Annexure-I
List of Products

Sr. No.	Name of Products	Quantity (MT/Month)
A	**Herbicides**	
1.	Bispyribac sodium	625
2.	Diuron	
3.	Glufosinate ammonium	
4.	Pyribenzoxim	
5.	Cyhalofop-butyl	
6.	Clordinafop-propargyl	
7.	Cloquintocet-mexyl	
8.	Benfuresate	
9.	Tembotrione	
10.	Pinoxaden	
11.	Penoxsulam	
12.	Chlorimuron-ethyl	
13.	Fomesafen	
14.	Metribuzin	
15.	Triclopyr	
16.	Flucetosulfuron	
17.	2,4-D amine salt	
18.	Glyphosate potassium salt	
B	**Insecticides**	
1.	Diafenthiuron	625
2.	Thiocyclam oxalate	
3.	Dinotefuran	
4.	Pymetrozine	
5.	Chloranthraniliprole	
6.	Cyantraniliprole	
7.	Ethiprole	
8.	Flubendiamide	
9.	Flonicamid	
10.	Spirotetramat	
11.	Cyenopyrafen	
12.	Profenofos	
13.	Thiamethoxam	
14.	Fenpyroximate	
C	**Fungicides**	
1.	Pyraclostrobin	250
2.	Kresoxim methyl	
3.	Trifloxystrobin	
4.	Cyazofamid	
5.	Dimethomorph	

6.	Boscalid	
7.	Metrafenone	
8.	Carbendazim	
9.	Myclobutanil	
10.	Copper oxychloride	
11.	Cuprus chloride	
12.	Cuprous oxide	
13.	Azoxystrobin	
	Total	**1500**

❖ **Intermediate Chemicals**

Sr. No.	**Name of Products**	**Quantity (MT/Month)**
1	Lambda acid	**1000**
2	Bifenthrin alcohol	
3	3-methyl-4-nitroimino perhydro 1,3,5-oxadiazine (MNIO)	
4	2-(Nitroimino) Imidazolidine (NII)	
5	2-Chloro-5-(Chloromethyl) Thiazole (CCMT)	
6	Phenyl 4,4-dimethoxy pyrimidine-2yl-carboxilate	
7	Diethyl thiophosphoryl chloride (DETCl)	
	Total	**1000**

LIST OF RAW MATERIALS

Sr. No.	Name of Products	Name of Raw Materials	Quantity (MT/MT)
1	Bispyribac Sodium	Ethyl Acetate	0.05
		2,6 DHBA	0.38
		Dimethyl Sulfate	0.33
		Sodium Bicarbonate	0.23
		4,6 DMMSP	1.05
		Potassium carbonate	0.70
		Dichloroethane	0.04
		Isopropanol	0.04
		Sodium Hydroxide	0.10
2	Diuron	Dichloroethane	0.08
		3,4-Dichloroaniline	0.73
		Triphosgene	0.45
		Dimethylamine 40%	0.47
3	Glufosiante Potassium	Ethanol	0.10
		Acrolein	0.31
		DEMP	0.64
		Sodium Cyanide	0.27
		Ammonium Carbonate	0.33
		Barium Hydroxide	0.87
		Sulfuric acid 30%	0.80
		Ammonium Hydroxide	0.80
4	Pyribenzoxim	Dichloroethane	0.05
		Bispyribac	0.73
		Benzophenone	0.35
		4 DMAP	0.01
5	Cyhalofop-butyl	Dichloroethane	0.05
		RHPPA	0.55
		3,4-DFBN	0.43
		Potassium carbonate	0.45
		n-butanol	0.25
		p-TSA	0.01
6	Clodinafop-propargyl	Dichloroethane	0.05
		RHPPA	0.55
		5-chloro 2,2 DFP	0.45
		Sodium hydroxide	0.25
		Propargyl alcohol	0.18
		p-TSA	0.01
7	Cloquintocet-Mexyl	Dichloroethane	0.04
		2-heptanol	0.36
		chloroacetic acid	0.30
		Sulfuric acid	0.003
		Potassium carbonate	0.23
		S-CQ	0.55
8	Benfuserate	Dichloroethane	0.06

		Morpholine	0.37
		Isobuteraldehyde	0.31
		4-benzoquinone	0.46
		Ethane Sulfonyl Chloride	0.54
		Dichloroethane	0.04
		HCl 30%	0.50
		Sodium borohydride	0.16
		Sulfuric acid	0.10
9	Tembotrione	Chlorobenzene	0.05
		MCMMSB	0.65
		Bromine	0.40
		SS of 2,2,2-TFE	0.30
		HCl 30%	0.33
		Thionyl chloride	0.28
		Cyclohexane-1,3 dione	0.28
10	Pinoxaden	Methanol	0.05
		MDEMP acetate	0.60
		Dimethyl Carbonate	0.25
		Sodium hydroxide	0.01
		Dichloroethane	0.08
		1,2,5-ODDHB	0.70
		2,2-DMPC	0.33
11	Penoxulam	Methanol	0.05
		2-FTFMA	0.40
		Sodium methoxide	0.01
		2,2 Difluro ethanol	0.19
		HCl 30%	0.31
		Sodium nitrite	0.18
		sodium sulfite	0.32
		Dichloroethane	0.06
		5,8 DMTPA	0.42
12	Chlorimuron-ethyl	Dichloroethane	0.06
		Ethyl 2- Sulfomoylbenzoate	0.59
		Triphosgene	0.26
		4-CMPA	0.39
13	Fomesafen	Dichloroethane	0.05
		3 hydroxybenzoic acid	0.34
		Sodium hydroxide	0.10
		1,2-DCTFMB	0.53
		Sulfuric acid	0.25
		nitric acid 65%	0.25
		Methansulfonamide	0.23
14	Metribuzin	Dichloroethane	0.05
		Pivaloyl chloride	0.53
		copper cyanide	0.33
		HCl 30%	0.05
		Thiocarbohydrazide	0.45
		Dimethyl sulfate	0.20

15	Triclopyr	NaOH 48%	0.72
		2,3,5,6-TCP	0.90
		Chloroacetic acid	0.40
		Dichloroethane	0.04
		HCl 30%	0.53
16	Flucetosulfuron	Dichloroethane	0.05
		BTPFP	0.63
		2-MAC	0.25
		Formic acid	0.13
		chlorine	0.16
		Ammonia 25%	0.18
		p-4,6-DMPC	0.60
17	2,4 D amine salt	Dimethylamine	0.60
		Emulsifier	0.03
		Oxalix Acid	0.02
		2,4 D acid	0.60
18	Glyphosate Potassium salt	Potassium hydroxide 85%	0.33
		Dichloroethane	0.05
		Glyphosate	0.83
19	Diafenthuron	Xylene	0.04
		2,6 DIPPTU	0.90
		Isopropanol	0.05
		tert-butylamine	0.20
20	Thiocyclam oxalate	Dichloroethane	0.05
		Allyl chloride	0.30
		NaOH 48%	0.37
		Dimethylamine 40%	0.45
		chlorine	0.28
		Sodium thiosulfate	1.20
		Sodium sulfide	0.50
		Oxalic acid	0.33
21	Dinotefuran	MMNCI	0.73
		NaOH 40 %	0.55
		3-AMTHF	0.55
22	Pymetrozine	Dichloroethane	0.05
		Ethyl acetate	0.44
		Hydrazine hydrate	0.48
		Triphosgene	0.50
		Potassium carbonate	0.33
		chloroacetone	0.45
		Methanol	0.06
		HCl	0.10
		Nicotinaldehyde	0.50
23	Chlorantraniliprole	Dichloroethane	0.05
		EBCPPC	0.75
		oxalyl chloride	0.29
		Sulfuric acid	0.001

		ACMBA	0.42
		Thionyl chloride	0.27
		Methyl amine	0.07
24	Cyantraniliprole	Dichloroethane	0.05
		EBCPPC	0.76
		oxalyl chloride	0.30
		Sulfuric acid	0.001
		ACNMBA	0.41
		Thionyl chloride	0.28
		Methyl amine	0.07
25	Ethiprole	Dichloroethane	0.05
		Acetic acid	0.03
		ADCTFMPETPCN	1.00
		H2O2 30%	0.33
		Sodium sulfite 10%	0.10
		NaOH 10%	0.23
26	Flubendiamide	Dichloromethane	0.01
		IMMTPMPFPPP	1.00
		m-CPBA	0.55
27	Flonicamid	Dichloroethane	0.05
		4-TFMNA	0.90
		2-AAN HCl	0.45
		Triphosgene	0.48
28	Spirotetramat	Dichloroethane	0.05
		2,5 DMBAA	0.48
		thionyl chloride	0.35
		Methanol	0.10
		HCl 30%	0.01
		1s, 4s-1 AMCHCA	0.50
		Potassium carbonate	0.40
		HCl 30%	0.38
		Ethoxy Formyl chloride	0.31
29	Cyenopyrafen	Dichloroethane	0.05
		MTMPC	0.46
		2-4 TBPAN	0.48
		Pivalic acid	0.28
30	Profenfos	Monochlorobenzene	0.05
		2-Chlorophenol	0.36
		Bromine	0.45
		DEPCT	0.51
		Trimethylamine	0.16
		n-propyl bromide	0.34
31	Thiamethoxam	Dichloroethane	0.04
		CCMT	0.60
		MNIO	0.58
		Potassium carbonate	0.25
32	Fenpyroximate	Dichloroethane	0.06

		1,3 DMPPCO	0.59
		TBCMB	0.58
		Potassium carbonate	0.18
33	Pyraclostrobin	methanol	0.08
		(4-chlorophenyl)hydrazine	0.43
		Methyl acrylate	0.26
		Sulfuric acid	0.01
		NaOH	0.10
		1-BMNB	0.57
		ammnium chloride	0.10
		Dichloroethane	0.03
		Methylchloroformate	0.27
		Potassium carbonate	0.04
		Dimethyl sulfate	0.15
34	kersoxim-methyl	Dichloroethane	0.05
		2-MPMBA	0.84
		Thionyl chloride	0.42
		Sodium cyanide	0.17
		HAOMHC	0.28
		methanol	0.11
35	Trifloxystrobin	potassium hydroxide 85%	0.18
		Dichloroethane	0.06
		3-TFMPEO	0.52
		TBAB	0.01
		MBMPMIA	0.73
36	Cyazofamid	Methanol	0.10
		2,2-DCPTE	0.66
		Glyoxal 45& soln	0.42
		Hydroxylamine HCl	0.70
		ethyl acetate	0.05
		Thionyl chloride	0.39
		Potassium carbonate	0.23
		NNDMASC	0.47
37	Dimethomorph	caustic soda lye 48%	0.50
		1,2 dihydroxybenzene	0.30
		Dimethyl sulfate	0.35
		Dichloroethane	0.05
		Aluminium chloride	0.04
		4-Chlorobenzoyl chloride	0.48
		1- morpholino ethanone	0.35
38	Boscalid	Dichloroethane	0.05
		4-CPBA	0.49
		o-toluidine	0.34
		Sodium carbonate	0.18
		2-chloronicotinoyl chloride	0.55
39	Metrafenone	Dichloroethane	0.05
		2-MMBA	0.44
		Bromine	0.43

		Thionyl chloride	0.31
		1,2,3-TM-5-MB	0.47
40	Carbendazim	caustic lye 48% soln	0.46
		Cyaniamide	0.46
		methylchloroformate	0.52
		1,2-diaminobenzene	0.59
		HCl 30%	0.67
41	myclobutanil	Dichloroethane	0.05
		4-chlorobenzyl cyanide	0.56
		caustic soda lye 48% soln	0.92
		n-butyl chloride	0.35
		Dichloromethane	0.31
		1,2,4 triazole	0.25
42	Copper oxychloride	HCl 30 %	0.61
		copper powder	0.61
43	Cuporous chloride	copper powder	0.64
		chlorine	0.36
44	Cuporous oxide	copper powder	0.80
45	Azoxystrobin	MMCP	0.90
		DMF	0.10
		2-cyano phenol	0.35
		Potassium carbonate	0.25
		Dichloroethane	0.08
		Methanol	0.30
46	lambda acid	t-butanol	0.20
		potassium t-butoxide	0.10
		MTCTFDMH	1.40
		sulfuric acid 50%	0.10
		potassium hydroxide	0.14
47	Bifenthrin alcohol	tetrahydrofuran	0.10
		magnesium powder	0.14
		2,6-dichlorotoluene	0.90
		bromobenzene	0.88
		HCl 30%	0.70
		magnesium powder	0.13
		N,N-dimethylformamide	0.40
		Dichloroethane	0.05
48	3-methyl-4-nitroimino perhydro 1,3,5-oxadiazine (MNIO)	sulfuric acid	0.70
		guanidine nitrate	0.83
		HCl	0.10
		Methylamine 40%	0.53
		Formic acid	0.05
		paraformaldehyde	0.40
		NaOH 30%	0.50
49	2-(Nitroimino) Imidazolidine (NII)	sulfuric acid	0.80
		guanidine nitrate	0.98
		sulfuric acid	0.25
		ethylene diamine	0.48

		NaOH 40%	0.50
50	2-Chloro-5-(Chloromethyl) Thiazole (CCMT)	Dichloroethane	0.05
		Allyl chloride	0.38
		Thionyl chloride	0.78
		chlorine	0.46
		NaOH 40%	0.55
		Sodium thiocyanate	0.52
		Chlorine	0.45
51	Phenyl 4,4-dimethoxy pyrimidine-2yl-carboxilate	ADMP	0.56
		1,4-dioxane	0.36
		Phenyl Chloroform	0.57
		IPA	0.07
52	Diethyl thiophosphoryl chloride (DETCl)	DETA	1.16
		Chlorine gas	0.44
		Nitrogen Purging	0.25
		Sodium Sulfide	0.19

Annexure -II
Manufacturing Process

A. HERBICIDES

1. Bispyribac Sodium

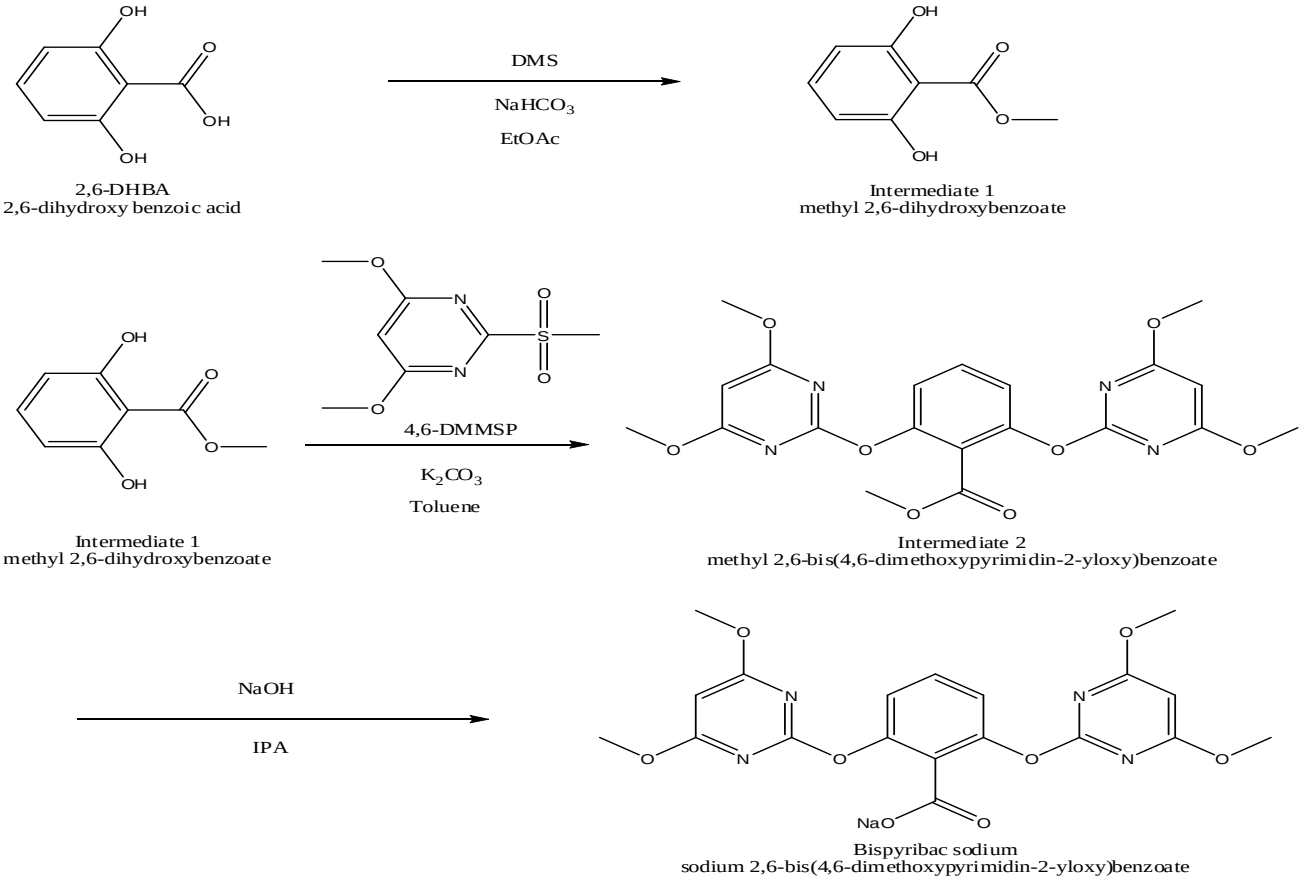
Manufacturing Process:

Charge ethyl acetate, 2, 6-dihydroxy benzoic acid (DHBA) and sodium bicarbonate. Add dimethyl sulfate and maintain the reaction at 50°C for 5 hours. Cool and add water and separate the organic phase. Distil out the organic phase to recover ethyl acetate. After recovery of ethyl acetate, cool the mass and add water to crystallize the intermediate. Filter the mass to obtain Intermediate 1.

Charge Intermediate 1, 4, 6-dimethoxy-2-(methyl sulphonyl) pyrimidine (4, 6-DMMSP), potassium carbonate and dichloroethane. Rise the temperature to reflux and remove reaction water. Cool and add water and separate the organic phase. Distil out the organic phase to recover dichloroethane and cool the mass. Add water to crystallize and filter the mass to obtain Intermediate 2.

Charge Intermediate 2, isopropanol and sodium hydroxide. Rise to reflux and reflux for 6 hours. Cool to 0°C and filter the mass. Dry the wet cake to obtain Bispyribac Sodium Technical.

Chemical Reaction:



Mass Balance:

Mass Balance of Bispyribac Sodium

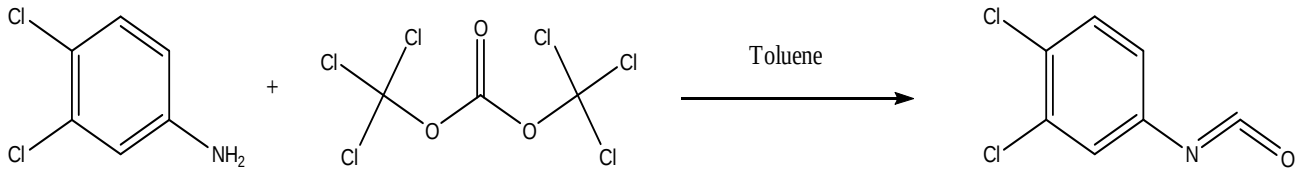
Input	kg	Output	kg
Ethyl Acetate	1250		
2,6 DHBA	375		
Dimethyl Sulfate	325		
Sodium Bicarbonate	225		
		Reaction	
Water	1000		
		Separation & Distillation	
		Aqueous effluent	1575
		Ethyl Acetate Reco	1200
		Residue	50
4,6 DMMSP	1050		
Potassium carbonate	700		
Dichloroethane	2000		
		Reaction	
Water	1000		
		Separation & Distillation	
		Aqueous effluent	2075
		Dichloroethane	1960
		Residue	40
Isopropanol	2000		
Sodium Hydroxide	100		
		Reaction	
		Crystallization, Filteration, Distillation & Drying	
		Isopropanol	1960
		Organic residue	40
		Drying loss	125
		Bispyribac Sodium	**1000**
Total	**10025**		**10025**

2. Diuron

Manufacturing Process:

Charge dichloroethane and 3, 4-dichloroaniline. Cool to 0oC and add Triphosgene for 4 hours. Rise to reflux slowly and reflux for 6 hours. Cool the reaction mass to room temperature. Add this reaction mass to dimethyl amine solution at 50oC for 4 hours. Rise to 70oC and maintain for 6 hours. Cool to room temperature and separate the aqueous phase. Cool the organic phase to 0°C and filter the mass. Dry the wet cake to obtain Diuron Technical.

