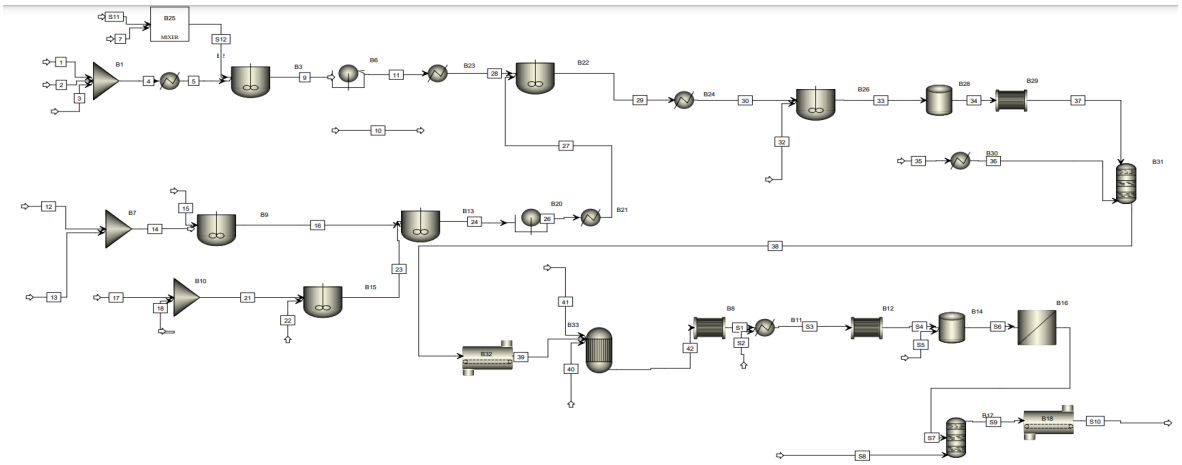
Chemical Formula: $(C_6H_4CO_2H)_2$

Chemical Name: Diphenic Acid

Process Title: Production of **Diphenic Acid** from the diazotization of **Anthranilic Acid** followed by reduction with copper(I)

Process Description:

Block Diagram



Equipment Labelling

Mixers: B_1, B_7, B_{10}, B_{25}

Heat Exchangers & Boilers: B_2, B_8, B_{11}, B_{12}, B_{21}, B_{23}, B_{24}, B_{29}, B_{30}

Storage & Cooling: B_{14}, B_{28}

Stirrers: B_3, B_9, B_{13}, B_{15}, B_{22}, B_{26}

Separators (filters, precipitators, driers): B_6, B_{16}, B_{17}, B_{18}, B_{20}, B_{31}, B_{32}

Process Conditions

Stream(s)	Condition(s)
4 and 5	Product cooled to ice point
28 and 5	Product cooled to 5°C
27 and 26	Reducing solution cooled to 10°C
30 and 29	Product cooled to 10°C

Mass Balance & Stream Labelling

Stream No.	Component(s) (C)	Flow Rate (R)
1	HCL	86.95 L/day
2	Anthranilic Acid	47.26 kg/day
3	Water	141.78 L/day
S11	$NaNO_2$	24.84 kg/day
7	Water	0.184 kg/day
4	C_1, C_2, C_3	262.49 L/day
5	-	262.49 L/day
S12	C_{S11}, C_7	25.02 kg/day
9	$C_{S12,}$ C_5	273.82 L/day
11, 28	Diazonium solution	10 cm^3/day
12	$CuSO_4.5H_2O$	85.8 kg/day
13	Water	340.476 L/day
15	NH_4OH (conc.)	143 L/day
17	Hydroxylammonium	28.6 kg/day

	sulphate	
18	Water	81.7 L/day
22	NaOH (sol.)	57.87 L/day
21	C_{17}, C_{18}	110.3 kg/day
14	C_{12}, C_{13}	426.276 kg/day
16	C_{14}, C_{15}	552.116 kg/day
23	C_{22}, C_{21}	233.56 kg/day
24	Reducing Sol.	785.67 kg/day
26	Filtration of reducing sol.	786.67 kg/day
27	Cooling of reducing sol.	786.67 kg/day
29	C_{28}, C_{27}	786.68 kg/day
30	C_{29}	786.68 kg/day
32	Makeup stream (partly optional)	-
33, 34	C_{30}	786.68 kg/day
37	C_{34} (After boiling)	786.68 kg/day
35	HCL (conc.)	300 kg/day
36	C_{35}	300 kg/day
S5	HCL (conc.)	6N and excess
S10	Diphenic Acid	1000 kg/day

Capital cost (only for the reactor):

Reactors	**Capacity (litre)**	**Cost ($)**
For Anthranilic acid	950	22,600
For $CuSO_4$	1400	27,700

		Total cost = $50,300

References:

1. http://www.matche.com/equipcost/Reactor.html

List the contributions of each author:

- **RAJ PATEL** and **MANAS DHAKAD** converted the lab scale design of the process flow into an industrial design design and performed the scale up process.
- **ADARSH PAL** and **AKASH KUMAR GUPTA** calculated the respective flow rates in the streams of the diagram and computed the capital cost of the reactors.

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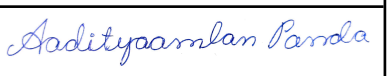
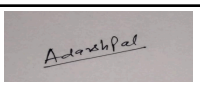
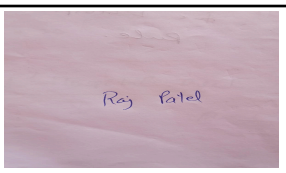
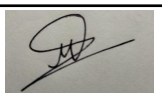
Aadityaamlan Panda	220007	
Adarsh Pal	220054	
Raj Patel	220860	
Manas Dhakad	220610	
Akash Kumar Gupta	220095