Annexure-I

List of Products

Sr. No.	Name of product	Quantity (MT/month)		
		Existing	Proposed	Total
Isophthalic Acid derivatives				
1.	Dimethyl 5- SodiosulfoIsophthalate	30	50	80
2.	5-Sodiosulfo Isophthalic Acid (Na-SIPA)	20	30	50
3.	5-Lithosulfo Isophthalic Acid (Li-SIPA)	00	20	20
4.	5-Hydroxy Isophthalic Acid (5-HIPA)	05	05	10
5.	5-Sodio Sulpho-bis-(B-Hydro Xyethyl) Isophthalate (Na-SIPHE)	00	10	10
6.	5-Nitro Isophthalic Acid (5-NIPA)	00	50	50
7.	Dimethyl 5-Nitro Isophthalate (DM 5-NIPA)	00	50	50
8.	Mono Methyl 5-Nitroisophthalic Acid (MM 5-NIPA)	05	05	10
9.	5-Amino Isophthalic Acid (5-AIPA)	05	05	10
10.	Dimethyl 5-Amino Isophthalic Acid (DM-5-AIPA)	00	10	10
11.	5-Amino Tri Iodo Isophthalic Acid (ATIPA)	00	05	05
12.	5-Amino Tri Iodo Dichloride	00	05	05
13.	5-Lithio Sulpho-bis-(B-Hydro Xyethyl) Isophthalate (Li-SIPHE)	00	10	10
14.	5-Amino N-N-Bis(2-3 Dihydroxy Propyl) Isophthalamide HCl (ABA-HCl)	00	50	50
15.	5-Amino N-N-Bis(2-3 Dihydroxy Propyl) 2,4,6 TriIodo Isophthalamide (ABATRIIODO)	00	10	10
16.	5-Acetylamino N-N-Bis(2-3 Dihydroxy Propyl) 2,4,6 TriIodo Isophthalamide (ACETRIIODO)	00	10	10
Benzoic Acid Derivatives				
17.	3,5 Di Nitro Benzoic Acid (DNBA)	00	20	20
18.	3,5 Di Amino Benzoic Acid (DABA)	00	20	20
19.	2-Chloro 5-Nitro Benzoic Acid	00	05	05
20.	4-Chloro 3,5 Di Nitro Benzoic Acid (4Cl DNBA)	00	05	05
21.	4-Chloro 3,5 Di Amino Benzoic Acid (4Cl DABA)	00	05	05
22.	4-Chloro 3,5 Di Amino Benzoic Acid Isobutyl Ester (4Cl DABA)	00	05	05

23.	3 Sulpho Benzoic Acid Sodium Salt	00	05	05
Thiopene Derivatives				
24.	Thiopene 2-Aldehyde	05	05	10
25.	Thiopene 2-Acetyl	05	05	10
26.	Thiopene 2-Methanol	05	00	05
27.	Thiopene 2-Carbo Oxalyic Acid	05	00	05
28.	**4-Amino Pyridine (4AP)**	**00**	**05**	**05**
29.	**Bromo benzene**	**00**	**10**	**10**
	Total	**85**	**415**	**500**
By Products				
1.	Sodium Nitrate solution	00	22	22
2.	Hydrochloric Acid 25%	00	4.16	4.16
3.	Aluminium chloride solution	00	34	34
4.	Sulfuric Acid (50 to 70%)	70	670	740
5.	HBr Solution	00	28	28
6.	Sodium Bisulphate Solution	00	8.5	8.5
7.	Acetic Acid	00	19.0	19.0
8.	IBA	00	6.0	6.0
	Total	**70**	**791.66**	**861.66**

List of Raw Materials

Sr. No.	Name of Raw Materials	Quantity (MT/month)		
		Existing	Proposed	Total
Dimethyl-5-Sodiosulfo Isophthalate (SIPM)				
1.	Oleum (23%)	41.10	68.50	109.60
2.	Isophthalic Acid	18.60	31.00	49.60
3.	Methanol	48.00	80.00	128.00
4.	Sodium Carbonate	13.20	22.00	35.20
5-Sodio Sulfo Isophthalic Acid (Na-SIPA)				
1.	Oleum (23%)	30.50	45.75	76.25
2.	Isophthalic Acid	13.80	20.70	34.50
4.	Sodium Hydroxide	4.00	6.00	10.00
5-Lithio Sulfo Isophthalic Acid(Li-SIPA)				
1.	Oleum (23%)	00	31.560	31.560
2.	Isophthalic Acid	00	14.280	14.280
3.	Nitric Acid (98%)	00	10.720	10.720
4.	Lithium Hydroxide	00	4.280	4.280
5-Hydroxy Isophthalic Acid (5-HIPA)				
1.	Oleum (23%)	11.05	11.05	22.10
2.	Isophthalic Acid	5.00	5.00	10.00
3.	Caustic Soda	4.00	4.00	8.00
6.	HCl (30%)	2.43	2.43	4.85
5-Sodio Sulpho-Bis-(B-Hydro Xyethyl) Isophthalate (Na-SIPHE)				
1.	Oleum (23%)	00	4.43	4.43
2.	Isophthalic Acid	00	2	2
3.	Methanol	00	5.17	5.17
4.	Sodium Carbonate	00	1.42	1.42
5.	Mono Ethyl Glycol	00	8.08	8.08
5-Nitro Isophthalic Acid (5-NIPA)				
1.	Isophthalic Acid	00	100	100
2.	Sulphuric Acid	00	21	21
3.	Nitric Acid (98%)	00	42.5	42.5
Dimethyl-5-Nitro Isophthalate (DM 5-NIPA)				
1.	Sulphuric Acid	00	100	100
2.	Nitric Acid (98%)	00	18.9	18.9
3.	Isophthalic Acid	00	38.25	38.25
4.	Methanol	00	20	20
5.	Sodium Carbonate	00	1.25	1.25
Monomethyl-5-Nitro Isophthalic Acid (MM-5-NIPA)				
1.	Sulphuric Acid (98%)	11.2	11.2	22.4
2.	Nitric Acid (98%)	2.115	2.115	4.23
3.	Isophthalic Acid	4.285	4.285	8.57
4.	Methanol	41.44	41.44	82.88
5.	Caustic Soda	0.84	0.84	1.68
6.	Hydrochloric Acid (30%)	2.53	2.53	5.06

7.	Sodium Carbonate	0.14	0.14	0.28
5-Amino Isophthalic Acid (5-AIPA)				
1.	Sulfuric acid (98%)	12.3	12.3	24.6
2.	Nitric Acid (98%)	2.58	2.58	5.16
3.	Isophthalic Acid	5.23	5.23	10.46
4.	Caustic soda	1.23	1.23	2.46
5.	HCl	1.845	1.845	3.69
6.	Catalyst	0.06	0.06	0.12
7.	Charcoal	0.02	0.02	0.03
8.	Hydrogen	0.18	0.18	0.35
Dimethyl-5-Amino Isophthalic Acid (DM-5-AIPA)				
1.	Sulfuric acid (98%)	00	24	24
2.	Nitric Acid (98%)	00	4.53	4.53
3.	Isophthalic Acid	00	9.18	9.18
4.	Methanol	00	4.8	4.8
5.	Caustic soda	00	2.4	2.4
6.	Catalyst	00	0.12	0.12
7.	HCl	00	3.6	3.6
8.	Hydrogen	00	0.35	0.35
9.	Charcoal	00	0.03	0.03
10.	Sodium carbonate	00	0.3	0.3
5-Amino Tri 2,4,6,Tri Iodo Isophthalic Acid (ATIPA)				
1.	Sulfuric acid (98%)	00	4.43	4.43
2.	Nitric Acid (98%)	00	0.93	0.93
3.	Isophthalic Acid	00	1.885	1.885
4.	Caustic soda	00	0.445	0.445
5.	Catalyst	00	0.02	0.02
6.	HCl	00	1.665	1.665
7.	Hydrogen	00	0.15	0.15
8.	Iodine Mono-chloride	00	5.075	5.075
9.	Charcoal	00	0.005	0.005
5-Amino Tri Iodo Dichloride (5-ATIDC)				
1.	Sulfuric acid (98%)	00	4.165	4.165
2.	Nitric Acid (98%)	00	0.875	0.875
3.	Isophthalic Acid	00	1.77	1.77
4.	Caustic soda	00	0.415	0.415
5.	Catalyst	00	0.02	0.02
6.	HCl	00	1.565	1.565
7.	Hydrogen	00	0.06	0.06
8.	Charcoal	00	0.005	0.005
9.	Iodine Mono-chloride	00	4.77	4.77
10.	Thionyl Chloride	00	4.4	4.4
5-Lithio Sulpho-bis-(B-Hydro Xyethyl) Isophthalate (Li-SIPHE)				
1.	Oleum (23%)	00	3.4	3.4
2.	Isophthalic Acid	00	1.54	1.54
3.	Nitric Acid	00	1.15	1.15
4.	Lithium hydroxide	00	0.46	0.46

5.	Mono Ethylene Glycol (MEG)	00	8.16	8.16
6.	Catalyst	00	0.04	0.04
5-Amino N-N-Bis(2-3 Dihydroxy Propyl) Isophthalamide HCl (ABA-HCl)				
1.	Sulfuric acid (98%)	00	72	72
2.	Nitric Acid (98%)	00	13.6	13.6
3.	Isophthalic Acid	00	27.55	27.55
4.	Methanol	00	99.4	99.4
5.	Amino propanediol	00	29	29
6.	Sodium carbonate	00	0.9	0.9
7.	Catalyst	00	0.5	0.5
8.	Hydrogen	00	0.6	0.6
9.	HCl	00	26	26
5-Amino N-N-Bis(2-3 Dihydroxy Propyl) 2,4,6 TriIodo Isophthalamide (ABATRIIODO)				
1.	Sulfuric acid (98%)	00	8.29	8.29
2.	Nitric Acid (98%)	00	1.57	1.57
3.	Isophthalic Acid	00	3.17	3.17
4.	Methanol	00	11.44	11.44
5.	Amino propanediol	00	3.34	3.34
6.	Catalyst	00	0.06	0.06
7.	Hydrogen	00	0.07	0.07
8.	HCl	00	11.05	11.05
9.	Sodium carbonate	00	0.85	0.85
10.	Iodo monochloride	00	8.06	8.06
11.	Sodium bisulfate	00	1.01	1.01
5-Acetylamino N-N-Bis(2-3 Dihydroxy Propyl) 2,4,6 TriIodo Isophthalamide (ACETRIIODO)				
1.	Sulfuric acid (98%)	00	8.29	8.29
2.	Nitric Acid (98%)	00	1.57	1.57
3.	Isophthalic Acid	00	3.17	3.17
4.	Methanol	00	11.44	11.44
5.	Amino propanediol	00	3.34	3.34
6.	Catalyst	00	0.06	0.06
7.	Hydrogen	00	0.07	0.07
8.	HCl	00	11.05	11.05
9.	Sodium carbonate	00	0.85	0.85
10.	Iodo monochloride	00	8.06	8.06
11.	Sodium bisulfate	00	1.01	1.01
12.	Acetic anhydride	00	1.87	1.87
13.	Acetic acid	00	21	21
3-5-Dinitrobenzoic Acid (DNBA)				
1.	Sulphuric Acid (98%)	00	20.8	20.8
2.	Benzoic Acid	00	12.5	12.5
3.	Nitric Acid (98%)	00	13.5	13.5
3-5-Diaminobenzoic Acid (DABA)				
1.	Sulphuric Acid (98%)	00	30.58	30.58
2.	Benzoic Acid	00	18.38	18.38

3.	Nitric Acid(98%)	00	19.84	19.84
4.	Catalyst	00	0.18	0.18
5.	Hydrochloric Acid (30%)	00	4.5	4.5
6.	Sodium Carbonate	00	2.2	2.2
7.	Hydrogen	00	1.8	1.8
2-Chloro 5-Nitro Benzoic Acid (CNBA)				
1.	Sulphuric Acid (98%)	00	7.125	7.125
2.	Nitric Acid (98%)	00	1.875	1.875
3.	Chloro Benzoic Acid	00	4.25	4.25
4-Chloro 3,5 Di Nitro Benzoic Acid (4Cl DNBA)				
1.	Sulfuric Acid	00	5.675	5.675
2.	Nitric Acid	00	3.06	3.06
3.	PCBA	00	3.4	3.4
4-Chloro 3,5 Di Amino Benzoic Acid (4Cl DABA)				
1.	Sulfuric Acid	00	8.625	8.625
2.	Nitric Acid	00	4.65	4.65
3.	PCBA	00	5.17	5.17
4.	Sodium Carbonate	00	1.60	1.60
5.	Catalyst	00	0.115	0.115
6.	Hydrogen gas	00	0.40	0.40
7.	HCl	00	3.8	3.8
4-Chloro 3,5 Di Amino Benzoic Acid Isobutyl Ester (4Cl DABAIBE)				
1.	Sulfuric Acid	00	9.63	9.63
2.	Nitric Acid	00	4.12	4.12
3.	PCBA	00	4.575	4.575
4.	Sodium Carbonate	00	1.415	1.415
5.	Catalyst	00	0.1	0.1
6.	Hydrogen gas	00	0.36	0.36
7.	HCl	00	3.365	3.365
8.	Isobutyl Alcohol	00	8	8
3 Sulpho Benzoic Acid Sodium Salt				
1.	Benzoic Acid	00	3	3
2.	Oleum	00	8.7	8.7
3.	Soda Ash	00	3	3
Thiopene 2-Aldehyde				
1.	Thiopene	4	4	8
2.	Phosphorous oxychloride	4	4	8
3.	Dimethyl Formamide	3.75	3.75	7.5
4.	Caustic lye	4	4	8
5.	Methylene Dichloride(MDC)	3.75	3.75	7.5
Thiopene 2-Acetyl				
1.	MDC	10.625	10.625	21.25
2.	Acetyl Chloride	4.05	4.05	8.1
3.	Thiopene	3.85	3.85	7.7

4.	Aluminium Chloride	7.315	7.315	14.63
Thiopene 2-Methanol				
1.	Thiopene	4.32	00	4.32
2.	Phosphorous oxychloride	4.32	00	4.32
3.	Dimethyl Formamide	4.05	00	4.05
4.	Caustic lye	4.32	00	4.32
5.	Methylene Dichloride(MDC)	4.05	00	4.05
6.	Methanol	1.575	00	1.575
7.	Formaldehyde	1.25	00	1.25
8.	NaOH Solution	1.1	00	1.1
Thiopene 2-Carbo Oxalyic Acid				
1.	MDC	11.69	00	11.69
2.	Acetyl Chloride	4.455	00	4.455
3.	Thiopene	4.235	00	4.235
4.	Aluminium Chloride	8.045	00	8.045
5.	Sodium hypochlorite	3.575	00	3.575
6.	Sodium carbonate	0.085	00	0.085
4-Amino Pyridine (4AP)				
1.	Chlorine	00	4.525	4.525
2.	Caustic lye	00	4.29	4.29
3.	Isonicotinamide	00	7.15	7.15
4.	Activated carbon	00	0.015	0.015
Bromo benzene				
1.	Benzene	00	5.2	5.2
2.	Bromine	00	11.75	11.75
3.	Catalyst	00	0.1	0.1

Annexure-II

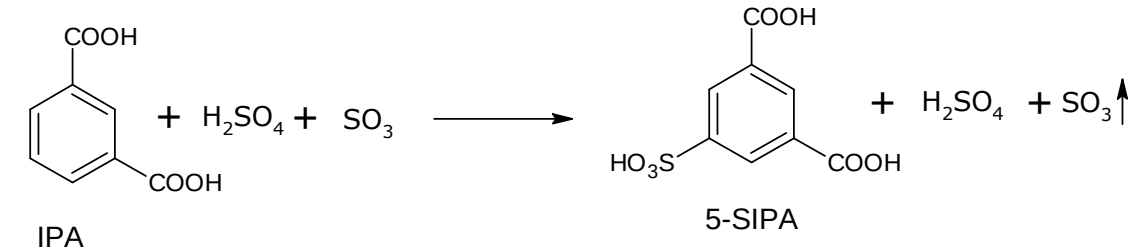
Manufacturing Process

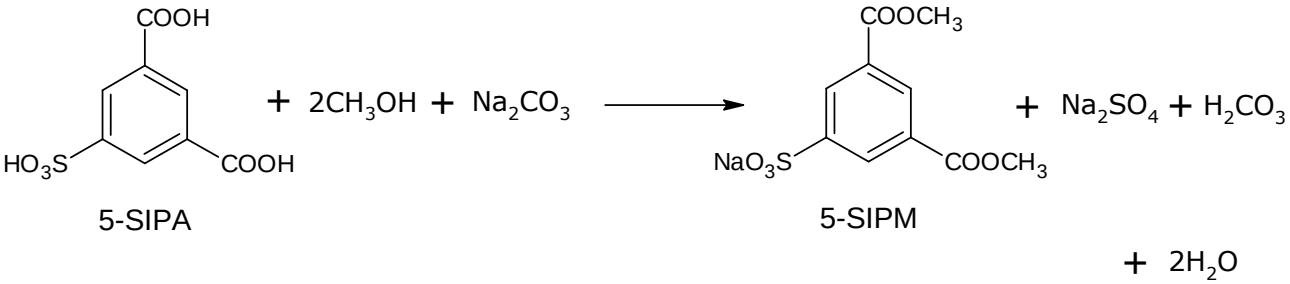
1. Dimethyl-5-Sodiosulfo Isophthalate (SIPM)

Manufacturing Process:

IPA is reacted with Oleum at high temperature in Glass lined reactor and then quenched into water in glass lined reactor, followed by chilling to 5°C to obtain 5-Sulfo Isophthalic Acid (5-SIPA), which is filtered and finally centrifuged. The wet 5-SIPA used directly for Esterification with methanol. After completion of reaction excess acid is removed by alkali Sodium carbonate and Crude Dimethyl-5-Sodiosulfo Isophthalate is centrifuged and dried to get pure Dimethyl-5-Sodio Sulfo Isophthalate.

Chemical reaction:





Mass Balance:

Mass Balance of SIPM

Input	KG		KG	Output
STAGE 1:				
Oleum (23%)	1370	MSGLR	9	SO2 to Scrubber
Isophthalic Acid	620			
Fresh Water	558			
		Centrifuge	1438	Dilute Sulfuric Acid (50% -70%)
			1101	5-SIPA Wet Cake
STAGE 2:				
5-SIPA Wet Cake	1101	MSGLR	1280	Methanol Distill and Recovered
Methanol	1600			
Sodium Carbonate	440			
Fresh Water	250			
Recycle Water	750			
Fresh Water Wash	250	Centrifuge	1361	Effluent to ETP
			500	Water to Recycle
		Drier	250	Drying Water Recovered to Recycle
		Final Product	1000	SIPM Dry
Total	**6939**		**6939**	

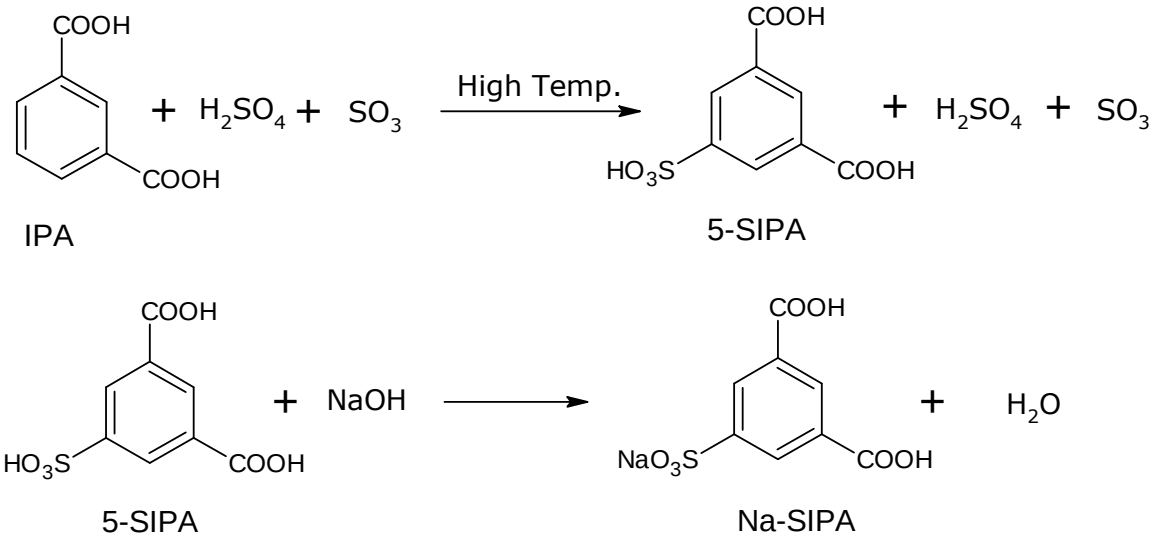
2. 5-SODIO SULFO ISOPHTHALIC ACID (Na-SIPA)

Manufacturing Process:

IPA is reacted with Oleum at high temperature in Glass lined reactor and then quenched into water in Lead lined reactor, followed by chilling to 5°C to obtain 5-Sulfo Isophthalic Acid (5-SIPA), which is filtered and finally centrifuged.