Chemical Reaction:



3,4-dichloroaniline triphosgene Intermediate 1
1,2-dichloro-4-isocyanatobenzene

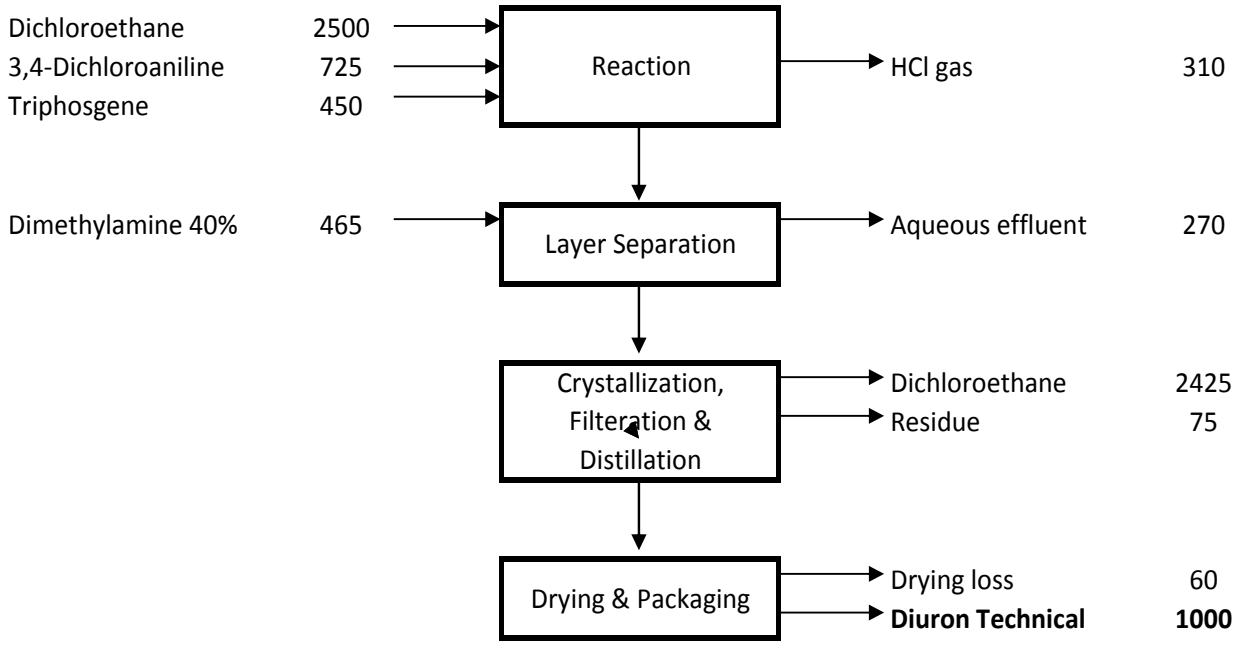
Intermediate 1
1,2-dichloro-4-isocyanatobenzene

dimethylamine

Diuron
3-(3,4-dichlorophenyl)-1,1-dimethylurea

Mass Balance:

Mass Balance of Diuron



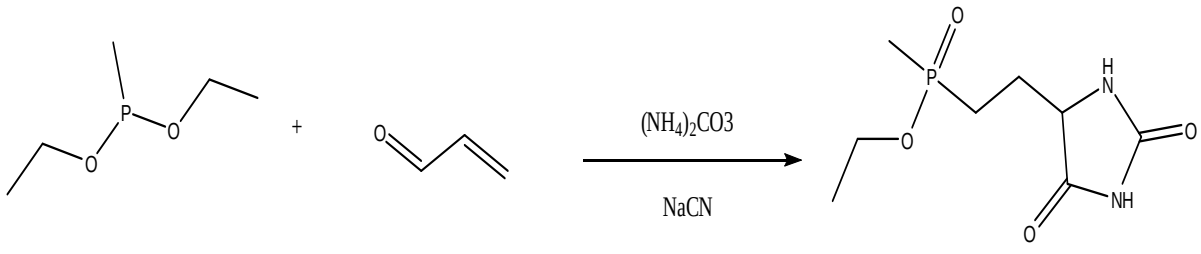
3. Glufosinate Ammonium

Manufacturing Process:

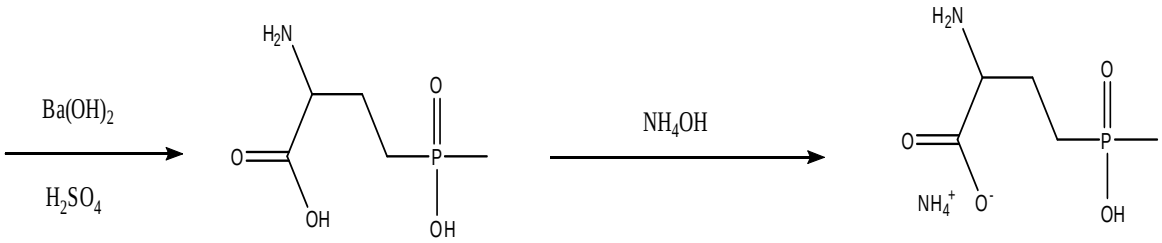
Charge ethanol, acrolein and diethyl methyl phosphate (DEMP). Stir at room temperature for 1 hour. Charge sodium cyanide and ammonium carbonate. Reflux for 4 hours and filter. Distil out the solvent to get 5-[2-ethoxy (methyl) phosphinylethyl) hydantoin. Charge barium hydroxide and water. Rise to 60oC and stir for 1 hour. Cool to room temperature and add 30% sulfuric acid to neutralize. Filter and wash with water.

Charge the filtrate and add ammonium hydroxide to pH 12. Filter the slurry to obtain Glufosinate Ammonium.

Chemical Reaction:



diethyl methylphosphonite prop-2-enal 5-[2-ethoxy(methyl)phosphinylethyl]hydantoin



Glufosinate

2-amino-4-[hydroxy(methyl) phosphinoyl]butyric acid

Glufosinate Ammonium

2-amino-4-[hydroxy(methyl)phosphinoyl] butyric acid monoammonium salt

Mass Balance:

Mass Balance of Glufosiante Potassium

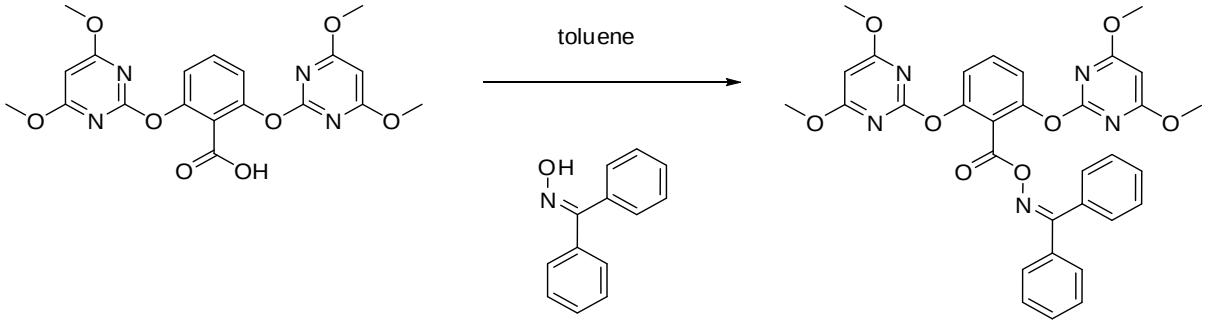
Input	kg		Output	kg
Ethanol	2000	Reaction	Ethanol	1900
Acrolein	310		Residue	100
DEMP	640			
Sodium Cyanide	270			
Ammonium Carbonate	330			
Water	1000	Reaction	Solid waste	950
Barium Hydroxide	870			
Sulfuric acid 30%	800			
Ammonium Hydroxide	800	Crystallization & Filteration	Aqueous effluent	2850
		Drying & Packaging	Drying loss	220
			Glufosiante Potassium	**1000**
Total	**7020**			**7020**

4. Pyribenzoxim

Manufacturing Process:

Charge dichloroethane, bispyribac and benzophenone oxime. Charge catalyst 4-dimethyl amino pyridine (4-DMAP). Rise the temperature to reflux and remove water azeotropically. After completion of the reaction, charge water and separate the aqueous phase. Cool the organic phase to 0°C and maintain for 4 hours. Filter the slurry and dry the wet cake to obtain Pyribenzoxim Technical.

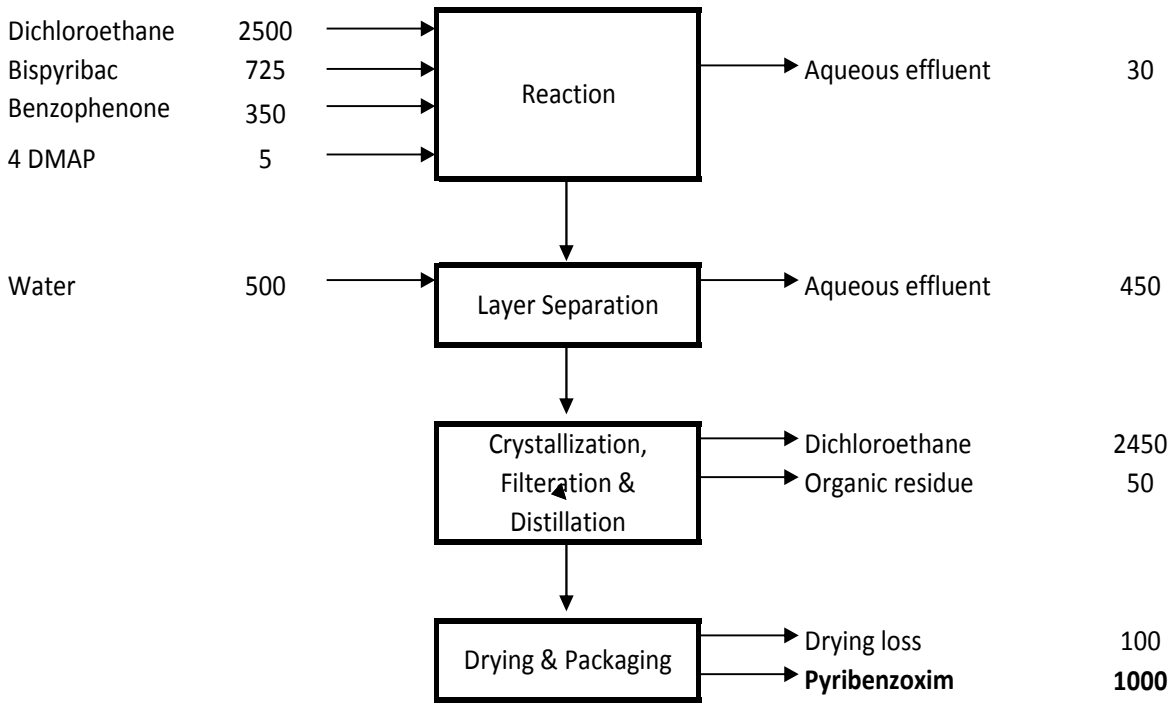
Chemical Reaction:



BISPYRIBAC **BENZOPHENONE OXIME** **PYRIBENZOXIM**

Mass Balance:

Mass Balance of Pyribenzoxim

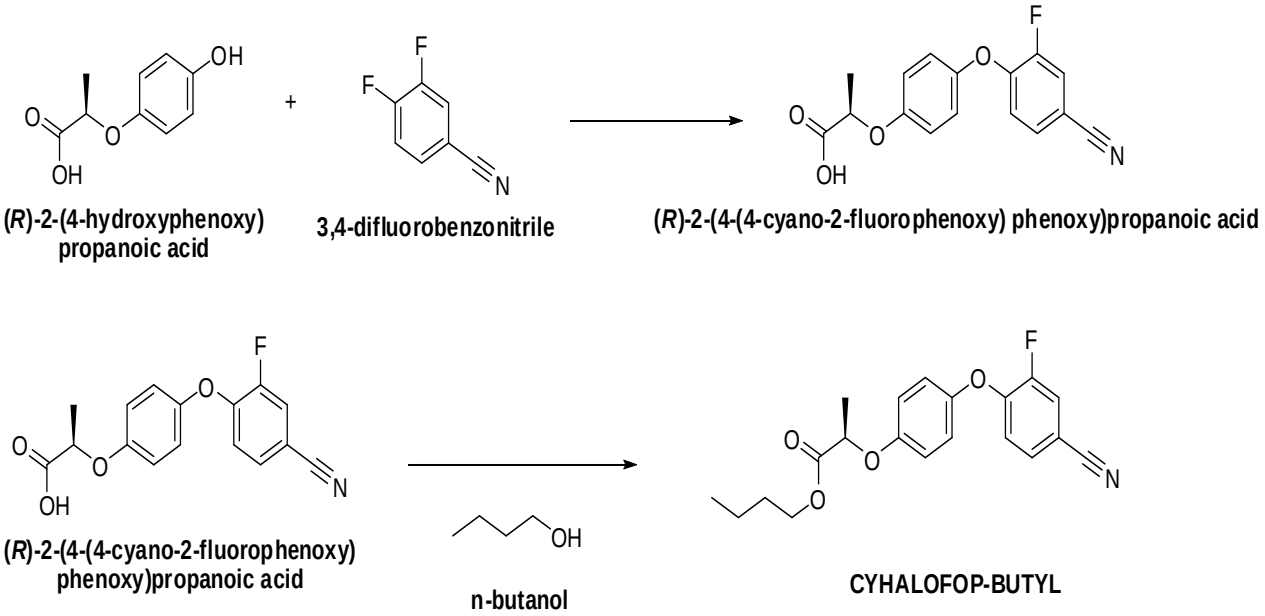


5. Cyhalofop-Butyl

Manufacturing Process:

Charge dichloroethane, (R)-2-(4-hydroxyphenoxy) propanoic acid (RHPPA) and 3, 4-difluorobenzonitrile (3, 4-DFBN). Add potassium carbonate lot-wise slowly at room temperature and rise to 75°C. Maintain at 75°C for 4 hours. After completion of the reaction, cool the mass to 30°C and add water. Stir for 1 hour and separate the aqueous phase. Charge n-butanol and p-toluene sulfonic acid (p-TSA). Rise to reflux and remove water azeotropically. Cool the mass to 30°C and add water. Stir for 1 hour and separate the aqueous phase. Cool the organic phase to 10°C and filter the slurry. Dry the wet cake to obtain Cyhalofop-butyl Technical.

Chemical Reaction:



(*R*)-2-(4-hydroxyphenoxy) propanoic acid

3,4-difluorobenzonitrile

(*R*)-2-(4-(4-cyano-2-fluorophenoxy) phenoxy)propanoic acid

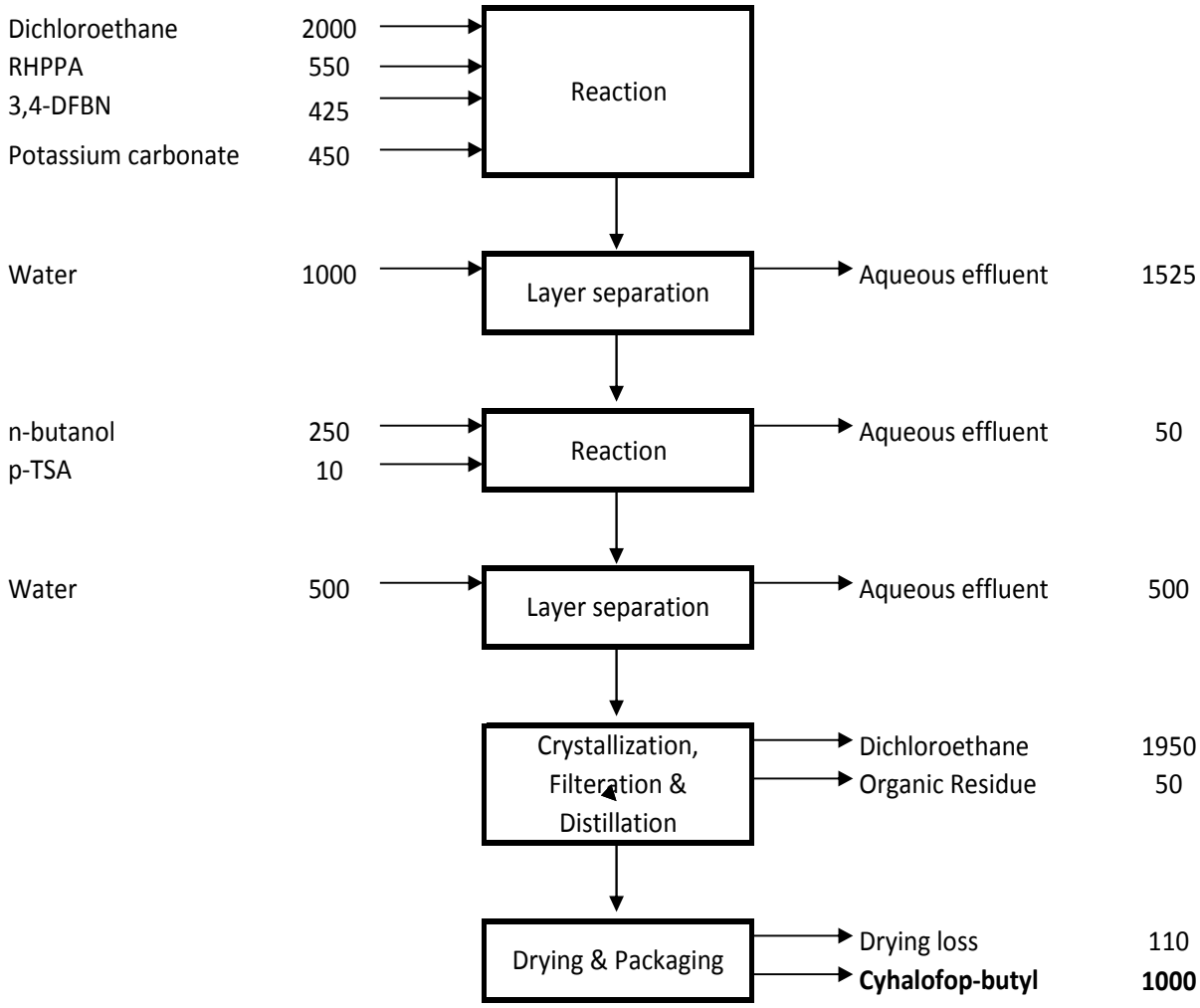
(*R*)-2-(4-(4-cyano-2-fluorophenoxy) phenoxy)propanoic acid

n-butanol

CYHALOFOP-BUTYL

Mass Balance:

Mass Balance of Cyhalofop-butyl



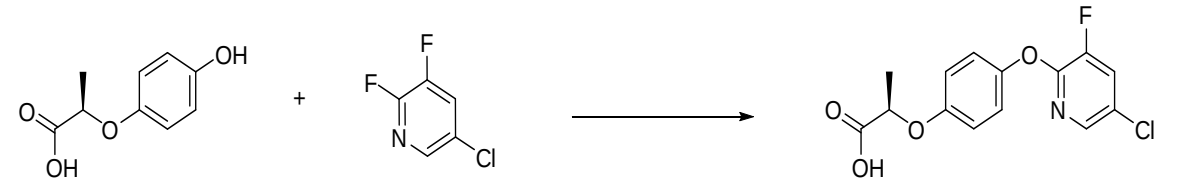
6. Clodinafop-Propargyl

Manufacturing Process:

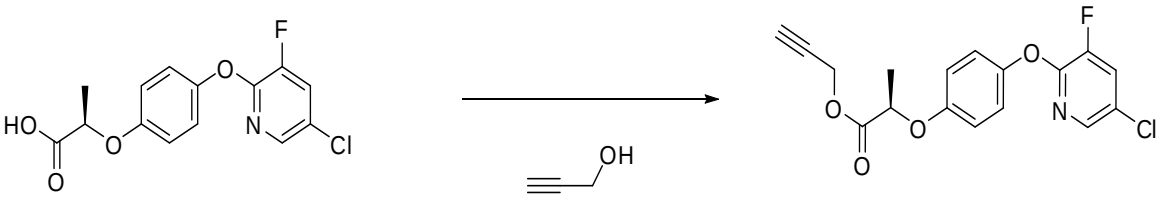
Charge dichloroethane, (R)-2-(4-hydroxyphenoxy) propanoic acid (RHPPA) and 5-chloro-2, 3-difluoro pyridine. Add sodium hydroxide and maintain the mass at 75°C for 6 hours. After completion of the reaction add water and adjust oG to 3 with 20% hydrochloric acid. Stir and separate the aqueous phase. The organic phase contains clodinafop acid and dichloroethane.

Charge p-toluene sulfonic acid monohydrate (p-TSA) and propargyl alcohol. Rise to reflux and remove water azeotropically. After completion of the reaction cool the mass to 30°C and add water. Stir and separate the aqueous phase. Cool the organic phase to 0°C and filter the slurry. Dry the wet cake to obtain Clodinafop-propargyl Technical.

Chemical Reaction:



(*R*)-2-(4-hydroxyphenoxy) propanoic acid | **5-chloro-2,3-difluoro-pyridine** | **(2R)-2-[4-[(5-chloro-3-fluoro-2-pyridinyl) oxy]phenoxy]propanoic acid**



CLODINAFOP ACID | **propargyl alcohol** | **CLODINAFOP-PROPARGYL**

Mass Balance:

Mass Balance of Clodinafop-propargyl

Input	kg		Output	kg
Dichloroethane	2000	→ Reaction		
RHPPA	550	→ Reaction		
5-chloro 2,2 DFP	450	→ Reaction		
Sodium hydroxide	250	→ Reaction		
Water	1000	→ Layer separation	Aqueous effluent	1290
Propargyl alcohol	175	→ Reaction	Aqueous effluent	45
p-TSA	10	→ Reaction		
Water	500	→ Layer separation	Aqueous effluent	520
		→ Crystallization, Filteration & Distillation	Dichloroethane	1950
			Residue	50
		→ Drying & Packaging	Drying loss	80
			Clodinafop-propargyl	**1000**
Total	**4935**			**4935**

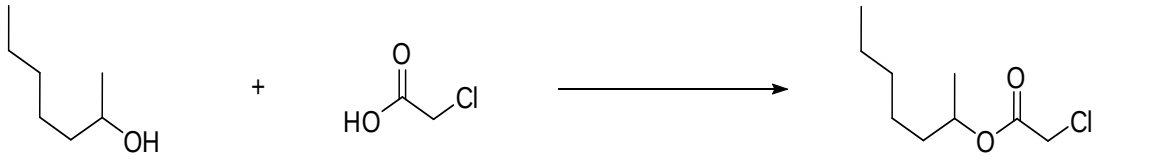
7. Cloquintocet-Mexyl

Manufacturing Process:

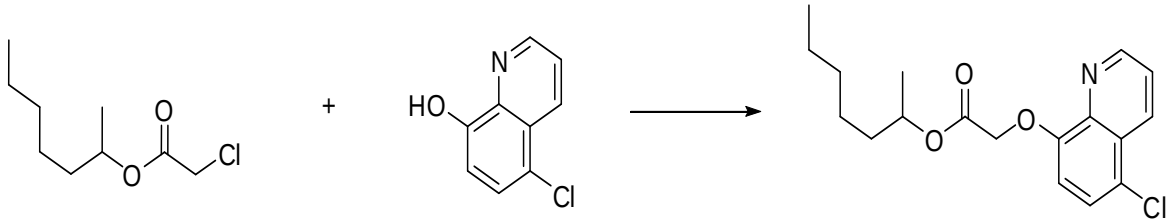
Charge 2-heptanol, chloro acetic acid and catalyst sulphuric acid in solvent dichloro ethane. Rise the temperature and reflux for 6 hours. Remove water during reflux. After completion of the reaction, add water and separate organic phase.

Charge heptan-2-yl-2-chloro acetate / dichloro ethane, 5-chloroquinolin-8-ol (5-CQ) and potassium carbonate. Rise to reflux and reflux for 10 hours. After completion of the reaction add water and separate the organic phase. Cool the mass to precipitate and filter the slurry. Dry the wet cake to obtain Cloquintocet-mexyl technical.

Chemical Reaction:



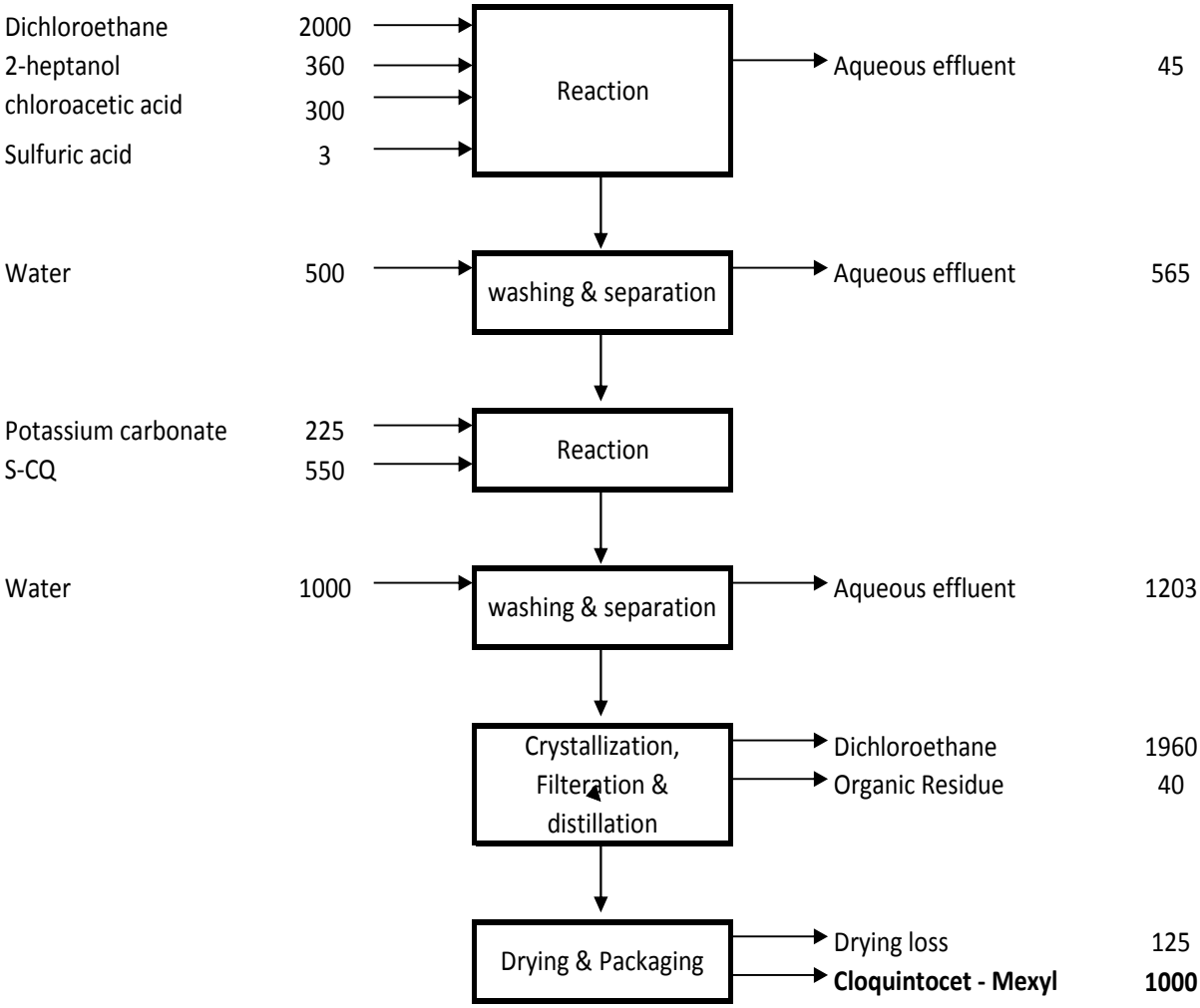
2-heptanol **chloroacetic acid** **heptan-2-yl 2-chloroacetate**



heptan-2-yl 2-chloroacetate **5-chloroquinolin-8-ol** **CLOQUINTOCET-MEXYL**

Mass Balance:

Mass Balance of Cloquintocet-Mexyl

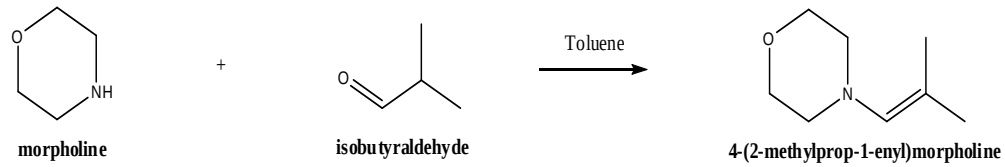


8. Benfuresate

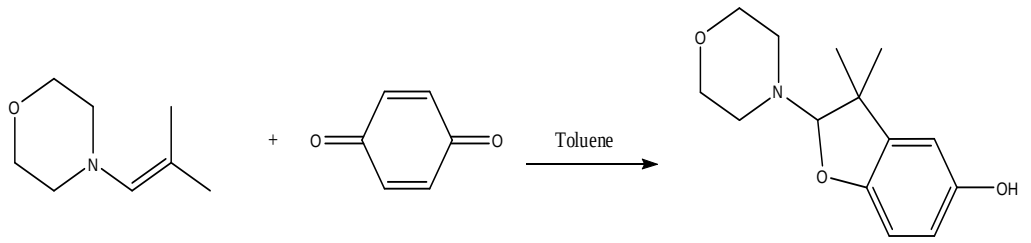
Manufacturing Process:

Charge dichloroethane, isobutyraldehyde and morpholine. Rise to reflux and remove water. After completion of the reaction cool the mass to 30°C.
Add (dichloroethane +4-benzoquinone) slurry and rise to reflux. Reflux for 5 hours and cool to 0°C.Add ethane sulfonyl chloride at 0°C and maintain for 6 hours. Rise to distil out dichloroethane under reduced pressure to obtain the intermediate-3. Add intermediate-3, dichloro ethane, water and hydrochloric acid. Rise to reflux and reflux for 3 hours. Cool to 30°C and separate the organic phase. Add sodium borohydride and maintain for 12 hours at 60°C. Add sulphuric acid and reflux for 3 hours. Cool to 30°C and add water. Separate the organic phase and cool to 0°C. Filter the slurry and dry to obtain Benfuresate Technical.

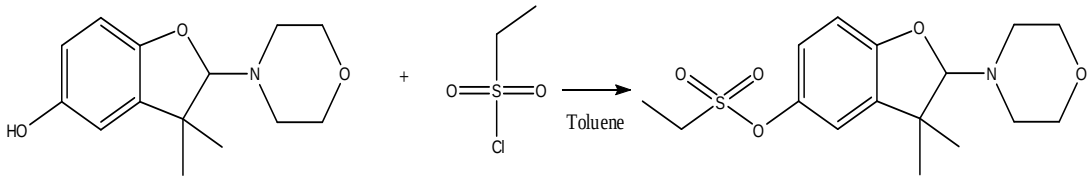
Chemical Reaction:



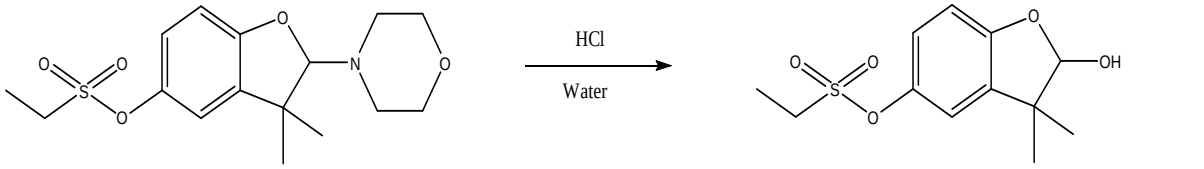
morpholine + isobutyraldehyde → 4-(2-methylprop-1-enyl)morpholine



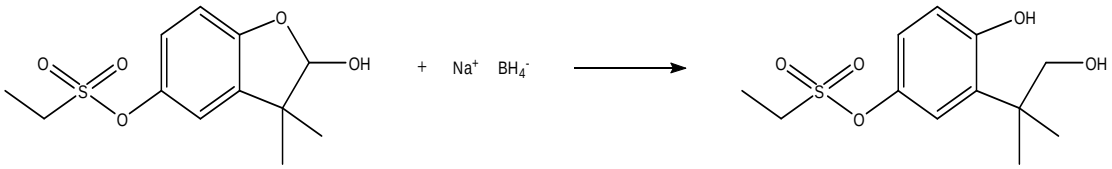
4-(2-methylprop-1-enyl)morpholine + 1,4-benzoquinone → 3,3-dimethyl-2-morpholino-2,3-dihydrobenzofuran-5-ol



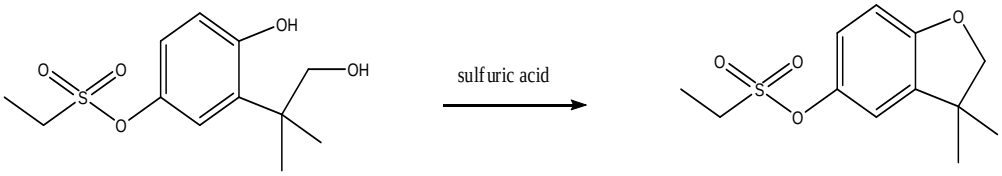
3,3-dimethyl-2-morpholino-2,3-dihydrobenzofuran-5-ol + ethane sulfonyl chloride → 3,3-dimethyl-2-morpholino-2,3-dihydrobenzofuran-5-yl ethanesulfonate



3,3-dimethyl-2-morpholino-2,3-dihydrobenzofuran-5-yl ethanesulfonate → 2-hydroxy-3,3-dimethyl-2,3-dihydrobenzofuran-5-yl ethanesulfonate



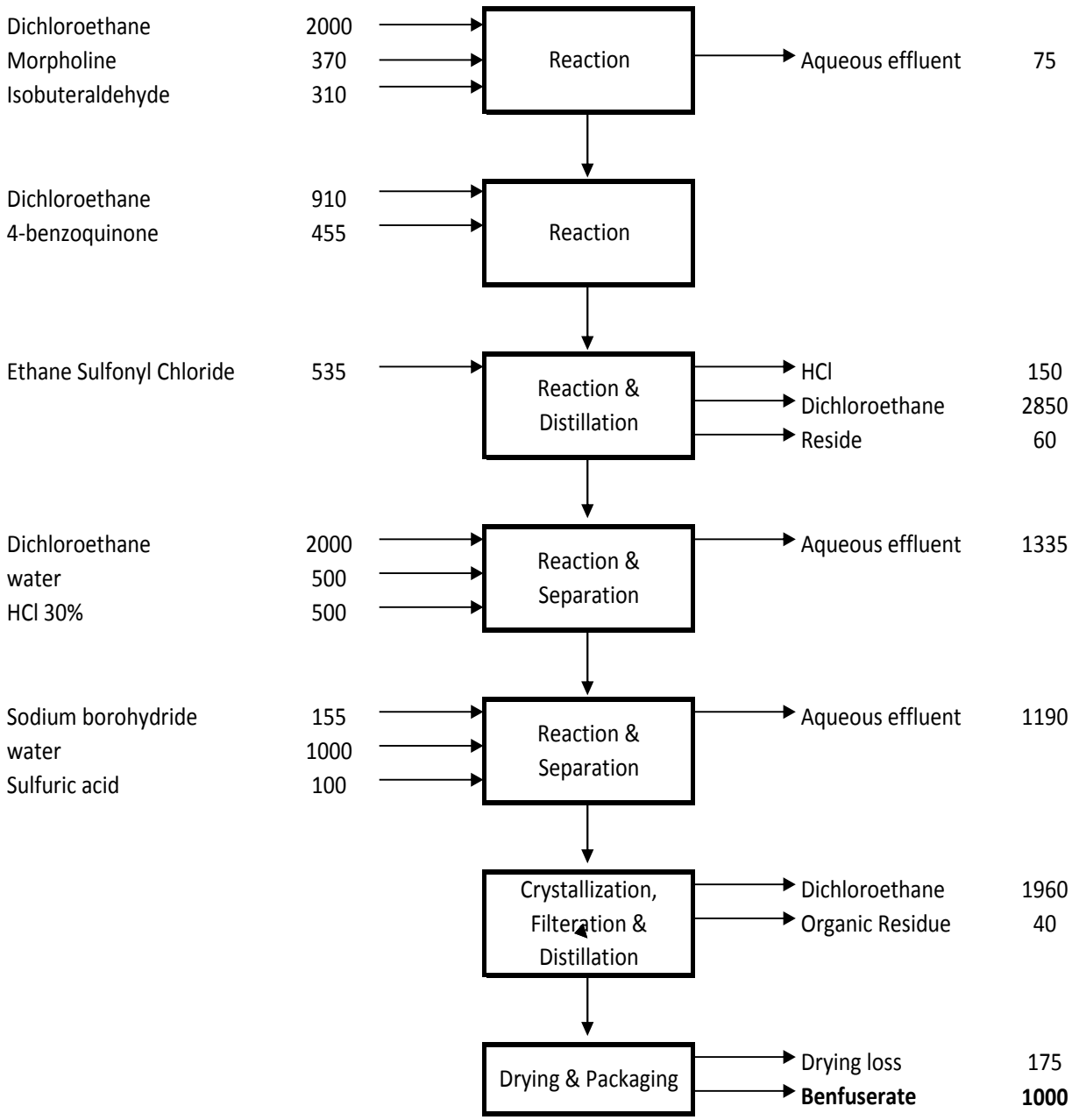
2-hydroxy-3,3-dimethyl-2,3-dihydrobenzofuran-5-yl ethanesulfonate + sodium borohydride → 4-hydroxy-3-(1-hydroxy-2-methylpropan-2-yl)phenyl ethanesulfonate



4-hydroxy-3-(1-hydroxy-2-methylpropan-2-yl)phenyl ethanesulfonate → BENFURESATE

Mass Balance:

Mass Balance of Benfuserate



9. Tembotrione

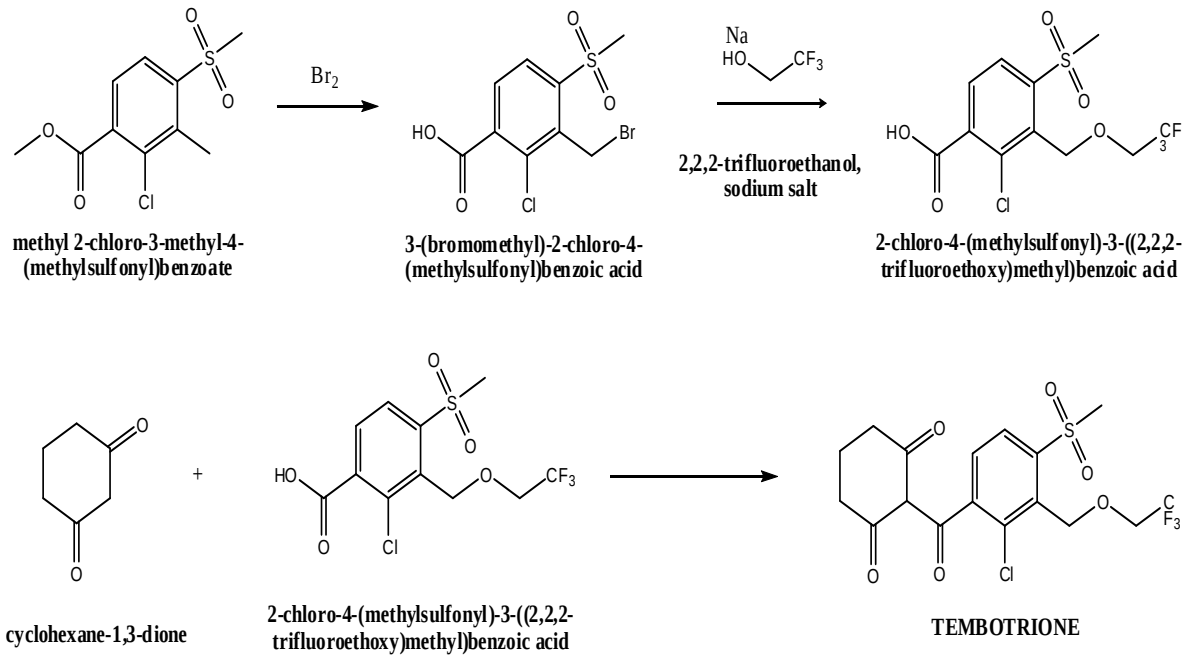
Manufacturing Process:

Charge methyl 2-chloro-3-methyl-4-(methyl sulfonyl) benzoate (MCMMSB) in solvent chloro benzene. Cool to 0°C and add bromine for 6 hours. Rise to room temperature and add water. Separate the organic phase.

Charge organic phase and add sodium salt of 2,2,2-trifluoro ethanol (SS of 2,2,2-TFE) lot-wise and rise to reflux. Reflux for 10 hours and cool to 30°C. Add hydrochloric acid to pH 2-3. Separate the organic phase.

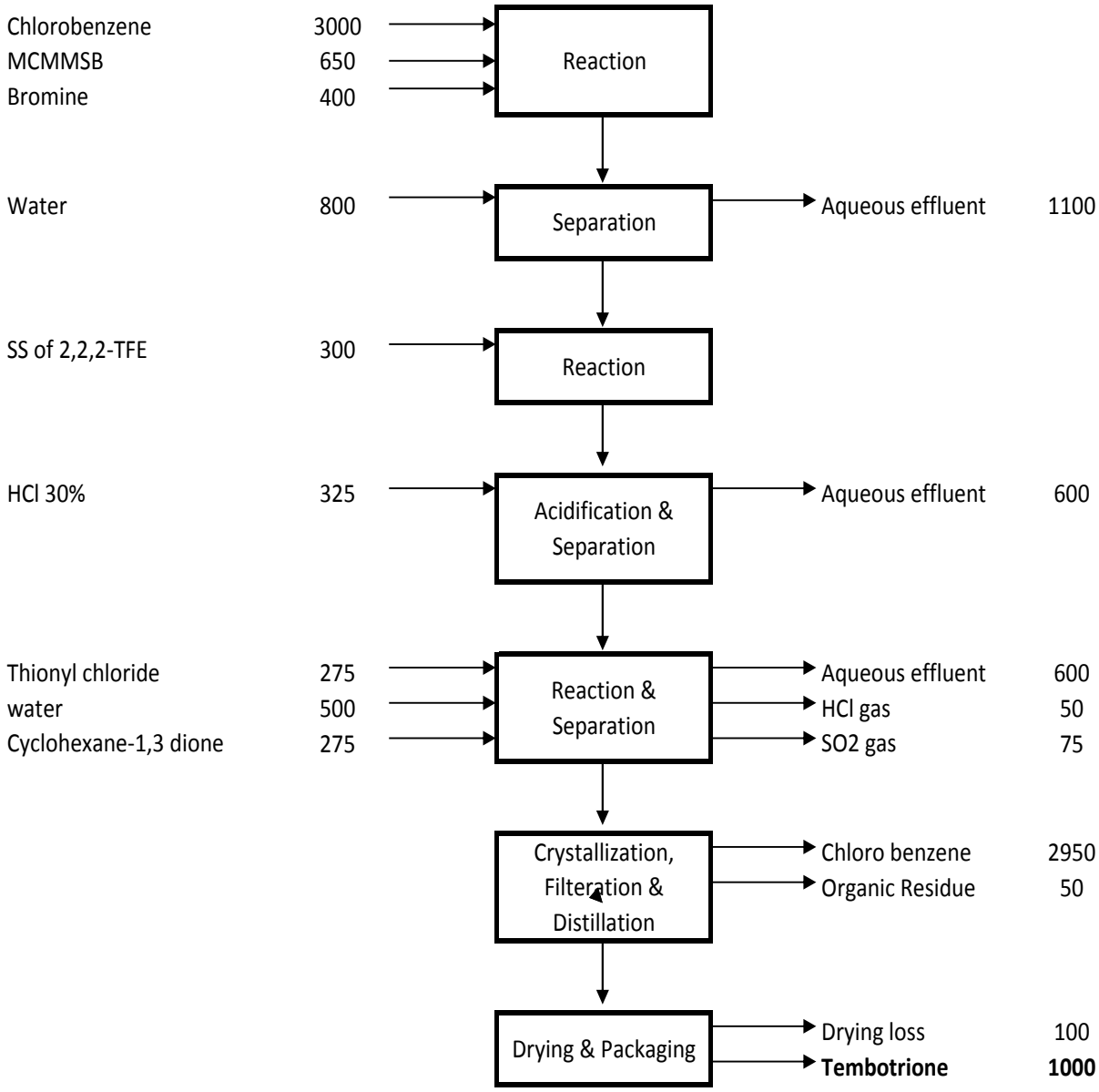
Charge organic phase and add thionyl chloride at 60°C. Rise to reflux and reflux for 4 hours and cool to 50°C. Add cyclohexane-1, 3-dione at 50°C and reflux for 6 hours. After completion of the reaction add water and separate the organic phase. Cool the organic phase to 0°C. Filter the slurry and dry to obtain Tembotrione Technical.

Chemical Reaction:



Mass Balance:

Mass Balance of Tembotrione



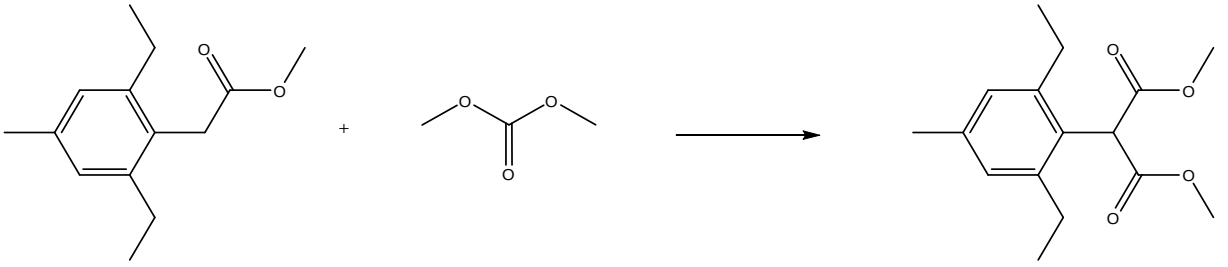
10. Pinoxaden

Manufacturing Process:

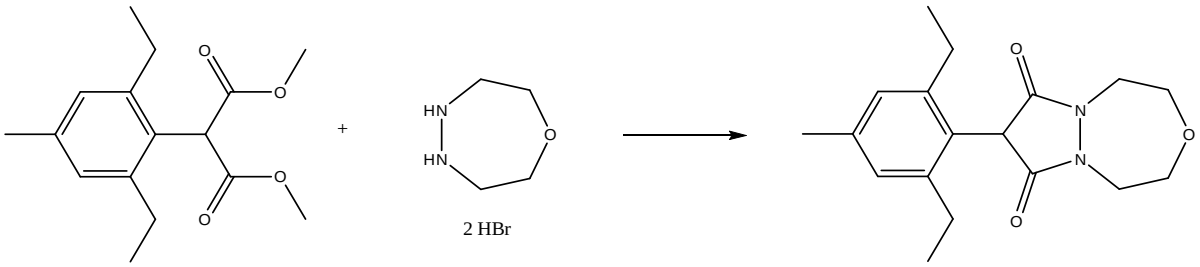
Charge methyl-2-(2, 6-diethyl-4-methylphenyl) acetate (MDEMP acetate), methanol and dimethyl carbonate. Add sodium hydroxide and rise to reflux. Reflux for 12 hours and distil out methanol and cool to 30°C.