5-SIPA dissolved in water and filtered. Into this solution a solution of Sodium Chloride and 5-Sodiosulfo Isophthalic Acid is centrifuged and washed with water and dried.

Chemical Reaction:



Mass balance:

Mass Balance of Na-SIPA

Input	KG		KG	Output
STAGE 1:				
Oleum (23%)	1525	MSGLR	10	SO2 to Scrubber
Isophthalic Acid	690			
Fresh Water	621			
		Centrifuge	1601	Dilute Sulfuric Acid (50% -70%)
			1225	5-SIPA Wet Cake
STAGE 2:				
5-SIPA Wet Cake	1225	MSGLR		
Sodium Hydroxide	200			
Fresh Water	350			
Recycle Water	150			
		Centrifuge	775	Effluent to ETP
		Drier	150	Drying Water Recovered to Recycle
		Final Product	1000	Na-SIPA Dry
Total	**4761**		**4761**	

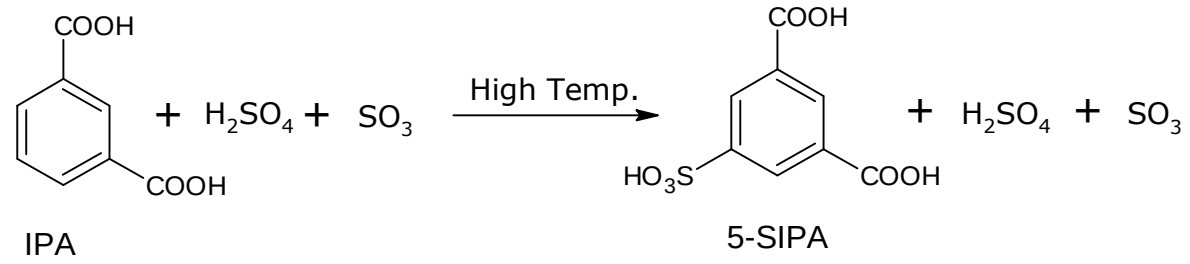
3. 5-LITHIO SULFO ISOPHTHALIC ACID (Li-SIPA)

Manufacturing Process:

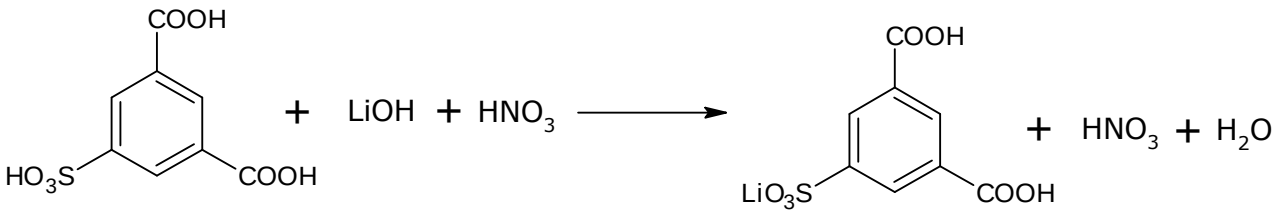
IPA is reacted with Oleum at high temperature in Glass lined reactor and then quenched into DM water in Lead lined reactor, followed by chilling to 5°C to obtain 5-Sulfo Isophthalic Acid (5-SIPA), which is filtered and finally centrifuged.

5-SIPA is dissolved in water and reacted with lithium hydroxide monohydrate + HNO_3 and heat up to 120°C. Then the mixture is cooled and centrifuged to obtain pure Li-SIPA product.

Chemical Reaction:



IPA 5-SIPA



5-SIPA Li-SIPA

Mass balance:

Mass Balance of Li-SIPA

Input	KG		KG	Output
STAGE 1:				
Oleum (23%)	1578	MSGLR	11	SO2 to Scrubber
Isophthalic Acid	714			
Fresh Water	643			
		Centrifuge	1657	Dilute Sulfuric Acid (50% -70%)
			1268	5-SIPA Wet Cake
STAGE 2:				
5-SIPA Wet Cake	1268	MSGLR		
Nitric Acid	536			
Lithium Hydroxide	214			
Fresh Water	425			
Recycle Water	75			
		Centrifuge	1443	Effluent to ETP
		Drier	75	Drying Water Recovered to Recycle
		Final Product	1000	Li-SIPA Dry
Total	**5454**		**5454**	

4. 5-Hydroxy Isophthalic Acid (5-HIPA)

Manufacturing Process:

Step-1: Isophthalic Acid (IPA) to 5-Sulfo Isophthalic Acid (5-SIPA)

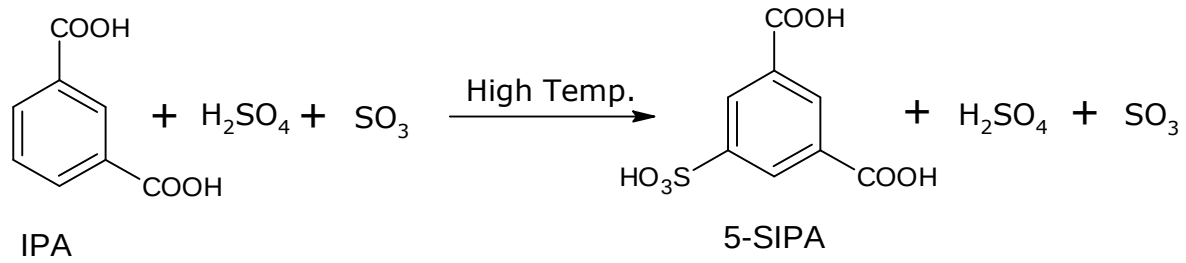
IPA is reacted with Oleum at high temperature in Glass lined reactor and then quenched into water in glass lined reactor, followed by chilling to 5°C to obtain 5-Sulfo Isophthalic Acid (5-SIPA), which is filtered and finally centrifuged.

Step-2: Sulfo isophthalic acid (5-SIPA) to 5-Hydroxy Isophthalic Acid (5-HIPA)

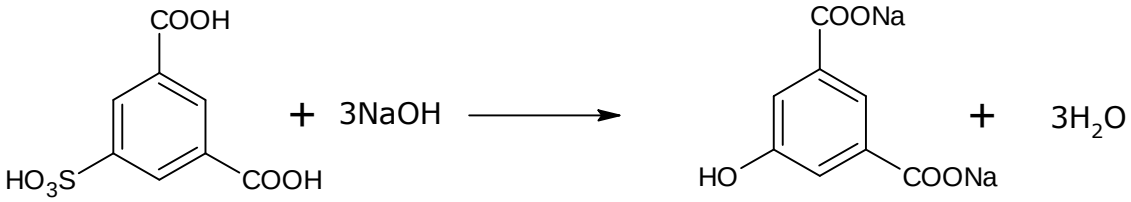
5-SIPA is converted in to its tri sodium salt by using excess Sodium Hydroxide and water as media and reaction carried out at room temperature.

Trisodium Salt fused with Sodium Hydroxide at very high temperature. The reaction mass is quenched in to ice cold water and acidity with Con.HCl and centrifuged and wash with water to get crude 5-HIPA.

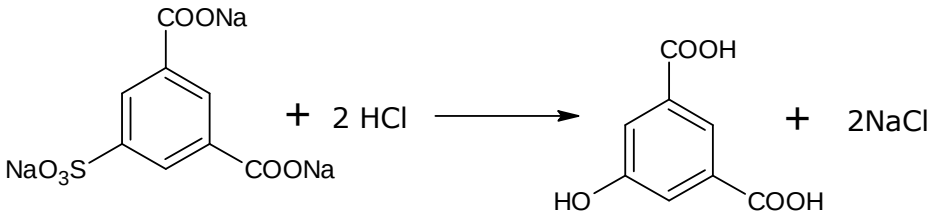
Chemical reaction:



IPA 5-SIPA



5-SIPA Tri Sodium salt



Tri Sodium salt 5-HIPA

Mass Balance:

Mass Balance of 5-HIPA

Input	KG		KG	Output
STAGE 1:				
Oleum (23%)	2210	MSGLR	15	SO2 to Scrubber
Isophthalic Acid	1000			
Fresh Water	900			
		Centrifuge	2320	Dilute Sulfuric Acid (50% -70%)
			1775	5-SIPA Wet Cake
STAGE 2:				
5-SIPA Wet Cake	1775	MSGLR		
Caustic Soda	800			
Hydrochloric Acid	485			
Fresh Water	200			
Recycle Water	1000			
Fresh Water Wash	300	Centrifuge	2560	Effluent to ETP
			800	Water to Recycle
		Drier	200	Drying Water Recovered to Recycle
		Final Product	1000	5-HIPA Dry
Total	**8670**		**8670**	

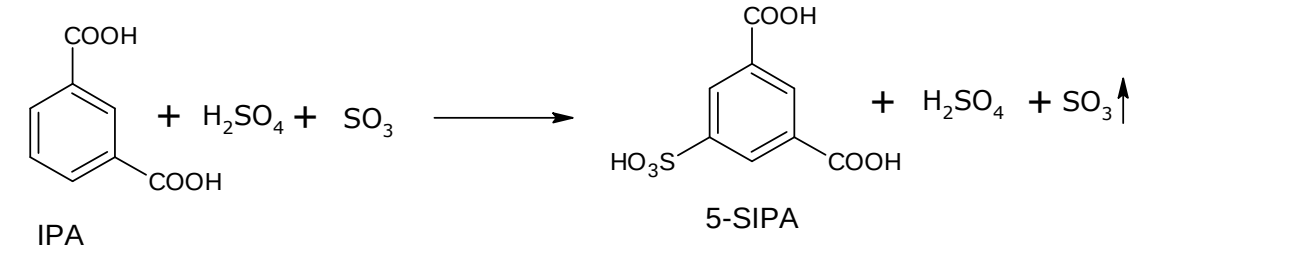
5. 5-SODIO SULPHO-BIS-(B-HYDROXY ETHYL) ISOPHTHALATE (Na-SIPHE)

Manufacturing process:

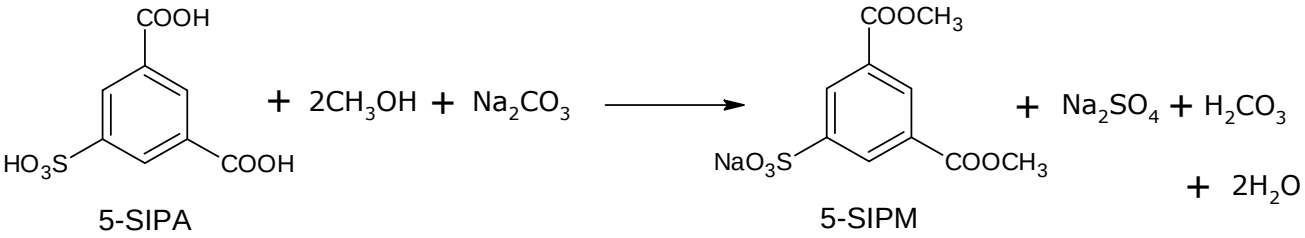
IPA is reacted with Oleum at high temperature in Glass lined reactor and then quenched into water in glass lined reactor, followed by chilling to 5°C to obtain 5-Sulfo Isophthalic Acid (5-SIPA), which is filtered and finally centrifuged.

The wet 5-SIPA used directly for Esterification with methanol in presence of after completion of reaction excess acid is removed by alkali Sodium carbonate and Crude Dimethyl-5-Sodiosulfo Isophthalate is centrifuged and dried to get pure Dimethyl-5-Sodio Sulfo Isophthalate (SIPM). Take mono ethylene glycol and add SIPM heat to high temperature (175 ^{0}C) cool and fill in the drum.

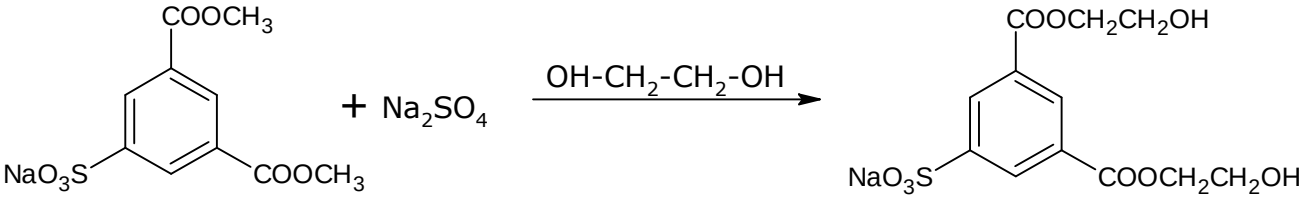
Chemical Reaction:



IPA 5-SIPA



5-SIPA 5-SIPM



5-SIPM Na-SIPHE

Mass Balance:

Mass Balance of Na-SIPHE

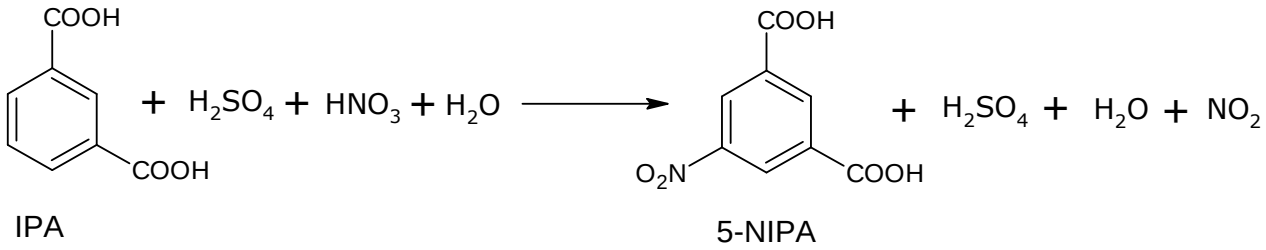
Input	KG		KG	Output
STAGE 1:				
Oleum (23%)	443	MSGLR	3	SO2 to Scrubber
Isophthalic Acid	200			
Fresh Water	180			
		Centrifuge	465	Dilute Sulfuric Acid (50% -70%)
			355	5-SIPA Wet Cake
STAGE 2:				
5-SIPA Wet Cake	355	MSGLR	413	Methanol Distill and Recovered
Methanol	517			
Sodium Carbonate	142			
Fresh Water	81			
Recycle Water	242			
Fresh Water Wash	81	Centrifuge	439	Effluent to ETP
			161	Water to Recycle
		Drier	82	Drying Water Recovered to Recycle
		Dry Product	323	SIPM Dry
STAGE 3:				
SIPM Dry	323	MSGLR	130	Methanol Distill and Recovered
Mono Ethyl Glycol	808		1000	Na-SIPHE solution
Total	**3372**		**3372**	

6. 5-Nitro Isophthalic Acid (5-NIPA)

Manufacturing Process:

Isophthalic Acid is nitrated with mixture of Con.Sulfuric Acid and fuming Nitric Acid at lower temperature. Then add water into reaction mass. It is then cooled & chilled and centrifuged. Add 5- NIPA wet cake into the water heat to clear filter cool, chill and centrifuge and dry to get product.

Chemical Reaction:



IPA 5-NIPA

Mass balance:

Mass Balance of 5-NIPA

Input	KG		KG	Output
STAGE 1:				
Nitric Acid	420	MSGLR	20	NO2 to Scrubber
Isophthalic Acid	850			
Sulfuric Acid	2000			
Recycle Water	1500			
Fresh Water	800	Nutch Filter	3150	Dilute Sulfuric Acid (50% -70%)
			900	Effluent to ETP
			200	Water to Recycle
			1300	5-NIPA Wet Cake
STAGE 2:				
5-NIPA Wet Cake	1300	MSGLR		
Recycle Water	2200			
Fresh Water Wash	1000	Centrifuge	3350	Water to Recycle
		Drier	151	Drying Water Recovered to Recycle
		Final Product	1000	5-NIPA Dry
Total	**10070**		**10070**	

7. Dimethyl-5-Nitro Isophthalate (DM 5-NIPA)

Manufacturing process:

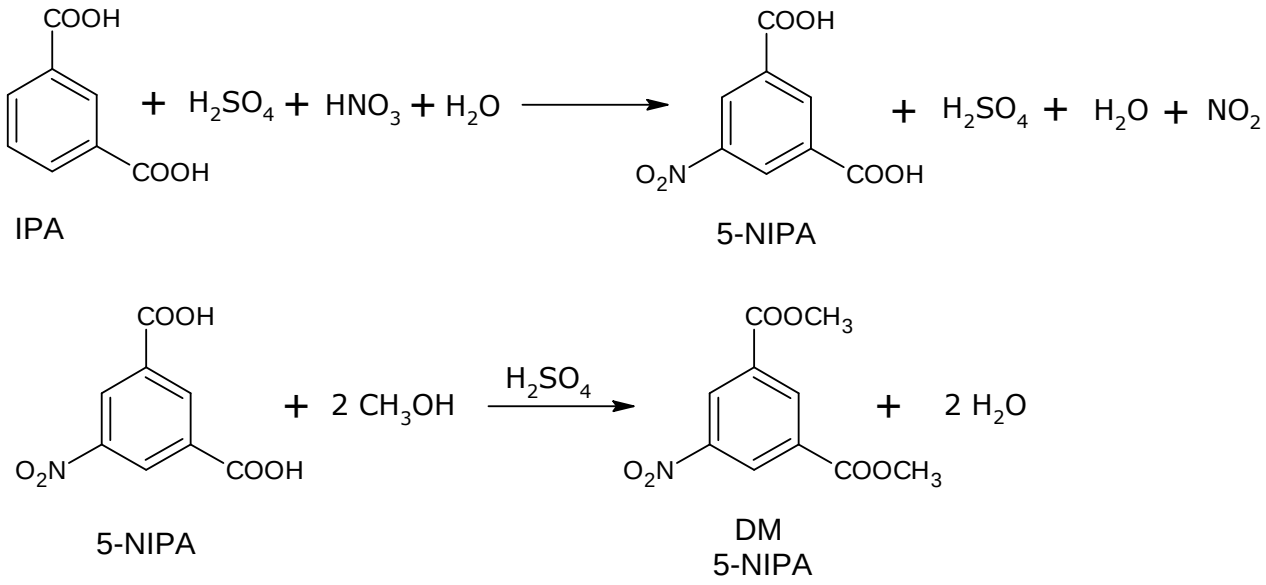
Step-1: Isophthalic Acid (IPA) to 5-Nitro Isophthalic Acid (5-NIPA)

Isophthalic Acid is nitrated with mixture of Con.Sulfuric Acid and Fuming Nitric Acid at lower temperature. The add water into reaction mass cool & chilled and centrifuged. This reaction mass is forwarded to next step.

Step-2: 5-NIPA to Dimethyl 5-NIPA (DM 5-NIPA)

5-NIPA esterifies with Methanol in presence of Con. Sulphuric Acid at reflux temperature. Cool the reaction mass and centrifuge. DME 5-NIPA purified with water and filter and dried to get final product.

Chemical Reaction:



Mass balance:

Mass Balance of DM-5-NIPA

Input	KG		KG	Output
STAGE 1:				
Nitric Acid	378	MSGLR	18	NO2 to Scrubber
Isophthalic Acid	765			
Sulfuric Acid	1800			
Recycle Water	1350			
Fresh Water	720	Nutch Filter	2835	Dilute Sulfuric Acid (50% -70%)
			810	Effluent to ETP
			180	Water to Recycle
			1170	5-NIPA Wet Cake
STAGE 2:				
5-NIPA Wet Cake	1170	MSGLR		
Recycle Water	1980			
Fresh Water Wash	900	Centrifuge	3015	Water to Recycle
		Drier	135	Drying Water Recovered to Recycle
		Dry Product	900	5-NIPA Dry
STAGE 3:				
5-NIPA Dry	900	MSGLR		
Methanol Fresh	400			
Methanol Recycle	2100			
Sulfuric Acid	200			
Sodium Carbonate	25	Nutch Filter	525	Effluent to ETP
Recycle Water Wash	200		2100	Methanol Distill and Recovered
		Drier	200	Drying Water Recovered to Recycle
		Final Product	1000	DM-5-NIPA Dry
Total	**12887**		**12887**	

8. Monomethyl-5-Nitro Isophthalic Acid (MM 5-NIPA)

Manufacturing Process:

Step-1: Isophthalic Acid (IPA) to 5-Nitro Isophthalic Acid (5-NIPA)

Isophthalic Acid is nitrated with mixture of fuming Nitric Acid and Con.Sulfuric Acid at low temperature. Add water into reaction mass. After cooling it down, the mixture is then centrifuged.

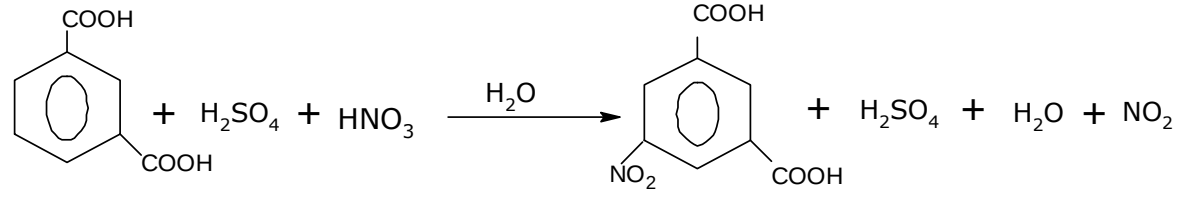
Step-2: 5-NIPA to Dimethyl 5-NIPA (DM 5-NIPA)

5-NIPA esterifies with Methanol in presence of Con. Sulphuric Acid at reflux temperature. Cool the reaction mass and centrifuge. Dried material is then used for the next step.

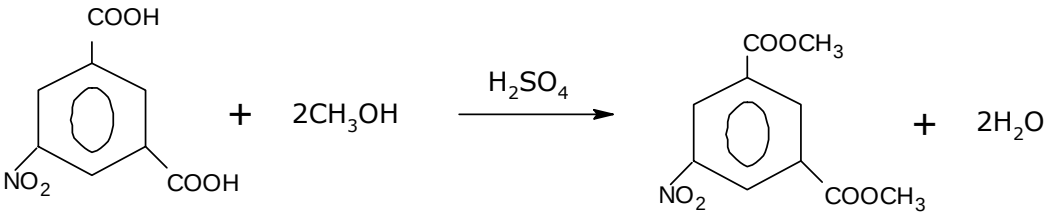
Step-3: DM-5-NIPA to Monomethyl 5-NIPA (MM 5-NIPA)

DM 5-NIPA is partially hydrolyzed by methanolic solution of NaOH at 55-60 ^{O}C. Reaction mass is then treated with HCl to crystalize. Crude Monomethyl-5-Nitro Isophthalate purified with Methanol and Activated Carbon is then cooled & centrifuged. The wet cake thus obtained is then dried to get the final dry product of Monomethyl 5-Nitro Isophthalic Acid.

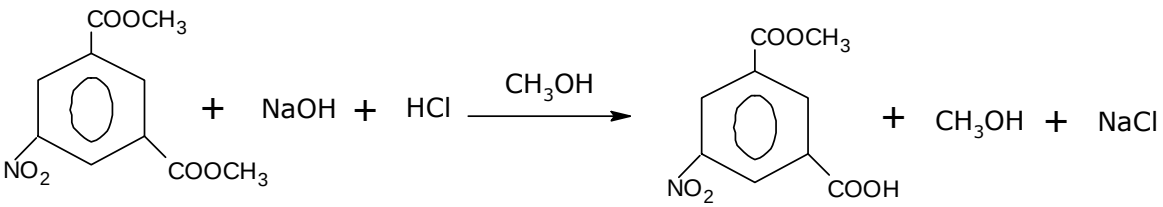
Chemical Reaction:



IPA **5-NIPA**



5-NIPA **DM-5-NIPA**



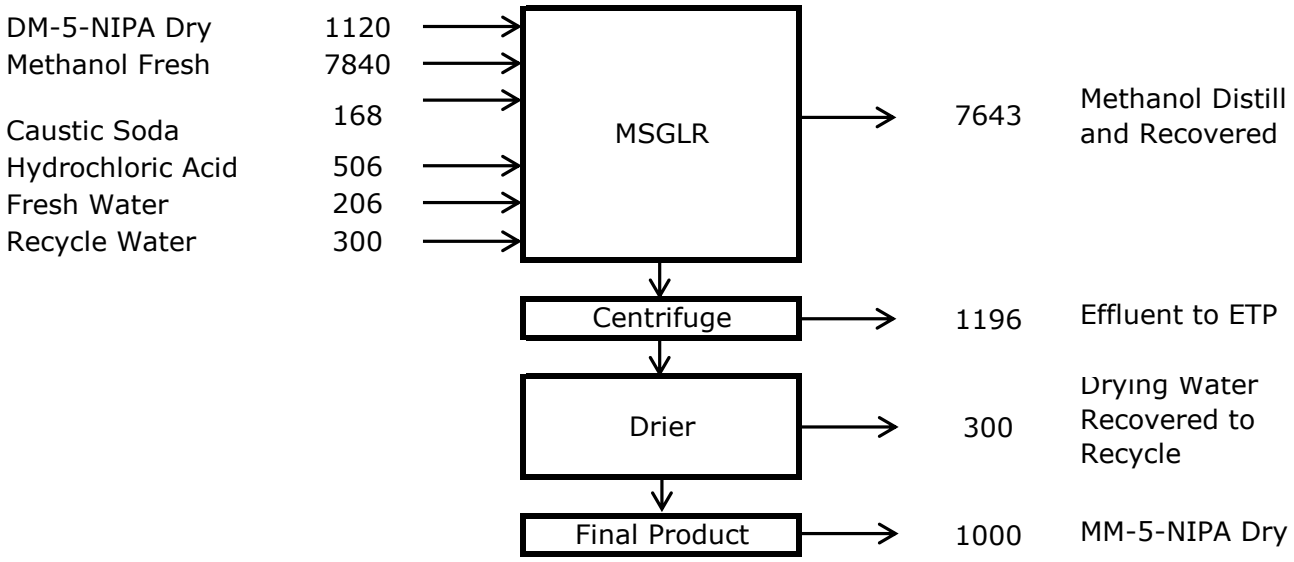
DM-5-NIPA **MM-5-NIPA**

Mass Balance:

Mass Balance of MM-5-NIPA

Input	KG		KG	Output
STAGE 1:				
Nitric Acid	423	MSGLR	21	NO2 to Scrubber
Isophthalic Acid	857			
Sulfuric Acid	2016			
Recycle Water	1512			
Fresh Water	806	Nutch Filter	3175	Dilute Sulfuric Acid (50% -70%)
			907	Effluent to ETP
			201	Water to Recycle
			1310	5-NIPA Wet Cake
STAGE 2:				
5-NIPA Wet Cake	1310	MSGLR		
Recycle Water	2218			
Fresh Water Wash	1008	Centrifuge	3377	Water to Recycle
		Drier	151	Drying Water Recovered to Recycle
		Dry Product	1008	5-NIPA Dry
STAGE 3:				
5-NIPA Dry	1008	MSGLR		
Methanol Fresh	448			
Methanol Recycle	2352			
Sulfuric Acid	224			
Sodium Carbonate	28	Nutch Filter	588	Effluent to ETP
Recycle Water Wash	224		2352	Methanol Distill and Recovered
		Drier	224	Drying Water Recovered to Recycle
		Dry Product	1120	DM-5-NIPA Dry

STAGE 4:



Total	**24574**		**24574**

9. 5-Amino Isophthalic Acid (5-AIPA)

Manufacturing Processs:

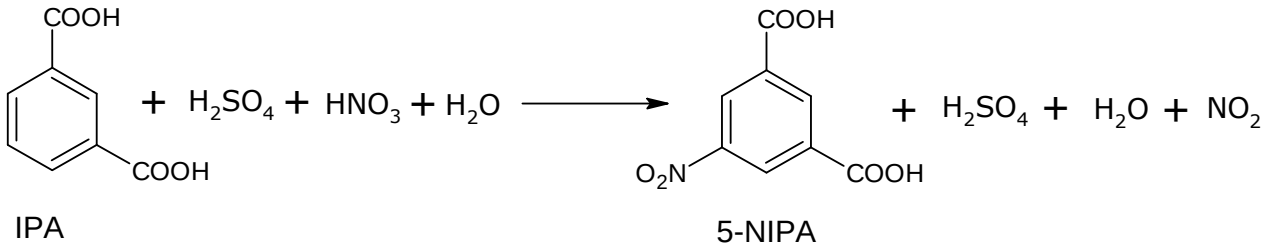
Step-1: Isophthalic Acid (IPA) to 5-Nitro Isophthalic Acid (5-NIPA)

Isophthalic Acid is nitrated with mixture of Conc. Sulfuric Acid and Fuming Nitric Acid at lower temperature. Then add water into reaction mass cool & chilled and centrifuged. This reaction mass forwarded to next step.

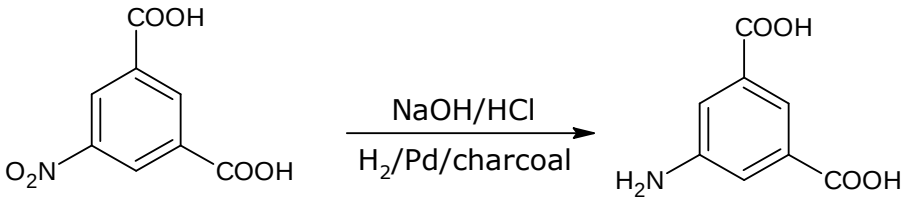
Step-2: Conversion of 5-NIPA to 5-Amino Isophthalic Acid (5-AIPA)

5-NIPA undergoes reduction with catalyst in presence of alkali solution at reflux temperature. The reaction mass is the treated with charcoal and filtered. The filtrate is further cooled and acidified with Conc. HCl for isolation of product (5-AIPA) and finally centrifuged the wet cake of 5-AIPA and dry. Mother liquor is recycled and catalyst is reactivated for next batch.

Chemical Reaction:



IPA 5-NIPA



5-NIPA 5-AIPA

Mass Balance:

Mass Balance of 5-AIPA

Input	KG		KG	Output
STAGE 1:				
Nitric Acid	516	MSGLR	25	NO2 to Scrubber
Isophthalic Acid	1046			
Sulfuric Acid	2460			
Recycle Water	1845			
Fresh Water	984	Nutch Filter	3875	Dilute Sulfuric Acid (50% -70%)
			1107	Effluent to ETP
			246	Water to Recycle
			1599	5-NIPA Wet Cake
STAGE 2:				
5-NIPA Wet Cake	1599	MSGLR		
Recycle Water	2706			
Fresh Water Wash	1230	Centrifuge	4121	Water to Recycle
		Drier	184	Drying Water Recovered to Recycle
		Dry Product	1230	5-NIPA Dry
STAGE 3:				
5-NIPA Dry	1230	HYGNR	10	Catalyst Recover
Caustic Soda	246		3	Spent Charcoal
Hydrochloric Acid	369			
Hydrogen	35			
Catalyst	12			
Charcoal	3			
Recycle Water	300			
		Centrifuge	881	Effluent to ETP
		Drier	300	Drying Water Recovered to Recycle
		Final Product	1000	5-AIPA Dry
Total	**14581**		**14581**	

10. Dimethyl-5-Amino Isophthalic Acid (DM-5-AIPA)

Manufacturing Process:

Step-1: Isophthalic Acid (IPA) to 5-Nitro Isophthalic Acid (5-NIPA)

Isophthalic Acid is nitrated with mixture of Conc. Sulfuric Acid and Fuming Nitric Acid at lower temperature. Then add water into reaction mass. After cool it and centrifuge.

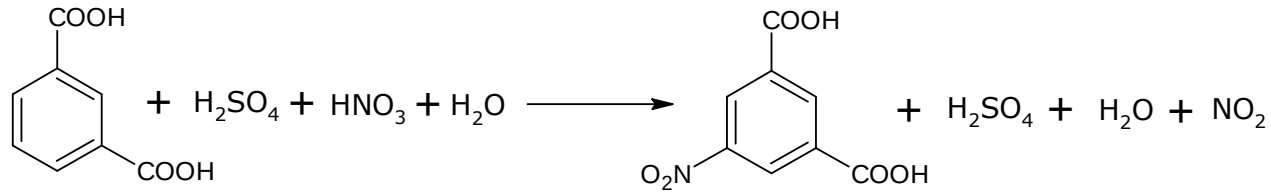
Step-2: 5-NIPA to Dimethyl 5-NIPA (DM 5-NIPA)

5-NIPA esterifies with Methanol in presence of Con. Sulphuric Acid at reflux temperature. Cool the reaction mass and centrifuge. DM 5-NIPA is then purified with water and filtered and dried.

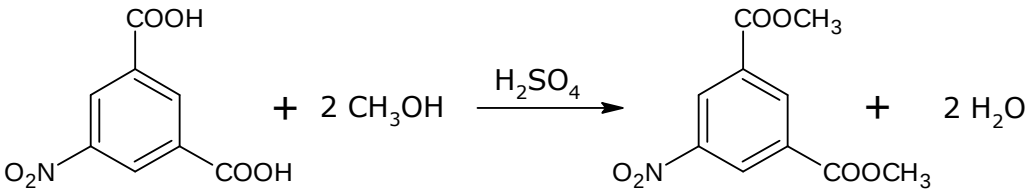
Step-3: Conversion of DM 5-NIPA to DM 5- AIPA

DM 5-NIPA undergoes reduction with alkali in presence of catalyst and alkali solution at reflux temperature. The reaction mass is then treated with charcoal and filtered. The filtrate is cooled and acidified with Con. HCl for isolation of product (DM 5-AIPA) and finally centrifuged the wet cake of DM 5-AIPA and dried. Mother liquor is recycled and catalyst is reactivated for next batch.

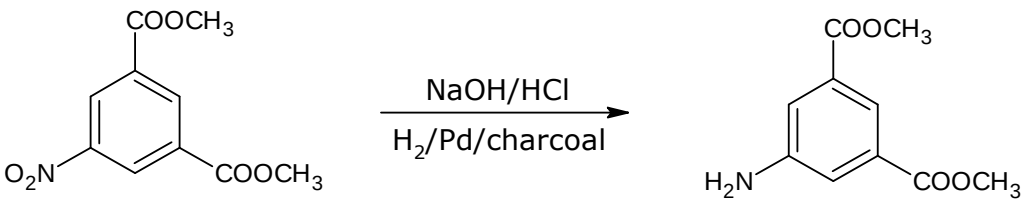
Chemical Reaction:



IPA 5-NIPA



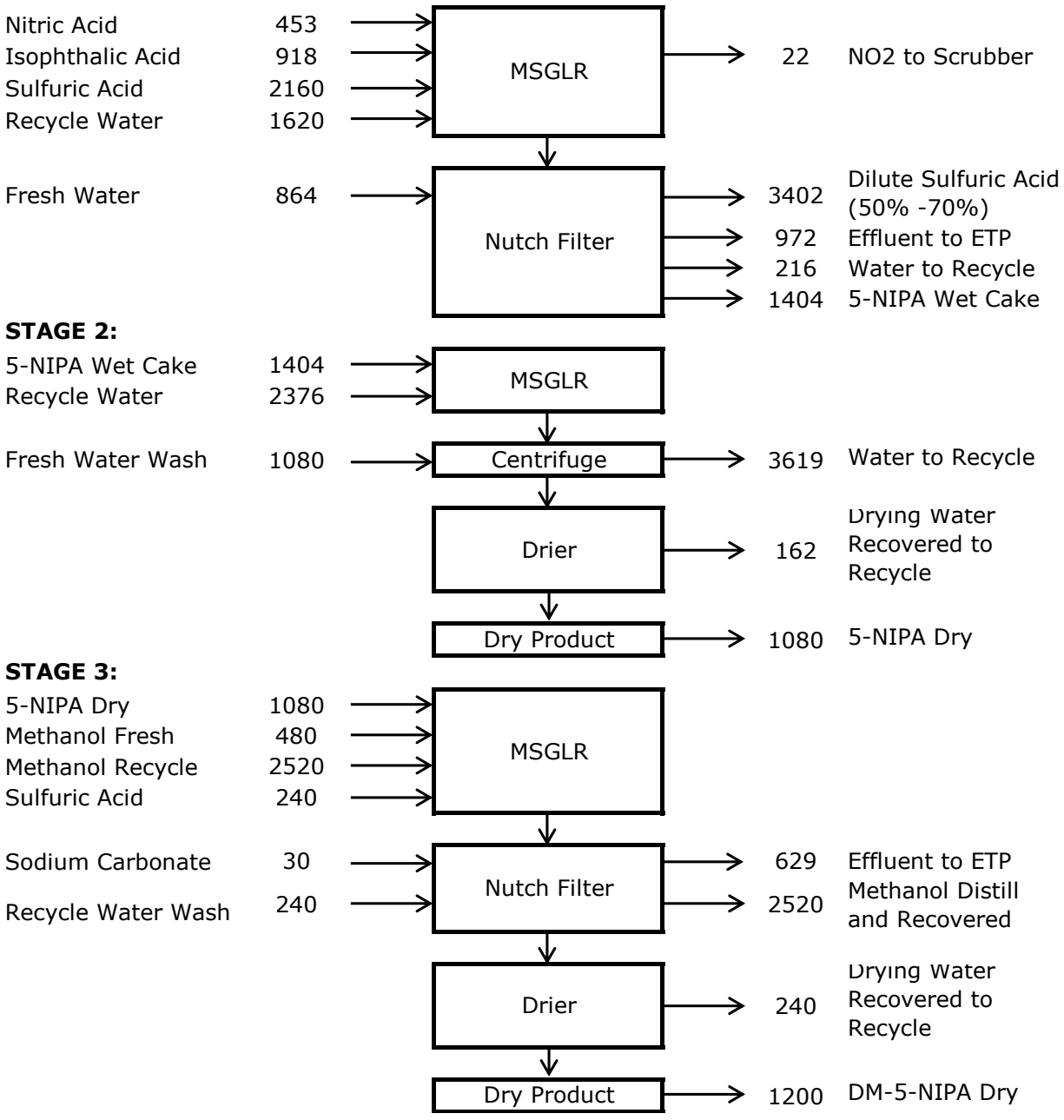
5-NIPA DM 5-NIPA



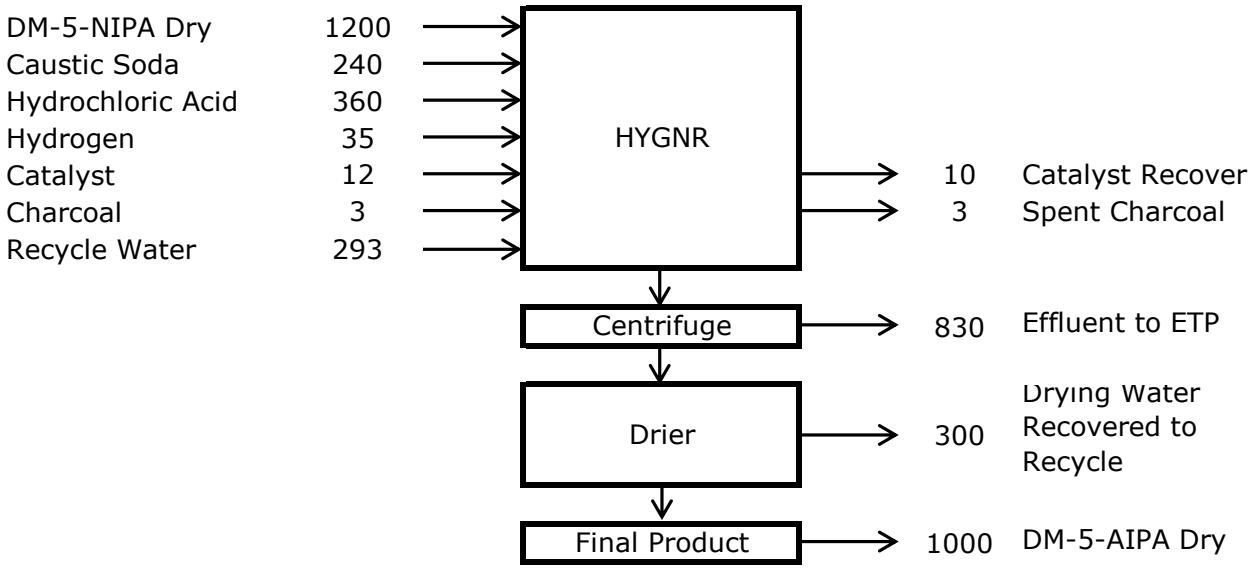
DM 5-NIPA DM 5-AIPA

Mass Balance:

Mass Balance of DM-5-AIPA



STAGE 4:



Total 17607 **17607**

11. 5-Amino Tri-iodo Isophthalic Acid (ATIPA)

Manufacturing Process:

Step-1: Isophthalic Acid (IPA) to 5-Nitro Isophthalic Acid (5-NIPA)

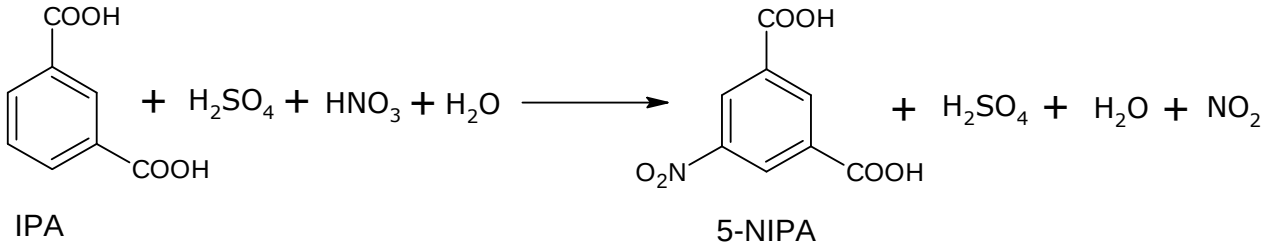
Isophthalic Acid is nitrated with mixture of Conc. Sulfuric Acid and Fuming Nitric Acid at lower temperature. Then add water into reaction mass. Cool down the reaction mass and centrifuge it.