Add dichloroethane and 1, 4, 5-oxadiazepane dihydro bromide (1, 4, 5-ODDHB). Rise to reflux and reflux for 4 hours. Cool to 30°C and add water. Separate the aqueous phase and distil out the organic phase to recover dichloroethane partially. Cool to 20°C.Add 2, 2-dimethyl propionyl chloride (2, 2,-DMPC) slowly for 6 hours at 20°C and maintain at 40°C for 3 hours. Add water and separate the aqueous phase. Cool the organic phase to 0°C. Filter the slurry mass and dry to obtain Pinoxaden Technical.

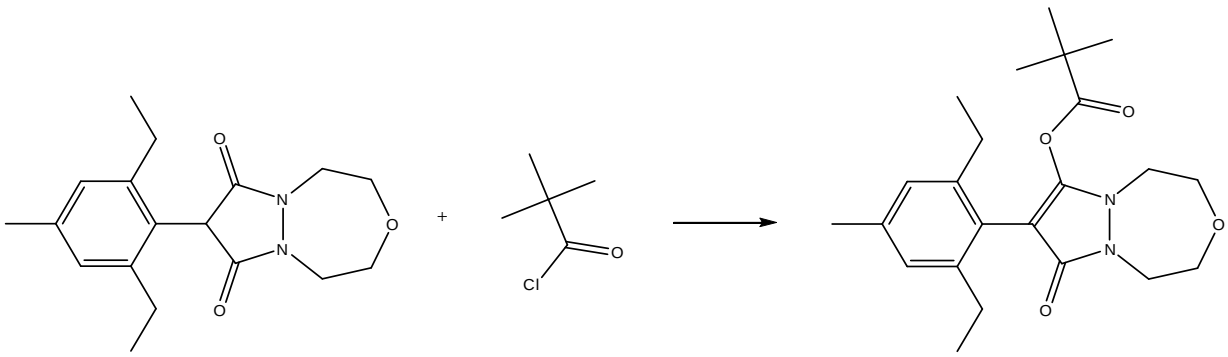
Chemical Reaction:



methyl 2-(2,6-diethyl-4-methylphenyl)acetate + **dimethylcarbonate** → **dimethyl 2-(2,6-diethyl-4-methylphenyl)malonate**



dimethyl 2-(2,6-diethyl-4-methylphenyl)malonate + **1,4,5-oxadiazepane dihydrobromide** (2 HBr) → **8-(2,6-diethyl-4-methylphenyl)tetrahydropyrazolo [1,2-d][1,4,5]oxadiazepine-7,9-dione**

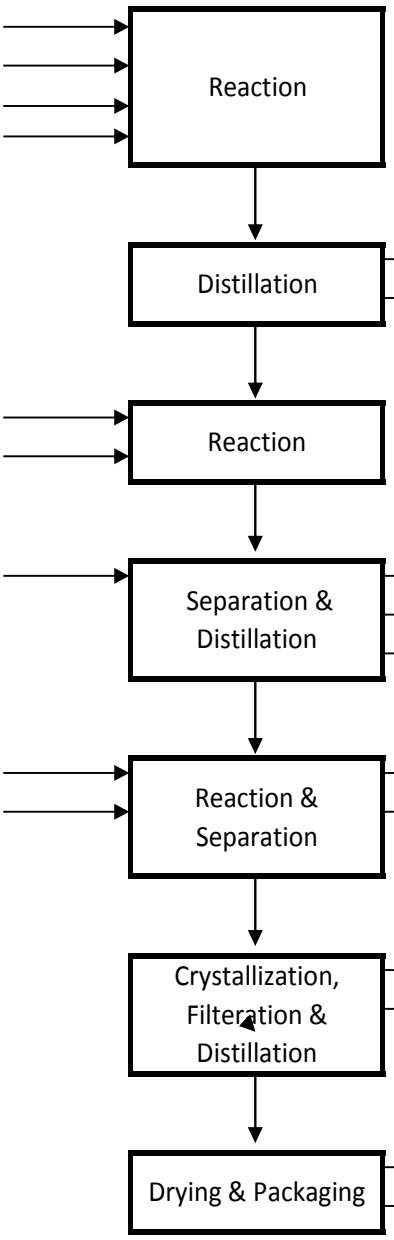


8-(2,6-diethyl-4-methylphenyl)tetrahydropyrazolo [1,2-d][1,4,5]oxadiazepine-7,9-dione + **2,2-dimethyl propionyl chloride** → **PINOXADEN**

Mass Balance:

Mass Balance of Pinoxaden

Input	kg	Output	kg
Methanol	2000		
MDEMP acetate	600		
Dimethyl Carbonate	250		
Sodium hydroxide	11		
		Methanol	1950
		Residue	50
Dichloroethane	2500		
1,2,5-ODDHB	700		
Water	900		
		Aqueous effluent	1530
		Dichloroethane	500
		Residue	25
2,2-DMPC	325		
water	500		
		Aqueous effluent	530
		HCl gas	76
		Dichloroethane	1925
		Organic Residue	50
		Drying loss	150
		Pinoxaden	**1000**
Total	**7786**		**7786**



11. Penoxsulam

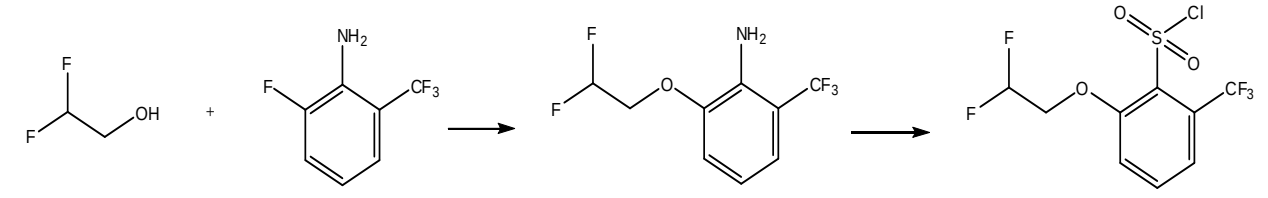
Manufacturing Process:

Charge 2-fluoro-6-(trifluoromethyl) aniline (2-FTFMA), catalyst sodium methoxide and solvent methanol. Rise to 50°C and add 2, 2-difluoro ethanol slowly for 4 hours. Rise to reflux and reflux for 3 hours. Distil out the mass to recover methanol and obtain 2-(2, 2-difluoroethoxy)-6-(trifluoromethyl) aniline (2-DFETFMA).

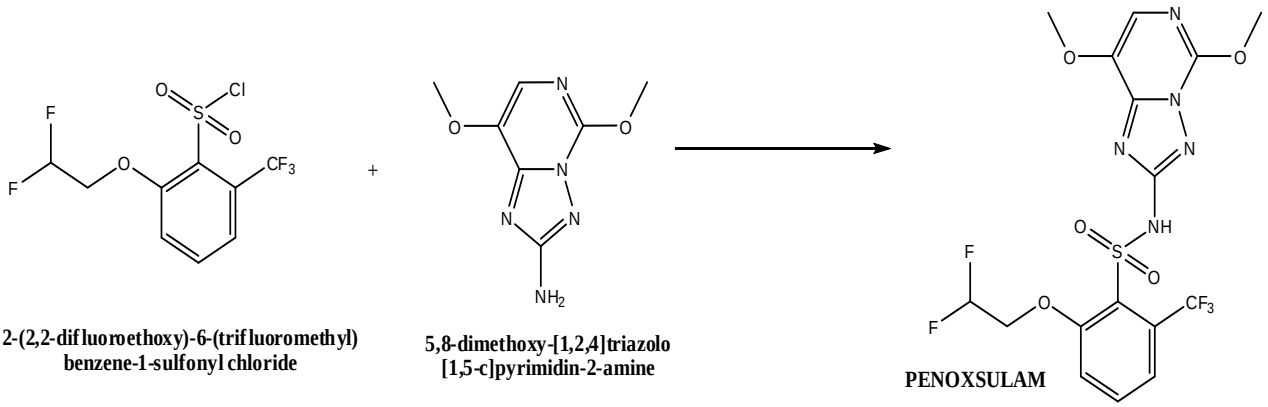
Charge water, hydrochloric acid and 2-DFETFMA. Cool to 0°C and add sodium nitrite lot-wise. After 2 hours add sodium Sulphite solution at 0°C for 4 hours. Rise to 30°C and maintain for 3 hours. Add Dichloroethane and extract. Separate the aqueous phase. Distil out the organic phase to recover Dichloroethane partially.

Add 5,8-dimethoxy-[1,2,4]-triazolo[1,5-c]pyrimidin-2-amine (5,8-DMTPA) slowly lot-wise at 30°C for 3 hours. Rise to reflux and reflux for 3 hours. Cool to 30°C and add water. Separate the aqueous phase. Cool the organic phase to 0°C and filter the slurry. Dry the wet cake to obtain Penoxsulam Technical.

Chemical Reaction:



2,2-difluoroethanol | 2-fluoro-6-(trifluoromethyl) aniline | 2-(2,2-difluoroethoxy)-6-(trifluoromethyl)aniline | 2-(2,2-difluoroethoxy)-6-(trifluoromethyl) benzene-1-sulfonyl chloride



2-(2,2-difluoroethoxy)-6-(trifluoromethyl) benzene-1-sulfonyl chloride | 5,8-dimethoxy-[1,2,4]triazolo [1,5-c]pyrimidin-2-amine | PENOXSULAM

Mass Balance:

Mass Balance of Penoxulam

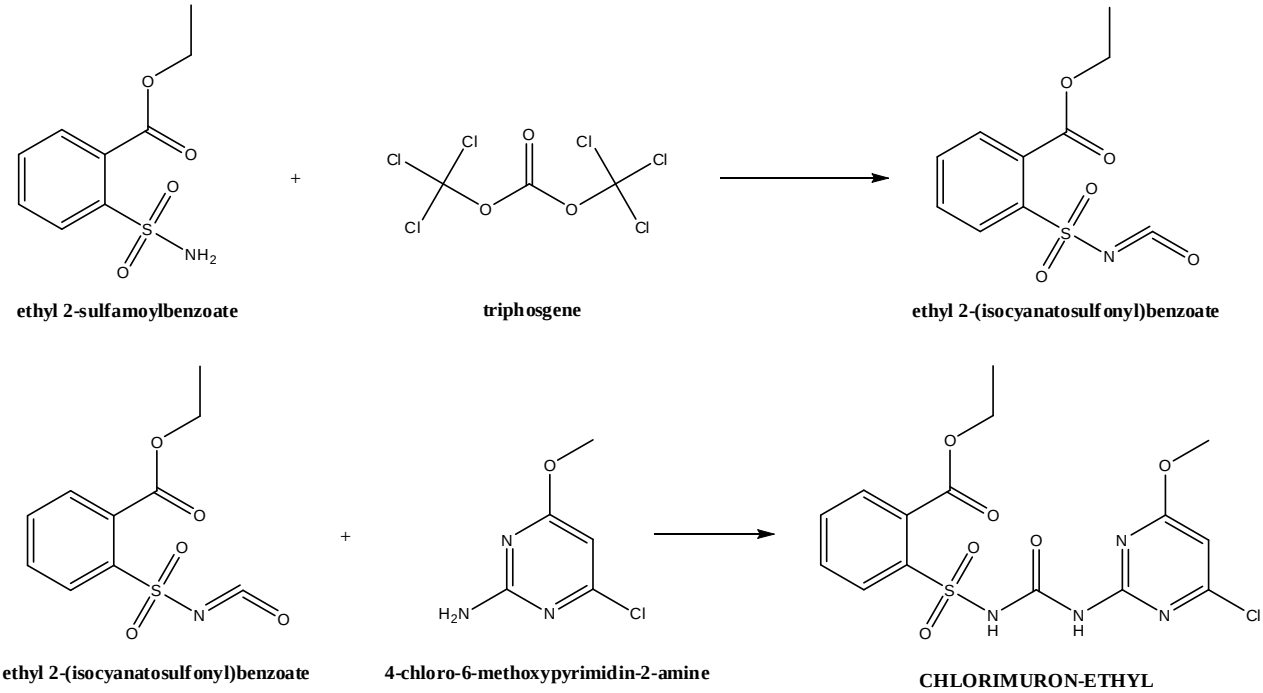
Input	kg		Output	kg
Methanol	2000	Reaction		
2-FTFMA	400			
Sodium methoxide	12			
2,2 Difluro ethanol	185			
		Distillation	Methanol	1950
			Residue	50
water	1000	Reaction		
HCl 30%	310			
Sodium nitrite	175			
sodium sulfite	315			
Dichloroethane	3000	Extraction, Separation & Distillation partially	Aqueous effluent	1672
			Dichloroethane	500
			Residue	17
5,8 DMTPA	420	Reaction & Separation	Aqueous effluent	525
water	500			
		Crystallization, Filteration & Distillation	Dichloroethane	2440
			Organic Residue	43
		Drying & Packaging	Drying loss	120
			Penoxulam	**1000**
Total	**8317**			**8317**

12. Chlorimuron-Ethyl

Manufacturing Process:

Charge dichloroethane and ethyl 2-sulfomoylbenzoate. Cool to 0°C and add Triphosgene lot-wise for 4 hours. Rise to reflux and distil out dichloroethane partially. Cool the ethyl 2-(isocyanatosulfonyl) benzoate in dichloroethane to 30°C. Add 4-chloro-6-methoxypyrimidin-2-amine (4-CMPA) at 30°C for 2 hours. Rise to 75°C and maintain for 3 hours. Cool the mass to 15°C and filter the slurry. Dry the wet cake to obtain Chlorimuron-ethyl technical.

Chemical Reaction:



Mass Balance:

Mass Balance of Chlorimuron-ethyl

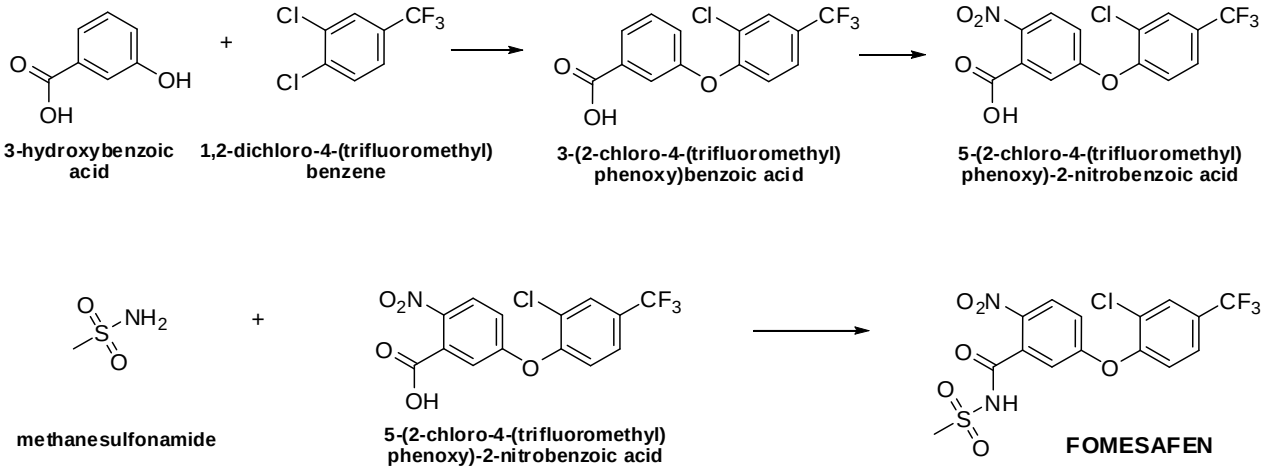
Input	kg		Output	kg
Dichloroethane	4000	Reaction	HCl gas	175
Ethyl 2- Sulfomoylbenzoate	585			
Triphosgene	260			
		Distillation	Dichloroethane	1000
			Residue	25
4-CMPA	390	Reaction		
		Crystallization, Filteration & distillation	Dichloroethane	2940
			Organic Residue	35
		Drying & Packaging	Drying loss	60
			Chlorimuron-ethyl	**1000**
Total	**5235**			**5235**

13. Fomesafen

Manufacturing Process:

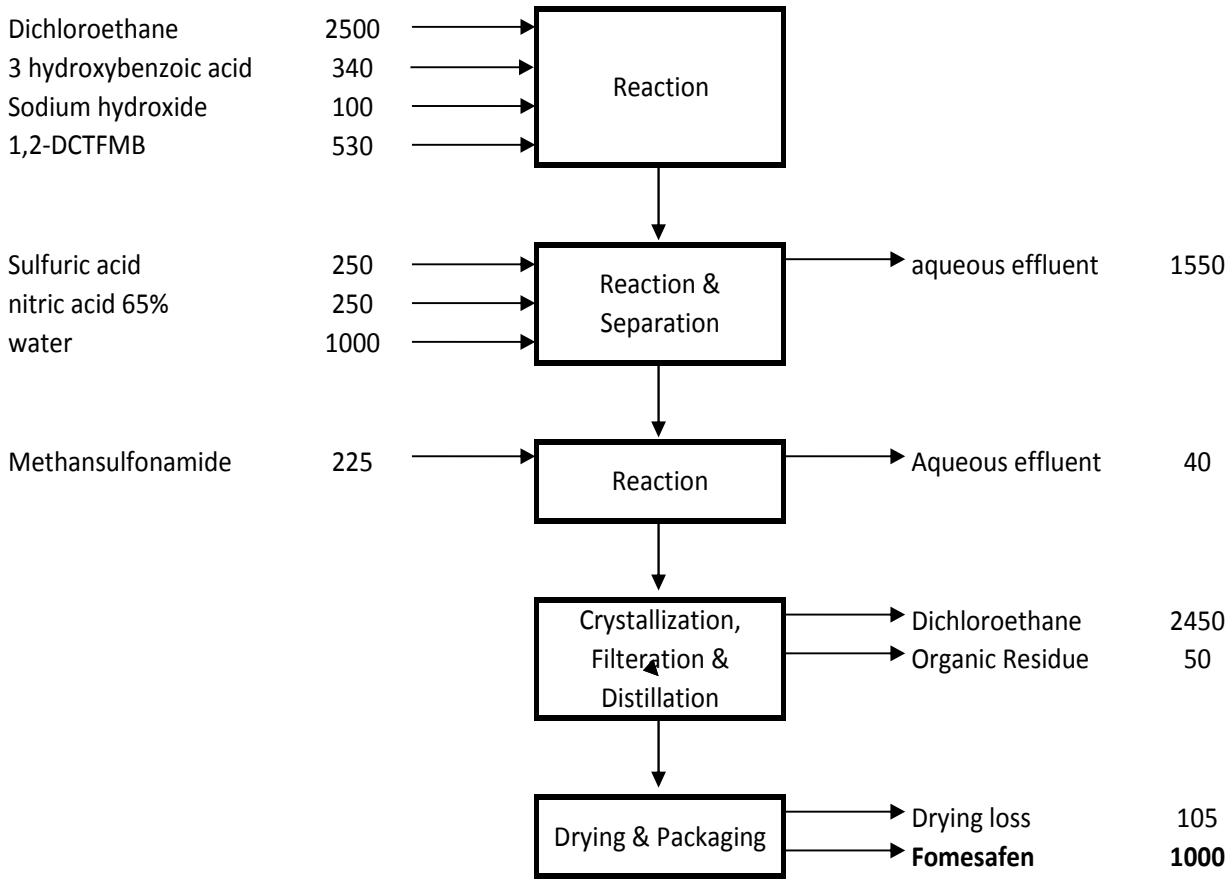
Charge 3-hydroxybenzoic acid, sodium hydroxide and solvent dichloro ethane. Rise to reflux and reflux for 4 hours. Add 1, 2-dichloro-4-(trifluoro methyl) benzene (1, 2-DCTFMB) lot-wise for 3 hours at reflux. Maintain reflux for 3 hours and cool to 0°C. Add sulphuric acid and followed by nitric acid for 3 hours at 0°C. Rise to 20-25°C and maintain for 2 hours. After completion of the reaction add water and separate the aqueous phase. Add methane sulfonamide and rise to reflux. Reflux for 6 hours and remove water azeo tropically. After removal of water cool the reaction mass to 10°C. Filter the slurry and dry the wet cake to obtain Fomesafen Technical.

Chemical Reaction:



Mass Balance:

Mass Balance of Fomesafen



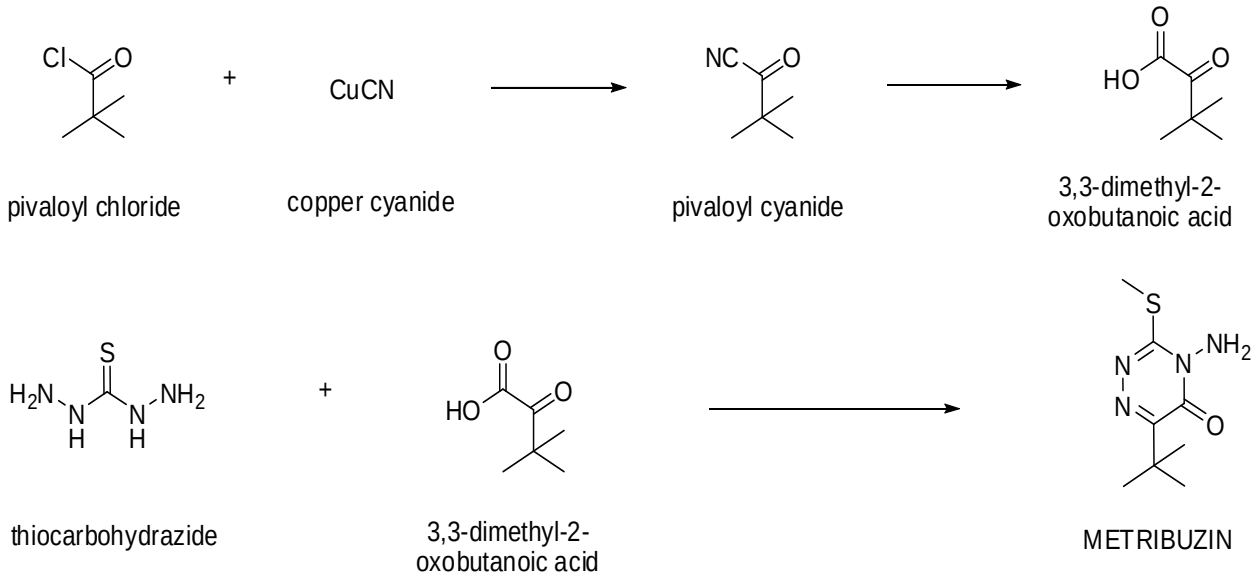
14. Metribuzin

Manufacturing Process:

Charge Dichloroethane, pivaloyl chloride and copper cyanide. Rise to reflux and reflux for 6 hours. Cool to 30°C and add hydrochloric acid. Rise to 50°C and maintain for 2 hours. Settle and separate the aqueous phase at 50°C. The organic phase contains 3, 3-dimethyl-2-oxobutanoic acid in Dichloroethane.

Charge the organic phase and Thiocarbohydrazide. Rise to reflux and remove water azeotropically. After completion of the reaction cool to 50°C and add dimethyl Sulphate for 2 hours. Maintain for 4 hours and cool to 30°C. Add water and separate the aqueous phase. Cool the organic phase and filter the slurry. Dry the wet cake to obtain Metribuzin technical.

Chemical Reaction:



Mass Balance:

Mass Balance of Metribuzin

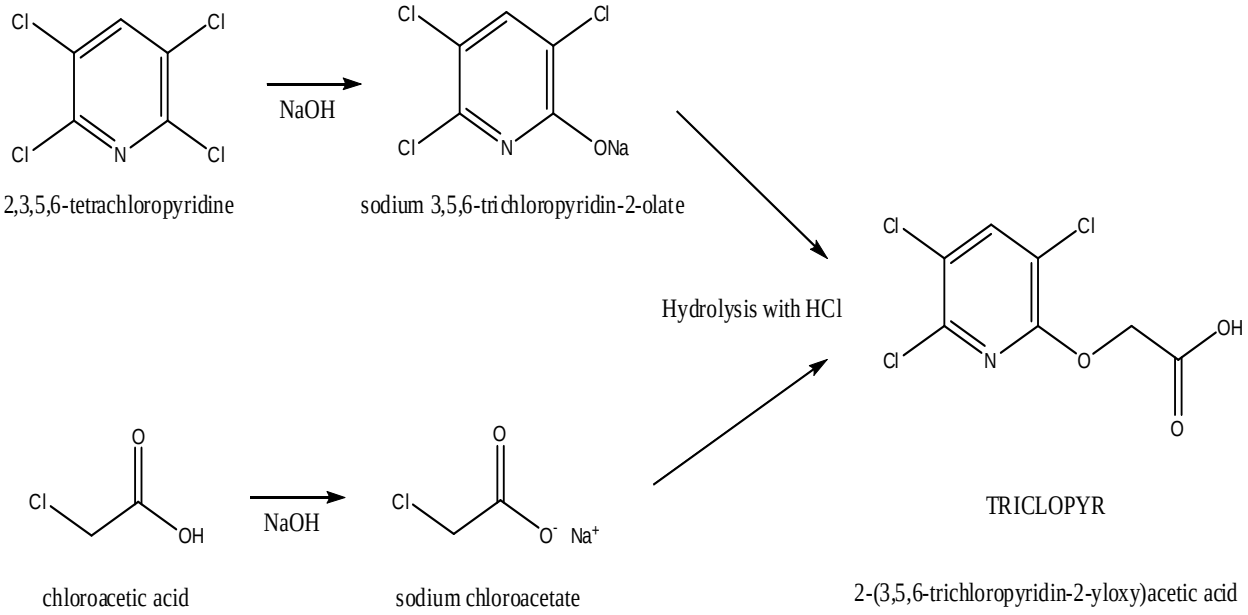
Input	kg		Output	kg
Dichloroethane	2600	Reaction		
Pivaloyl chloride	525			
copper cyanide	325			
HCl 30%	50			
water	1500	Separation	aqueous effluent	2065
Thiocarbohydrazide	450	Reaction	Aqueous effluent	175
Dimethyl sulfate	200	Reaction & Separation	aqueous effluent	1500
water	1800			
		Crystallization, Filteration & Distillation	Dichloroethane	2550
			Organic Residue	50
		Drying & Packaging	Drying loss	110
			Metribuzin	**1000**
Total	**7450**			**7450**

15. Triclopyr

Manufacturing Process:

Charge water, caustic lye and 2, 3, 5, 6-tetrachloropyridine (2, 3, 5, 6-TCP). Rise to reflux and reflux for 12 hours. Cool the mass of sodium 3, 5, 6-trichloropyridin-2-olate to 30°C; i.e., Mass 1.
Charge water and caustic lye. Add chloro acetic acid slowly at 30-40°C for 3 hours; i.e., Mass 2.
Add Mass 2 to Mass 1 at 40-50°C for 4 hours. Rise to reflux and reflux for 6 hours. Cool to 30°C and add dichloro ethane. Add hydrochloric acid to pH 2. Stir the mass for 2 hours and cool to 0°C. Filter the slurry and dry the wet cake to obtain Triclorpyr Technical.

Chemical Reaction:



Mass Balance:

Mass Balance of Triclopyr

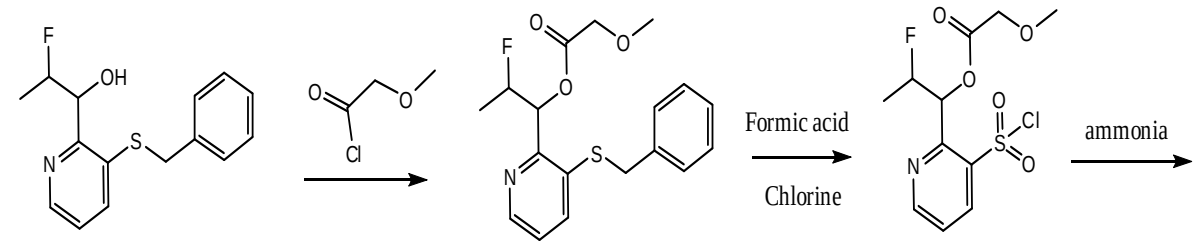
Input	kg	Output	kg
water	360		
NaOH 48%	360		
2,3,5,6-TCP	900		
		Reaction	
water	360		
NaOH 48%	360		
Chloroacetic acid	400		
		Reaction	
Dichloroethane	2500		
water	500		
HCl 30%	525		
		Extraction & Separation	
		aqueous effluent	2645
		Crystallization, Filteration & Distillation	
		Dichloroethane	2460
		Organic Residue	40
		Drying & Packaging	
		Drying loss	120
		Triclopyr	**1000**
Total	**6265**		**6265**

16. Flucetosulfuron

Manufacturing Process:

Charge dichloro ethane and 1-(3-(benzylthio) pyridine-2-yl)-2-fluoropropan-1-ol (BTPFP). Cool to 10°C and add 2-methoxyacetyl chloride (2-MAC) slowly for 3 hours. Rise to reflux and reflux for 3 hours. Cool the mass to 0°C and add formic acid. Pass chlorine gas at 0°C for 6 hours. Rise to reflux and distil out dichloro ethane partially. Cool the mass to 0°C and add ammonia solution for 3 hours. Rise to 30°C and separate the aqueous phase. Charge organic phase and phenyl 4, 6-dimethoxypyrimidin-2-ylcarbamate (P-4, 6-DMPC). Rise to 65°C and maintain for 6 hours. Add water and maintain at 65°C for 2 hours. Separate the aqueous phase. Cool the organic phase to 5-10°C and filter the slurry. Dry the wet cake to obtain Flucetosulfuron Technical.

Chemical Reaction:

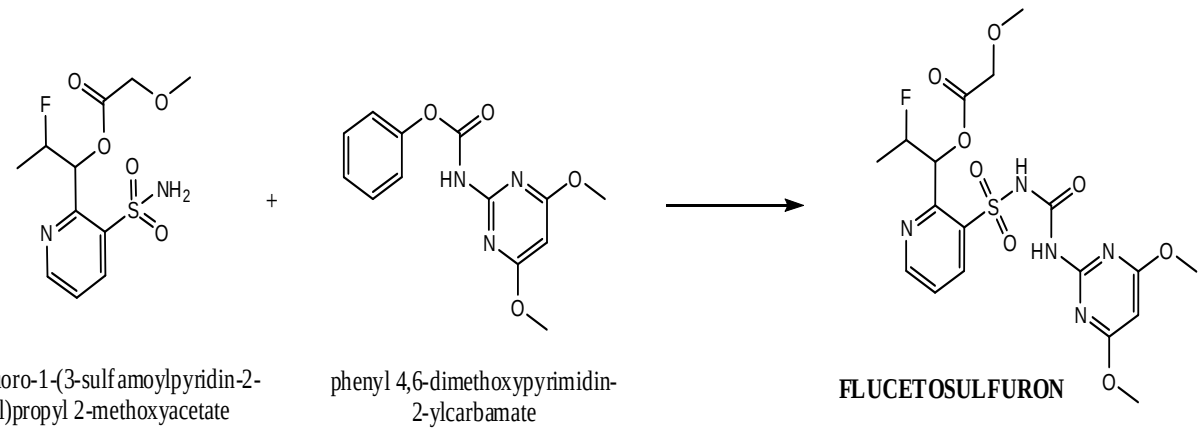


1-(3-(benzylthio)pyridin-2-yl)-2-fluoropropan-1-ol

2-methoxyacetyl chloride

1-(3-(benzylthio)pyridin-2-yl)-2-fluoropropyl 2-methoxyacetate

1-(3-(chlorosulfonyl)pyridin-2-yl)-2-fluoropropyl 2-methoxyacetate



2-fluoro-1-(3-sulfamoylpyridin-2-yl)propyl 2-methoxyacetate

phenyl 4,6-dimethoxypyrimidin-2-ylcarbamate

FLUCETOSULFURON

Mass Balance:

Mass Balance of Flucetosulfuron

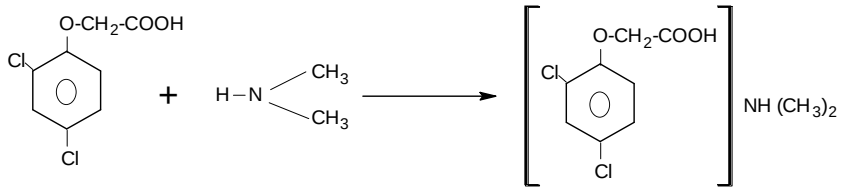
Input	kg		Output	kg
EDC	3500	Reaction	HCl	80
BTPFP	625			
2-MAC	245			
Formic acid	125	Reaction & Distillation	EDC	1000
chlorine	155			
Ammonia 25%	175	Reaction & Separation	aqueous effluent	1470
water	1000			
p-4,6-DMPC	600	Reaction & Separation	aqueous effluent	1000
water	750			
		Crystallization, Filteration & Distillation	EDC	2450
			Organic Residue	50
		Drying & Packaging	Drying loss	125
			Flucetosulfuron	**1000**
Total	**7175**			**7175**

17. 2,4-D Amine Salt

Manufacturing Process:

In the manufacturing process, dimethyl amine (40%) is charged in a SS Reactor. 2,4-D acid is added slowly to the reactor, with constant stirring, so as to dissolve it in the mixture. The stirring is continued for half an hour for proper reactions. In the reactor, dilute amine react with 2,4-D acid to form the amber coloured 2,4-D Dimethyl Amine. The reaction is exothermic and raises the temperature. The temperature comes down after completion of reaction, i.e. within 2 hours. When temperature begins to fall, oxalic acid is added to minimize the excess amine and maintain the pH between 7-9. The material in the reactor is allowed to cool down to room temperature with constant stirring. After two hours of settling, the material is transferred to SS or HDPE storage tanks and allowed to settle for 35 to 40 hours. After settling the material, the product is filtered through vacuums filter and stored in HDPE drums. No waste material is produced in this process.

Chemical Reaction:



2,4-D Acid | Dimethyl Amine | 2,4-Dimethyl Amine

Mass Balance:

Mass Balance of 2,4 D amine salt

Input	Kg	Output	Kg
2,4-D Acid	595		
Dimethyl Amine, 40%	975		
Emulsifier	30		
Oxalic Acid	15		
		Waste	45
		ML	570
		2, 4 D Amine Salt	1000
TOTAL	**1615**		**1615**

18. Glyphosate Potassium Salt

Manufacturing Process:

Charge water and potassium hydroxide 85%. Charge dichloroethane and glyphosate. Rise to reflux and remove water azeotropically. Cool to 10°C and filter the slurry. Dry to obtain Glyphosate potassium salt.

Chemical Reaction:

glyphosate potassium hydroxide **GLYPHOSATE POTASSIUM SALT**

Mass Balance:

Mass Balance of Glyphosate Potassium salt

Input	kg	Output	kg
Potassium hydroxide 85%	325	Aqueous effluent	130
Water	100	Dichloroethane	2950
Dichloroethane	3000	Organic Residue	50
Glyphosate	830	Drying loss	125
		Glyphosate K salt	**1000**
Total	**4255**		**4255**

B. INSECTICIDES

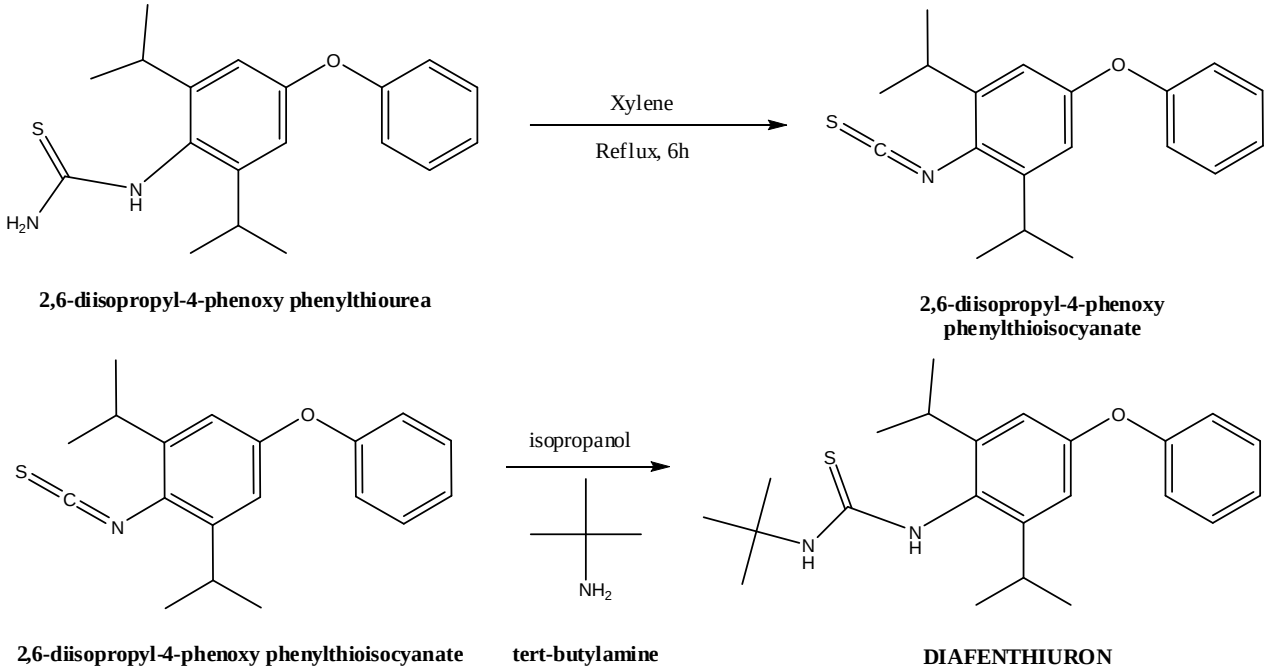
1. Diafenthuron

Manufacturing Process:

Charge xylene and 2, 6-diisopropyl-4-phenoxy phenylthiourea. Rise to reflux and maintain for 6 hours. Distil out xylene under reduced pressure to obtain 2, 6-isopropyl-4-phenoxy phenylthioisocyanate.

Charge isopropanol and 2, 6-isopropyl-4-phenoxy phenylthioisocyanate. Rise to 50°C and add tert-butylamine for 2 hours. Rise to 65°C and maintain for 4 hours. Cool the mass to 10°C and filter the slurry. Dry the wet cake to obtain Diafenthuron Technical. Distil out the filtrate to recover isopropanol for recycling the solvent.

Chemical Reaction:



2,6-diisopropyl-4-phenoxy phenylthiourea

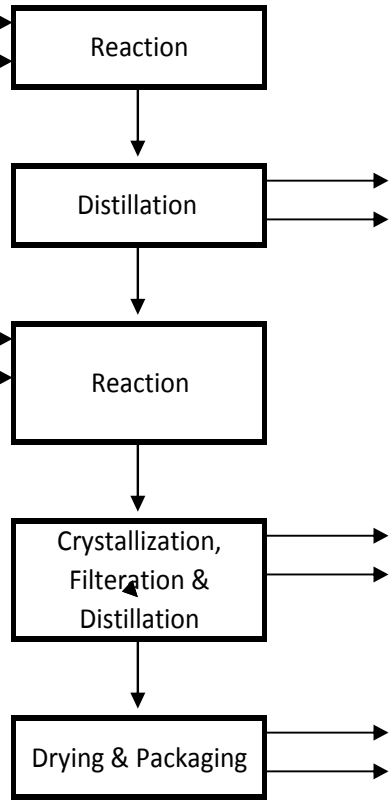
2,6-diisopropyl-4-phenoxy phenylthioisocyanate

2,6-diisopropyl-4-phenoxy phenylthioisocyanate + **tert-butylamine** → **DIAFENTHIURON**

Mass Balance:

Mass Balance of Diafenthuron

Input	kg	Output	kg
Xylene	2500		
2,6 DIPPTU	900		
		xylene	2460
		Residue	40
Isopropanol	2000		
tert-butylamine	200		
		Isopropanol	1955
		Organic Residue	45
		Drying loss	100
		Diafenthuron	**1000**
Total	**5600**		**5600**

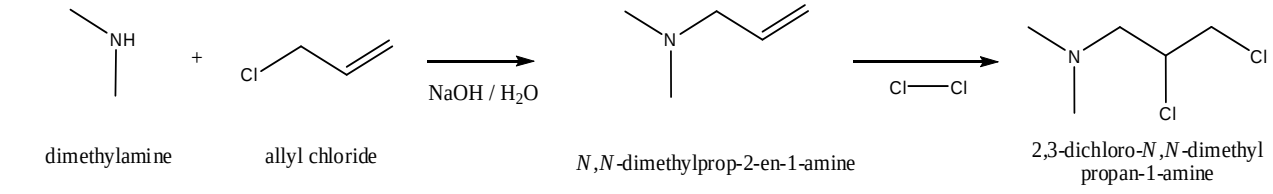


2. Thiocyclam Oxalate

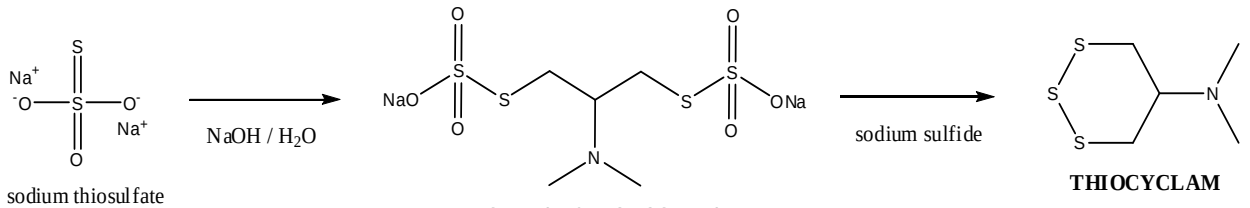
Manufacturing Process:

Charge Allyl chloride and dichloroethane. Add sodium hydroxide solution and Dimethylamine 40% solution. Rise to 50°C and maintain for 4 hours. Cool, settle and separate the organic phase. Take the organic phase rise to 40°C and pass chlorine for 3 hours. Rise to reflux and distil out dichloroethane partially. Cool to 30°C and add water, sodium hydroxide solution and sodium thiosulfate. Maintain for 3 hours at 70°C, cool the products of monosultap and disultap to -5°C and add sodium sulfide. Separate the organic phase of Thiocyclam in dichloroethane. Add oxalic acid to pH 6-8. Cool to 0°C and filter the slurry. Dry the wet cake to obtain Thiocyclam oxalate technical.

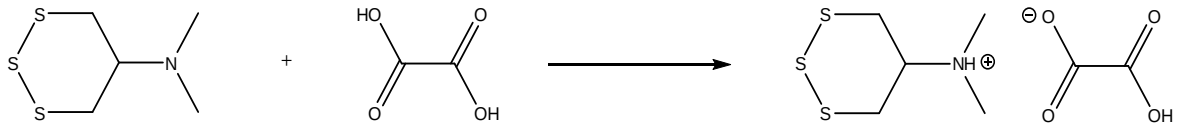
Chemical Reaction:



dimethylamine allyl chloride *N*,*N*-dimethylprop-2-en-1-amine 2,3-dichloro-*N*,*N*-dimethyl propan-1-amine



sodium thiosulfate BISULTAP & MONOSULTAP **THIOCYCLAM**



THIOCYCLAM oxalic acid **THIOCYCLAM HYDROGEN OXALATE**

Mass Balance:

Mass Balance of Thiocyclam oxalate

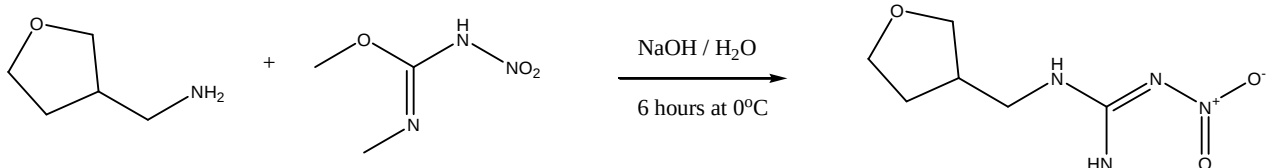
Input	kg		Output	kg
Dichloroethane	3000	Reaction & Separation	aqueous effluent	735
Allyl chloride	300			
NaOH 48%	335			
Dimethylamine 40%	450			
chlorine	280	Reaction & Distillation	Dichloroethane	750
			Residue	20
water	1000	Reaction		
NaOH 48%	35			
Sodium thiosulfate	1200			
Sodium sulfide	500	Reaction & Separation	aqueous effluent	2555
Oxalic acid	325	Crystallization, Filteration, distillation	Dichloroethane	2200
			Organic Residue	30
		Drying & Packaging	Drying loss	135
			Thiocyclam oxalate	**1000**
Total	**7425**			**7425**

3. Dinotefuran

Manufacturing Process:

Charge oily liquid of (tetrahydrofuran-3-yl)methanamine and water. Cool to 0°C. Add sodium hydroxide solution and methyl-N-methyl-N-nitrocarbamimidate at 0°C. Maintain the reaction for 6 hours at 0°C. Filter the slurry and dry to obtain Dinotefuran Technical.