Step-2: Conversion of 5-NIPA to 5-Amino Isophthalic Acid (5-AIPA)

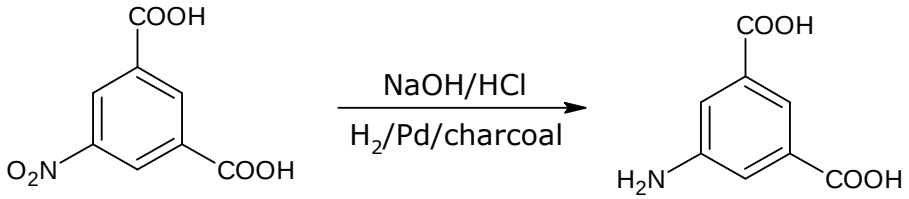
DM 5-NIPA undergoes reduction in presence of catalyst and alkali solution at reflux temperature. The reaction mass is then treated with charcoal and filtered. The filtrate is further cooled and acidified with Con. HCl for isolation of product (DM 5-AIPA) and finally centrifuged the wet cake of DM 5-AIPA and dried. Mother liquor is recycled and catalyst is reactivated for next batch.

Step-3: 5-AMINO IPA is the reacted with Iodine mono Chloride at low Temperature, in presence of hydrochloric acid at room temperature. Then the reaction mass is cooled, centrifuged and dried to obtain the final product.

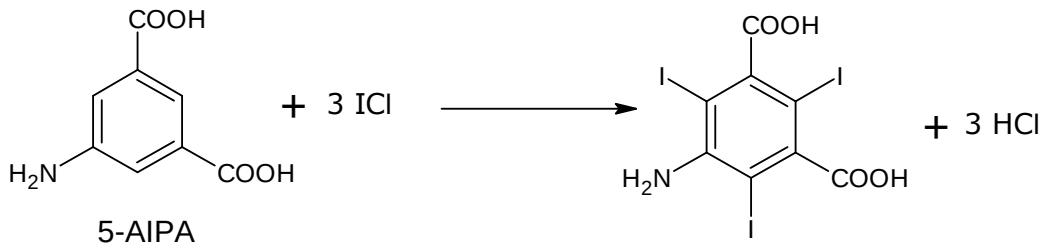
Chemical reaction:



IPA 5-NIPA



5-NIPA 5-AIPA



5-AIPA ATIPA

Mass Balance:

Mass Balance of ATIPA

Input	KG		KG	Output
STAGE 1:				
Nitric Acid	186	MSGLR	9	NO2 to Scrubber
Isophthalic Acid	377			
Sulfuric Acid	886			
Recycle Water	665			
Fresh Water	354	Nutch Filter	1395	Dilute Sulfuric Acid (50% -70%)
			399	Effluent to ETP
			88	Water to Recycle
			576	5-NIPA Wet Cake
STAGE 2:				
5-NIPA Wet Cake	576	MSGLR		
Recycle Water	975			
Fresh Water Wash	443	Centrifuge	1484	Water to Recycle
		Drier	66	Drying Water Recovered to Recycle
		Dry Product	443	5-NIPA Dry
STAGE 3:				
5-NIPA Dry	443	HYGNR	4	Catalyst Recover
Caustic Soda	89		1	Spent Charcoal
Hydrochloric Acid	133			
Hydrogen	13			
Catalyst	4			
Charcoal	1			
Recycle Water	108			
		Centrifuge	317	Effluent to ETP
		Drier	108	Drying Water Recovered to Recycle
		Dry Product	360	5-AIPA Dry
STAGE 4:				
5-AIPA Dry	360	MSGLR	20	HCL to Scrubber
Iodine Monochloride	1015			
Hydrochloric Acid	200			
		Centrifuge	455	Effluent to ETP
		Drier	102	Water Vapor Loss
		Final Product	1000	ATIPA Dry
Total	**6827**		**6827**	

12. 5-Amino Tri Iodo DiChloride

Manufacturing process:

Step-1: Isophthalic Acid (IPA) to 5-Nitro Isophthalic Acid (5-NIPA)

Isophthalic Acid is nitrated with mixture of Conc. Sulfuric Acid and Fuming Nitric Acid at lower temperature. Then add water into reaction mass, cool & chill it and centrifuge. This mass is used for the next step.

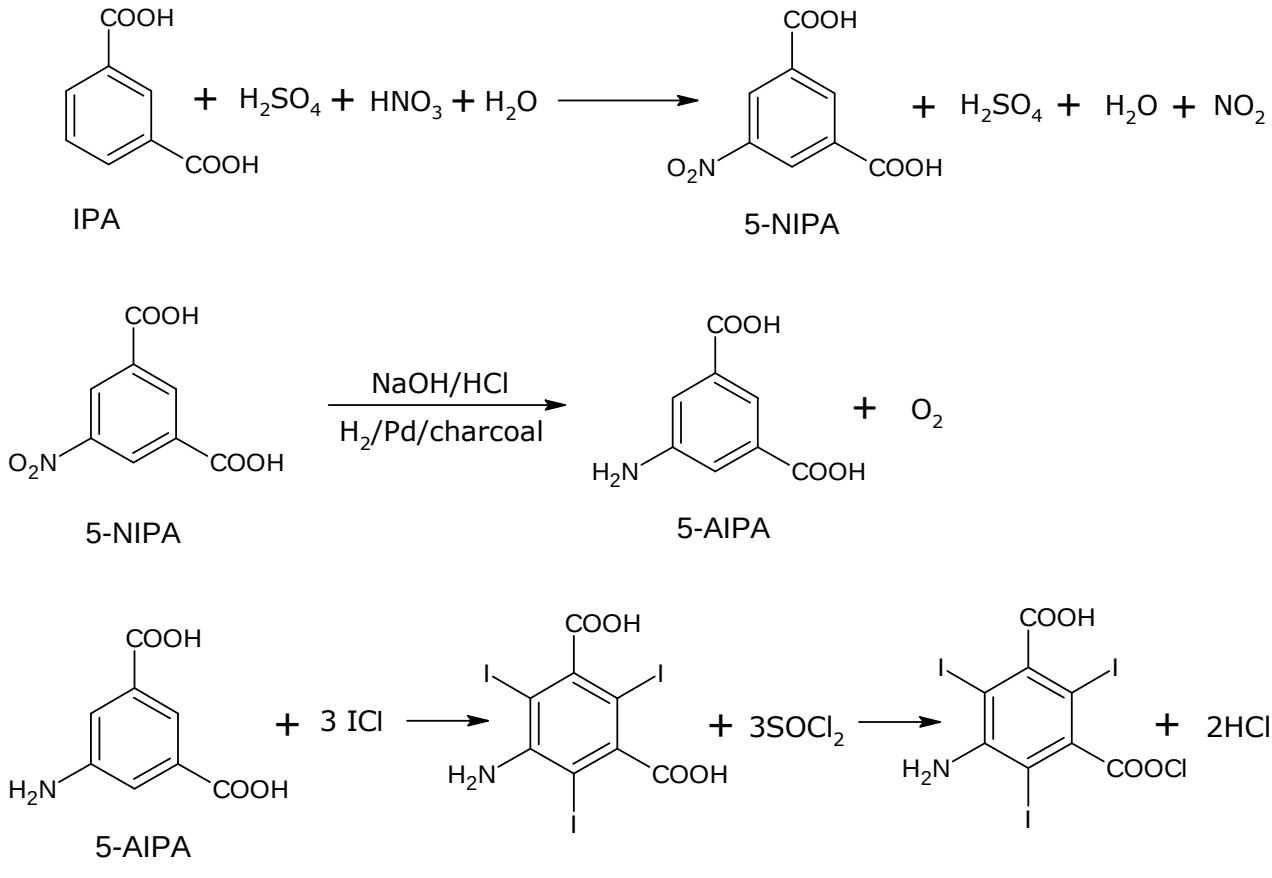
Step-2: Conversion of 5-NIPA to 5-Amino Isophthalic Acid (5-AIPA)

5-NIPA undergoes reduction in presence of catalyst and alkali solution at reflux temperature. The reaction mass is then treated with charcoal and filtered. The filtrate is cooled and acidified with Con. HCl for isolation of product (5-AIPA) and finally centrifuged the wet cake of 5-AIPA and dried. Mother liquor is recycled and catalyst is reactivated for next batch.

Step 3: 5-AMINO IPA reacts with Iodine mono Chloride at low temperature, in presence of hydrochloric acid at Room Temperature. Cool the reaction mass and centrifuge and dry to obtain ATIPA.

Step 4: ATIPA reacts with Thionyl chloride at low temperature. The reaction mass is then centrifuged and purified with 1-4 dioxin and filtered and dried.

Chemical Reaction:

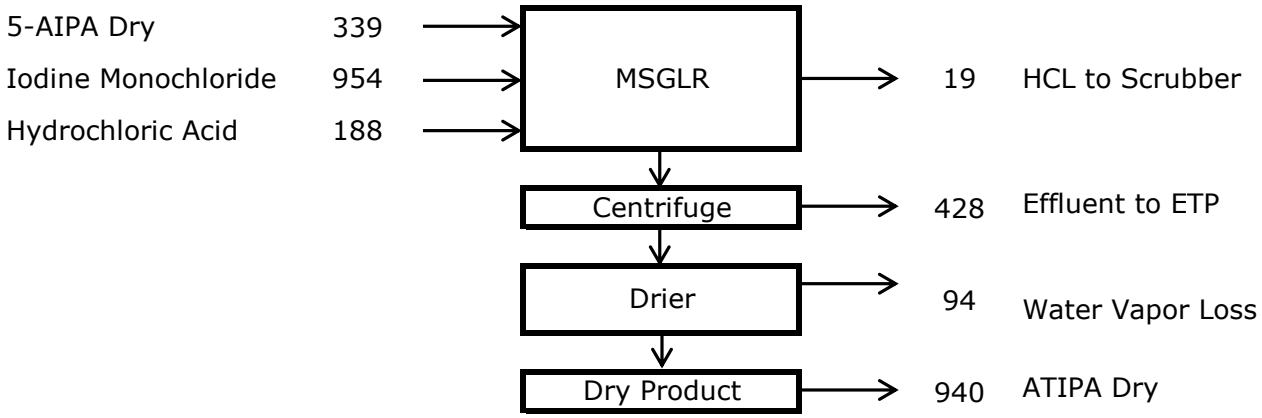


Mass Balance:

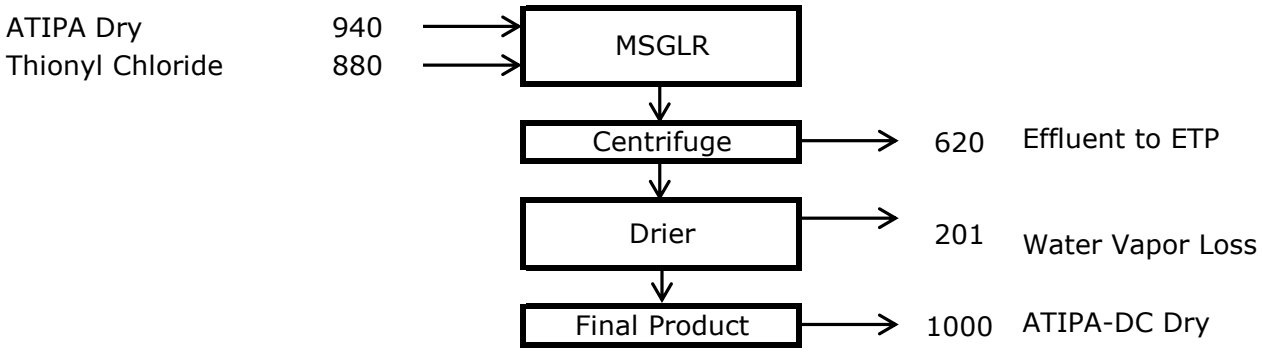
Mass Balance of ATIPA-DICHLORIDE

Input	KG		KG	Output
STAGE 1:				
Nitric Acid	175	MSGLR	8	NO2 to Scrubber
Isophthalic Acid	354			
Sulfuric Acid	833			
Recycle Water	625			
Fresh Water	333	Nutch Filter	1312	Dilute Sulfuric Acid (50% -70%)
			375	Effluent to ETP
			83	Water to Recycle
			541	5-NIPA Wet Cake
STAGE 2:				
5-NIPA Wet Cake	541	MSGLR		
Recycle Water	916			
Fresh Water Wash	417	Centrifuge	1395	Water to Recycle
		Drier	62	Drying Water Recovered to Recycle
		Dry Product	416	5-NIPA Dry
STAGE 3:				
5-NIPA Dry	416	HYGNR	3	Catalyst Recover
Caustic Soda	83		1	Spent Charcoal
Hydrochloric Acid	125			
Hydrogen	12			
Catalyst	4			
Charcoal	1			
Recycle Water	102			
		Centrifuge	298	Effluent to ETP
		Drier	102	Drying Water Recovered to Recycle
		Dry Product	339	5-AIPA Dry

STAGE 4:



STAGE 5:



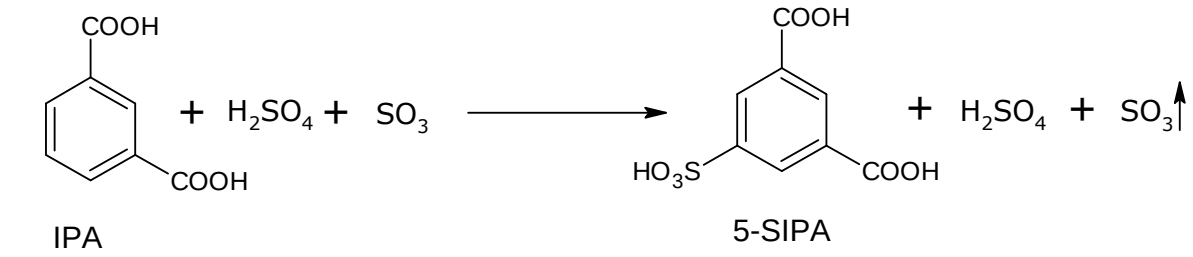
Total	**8238**	**8238**

13. 5-Lithio Sulpho-Bis-(B-Hydroxy ethyl) Isophthalate (Li-SIPHE)

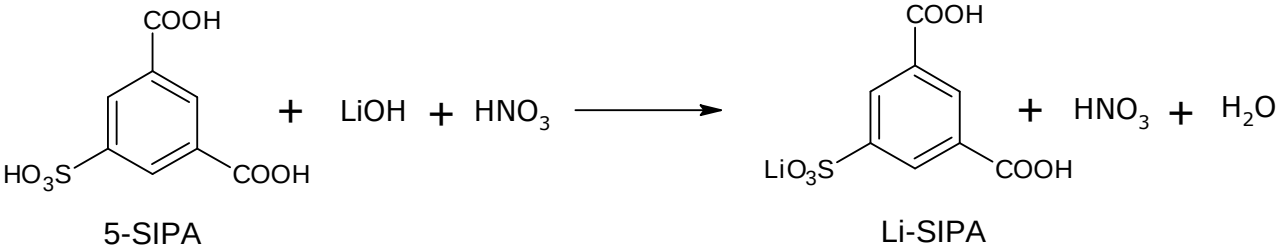
Manufacturing Process:

IPA is reacted with Oleum at high temperature in glass lined reactor and then quenched into water in Glass lined reactor, followed by chilling to 5 ^{o}C to obtain 5-Sulfo Isophthalic acid, which is filtered and finally centrifuged. 5-SIPA dissolved in water and reacts with lithium hydroxide monohydrate + HNO_3 at 120 ^{o}C. Then the mixture is cooled and centrifuged and dried to obtain pure Li-SIPA. Further add Mono Ethylene glycol to Li-SIPA at high temperature, cool and dry the mass to obtaine final product Li-SIPHE

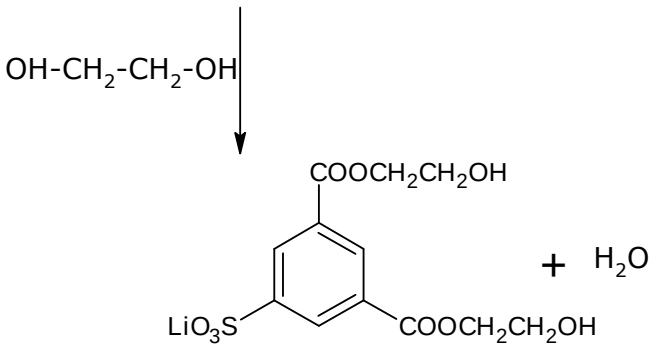
Chemical reaction:



IPA 5-SIPA



5-SIPA Li-SIPA



Li-SIPHE

Mass Balance:

Mass Balance of Li-SIPHE

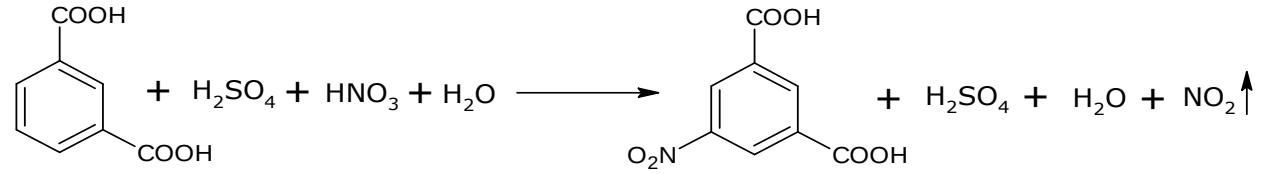
Input	KG		KG	Output
STAGE 1:				
Oleum (23%)	340	MSGLR	2	SO2 to Scrubber
Isophthalic Acid	154			
Fresh Water	138			
		Centrifuge	357	Dilute Sulfuric Acid (50% -70%)
			273	5-SIPA Wet Cake
STAGE 2:				
5-SIPA Wet Cake	273	MSGLR		
Nitric Acid	115			
Lithium Hydroxide	46			
Fresh Water	91			
Recycle Water	16			
		Centrifuge	311	Effluent to ETP
		Dryer	16	Drying Water Recovered to Recycle
		Dry Product	215	Li-SIPA Dry
STAGE 3:				
Li-SIPA Dry	215	MSGLR	35	Methanol Distill and Recovered
Catalyst	4			
Mono Ethyl Glycol	816		1000	Li-SIPHE solution
Total	**2209**		**2209**	

14. 5-Amino –N-N-Bis(2, 3 Dihydroxypropal) Isophthalamide HCl (ABAHCl)

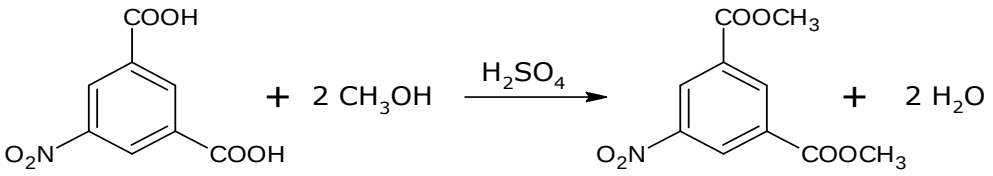
Manufacturing Process:

Isophthalic acid is nitrated with mixture of conc. Sulfuric acid and nitric acid at lower temperature. Then add water into reaction mass and cool the mixture and centrifuge it. 5-NIPA esterifies with methanol in presence of conc. Sulphuric acid at reflux temperature. Cool the reaction mass and centrifuge. DME-5-NIPA is purified and dried. DM-5-NIPA then undergoes reduction with Amino 2, 3 propanediol in presence of catalyst at reflux temperature. The reaction mass is then cooled and acidified with conc. HCl. The wet cake of ABA.HCl is then centrifuged and dried. Catalyst is recycled to reactivate for next batch.