Chemical Reaction:



(tetrahydrofuran-3-yl) methanamine + methyl *N*'-methyl-*N*-nitrocarbamimidate → DINOTEFURAN

Mass Balance:

Mass Balance of Dinotefuran

Input	kg		Output	kg
Water	2500	→ Reaction & Filteration →	Aqueous Effluent	3325
MMNCl	725		Dinotefuran	1000
NaOH 40 %	550			
3-AMTHF	550			
Total	**4325**			**4325**

4. Pymetrozine

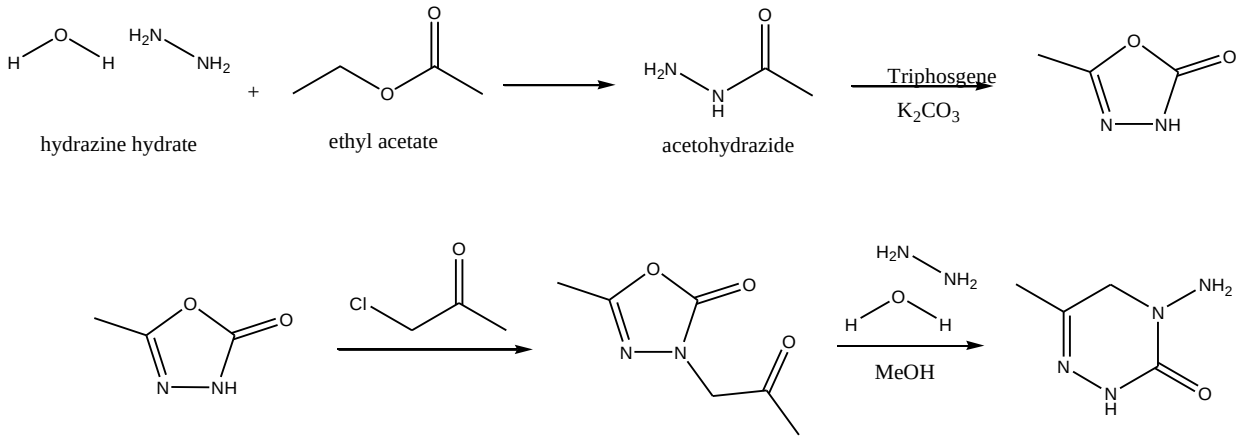
Manufacturing Process:

Charge ethyl acetate and hydrazine hydrate in dichloroethane. Reflux for 6 hours and separate the organic phase at 30°C. The organic phase contains acetohydrazide in dichloroethane.

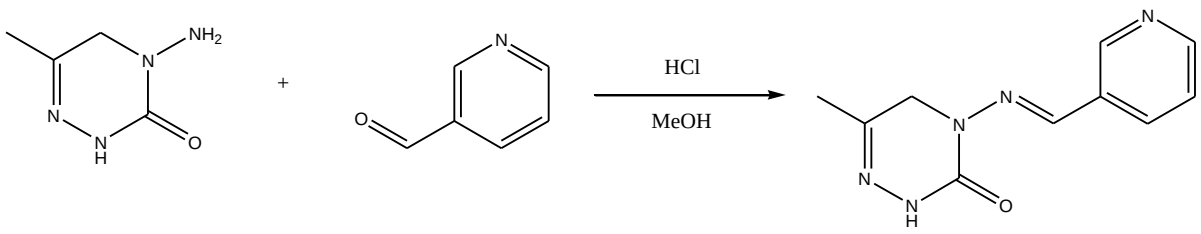
Charge triphosgene and potassium carbonate to the organic phase. reflux for 6 hours. 5-methyl-1,3,4-oxadiazol-2-(3H)-one is obtained. Cool to 30°C.
Add chloroacetone at 50°C and maintain for 3 hours. Cool to 30°C and charge water. Separate the organic phase and cool to 0°C. Filter the slurry to obtain 5-methyl-3-(2-oxopropyl)-1,3,4-oxadiazol-2-(3H)-one.

Charge 5-methyl-3-(2-oxopropyl)-1,3,4-oxadiazol-2-(3H)-one and methanol. Add hydrazine hydrate and maintain for 6 hours at 65°C. Cool and add hydrochloric acid and nicotinaldehyde. Maintain at 60°C for 3 hours and cool to 0°C. Filter the slurry and dry to obtain Pymetrozine Technical.

Chemical Reaction:



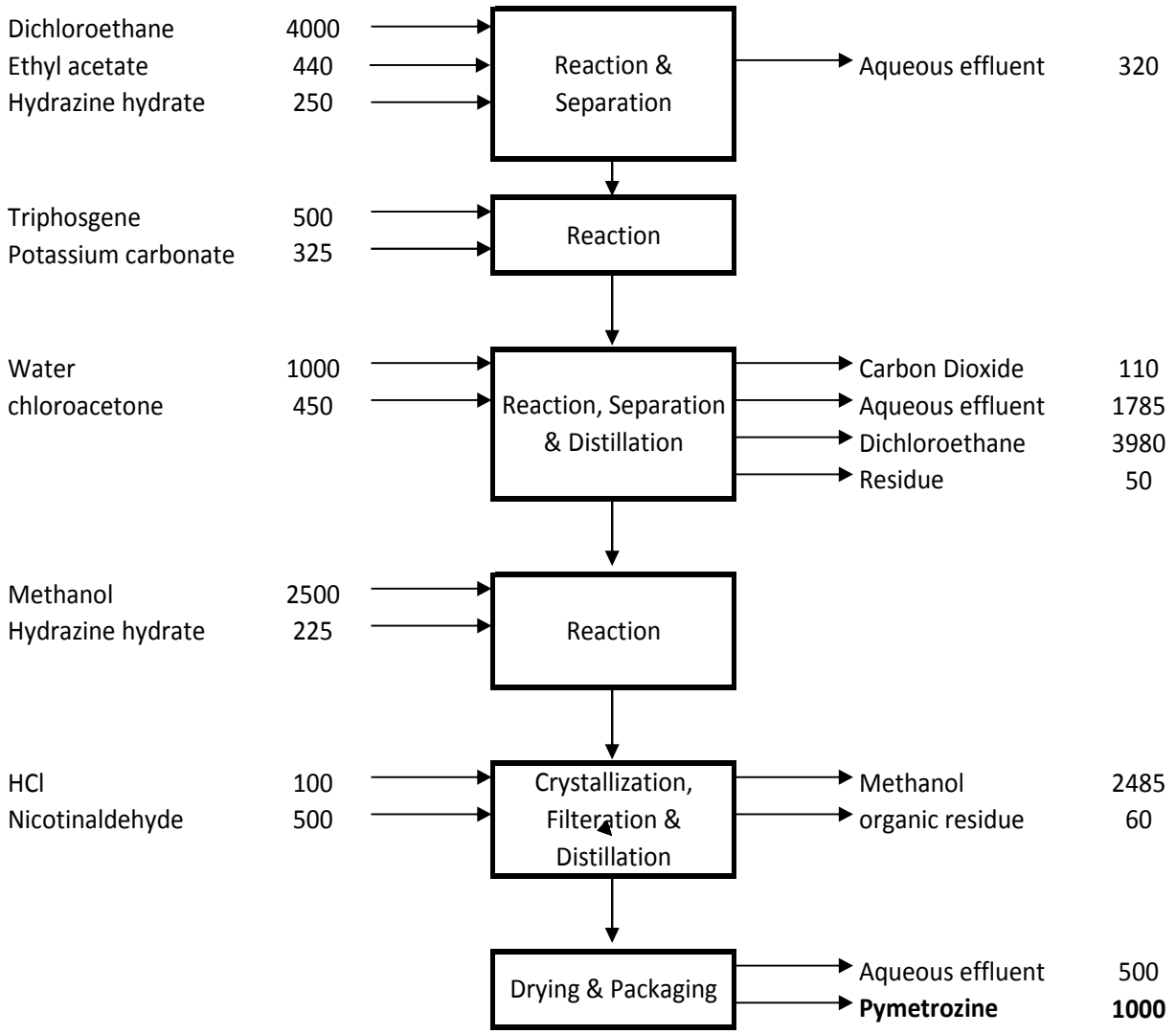
hydrazine hydrate + ethyl acetate → acetohydrazide → 5-methyl-1,3,4-oxadiazol-2(3*H*)-one → 5-methyl-3-(2-oxopropyl)-1,3,4-oxadiazol-2(3*H*)-one → 4-amino-6-methyl-4,5-dihydro-1,2,4-triazin-3(2*H*)-one



4-amino-6-methyl-4,5-dihydro-1,2,4-triazin-3(2*H*)-one + nicotinaldehyde → **PYMETROZINE**

Mass Balance:

Mass Balance of Pymetrozine



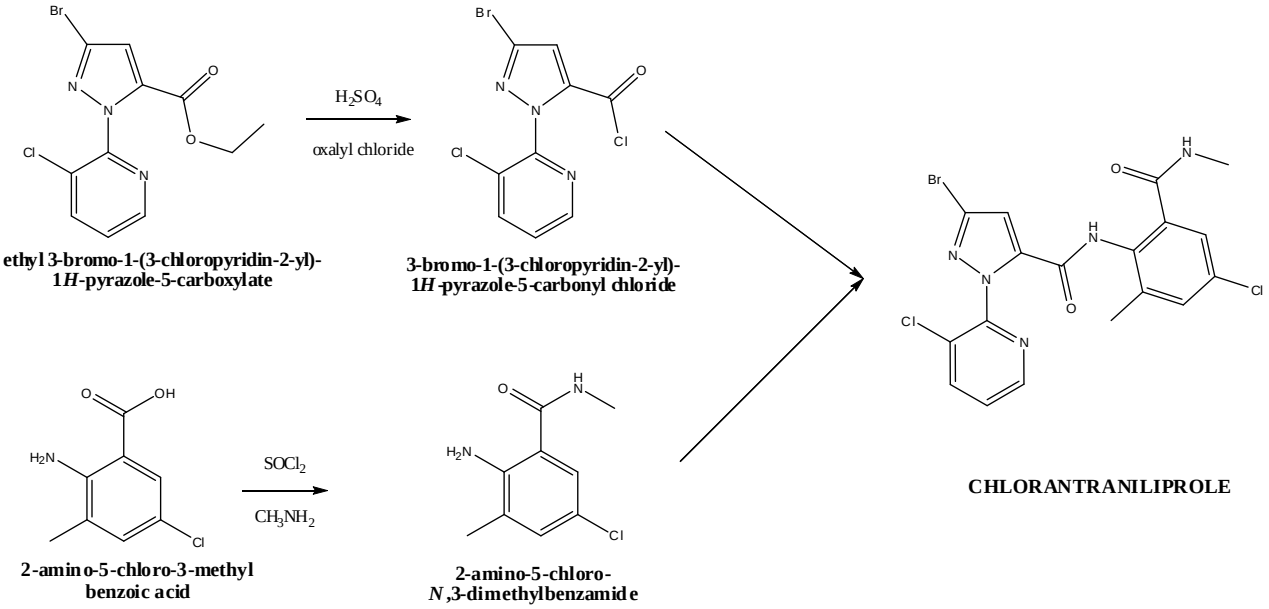
5. Chloranthraniliprole

Manufacturing Process:

Charge dichloroethane, ethyl 3-bromo-1-(3-chloropyridin-2-yl)-1H-pyrazole-5-carboxylate (EBCPPC) and catalyst sulphuric acid. Rise to 55°C and add oxalyl chloride for 3 hours. Rise to reflux and reflux for 3 hours. It contains 3-bromo-1-(3-chloropyridin-2-yl)-1H-pyrazole-5-carbonyl chloride (BCPPCC) in dichloro ethane, say Mass 1.

Charge dichloro ethane and 2-amino-5-chloro-3-methyl benzoic acid (ACMBA). Rise to 55°C and add thionyl chloride for 2 hours. Rise to reflux and reflux for 4 hours. Cool to 20°C and pass methylamine for 4 hours. Rise to reflux and reflux for 2 hours. Cool the mass of 2-amino-5-chloro-N,3-dimethyl benzamide (ACDMB) in dichloro ethane to 30°C. Add Mass 1 slowly for 3 hours and maintain for 2 hours. Add water and separate the aqueous phase. Cool the organic phase to 5°C and maintain for 1 hour. Filter the slurry and dry the wet cake to obtain Chlorantraniliprole technical.

Chemical Reaction:



Mass Balance:

Mass Balance of Chlorantraniliprole

Input	kg		Output	kg
Dichloroethane	2000	Reaction		
EBCPPC	750			
oxalyl chloride	285			
Sulfuric acid	1			
		Mass 1		
Dichloroethane	2000	Reaction	HCl gas	80
ACMBA	415		SO2 gas	140
Thionyl chloride	270			
Methyl amine	70	Reaction	HCl gas	75
Water	1200	Reaction & Separation	Aqueous effluent	1546
		Crystallization, Filteration & Distillation	Dichloroethane	3950
			Organic residue	50
		Drying & Packaging	Drying loss	150
			Chlorantraniliprole	**1000**
Total	**6991**			**6991**

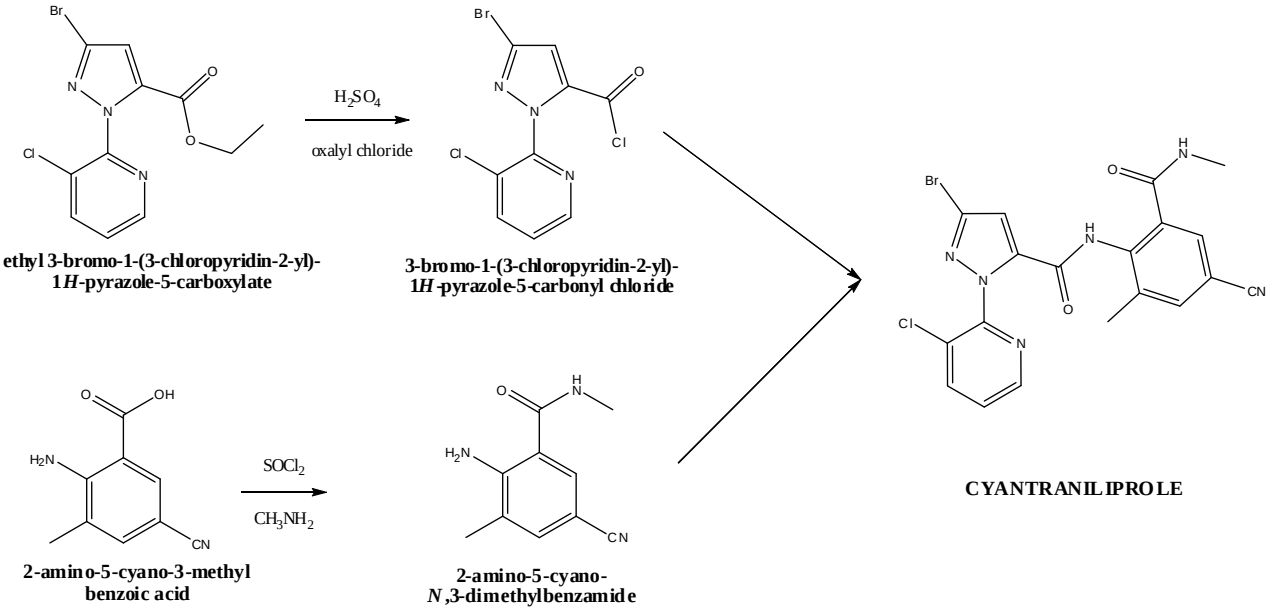
6. Cyantraniliprole

Manufacturing Process:

Charge dichloro ethane, ethyl 3-bromo-1-(3-chloropyridin-2-yl)-1H-pyrazole-5-carboxylate (EBCPPC) and catalyst sulphuric acid. Rise to 55°C and add oxalyl chloride for 3 hours. Rise to reflux and reflux for 3 hours. It contains 3-bromo-1-(3-chloropyridin-2-yl)-1H-pyrazole-5-carbonyl chloride (BCPPCC) in dichloro ethane, say Mass 1.

Charge dichloro ethane and 2-amino-5-cyano-3-methyl benzoic acid (ACNMBA). Rise to 55°C and add thionyl chloride for 2 hours. Rise to reflux and reflux for 4 hours. Cool to 20°C and pass methylamine for 4 hours. Rise to reflux and reflux for 2 hours. Cool the mass of 2-amino-5-chloro-N,3-dimethyl benzamide (ACDMB) in dichloro ethane to 30°C. Add Mass 1 slowly for 3 hours and maintain for 2 hours. Add water and separate the aqueous phase. Cool the organic phase to 5°C and maintain for 1 hour. Filter the slurry and dry the wet cake to obtain Cyantraniliprole technical.

Chemical Reaction:



Mass Balance:

Mass Balance of Cyantraniliprole

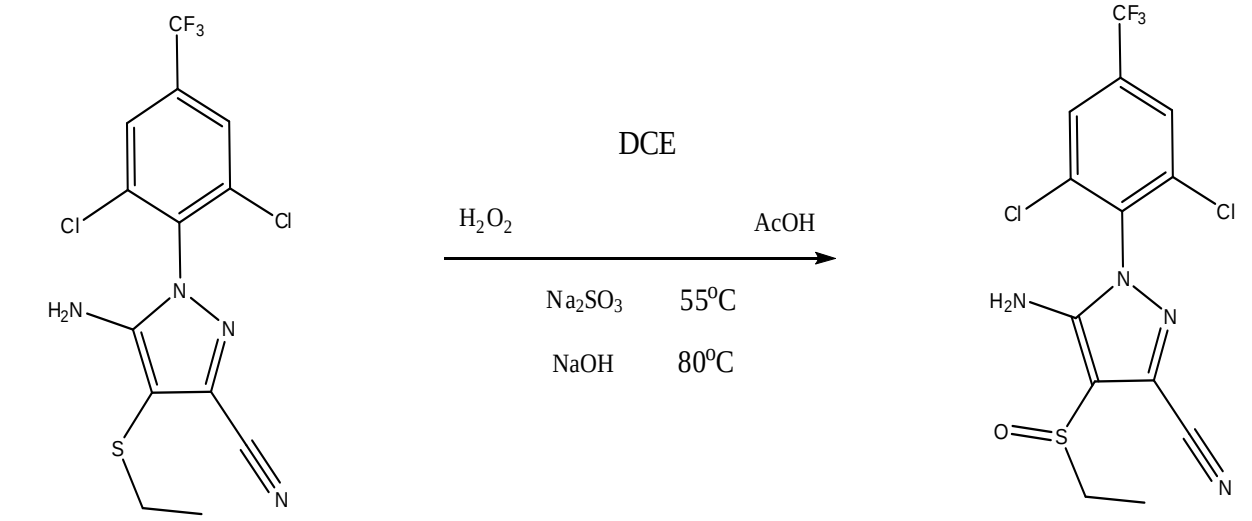
Input	kg		Output	kg
Dichloroethane	2000	Reaction		
EBCPPC	760			
Oxalyl chloride	295			
Sulfuric acid	1			
		Mass 1		
Dichloroethane	2000	Reaction	HCl gas	82
ACNMBA	405		SO2 gas	145
Thionyl chloride	275			
Methyl amine	72	Reaction	HCl gas	76
Water	1200	Reaction & Separation	Aqueous effluent	1555
		Crystallization, Filteration & Distillation	Dichloroethane	3950
			organic residue	50
		Drying & Packaging	Drying loss	150
			Cyantraniliprole	**1000**
Total	**7008**			**7008**

7. Ethiprole

Manufacturing Process:

Charge dichloro ethane, acetic acid and 5-amino-1-(2,6-dichloro-4-(trifluoromethyl)phenyl)-4-(ethylthio)-1H-pyrazole-3-carbonitrile (ADCTFMPETPCN). Add hydrogen peroxide at 30°C for 4 hours and maintain for 6 hours. Add water and sodium sulphite solution slowly at 55°C for 1 hour. Rise to 80°C and add sodium hydroxide solution to pH 7. Rise to reflux and reflux for 3 hours. Cool to 10°C and filter the slurry. Dry the wet cake to obtain Ethiprole Technical.

Chemical Reaction:



5-amino-1-(2,6-dichloro-4-(trifluoromethyl) phenyl)-4-(ethylthio)-1*H*-pyrazole-3-carbonitrile

ETHIPROLE
5-amino-1-[2,6-dichloro-4-(trifluoromethyl)phenyl]-4-(ethylsulfinyl)-1H-pyrazole-3-carbonitrile

Mass Balance:

Mass Balance of Ethiprole

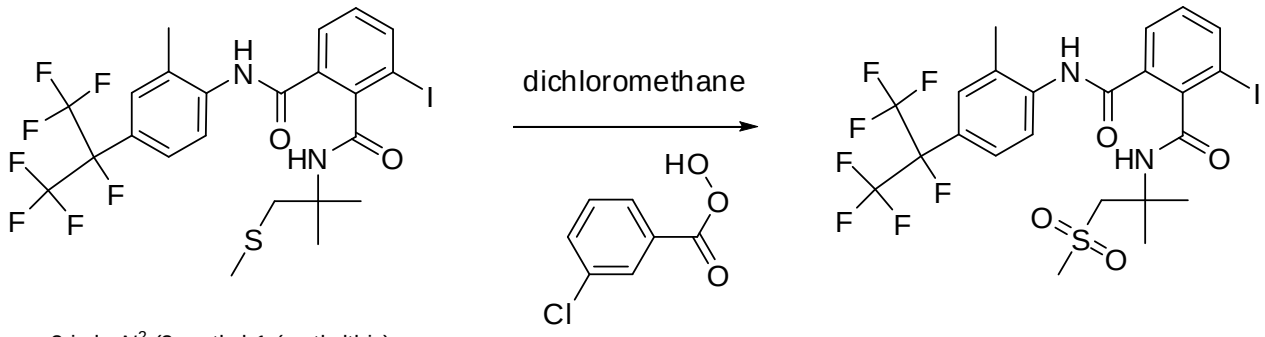
Input	kg		Output	kg
Dichloroethane	3000	Charge		
Acetic acid	32			
ADCTFMPETPCN	1000			
H2O2 30%	325	Reaction		
water	1000	Separation	Aqueous effluent	1560
Sodium sulfite 10%	100			
NaOH 10%	225			
		Crystallization, Filteration & Distillation	Dichloroethane	2950
			organic residue	50
		Drying & Packaging	Drying loss	122
			Ethiprole	**1000**
Total	**5682**			**5682**

8. Flubendiamide

Manufacturing Process:

Charge 3-iodo-N^2-(2-methyl-1-(methylthio) propan-2-yl)-N^1-(2-methyl-4-(perfluoropropan-2-yl)phenyl)phthalamide (IMMTPMPFPPP) and dichloromethane. Add 3-chloro peroxy benzoic acid (m-CPBA) lot-wise slowly for 6 hours and maintain for 4 hours. After completion of the reaction add water and separate the aqueous phase. Cool the organic phase to 0-5°C and filter the slurry. Dry to obtain Flubendiamide technical.

Chemical Reaction:



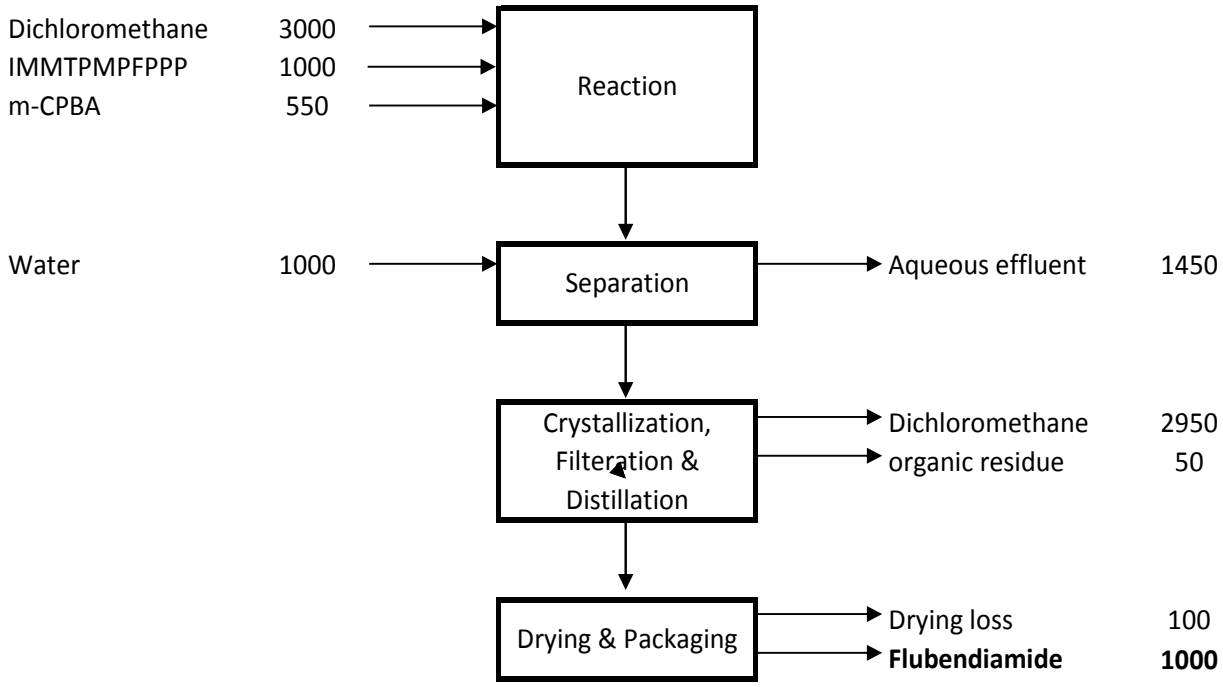
3-iodo-*N*^{2}-(2-methyl-1-(methylthio) propan-2-yl)-*N*^{1}-(2-methyl-4-(perfluoropropan-2-yl)phenyl)phthalamide

m-chloro peroxybenzoic acid

FLUBENDIAMIDE

Mass Balance:

Mass Balance of Flubendiamide

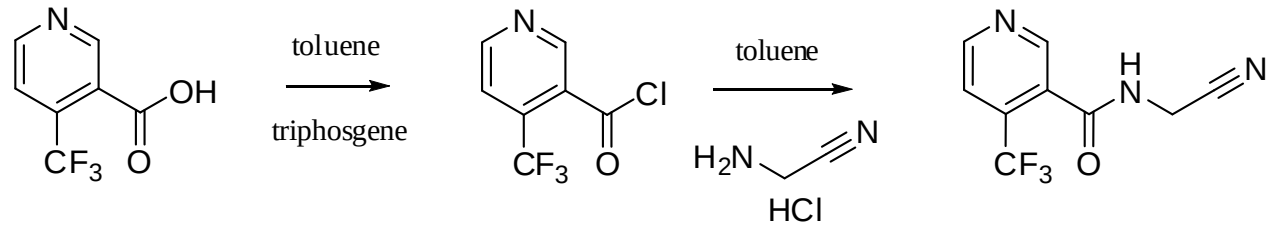


9. Flonicamid

Manufacturing Process:

Charge dichloroethane, 4-(trifluoromethyl) nicotinic acid (4-TFMNA) and 2-aminoacetonitrile hydrochloride (2-AAN HCl). Cool the mass to 0°C and add triphosgene lot-wise for 6 hours. Rise to 30°C and maintain for 4 hours. Add water and separate the aqueous phase. Cool the organic phase to 0-5°C and filter the slurry. Dry the wet cake to obtain Flonicamid Technical.

Chemical Reaction:



4-(trifluoromethyl) nicotinic acid

4-(trifluoromethyl) nicotinoyl chloride

2-aminoacetonitrile hydrochloride

FLONICAMID

Mass Balance:

Mass Balance of Flonicamid

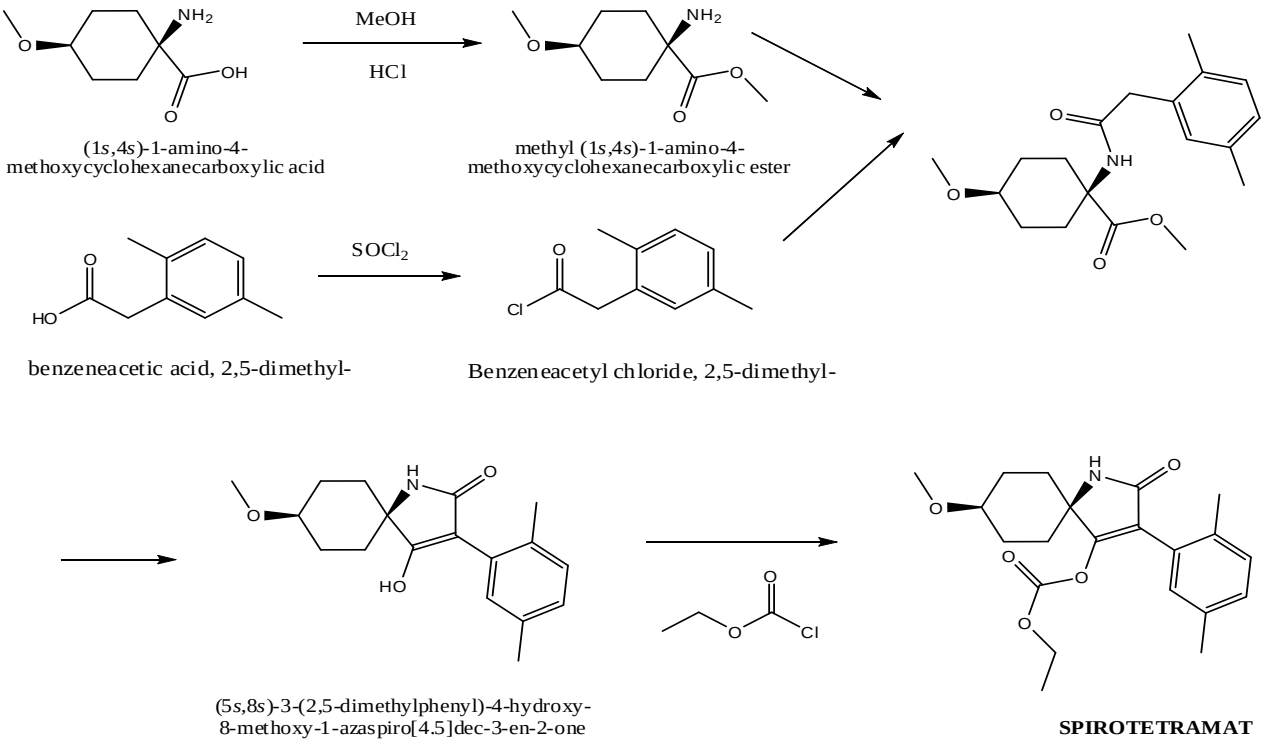
Input	kg		Output	kg
Dichloroethane	3000	Reaction		
4-TFMNA	900			
2-AAN HCl	450			
Triphosgene	475			
Water	1000	Separation	Aqueous effluent	1710
		Crystallization, Filteration & Distillation	Dichloroethane	2950
			organic residue	50
		Drying & Packaging	Drying loss	115
			Flonicamid	**1000**
Total	**5825**			**5825**

10. Spirotetramat

Manufacturing Process:

Charge benzene acetic acid, 2,5-dimethyl (2,5-DMBAA) and dichloroethane. Rise to 60°C and add thionyl chloride for 2 hours. Rise to reflux and reflux for 4 hours. Cool the acid chloride mass to 30°C, say Mass 1. Charge dichloroethane, methanol, hydrochloric acid and (1s,4s)-1-amino-4-methoxycyclohexanecarboxylic acid (1s,4s-1AMCHCA). Rise to reflux and remove water azeotropically. Cool to 50°C and add Mass 1 slowly for 3 hours. Rise to 100°C and maintain for 4 hours. Cool to 60°C. Charge potassium carbonate lot-wise for 3 hours at 60°C and maintain for 3 hours. Cool to 30°C, add water and hydrochloric acid to pH 2-3. Separate the aqueous phase and organic phase. Charge organic phase and rise to 50°C. Add ethoxy formyl chloride (EFC) for 2 hours and rise to reflux. Reflux for 4 hours and cool to 20°C. Add water and separate the aqueous phase. Cool the organic phase to 10-15°C and filter the slurry. Dry the wet cake to obtain Spirotetramat technical.

Chemical Reaction:



Mass Balance:

Mass Balance of Spirotetramat

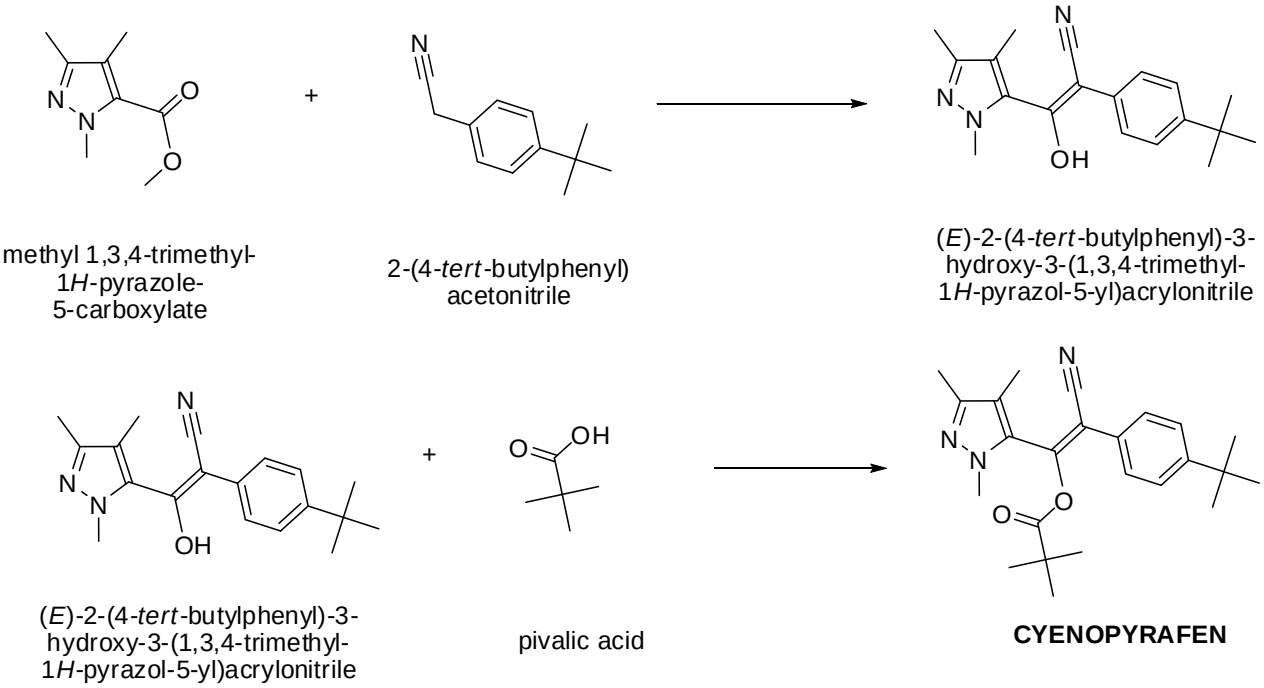
Input	kg		Output	kg
Dichloroethane	1500	Reaction	HCl gas	100
2,5 DMBAA	475		SO2 gas	175
thionyl chloride	350			
		Mass 1		
Dichloroethane	1500	Reaction	Aqueous effluent	50
Methanol	100			
HCl 30%	10			
1s, 4s-1 AMCHCA	500			
		Reaction	HCl gas	100
Potassium carbonate	400	Reaction & Separation	Aqueous effluent	1800
water	1000			
HCl 30%	375			
water	1000	Reaction & Separation	Aqueous effluent	1160
Ethoxy Formyl chloride	310			
		Crystallization, Filteration & Distillation	Dichloroethane	2950
			organic residue	50
		Drying & Packaging	Drying loss	135
			Spirotetramat	**1000**
Total	**7520**			**7520**

11. Cyenopyrafen

Manufacturing Process:

Charge dichloroethane, methyl 1,3,4-trimethyl-1H-pyrazole-5-carboxylate (MTMPC) and 2-(4-tert-butylphenyl) acetonitrile (2-4-TBPAN). Rise to reflux and reflux for 6 hours. Cool to 10°C and add water. Separate the aqueous phase at 10°C. Charge organic phase and pivalic acid. Rise to reflux and remove water azeotropically during reflux for 6 hours. Cool to -5°C and maintain for 6 hours. Filter the slurry and dry to obtain Cyenopyrafen Technical.

Chemical Reaction:



methyl 1,3,4-trimethyl-1*H*-pyrazole-5-carboxylate

2-(4-*tert*-butylphenyl) acetonitrile

(*E*)-2-(4-*tert*-butylphenyl)-3-hydroxy-3-(1,3,4-trimethyl-1*H*-pyrazol-5-yl)acrylonitrile

(*E*)-2-(4-*tert*-butylphenyl)-3-hydroxy-3-(1,3,4-trimethyl-1*H*-pyrazol-5-yl)acrylonitrile

pivalic acid

CYENOPYRAFEN

Mass Balance:

Mass Balance of Cyenopyrafen

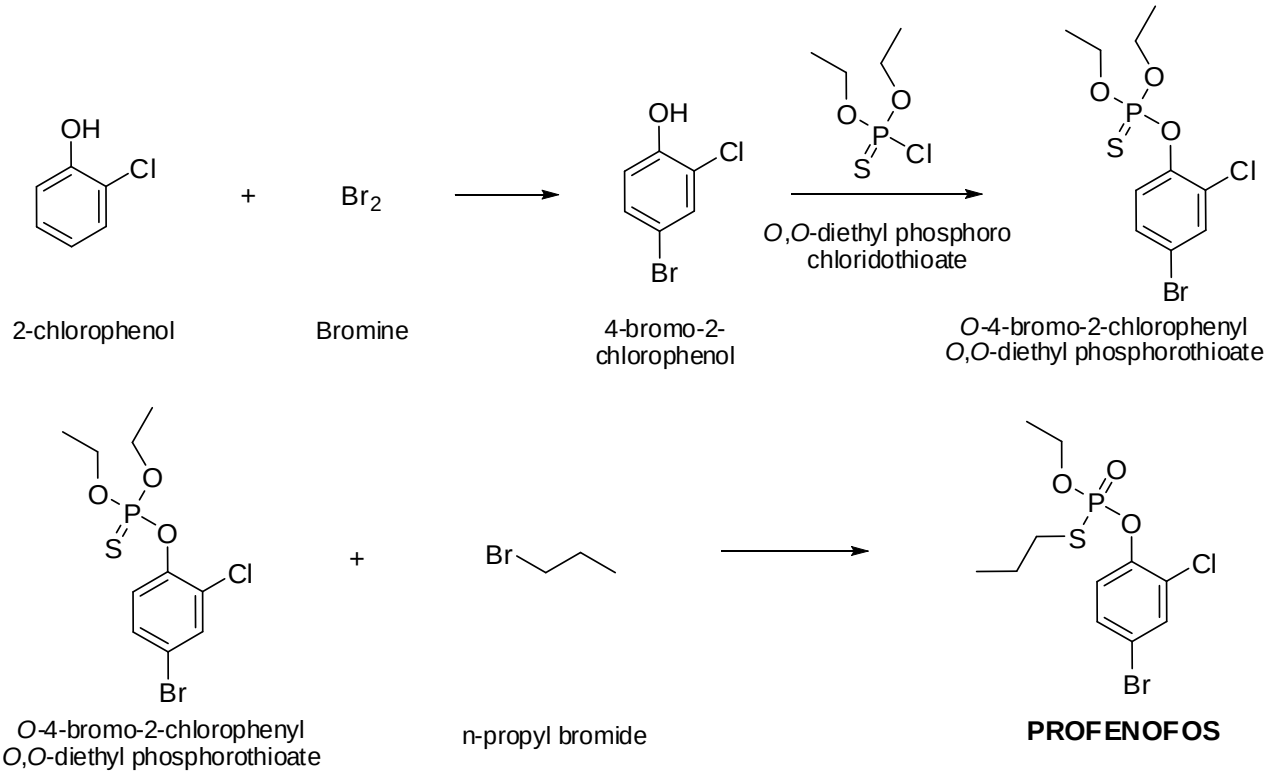
Input	kg		Output	kg
Dichloroethane	3500	Reaction		
MTMPC	460			
2-4 TBPAN	475			
water	1000	Separation	Aqueous effluent	1065
Pivalic acid	275	Reaction	Aqueous effluent	45
		Crystallization, Filteration & Distillation	Dichloroethane	3450
			organic residue	50
		Drying & Packaging	Drying loss	100
			Cyenopyrafen	**1000**
Total	**5710**			**5710**

12. Profenofos

Manufacturing Process:

Charge mono chloro benzene and 2-chlorophenol. Cool to 0°C and add bromine slowly for 6 hours. Rise to 30°C and maintain for 2 hours. Add water and separate the aqueous phase. Add O,O-diethyl phosphoro chloridothioate (DEPCT) slowly for 2 hours. Rise to 75°C and maintain at 75°C 3 hours. Add water and separate the aqueous phase.
Charge organic phase and trimethyl amine. Cool to 10°C. Add n-propyl bromide for 3 hours and maintain for 2 hours. Rise to 50°C and maintain for 5 hours. Cool water and separate the aqueous phase. Distil out the organic phase to recover solvent mono chloro benzene under reduced pressure to obtain Profenofos Technial.

Chemical Reaction:



Mass Balance:

Mass Balance of Profenfos

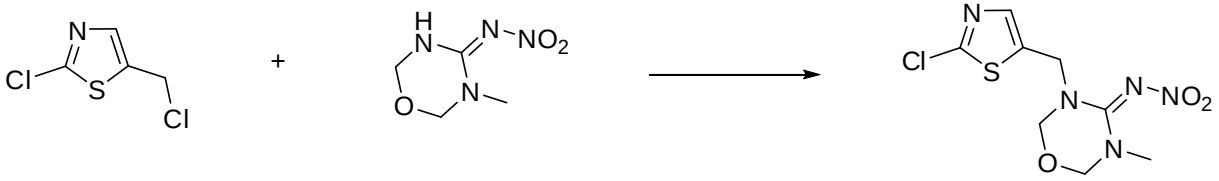
Input	kg		Output	kg
Monochlorobenzene	3000	Reaction		
2-Chlorophenol	360			
Bromine	450			
water	500	Separation	aqueous effluent	715
water	500	Reaction & Separation	aqueous effluent	580
DEPCT	510			
Trimethylamine	160	Reaction		
n-propyl bromide	335			
water	1000	Separation	aqueous effluent	1520
		Distillation under reduced pressure	Monochlorobenzene	2950
			Residue	50
			Profenfos	**1000**
Total	**6815**			**6815**

13. Thiamethoxam

Manufacturing Process:

Charge dichloroethane, 2-chloro-5-(chloromethyl) thiazole (CCMT) and N-(3-methyl-1,3,5-oxadiazinan-4-ylidene) nitramide (MNIO). Rise to 50°C and add potassium carbonate lot-wise for 4 hours. Rise to 75°C and maintain for 5 hours. Cool to 40°C and add water. Separate the aqueous phase and organic phase. Cool the organic phase to 0°C and filter the slurry. Dry the wet cake to obtain Thiamethoxam Technical.