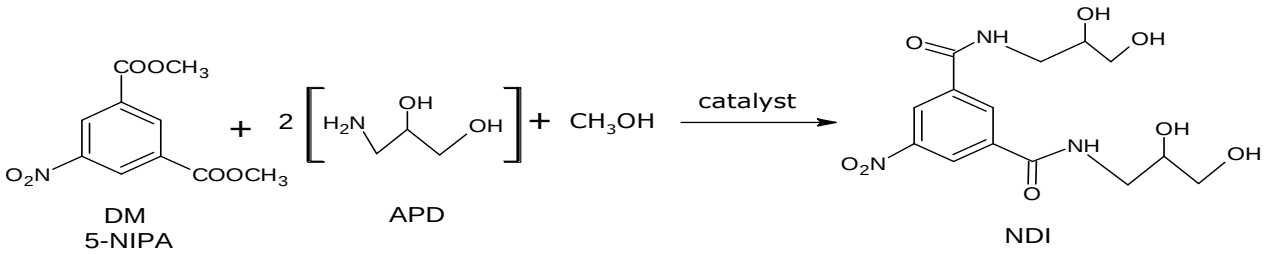
Chemical Reaction:



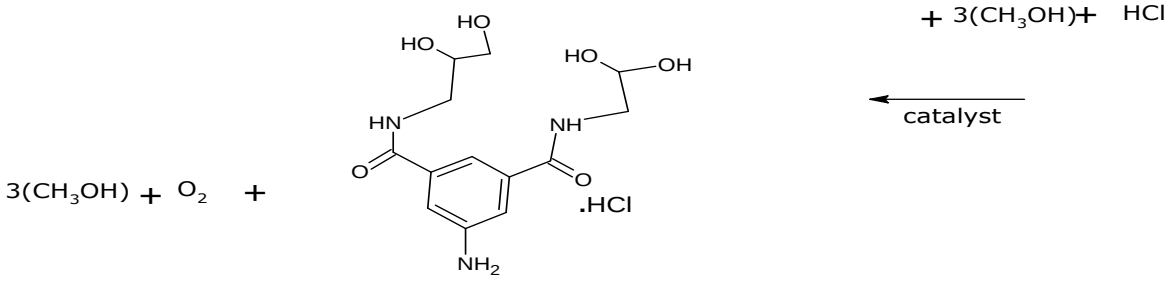
IPA 5-NIPA



5-NIPA DM 5-NIPA



DM 5-NIPA APD NDI



ABA.HCl

Mass Balance:

Mass Balance of ABA.HCL

Input	KG		KG	Output
STAGE 1:				
Nitric Acid	272	MSGLR	13	NO2 to Scrubber
Isophthalic Acid	551			
Sulfuric Acid	1296			
Recycle Water	972			
Fresh Water	518	Nutch Filter	2041	Dilute Sulfuric Acid (50% -70%)
			583	Effluent to ETP
			129	Water to Recycle
			842	5-NIPA Wet Cake
STAGE 2:				
5-NIPA Wet Cake	842	MSGLR		
Recycle Water	1426			
Fresh Water Wash	648	Centrifuge	2171	Water to Recycle
		Drier	97	Drying Water Recovered to Recycle
		Dry Product	648	5-NIPA Dry
STAGE 3:				
5-NIPA Dry	648	MSGLR		
Methanol Fresh	288			
Methanol Recycle	1512			
Sulfuric Acid	144			
Sodium Carbonate	18	Nutch Filter	378	Effluent to ETP
Recycle Water Wash	144		1512	Methanol Distill and Recovered
		Drier	144	Drying Water Recovered to Recycle
		Dry Product	720	DM-5-NIPA Dry
STAGE 4:				
DM-5-NIPA Dry	720	MSGLR	9	Catalyst Recover
Methanol	1700			
APD	580			
Catalyst	10			
Hydrogen	12			
Hydrochloric Acid	520			
		Centrifuge	1625	Methanol Distill and Recovered
			30	APD Recovered
			728	Effluent to ETP
		Drier	150	Water Vapor Loss
		Final Product	1000	ABA.HCL Dry
Total	**12821**		**12821**	

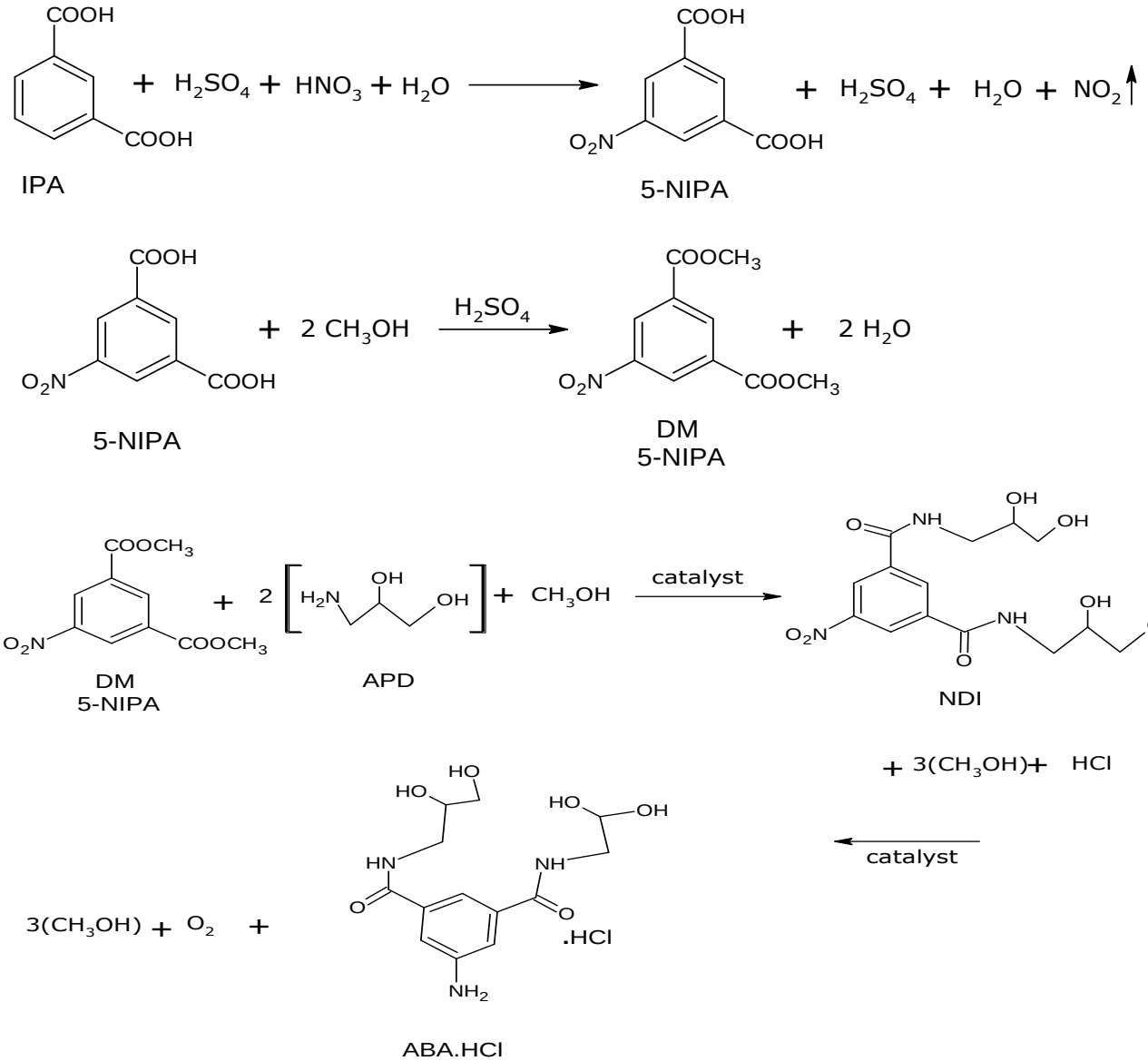
15. 5-Amino-N, N'-Bis (2, 3 Dihydroxypropyl)-2, 4, 6 TriIodo Isophthalamide

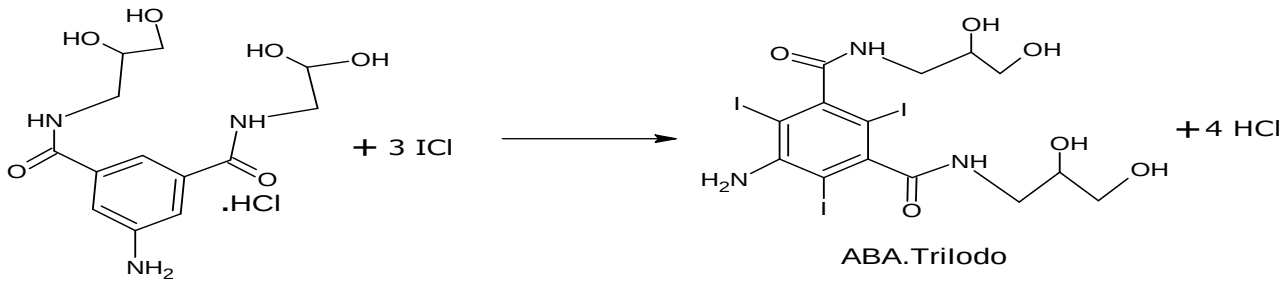
Manufacturing Process:

Isophthalic acid is nitrated with mixture of conc. Sulfuric acid and nitric acid at lower temperature. Then add water to the reaction mass and cool & centrifuge it. 5-NIPA formed is further esterified with methanol in presence of conc. Sulfuric acid at reflux temperature. Cool the reaction mass and centrifuge. DME-5-NIPA is then purified with water and filtered and dried.

DM-5-NIPA then undergoes reduction with Amino 2, 3 propanediol in presence of catalyst at reflux temperature. The reaction mass is then first cooled and then acidified with conc. HCl. The wet cake of ABA.HCl is then centrifuged and dried. This dry mass then reacts with iodine mono chloride and sodium carbonate. The reaction mass obtained is then cooled, centrifuged and dried to obtain the final product.

Chemical Reaction:





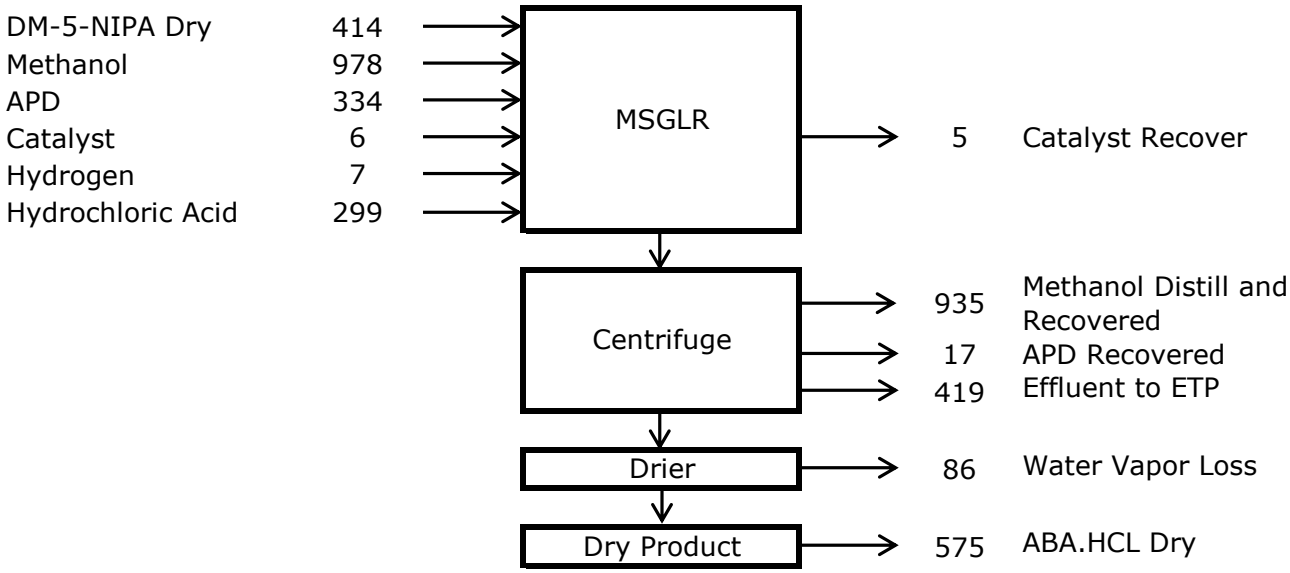
ABA.Triiodo

Mass Balance:

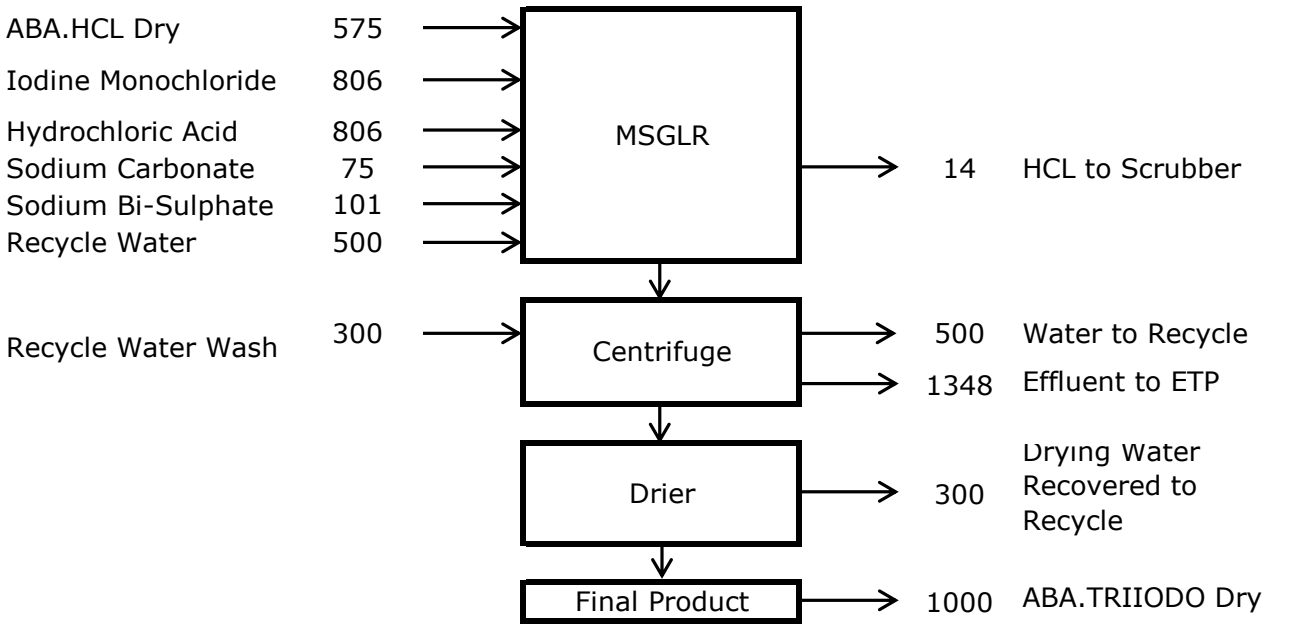
Mass Balance of ABA.TRIIODO

Input	KG		KG	Output
STAGE 1:				
Nitric Acid	157	MSGLR	8	NO2 to Scrubber
Isophthalic Acid	317			
Sulfuric Acid	746			
Recycle Water	560			
Fresh Water	298	Nutch Filter	1175	Dilute Sulfuric Acid (50% -70%)
			336	Effluent to ETP
			75	Water to Recycle
			485	5-NIPA Wet Cake
STAGE 2:				
5-NIPA Wet Cake	485	MSGLR		
Recycle Water	821			
Fresh Water Wash	373	Centrifuge	1250	Water to Recycle
		Drier	56	Drying Water Recovered to Recycle
		Dry Product	373	5-NIPA Dry
STAGE 3:				
5-NIPA Dry	373	MSGLR		
Methanol Fresh	166			
Methanol Recycle	870			
Sulfuric Acid	83			
Sodium Carbonate	10	Nutch Filter	218	Effluent to ETP
Recycle Water Wash	83		870	Methanol Distill and Recovered
		Drier	83	Drying Water Recovered to Recycle
		Dry Product	414	DM-5-NIPA Dry

STAGE 4:



STAGE 5:



Total 10543 **10543**

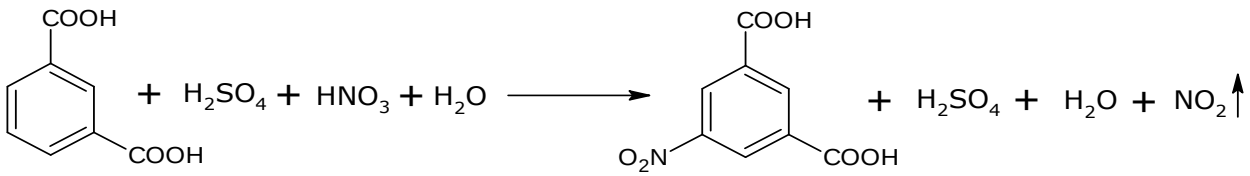
16. 5-Acetylamino-N, N'-Bis (2,3 Dihydroxy Propyl)-2, 4, 6- TriIodo Isophthalamide

Manufacturing Process:

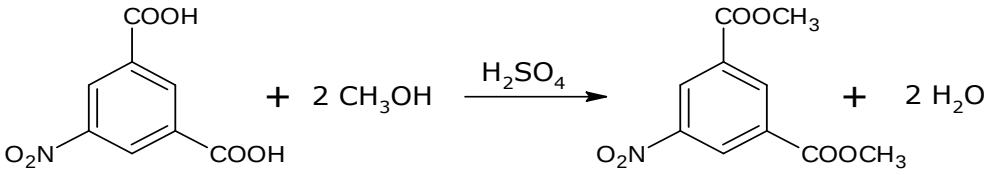
Isophthalic acid is nitrated with mixture of conc. Sulfuric acid and nitric acid at lower temperature. Then add water to the reaction mass and cool & centrifuge it. 5-NIPA formed is further esterified with methanol in presence of conc. Sulfuric acid at reflux temperature. Cool the reaction mass and centrifuge. DME-5-NIPA is then purified with methanol and filtered and dried.

DM-5-NIPA then undergoes reduction with Amino 2, 3 propanediol in presence of catalyst at reflux temperature. The reaction mass is then first cooled and then acidified with conc. HCl. The wet cake of ABA.HCl is then centrifuged and dried. This dry mass then reacts with iodine mono chloride and sodium carbonate. The reaction mass obtained is then cooled, centrifuged and dried to obtain 5-Amino-N, N'-Bis (2, 3 Dihydroxypropyl)-2, 4, 6 TriIodo Isophthalamide. ABA-triiodo reacts with acetic anhydride in presence of acetic acid. Then add the water to cool, centrifuge and dried.

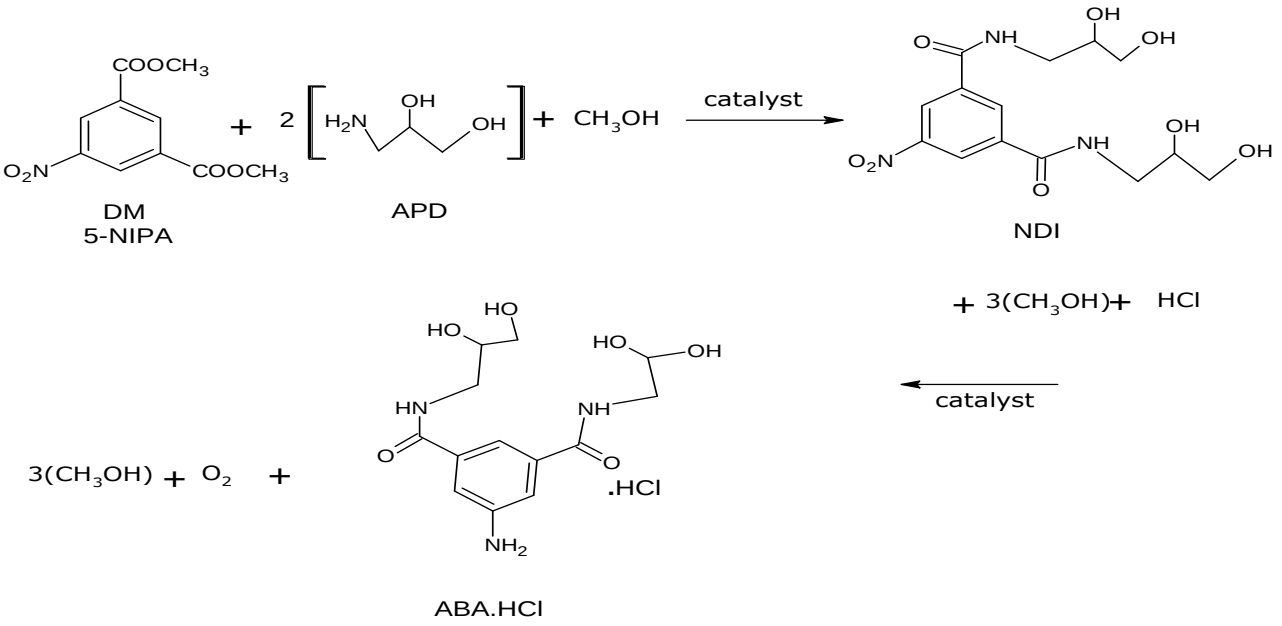
Chemical Reaction:

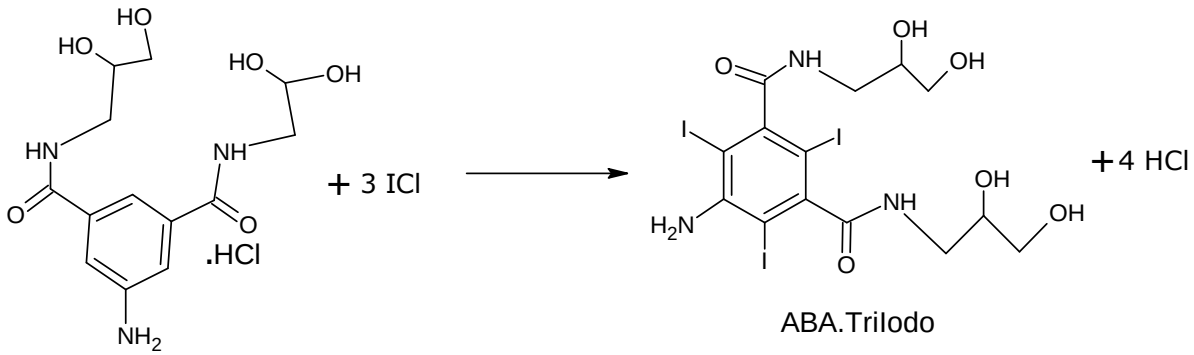


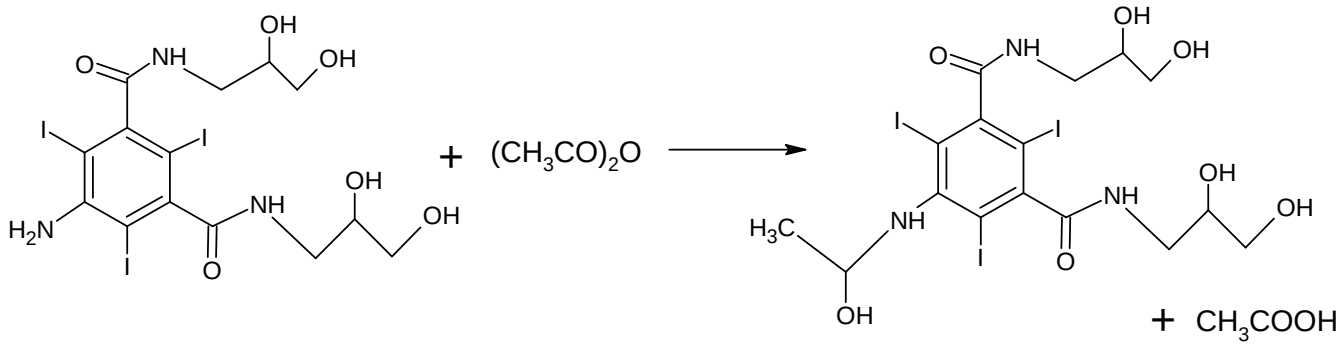
IPA 5-NIPA



5-NIPA DM 5-NIPA


COOCH3
O2N
COOCH3
DM
5-NIPA
+ 2
H2N
OH
OH
APD
+ CH3OH
catalyst
NH
OH
O
O2N
NDI
+ 3(CH3OH)+ HCl
catalyst
3(CH3OH) + O2 +
HO
HN
NH
.HCl
NH2
ABA.HCl


+ 3 ICl
.HCl
NH2
+4 HCl
I
H2N
ABA.Trilodo

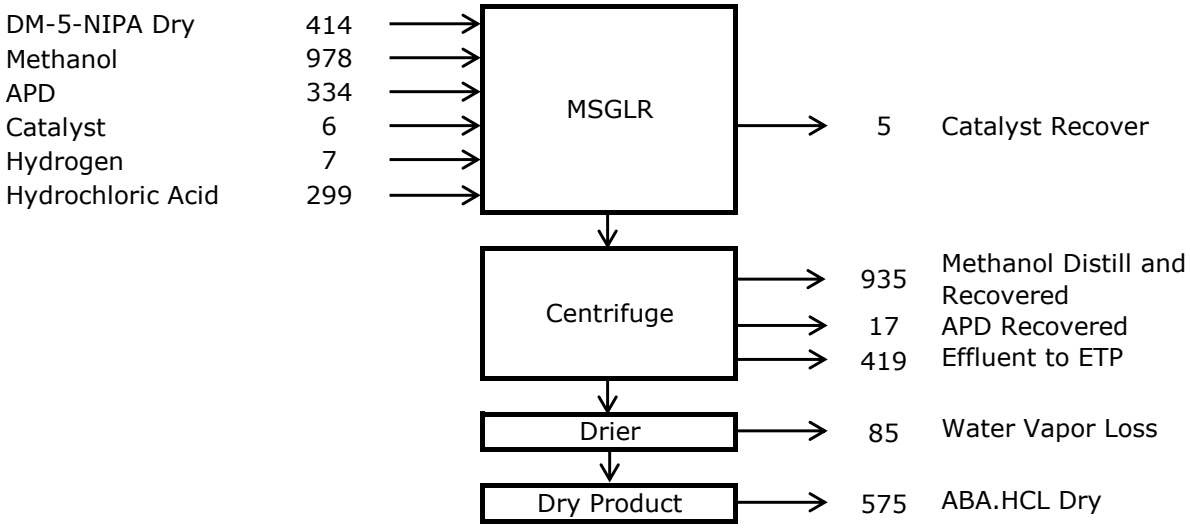

ABA Trilodo
+ (CH3CO)2O
H3C
+ CH3COOH
Acetyl ABA Trilodo

Mass Balance:

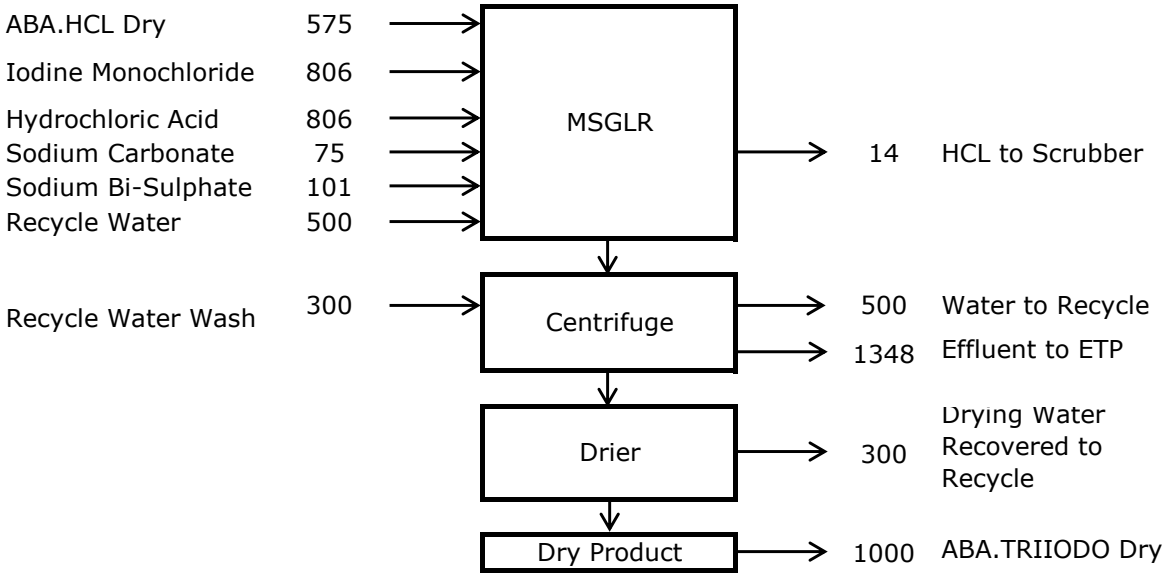
Mass Balance of ACETYL ABA.TRIIODO

Input	KG		KG	Output
STAGE 1:				
Nitric Acid	157	MSGLR	8	NO2 to Scrubber
Isophthalic Acid	317			
Sulfuric Acid	746			
Recycle Water	560			
Fresh Water	298	Nutch Filter	1175	Dilute Sulfuric Acid (50% -70%)
			336	Effluent to ETP
			75	Water to Recycle
			485	5-NIPA Wet Cake
STAGE 2:				
5-NIPA Wet Cake	485	MSGLR		
Recycle Water	821			
Fresh Water Wash	373	Centrifuge	1250	Water to Recycle
		Drier	56	Drying Water Recovered to Recycle
		Dry Product	373	5-NIPA Dry
STAGE 3:				
5-NIPA Dry	373	MSGLR		
Methanol Fresh	166			
Methanol Recycle	870			
Sulfuric Acid	83			
Sodium Carbonate	10	Nutch Filter	218	Effluent to ETP
Recycle Water Wash	83		870	Methanol Distill and Recovered
		Drier	83	Drying Water Recovered to Recycle
		Dry Product	414	DM-5-NIPA Dry

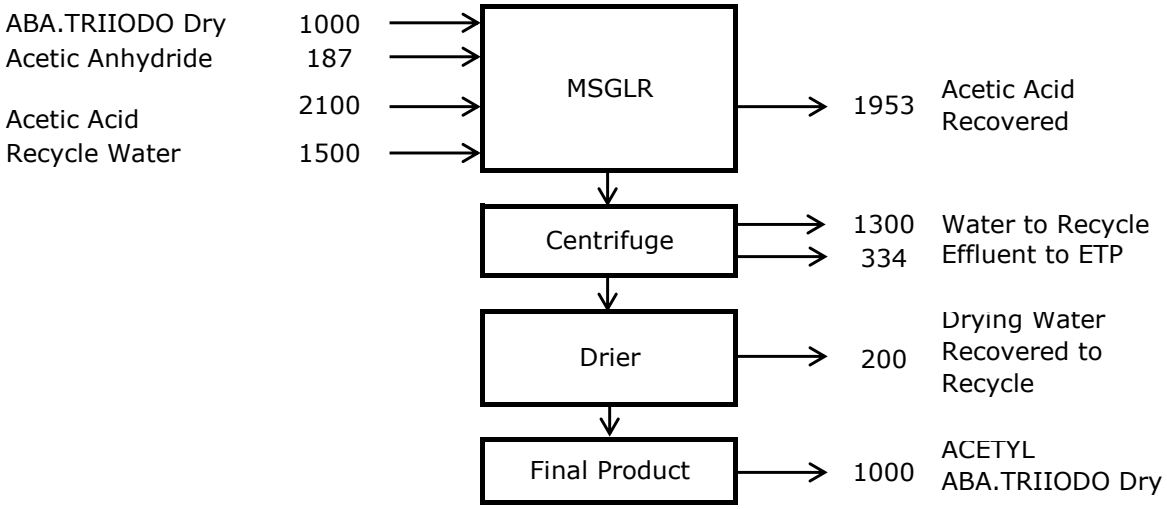
STAGE 4:



STAGE 5:



STAGE 6:



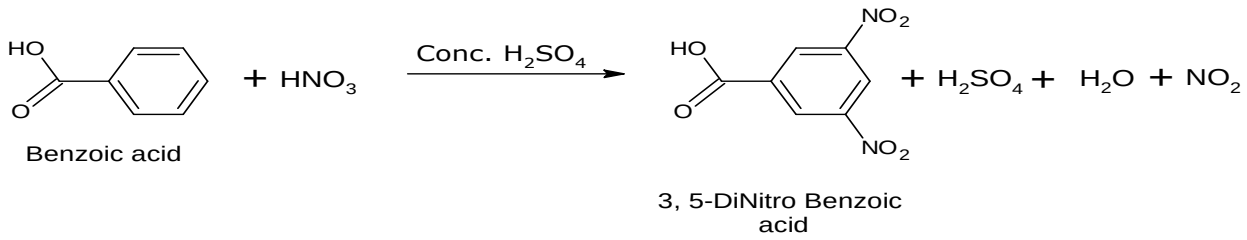
Total 15330 **15330**

17. 3-5-Dinitrobenzoic Acid (DNBA):

Manufacturing Process:

Benzoic acid is nitrated with a mixture of con. Sulphuric acid and fuming nitric acid in glass lined reactor at low temperature. Then the reaction mass is poured into chilled water and purified with wash water and centrifuge to get crude 3, 5- DNBA.

Chemical reaction:



Benzoic acid

3, 5-DiNitro Benzoic acid

Mass Balance:

Mass Balance of 3,5-DNBA

Input	KG		KG	Output
STAGE 1:				
Nitric Acid	675	MSGLR	15	NO2 to Scrubber
Benzoic Acid	625			
Sulfuric Acid	1040			
Recycle Water	560			
Fresh Water Wash	275	Centrifuge	1600	Dilute Sulfuric Acid (50% -70%)
			310	Water to Recycle
		Drier	250	Drying Water Recovered to Recycle
		Final Product	1000	3,5-DNBA Dry
Total	**3175**		**3175**	

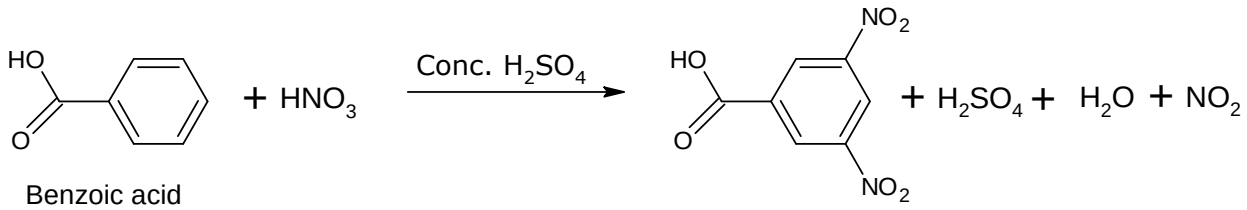
18. 3-5-Diaminobenzoic Acid (DABA):

Manufacturing Process:

Benzoic acid is nitrated with a mixture of con. Sulphuric acid and fuming nitric acid in glass lined reactor at low temperature. Then the reaction mass is poured into chilled water and purified through a centrifuge to get crude 3, 5- DNBA.

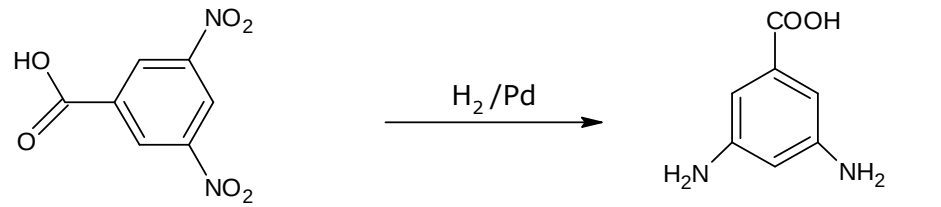
3-5-DNBA undergoes reduction with hydrogen in presence of alkali at reflux temperature. The reaction mass is then cooled and acidified with Con. HCl for isolation of product (3-5-DABA) and finally centrifuged the wet cake of 3-5-DABA and dried. Mother Liquor is recycled and catalyst is reactivated for next batch.

Chemical reaction:



Benzoic acid

3, 5-DiNitro Benzoic acid



3, 5-DiNitro Benzoic acid

3, 5-Diamino Benzoic acid

Mass Balance:

Mass Balance of 3,5-DABA

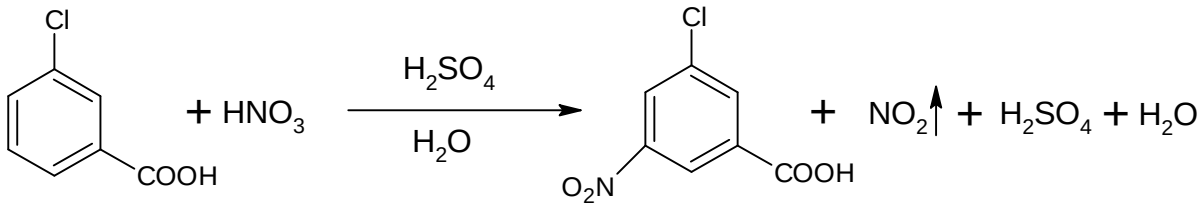
Input	KG		KG	Output
STAGE 1:				
Nitric Acid	992	MSGLR	22	NO2 to Scrubber
Benzoic Acid	919			
Sulfuric Acid	1529			
Recycle Water	823			
Fresh Water Wash	404	Centrifuge	2352	Dilute Sulfuric Acid (50% -70%)
			456	Water to Recycle
		Drier	368	Drying Water Recovered to Recycle
		Dry Product	1470	3,5-DNBA Dry
STAGE 2:				
3,5-DNBA Dry	1470	HYGNR	7	Catalyst Recover
Sodium Carbonate	110			
Hydrochloric Acid	225			
Hydrogen	90			
Catalyst	9			
Fresh Water	500			
Recycle Water	200			
		Centrifuge	1397	Effluent to ETP
		Drier	200	Drying Water Recovered to Recycle
		Final Product	1000	3,5-DABA Dry
Total	**7271**		**7271**	

19. 2-Chloro-5-Nitro Benzoic Acid (CNBA):

Manufacturing Process:

Charge ortho chloro benzoic acid; under stirring slowly add sulphuric acid and nitric acid at temperature less than 10 ^{o}C. After the completion of reaction, cool and filter with water and centrifuge and dried to CNBA.

Chemical Reaction:



OCBA CNBA

Mass Balance:

Mass Balance of CNBA

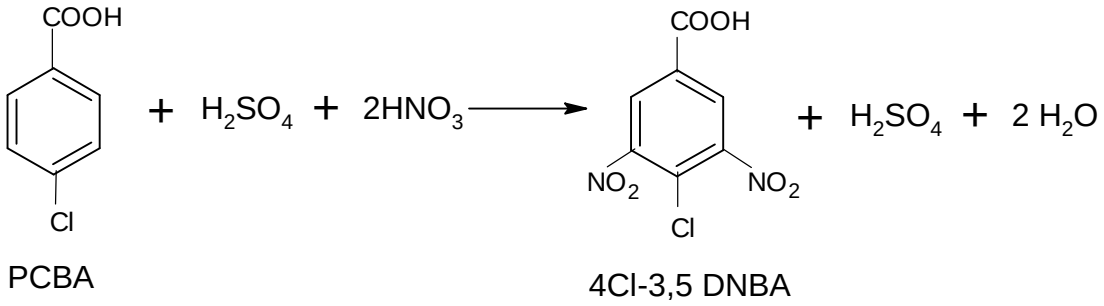
Input	KG		KG	Output
STAGE 1:				
Nitric Acid	375	MSGLR	15	NO2 to Scrubber
2-Chloro Benzoic Acid	850			
Sulfuric Acid	1425			
Fresh Water	465			
Recycle Water	300			
Fresh Water Wash	500	Centrifuge	2100	Dilute Sulfuric Acid (50% -70%)
			500	Effluent to ETP
		Drier	300	Drying Water Recovered to Recycle
		Final Product	1000	CNBA Dry
Total	**3914**		**3914**	

20. 4-Chloro Dinitro Benzoic Acid (4-Cl, 3, 5 DNBA)

Manufacturing Process:

P-Chloro benzoic acid is nitrated with nitric acid and conc. Sulphuric acid at lower temperature. Further add water to this reaction mass; cool, centrifuge and dry the mass to obtain the final product.

Chemical Reaction:



PCBA

4Cl-3,5 DNBA

Mass Balance:

Mass Balance of 4-CHLORO 3,5-DNBA

Input	KG		KG	Output
STAGE 1:				
Nitric Acid	612	MSGLR	9	NO2 to Scrubber
4-Chloro Benzoic Acid	680			
Sulfuric Acid	1135			
Fresh Water	362			
Recycle Water	250			
Fresh Water Wash	340	Centrifuge	1740	Dilute Sulfuric Acid (50% -70%)
			380	Effluent to ETP
		Drier	250	Drying Water Recovered to Recycle
		Final Product	1000	4-CHLORO 3,5-DNBA Dry
Total	**3379**		**3379**	

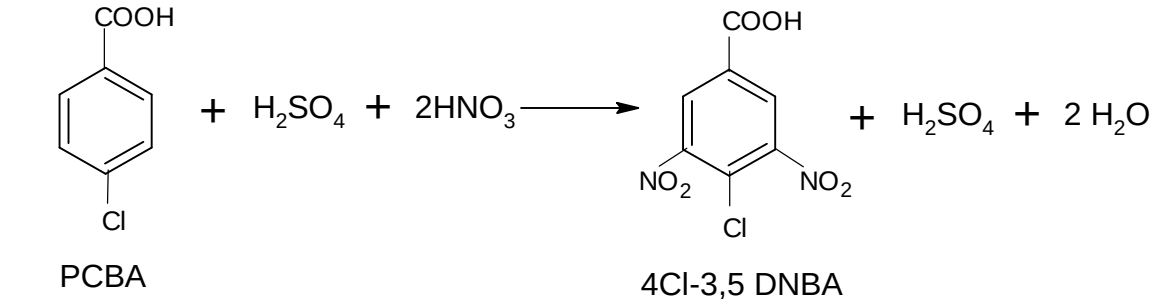
21. 4-Chloro 3, 5 Diamino Benzoic Acid (4-Cl, 3, 5 DABA)

Manufacturing Process:

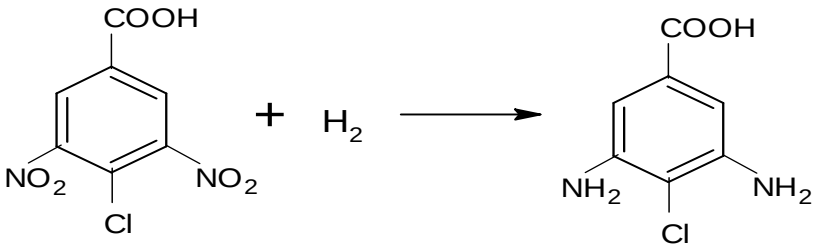
P-Chloro benzoic acid is nitrated with nitric acid and conc. Sulphuric acid at lower temperature. Further add water to this reaction mass cool, centrifuge and dry the mass to obtain 4-chloro 3, 5 dinitro benzoic acid.

4-chloro 3, 5 dinitro benzoic acid further undergoes hydrogenation in presence of catalyst at reflux temperature. The reaction mass is then cooled and acidified with conc. HCl. The wet cake is then cooled, centrifuged and dried to obtain the final product.

Chemical reaction:



PCBA 4Cl-3,5 DNBA



4Cl-3,5 DNBA 4Cl-3,5 DABA

Mass Balance:

Mass Balance of 4-CHLORO 3,5-DABA

Input	KG		KG	Output
STAGE 1:				
Nitric Acid	930	MSGLR	13	NO2 to Scrubber
4-Chloro Benzoic Acid	1034			
Sulfuric Acid	1725			
Fresh Water	550			
Recycle Water	380			
Fresh Water Wash	517	Centrifuge	2645	Dilute Sulfuric Acid (50% -70%)
			577	Effluent to ETP
		Drier	380	Drying Water Recovered to Recycle
		Dry Product	1520	4-CHLORO 3,5-DNBA Dry
STAGE 2:				
4-CHLORO 3,5-DNBA Dry	1520	HYGNR	22	Catalyst Recover
Sodium Carbonate	320			
Hydrochloric Acid	760			
Hydrogen	80			
Catalyst	23			
Fresh Water	152			
Recycle Water	912			
Fresh Water Wash	500	Centrifuge	712	Water to Recycle
			2334	Effluent to ETP
		Drier	200	Drying Water Recovered to Recycle
		Final Product	1000	4-CHLORO 3,5-DABA Dry
Total	**9404**		**9404**	

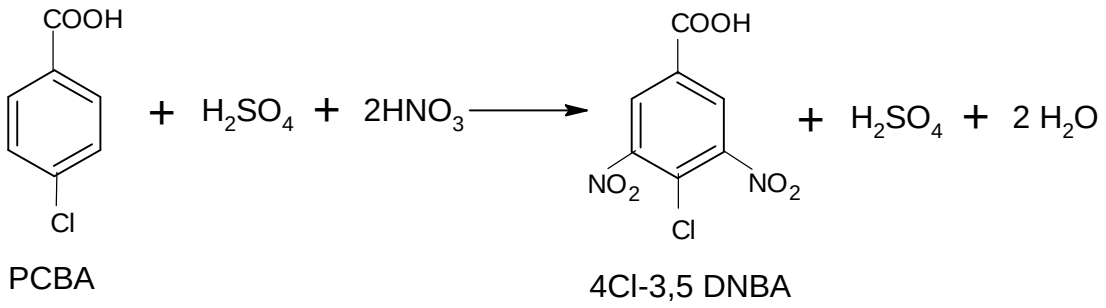
22. 4-Chloro 3, 5 Diamino Benzoic Acid Isobutyl Ester

Manufacturing Process:

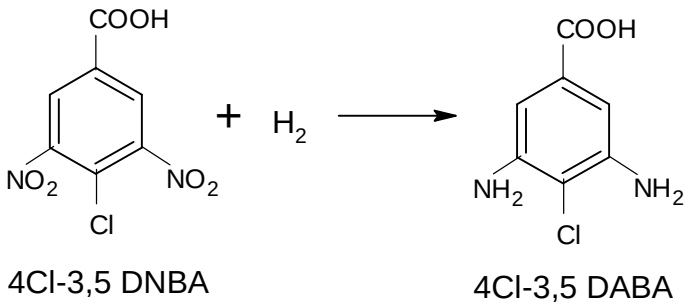
P-Chloro benzoic acid is nitrated with nitric acid and conc. Sulphuric acid at low temperature. Further add water to this reaction mass cool, centrifuge and dry the mass to obtain 4-chloro 3, 5 dinitro benzoic acid.

4-chloro 3, 5 dinitro benzoic acid further undergoes hydrogenation in presence of catalyst at reflux temperature. The reaction mass is then cooled and acidified with conc. HCl. The wet cake is then cooled, centrifuged and dried to obtain 4-Chloro 3, 5 Diamino benzoic acid. Isobutyl alcohol and sulfuric acid are then added to this reaction mass and at the end final product 4-Chloro 3, 5 Diamino benzoic acid, Isobutyl ester is obtained.

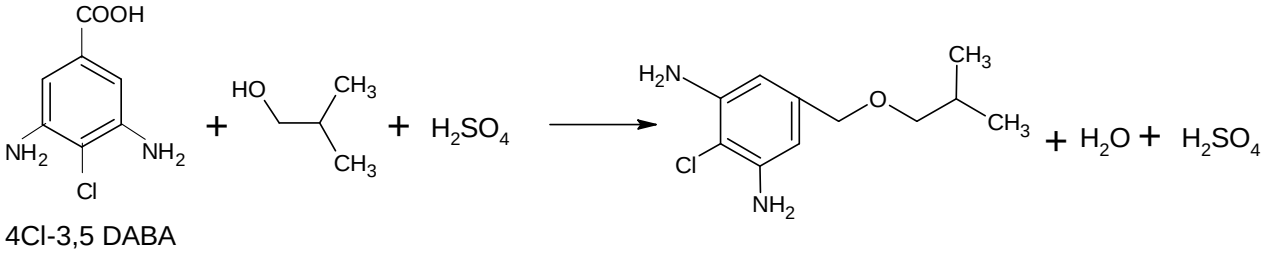
Chemical Reaction:



PCBA 4Cl-3,5 DNBA



4Cl-3,5 DNBA 4Cl-3,5 DABA



4Cl-3,5 DABA

Mass Balance:

Mass Balance of 4-CHLORO 3,5-DABA.IBE

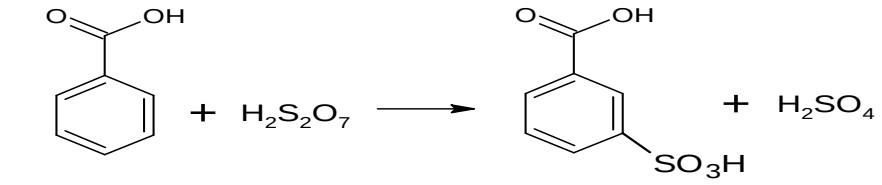
Input	KG		KG	Output
STAGE 1:				
Nitric Acid	823	MSGLR	11	NO2 to Scrubber
4-Chloro Benzoic Acid	915			
Sulfuric Acid	1526			
Fresh Water	487			
Recycle Water	338			
Fresh Water Wash	457	Centrifuge	2340	Dilute Sulfuric Acid (50% -70%)
			511	Effluent to ETP
		Drier	338	Drying Water Recovered to Recycle
		Dry Product	1345	4-CHLORO 3,5-DNBA Dry
STAGE 2:				
4-CHLORO 3,5-DNBA Dry	1345	HYGNR	19	Catalyst Recover
Sodium Carbonate	283			
Hydrochloric Acid	673			
Hydrogen	71			
Catalyst	20			
Fresh Water	135			
Recycle Water	807			
Fresh Water Wash	443	Centrifuge	630	Water to Recycle
			2065	Effluent to ETP
		Drier	177	Drying Water Recovered to Recycle
		Dry Product	885	4-CHLORO 3,5-DABA Dry
STAGE 3:				
4-CHLORO 3,5-DABA Dry	885	MSGLR	1200	Isobutyl Alchol Recovered
Isobutyl Alchol	1600			
Sulfuric Acid	398			
Recycle Water	300			
		Centrifuge	683	Effluent to ETP
		Drier	300	Drying Water Recovered to Recycle
		Final Product	1000	4-CHLORO 3,5-DNBA.IBE Dry
Total	**11505**		**11505**	

23. 3-SulphoBenzoic Acid Sodium Salt

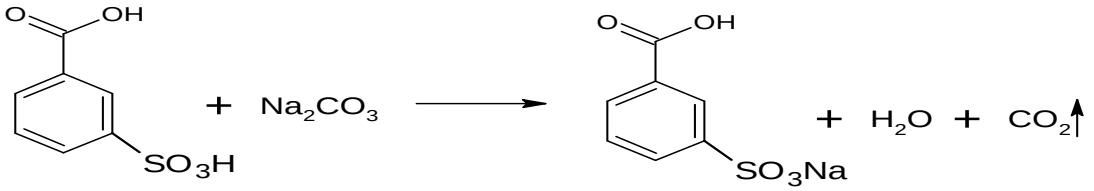
Manufacturing Process:

Benzoic acid is sulphonated with Oleum in glass lined reactor at low temperature. The reaction mass is then poured into chilled water and centrifuged to get 3-Sulpho benzoic acid. Further water and sodium carbonate are added to it and crystalized, centrifuged and dried to obtain final product.

Chemical Reaction:



Benzoic Acid — 3- Sulpho Benzoic Acid



3- Sulpho Benzoic Acid — 3- Sulpho Benzoic Acid Na-salt

Mass Balance:

Mass Balance of Na-SBA

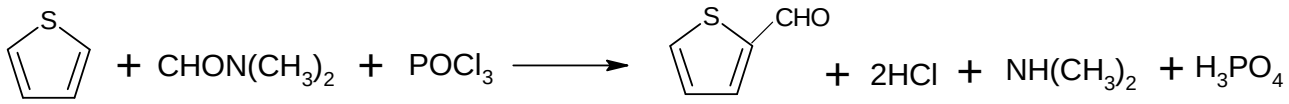
Input	KG		KG	Output
STAGE 1:				
Oleum (23%)	1740	MSGLR	12	SO2 to Scrubber
Benzoic Acid	600			
Fresh Water	660			
		Centrifuge	1788	Dilute Sulfuric Acid (50% -70%)
			1200	3-SBA Wet Cake
STAGE 2:				
3-SBA Wet Cake	1200	MSGLR		
Soda Ash	600			
Recycle Water	1200			
Fresh Water Wash	800	Centrifuge	1600	Effluent to ETP
Recycle Water Wash	200		1200	Water to Recycle
		Drier	200	Drying Water Recovered to Recycle
		Final Product	1000	Na-SIPA Dry
Total	**7000**		**7000**	

24. Thiophene-2-Aldehyde (T2A):

Manufacturing Process:

Thiophene is reacted in the presence of Dimethyl Formamide and $POCl_3$ followed by quenching in water. The resultant crude is then distilled for getting pure Thiophene-2-Aldehyde.

Chemical Reaction:

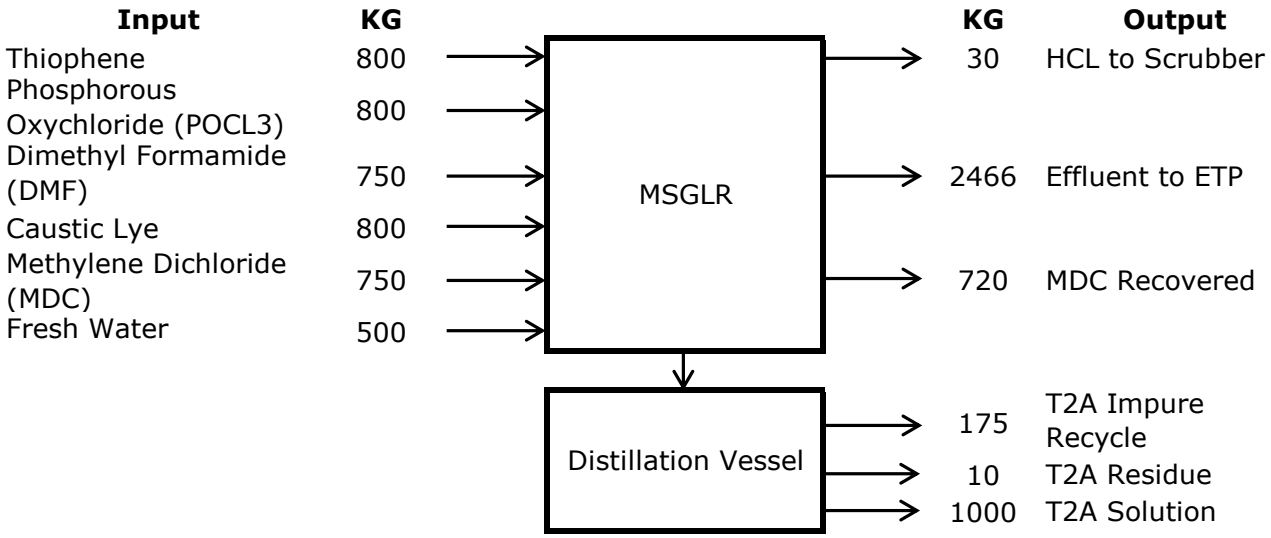


Thiopene

Thiopene 2-Aldehyde

Mass Balance:

Mass Balance of T2A



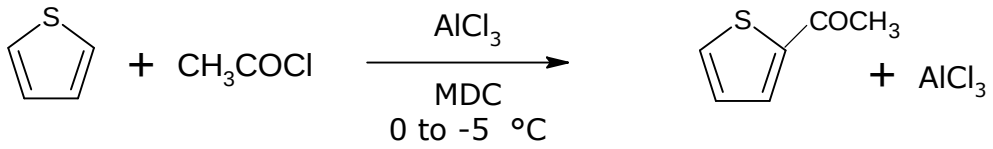
Total	**4401**		**4401**

25. Thiophene-2-Acetyl (T2AC)

Manufacturing process:

Thiophene is reacted in with Acetyl Chloride in the presence of $AlCl_3$ & MDC. Then it is filtered out to separate the clay for its reuse and the liquid mass is distilled out for getting pure Thiophene-2-Acetyl.

Chemical reaction:



Thiopene

Thiopene 2-Acetyl

Mass Balance:

Mass Balance of T2AC

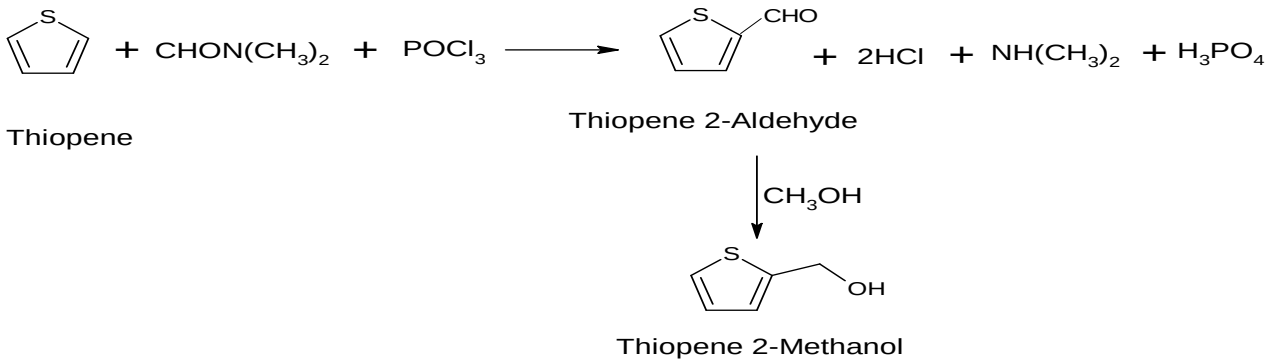
Input	KG		KG	Output
Thiophene	770		19	HCL to Scrubber
Methylene Dichloride (MDC)	2125		1912	MDC Recovered
Acetyl Chloride	810	MSGLR	649	Effluent to ETP
Aluminium Chloride	1463		2195	Aluminium Chloride Solution
Fresh Water	770			
		Distillation Vessel	155	T2AC Impure Recycle
			8	T2AC Residue
			1000	T2AC Solution
Total	**5938**		**5938**	

26. Thiopene-2-Methanol

Manufacturing Process:

Thiophene is reacted in the presence of Dimethyl Formamide and $POCl_3$ followed by quenching in water. The resultant crude is then distilled for getting pure Thiophene-2-Aldehyde.Thiopene-2-Aldehyde then reacts in the presence of Formaldehyde and methanol to form thiophene-2-methanol. pH adjustment is done further and layer separation is done to obtain pure thiophene-2-methanol.

Chemical Reaction:



Mass Balance:

Mass Balance of T2ME

Input	KG		KG	Output
STAGE 1:				
Thiophene	864	MSGLR	32	HCL to Scrubber
Phosphorous Oxychloride (POCL3)	864			
Dimethyl Formamide (DMF)	810		2663	Effluent to ETP
Caustic Lye	864			
Methylene Dichloride (MDC)	810		779	MDC Recovered
Fresh Water	540			
		Distillation Vessel	189	T2A Impure Recycle
			11	T2A Residue
			1080	T2A Solution
STAGE 2:				
T2A Solution	1080	MSGLR	743	Effluent to ETP
Methanol	315			
Formaldehyde	250			
Sodium Hydroxide Solution	220			
		Distillation Vessel	113	T2ME Impure Recycle
			10	T2ME Residue
			1000	T2ME Product
Total	**6619**		**6619**	

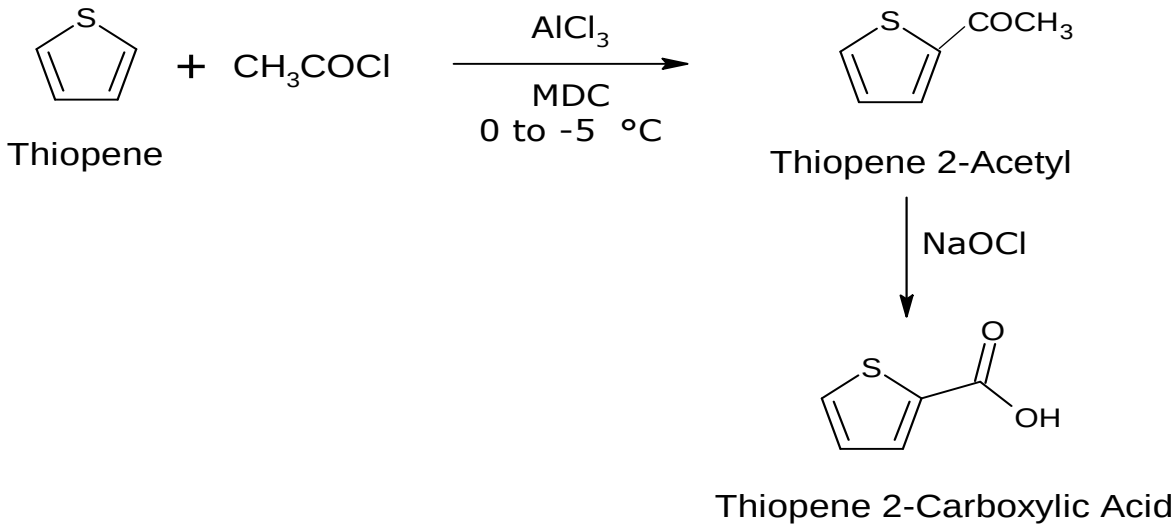
27. Thiopene-2-Carboxylic Acid

Manufacturing Acid:

Thiophene is reacted with Acetyl Chloride in the presence of $AlCl_3$ & MDC. Then it is filtered out to separate the clay for its reuse and the liquid mass is distilled out for getting pure Thiophene-2-Acetyl.

Thiophene-2-Acetyl is further oxidized in the presence of sodium hypochlorite, followed by pH adjustment with sodium carbonate and the precipitated to obtain final product Thiophene-2-Carboxylic acid.

Chemical Reaction:



Mass Balance:

Mass Balance of T2CA

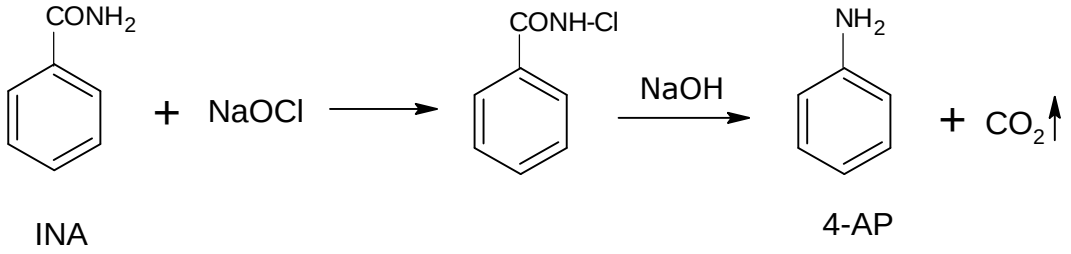
Input	KG		KG	Output
STAGE 1:				
Thiophene	847	MSGLR	21	HCL to Scrubber
Methylene Dichloride (MDC)	2338		2104	MDC Recovered
Acetyl Chloride	891		713	Effluent to ETP
Aluminium Chloride	1609		2414	Aluminium Chloride Solution
Fresh Water	847			
		Distillation Vessel	171	T2AC Impure Recycle
			9	T2AC Residue
			1100	T2AC Solution
STAGE 2:				
T2AC Solution	1100	MSGLR		
Sodium Hypochloride	715			
Sodium Carbonate	17			
		Centrifuge	682	Effluent to ETP
		Drier	150	Water Vapor Loss
		Final Product	1000	T2CA Dry
Total	**8364**		**8364**	

28. 4- Amino Pyridine (4AP)

Manufacturing Process:

Take Caustic Lye, Cl_2 & Hypo Solution. Add INA and heat it & add caustic lye. Reflux, cool & filter the reaction mass. After filtering purify it with water & get 4-AP.

Chemical Reaction:



Mass Balance:

Mass Balance of 4-AP

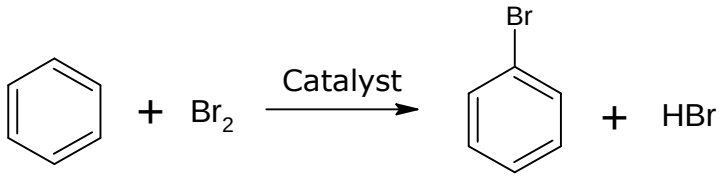
Input	KG		KG	Output
Chlorine	905	→ MSGLR		
Isonicotinamide	1430	→ MSGLR		
Caustic Lye	858	→ MSGLR		
Activated Carbon	3	→ MSGLR	4	Spent Carbon
Fresh Water	1000	→ MSGLR		
		MSGLR → Centrifuge	2992	Effluent to ETP
		Centrifuge → Drier	200	Water Vapor Loss
		Drier → Final Product	1000	4-AP Dry
Total	**4196**		**4196**	

29. Bromo Benzene

Manufacturing Process:

Take benzene into the glass lined reactor add catalyst and slowly add bromine at low temperature. After the additions maintain the temperature for 4 hours and at the end final product is obtained.

Chemical Reaction:



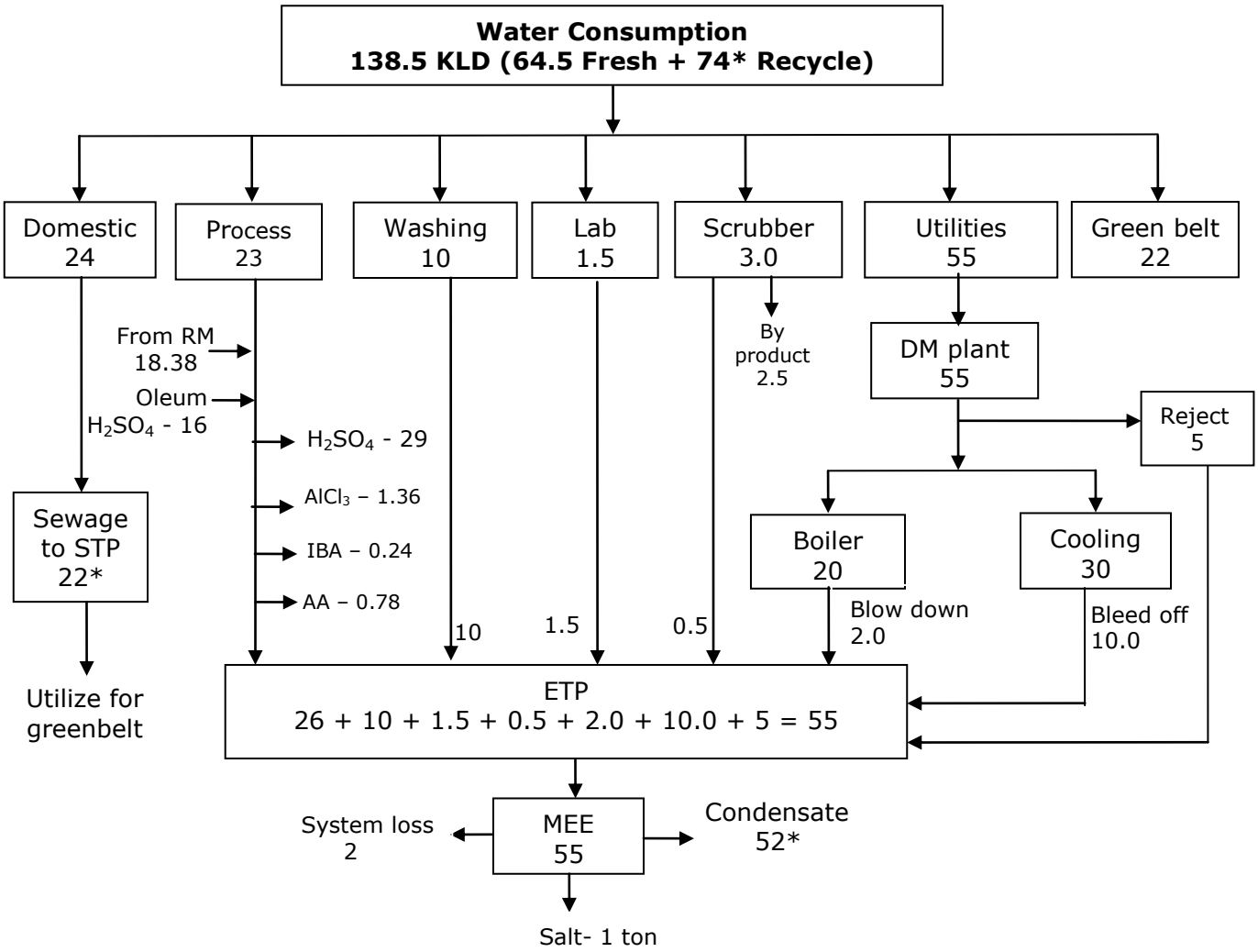
Mass Balance:

Mass Balance of Bromo-benzene

Input	KG		KG	Output
Benzene	520	→ MSGLR →	697	HBr By-product
Bromine	1175	→	8	Catalyst recovered
Catalyst	10	→		
		→ Final Product →	1000	Bromo Benzene
Total	**1705**		**1705**	

Annexure-III

Water Balance Diagram – Total after expansion



Water Consumption

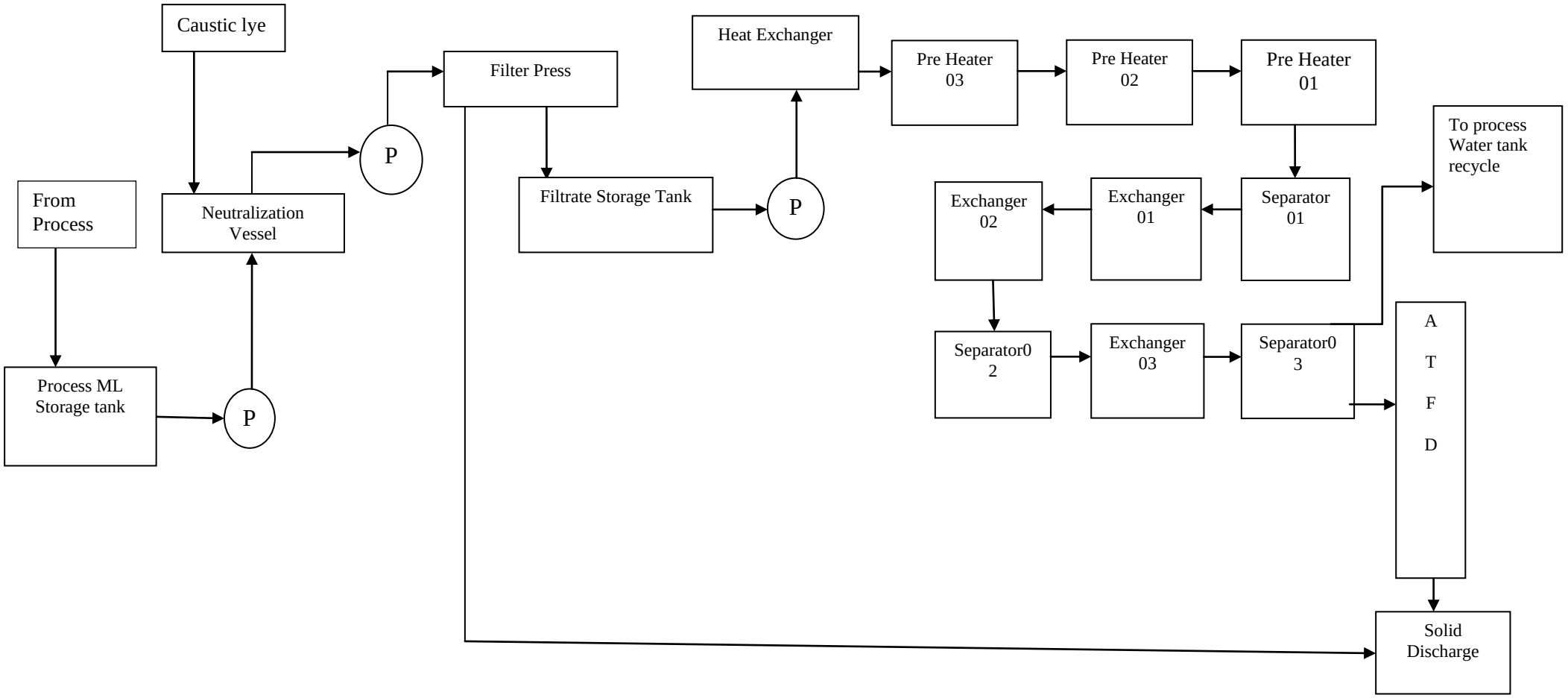
Sr. No.	Break up	Existing Water Consumption (KL/day)	Total Water Consumption after expansion (KL/day)
1.	**Domestic**	1.0	24
2.	**Green Belt**	10	22
3.	**Industrial**		
a.	Water treatment (DM Plant/RO Plant)	1.0	5
b.	Process	7.0	23
c.	Lab	00	1.5
d.	Boiler	00*	20
e.	Cooling Tower/Chilling plant	3.0	30
f.	Scrubber	0.5	3.0
g.	Washing	1.0	10
Total Industrial		**12.5**	92.5
Total (1 +2 + 3)		**23.5**	138.5
Recycle water		**-**	74.0
Fresh water requirement		**-**	**64.5**

Wastewater Generation

Sr. No.	Break up	Existing w/w Generation KLD	Total w/w generation after expansion (KL/day)
I	**Domestic**	0.6	22
II	**Industrial**		
a.	Water treatment (DM Plant/RO Plant)	--	5
b.	Process	3.0	26
c.	Lab	--	1.5
d.	Boiler	--	2.0
e.	Cooling Tower/Chilling plant	0.0	10.0
f.	Scrubber	0.0	0.5
g.	Washing	1.0	10
Total Industrial		**4.0**	**55.0**
Total		**4.6**	**77.0**

Annexure-III (a)

Process flow chart of Multi Effect Evaporator



MEE units with dimension and capacity

Sr. No.	Particulars	Capacity	Dimensions
01	Process ML storage tank	93 KL	(3900 mm X 11900 mm X 2000 mm)
02	Neutralization vessel	12 KL	Shell I. D 2300 mm Shell length 2800 mm
03	Filter press	36"X36"	915 mm X 915 mm polypropylene plate cake thickness (22.5 mm+/-2 mm) 44 chambers body
04	Filter storage tank	18 KL	(1900 X 18000 X 5100)
Details of MEE			
05	Heat exchanger	2 m^2	Shell SS-304, Tubes SS-316 Ti Seamless, tube sheet SS-316 Ti
06	Pre heater	2 m^2 x 3 Nos.	Shell SS-304, Tubes SS-316 Ti Seamless, tube sheet SS-316 Ti
07	Separator	6.1 KL	Vapour liquid separator SS-316 shell O. D 1500 mm shell length 3500 mm shell thick. 4 mm
08	Exchanger	75 m^2	Evaporation Rate 3000 kg/h ,evaporation rate 2580 kg/h Shell SS-304, Tubes SS-316 Ti Seamless ,tube sheet SS-316 Ti
09	Exchanger	45 m^2	Evaporation Rate 3000 kg/h , evaporation rate 2580 kg/h Shell SS-304, Tubes SS-316 Ti Seamless ,tube sheet SS-316 Ti
10	Separator	1.6 KL	Vapour liquid separator SS-316 shell O. D 1000 mm shell length 2000 mm shell thick. 4 mm
11	Exchanger	45 m^2	Evaporation Rate 3000 kg/h , evaporation rate 2580 kg/h ,Shell SS-304, Tubes SS-316 Ti Seamless ,tube sheet SS-316 Ti
12	Separator	1.6 KL	Vapour liquid separator SS-316, shell O. D 1000 mm shell length 2000 mm shell thick. 4 mm
13	ATFD	7.5 m^2	Agitated thin film dryer capacity 420 Kg/hrs , MOC SS-316

Annexure-IV

Hazardous waste generation & disposal details

Sr. No.	Type of Waste	Category No. as per HWM rules, 2016	Quantity		Method of Disposal
			Existing	Total after expansion	
1.	ETP waste + MEE salt	35.3	--	50 + 25 =75	Collection, storage & disposal at TSDF site approved by GPCB.
2.	Discarded containers/ drums/ liners	33.1	25 nos./year	2500 nos./year	Collection, storage and disposal by selling to approved recycler or traders.
3.	Used Lubricating Oil	5.1	2.5 lit/year	500 lit/year	Collection, storage & use within premises as lubricant/sell to registered recycler.
4.	Spent Carbon	28.3	2.5 MT/year	1.1 MT/year	Collection, Storage, Transportation, Disposal at TSDF.
5.	Spent Catalyst	28.2	--	1.2 MT/month	Collection, Storage, Transportation and sent back to supplier/ manufacturer for regeneration.
6.	Spent Sulphuric Acid	26.3	--	740 MT/month	Collection, Storage, Transportation and sold to actual users.
7.	Hydro Chloric Acid (25%)	26.3	--	4.16 MT/month	Collection, Storage, Transportation and sold to actual users.
8.	Aluminum Chloride (20%)	26.3	--	34 MT/month	Collection, Storage, Transportation and sold to actual users.
9.	Hydrogen Bromide (20%)	-	-	28 MT/month	Collection, Storage, Transportation and sold to actual users.

Annexure-V

Details of Air Pollution

Sr. No.	Stack attached to	Stack height in meter	Fuel Type & Fuel Consumption Rate	APC measure	Pollutant
⇒ **Flue Gas Stack – Existing**					
1.	Thermic fluid heater (2 Lac Kcal/hr.)	14	LDO – 16 Lit/hr.	**--**	SPM<150 mg/Nm^3 SO_2<100 ppm NO_X<50 ppm
2.	Boiler (5 TPH)	31	Coal/ Lignite/Agro waste-Agro-briquettes– 28 MT/day	Multi Cyclone Dust Collector	SPM<150 mg/Nm^3 SO_2<100 ppm NO_X<50 ppm
⇒ **Process Gas Emission - Existing**					
1.	Scrubber of Sulfonation vessel	11	--	Alkali scrubber (This scrubber will be desmental after expantion)	SPM<150 mg/Nm^3 SO_2<40 mg/Nm^3 NO_X<25 mg/Nm^3
⇒ **Flue Gas Stack – Proposed**					
2.	TFH (4 Lac Kcal/hr.)	21	Coal – 3 MT/day LDO/FO – 500 lit/day	Multi Cyclone Dust Collector	SPM<150 mg/Nm^3 SO_2<100 ppm NO_X<50 ppm
3.	DG Set – Standby (500 KVA)	11	Diesel – 80 lit/hr	--	
⇒ **Process Gas Emission - Proposed**					
1.	Scrubber-1	11	--	Water & Alkali scrubber	HCl<20 mg/Nm^3 HBr<20 mg/Nm^3
2.	Scrubber-2	11	--	Alkali scrubber	SO_2<40 mg/Nm^3
3.	Scrubber-3	11	--	Alkali scrubber	NO_X<25 mg/Nm^3