Chemical Reaction:



2-chloro-5-(chloromethyl) thiazole

CCMT

N-(3-methyl-1,3,5-oxadiazinan-4-ylidene)nitramide

MNIO

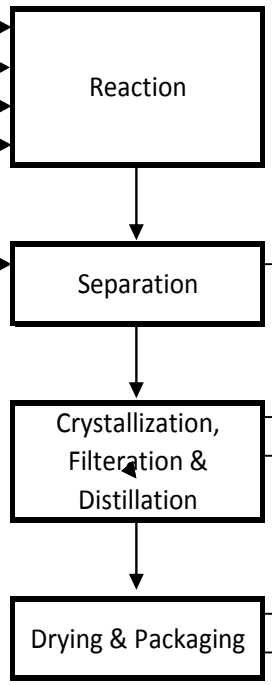
THIAMETHOXAM

TMX

Mass Balance:

Mass Balance of Thiamethoxam

Input	kg	Output	kg
Dichloroethane	2500		
CCMT	600		
MNIO	575		
Potassium carbonate	250		
water	1000	Aqueous effluent	1300
		Dichloroethane	2460
		organic residue	40
		Drying loss	125
		Thiamethoxam	**1000**
Total	**4925**		**4925**

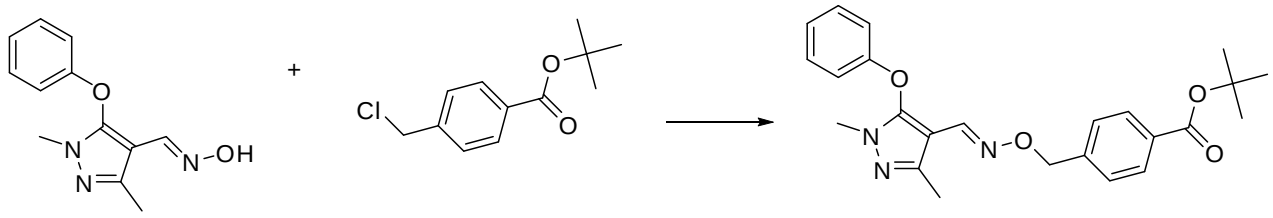


14. Fenpyroximate

Manufacturing Process:

Charge dichloroethane,1,3-dimethyl-5-phenoxy-1H-pyrazole-4-carbaldehyde oxime (1,3-DMPPCO) and tert-butyl 4-(chloromethyl) benzoate (TBCMB). Rise to 50°C and add potassium carbonate lot-wise for 4 hours. Rise to 65°C and maintain for 4 hours. Cool to 40°C and add water. Separate the aqueous phase and organic phase. Cool the organic phase to 0°C and filter the slurry. Dry to obtain Fenpyroximate Technical.

Chemical Reaction:



(*E*)-1,3-dimethyl-5-phenoxy-1*H*-pyrazole-4-carbaldehyde oxime

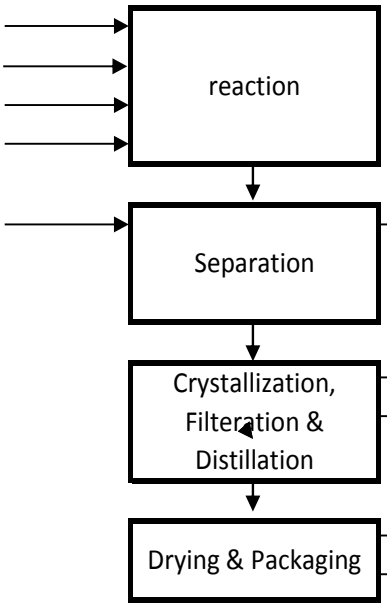
tert-butyl 4-(chloromethyl) benzoate

FENPYROXIMATE

Mass Balance:

Mass Balance of Fenpyroximate

Input	kg	Output	kg
Dichloroethane	3000		
1,3 DMPPCO	590		
TBCMB	580		
Potassium carbonate	180		
water	1000	Aqueous effluent	1210
		Dichloroethane	2940
		organic residue	60
		Drying loss	140
		Fenpyroximate	**1000**
Total	**5350**		**5350**



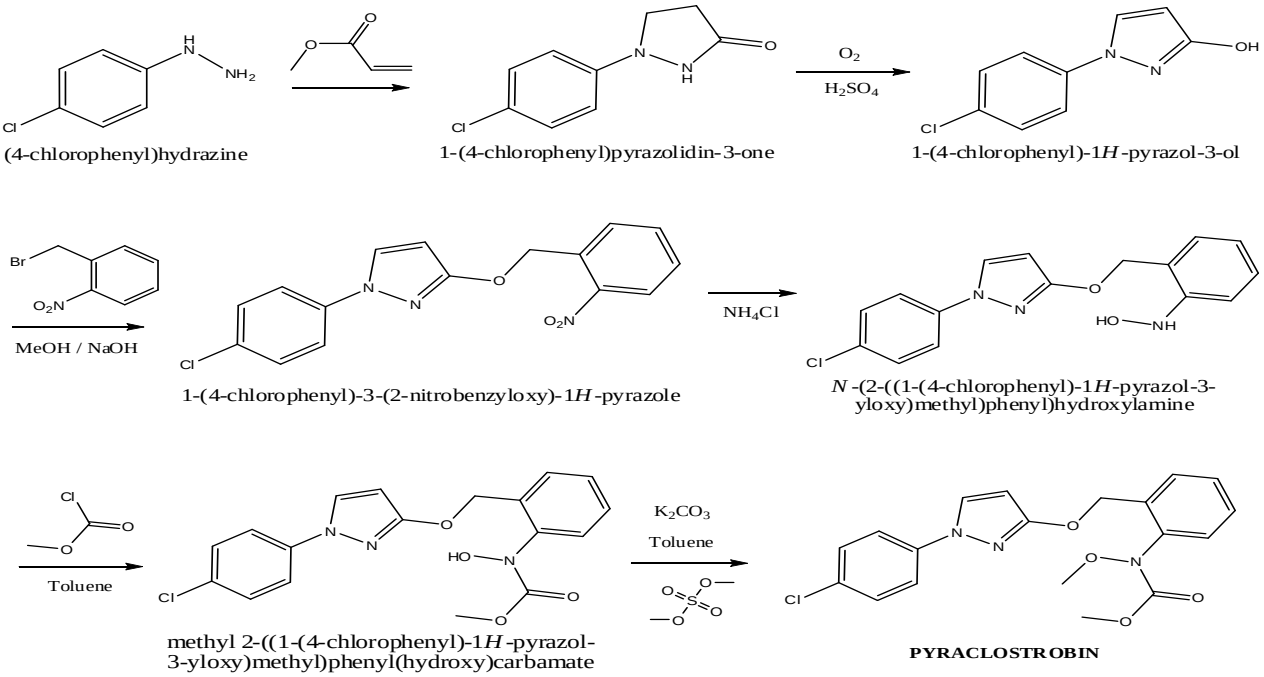
C. FUNGICIDES

1. Pyraclostrobin

Manufacturing Process:

Charge methanol, (4-chlorophenyl) hydrazine and methyl acrylate. Maintain at 80°C for 3 hours. Cool to 30°C to obtain 1-(4-chlorophenyl) pyrazolidin-3-one. Charge sulfuric acid and pass air at 60°C for 6 hours. Cool to 30°C to obtain 1-(4-chlorophenyl)-1H-pyrazol-3-ol. Charge sodium hydroxide and 1-(bromo methyl) -2-nitrobenzene (1-BMNB). Maintain at 65°C for 3 hours to obtain 1-(4-chlorophenyl)-3-(2-nitrobenzyloxy)-1H-pyrazole. Charge ammonium chloride and maintain at 35°C for 4 hours. Distil out to recover methanol under reduced pressure. Add dichloroethane and water. Separate the aqueous phase and the organic phase of dichloroethane and N-(2-((1-(4-chlorophenyl)-1H-pyrazol-3-yloxy) methyl) phenyl) hydroxylamine. Charge organic phase and add methyl chloroformate. Maintain at 30°C for 3 hours to obtain methyl 2-((1-(4-chlorophenyl)-1H-pyrazol-3-yloxy) methyl) phenyl (hydroxy) carbamate. Charged potassium carbonate and add dimethyl sulfate. Maintain at 50°C for 5 hours. Add water and separate the aqueous phase. Cool the organic phase to 0°C. Filter the slurry and dry the wet cake to obtain Pyraclostrobin Technical.

Chemical Reaction:



Mass Balance:

Mass Balance of Pyraclostrobin

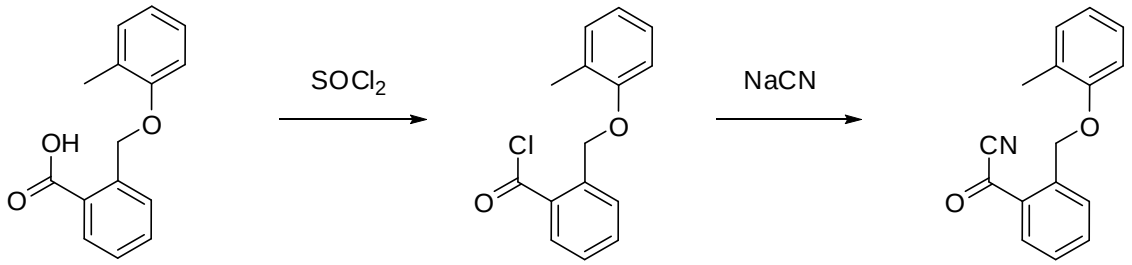
Input	kg		Output	kg
methanol	3000	Reaction		
(4-chlorophenyl)hydrazin	425			
Methyl acrylate	260			
Sulfuric acid	13	Reaction		
Air(oxygen)	50			
NaOH	100	Reaction		
1-BMNB	565			
ammnium chloride	100	Reaction, Distillation & Separation	Aqueous effluent	2130
Dichloroethane	4000		methanol	2920
water	2000		Residue	80
Methylchloroformate	265	Reaction	ML	90
Potassium carbonate	40	Reaction & Separation	Aqueous effluent	2460
Dimethyl sulfate	150			
water	2000			
		Crystallization, Filteration & Distillation	Dichloroethane	3975
			organic residue	25
		Drying & Packaging	Drying loss	288
			Pyraclostrobin	**1000**
Total	**12968**			**12968**

2. Kresoxim-Methyl

Manufacturing Process:

Charge dichloroethane, 2-[(2-methylphenoxy)methyl]-benzoic acid (2-MPMBA). Rise to 50°C and add thionyl chloride for 3 hours. Rise to reflux and reflux for 4 hours. Cool to 10°C add sodium cyanide lot-wise slowly for 3 hours. Rise to 20°C and maintain for 2 hours. Add hydroxylamine O-methyl, hydrochloride (HAOMHC) lot-wise for 2 hours at 20°C. Rise to 30°C and add water. Maintain for 4 hours at 50°C. Separate the aqueous phase. Charge methanol and rise to reflux slowly. Reflux and remove water azeotropically. Cool 0°C and filter the slurry. Dry the wet cake to obtain Kresoxim-methyl technical.

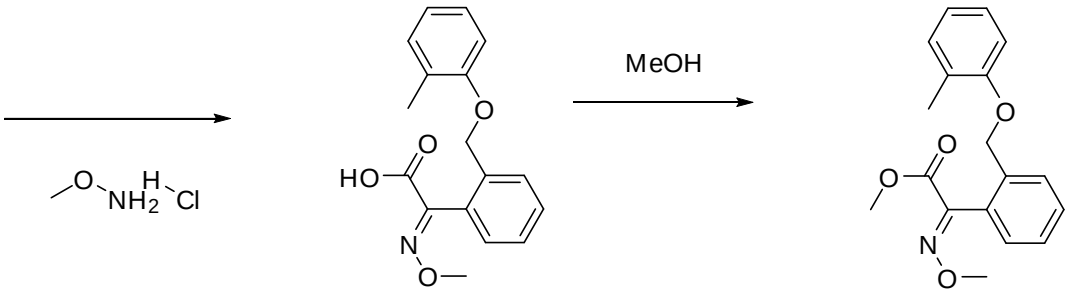
Chemical Reaction:



2-[(2-methylphenoxy) methyl]-benzoic acid

2-[(2-methylphenoxy) methyl]-benzoyl chloride

2-(*o*-tolyloxymethyl) benzoyl cyanide



Hydroxylamine, O-methyl-, hydrochloride

(*E*)-2-(methoxyimino)-2-(2-(*o*-tolyloxymethyl) phenyl)acetic acid

KRESOXIM-METHYL

Mass Balance:

Mass Balance of kersoxim-methyl

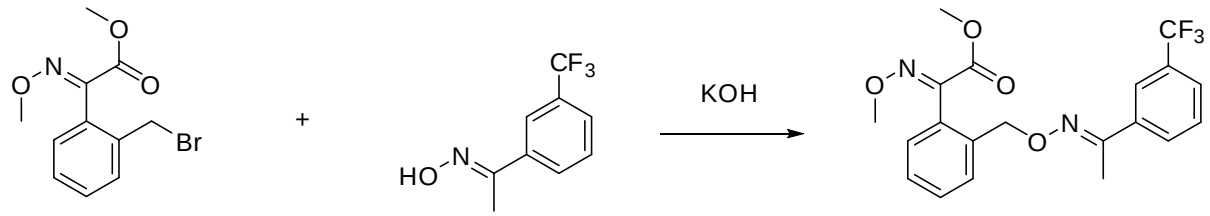
Input	kg		Output	kg
Dichloroethane	3000	Reaction	HCl	125
2-MPMBA	835		SO2	220
Thionyl chloride	415			
Sodium cyanide	167	Reaction		
HAOMHC	280	Reaction & Separation	Aqueous effluent	1265
water	1000			
methanol	110	Reaction	Aqueous effluent	57
		Crystallization, Filteration & Distillation	Dichloroethane	2950
			organic residue	50
		Drying & Packaging	Drying loss	140
			kersoxim-methyl	**1000**
Total	**5807**			**5807**

3. TRIFLOXYSTROBIN

Manufacturing Process:

Charge water, potassium hydroxide and dichloroethane. Add (E)-1-(3-(trifluoro methyl) phenyl) ethanone oxime (3-TFMPEO) and stir for 2 hours at 30°C. Add tetra-n-butyl ammonium bromide (TBAB). Add (E)-methyl 2-(2-(bromo methyl) phenyl)-2-(methoxy imino) acetate (MBMPMIA) lot-wise for 2 hours. Rise to 65°C and maintain for 3 hours. Settle and separate the aqueous phase. Cool the organic phase to 0°C and filter the slurry. Dry the wet cake to obtain Trifloxystrobin technical.

Chemical Reaction:



(*E*)-methyl 2-(2-(bromomethyl)phenyl)-2-(methoxyimino)acetate

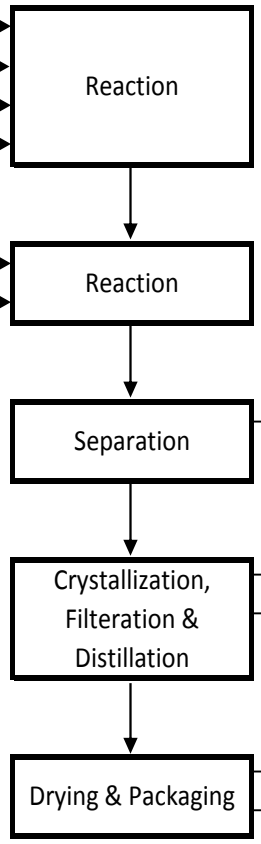
(*E*)-1-(3-(trifluoromethyl) phenyl)ethanone oxime

TRIFLOXYSTROBIN

Mass Balance:

Mass Balance of Trifloxystrobin

Input	kg	Output	kg
Water	1000		
Potassium hydroxide 85%	175		
Dichloroethane	2000		
3-TFMPEO	520		
TBAB	5		
MBMPMIA	730		
		Aqueous effluent	1290
		Dichloroethane	1940
		organic residue	60
		Drying loss	140
		Trifloxystrobin	**1000**
Total	**4430**		**4430**

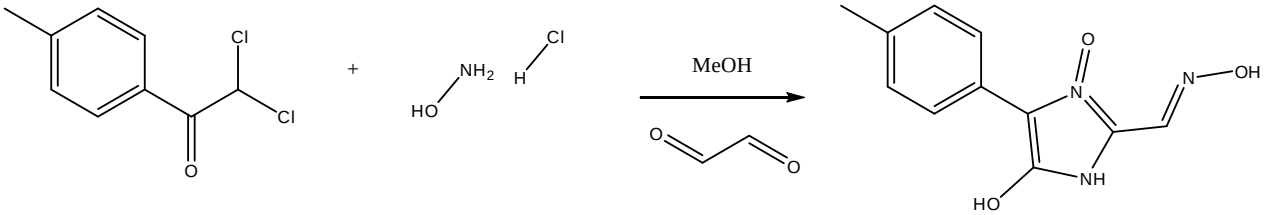


4. CYAZOFAMID

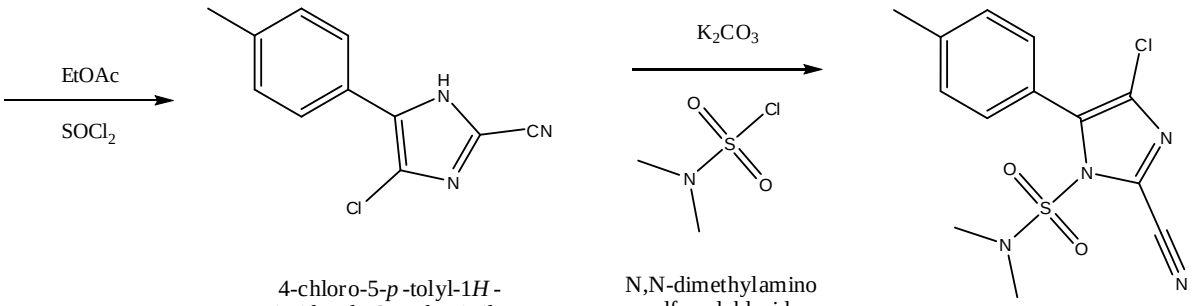
Manufacturing Process:

Charge methanol, 2,2-dichloro-1-p-tolylethanone (2,2-DCPTE), glyoxal and hydroxylamine hydrochloride (HAHC). Rise to reflux and reflux for 2 hours. Distil out methanol under reduced pressure and cool the mass to 30°C. Charge ethyl acetate. Add thionyl chloride and reflux for 3 hours. Cool to 30°C to obtain 4-chloro-5-p-tolyl-1H-imidazole-2-carbonitrile.
Charge potassium carbonate and add N,N-dimethyl amino sulfonylchloride (NNDMASC). Rise to 70°C and maintain for 3 hours. Cool to 30°C and add water. Separate the organic phase and cool to 0°C. Filter the slurry and dry to obtain Cyazofamid Technical.

Chemical Reaction:



2,2-dichloro-1-*p*-tolylethanone | hydroxylamine hydrochloride | glyoxal | 5-hydroxy-2-((hydroxyimino)methyl)-4-*p*-tolyl-1*H*-imidazole 3-oxide



4-chloro-5-*p*-tolyl-1*H*-imidazole-2-carbonitrile | N,N-dimethylamino sulfonylchloride | **CYAZOFAMID**

Mass Balance:

Mass Balance of Cyazofamid

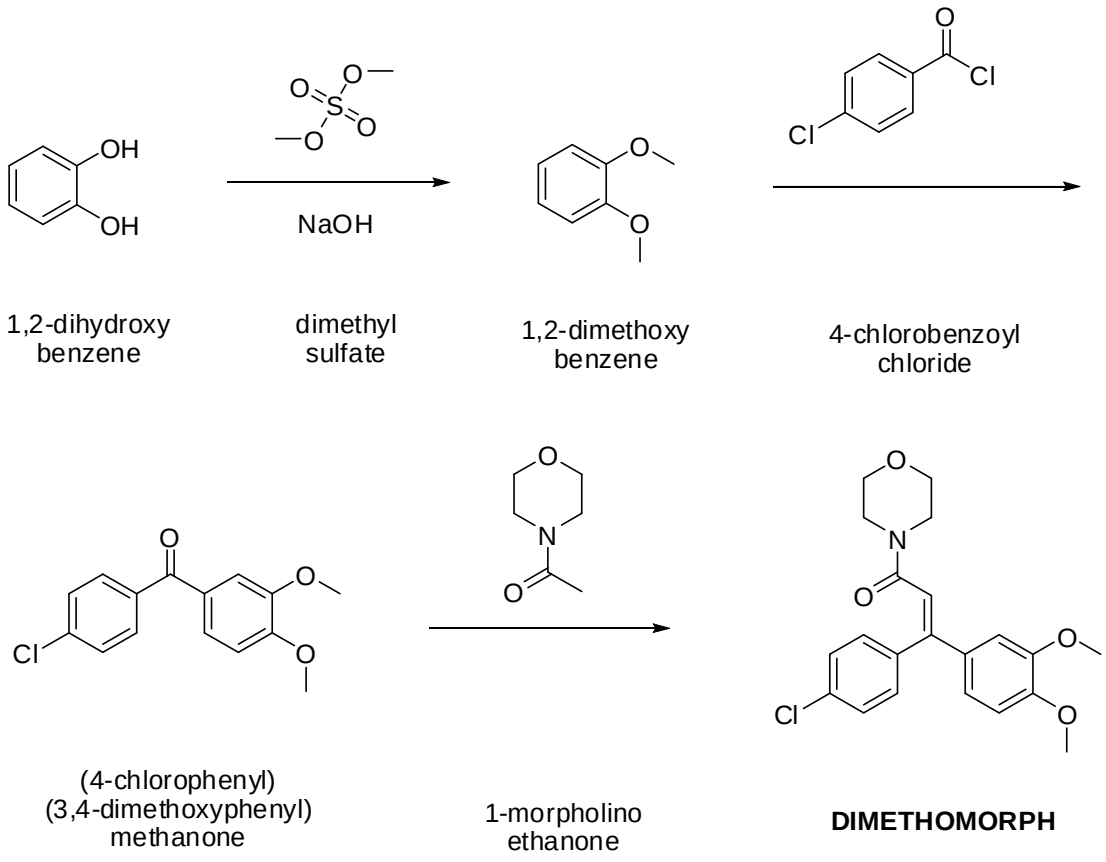
Input	kg		Output	kg
Methanol	4000	Reaction & Filteration	Methanol	3900
2,2-DCPTE	660		Residue	100
Glyoxal 45& soln	420			
Hydroxylamine HCl	700			
ethyl acetate	2500	Reaction	HCl	119
Thionyl chloride	390		SO2	210
Potassium carbonate	225	Reaction & Separation	Aqueous effluent	2900
NNDMASC	470			
water	1500			
		Crystallization, Filteration & Distillation	ethyl acetate	2450
			organic residue	50
		Drying & Packaging	Drying loss	136
			Cyazofamid	**1000**
Total	**10865**			**10865**

5. Dimethomorph

Manufacturing Process:

Charge water caustic soda lye solution and 1,2-dihydroxybenzene. Stir for 30°C for 2 hours. Add dimethyl sulphate for 2 hours at 30°C. Rise to 85°C and maintain for 3 hours. Cool to 50°C and add dichloroethane. Stir, settle and separate the aqueous phase. Charge catalyst aluminium chloride and add 4-chlorobenzoyl chloride for 3 hours. Rise to 75°C and maintain for 4 hours. Cool to 50°C and add water. Stir, settle and separate the aqueous phase. Charge 1-morpholino ethanone and rise to reflux. Reflux for 6 hours and remove water azeotropically. Cool to 0°C and filter the slurry. Dry the wet cake to obtain Dimethomorph technical.

Chemical Reaction:



Mass Balance:

Mass Balance of Dimethomorph

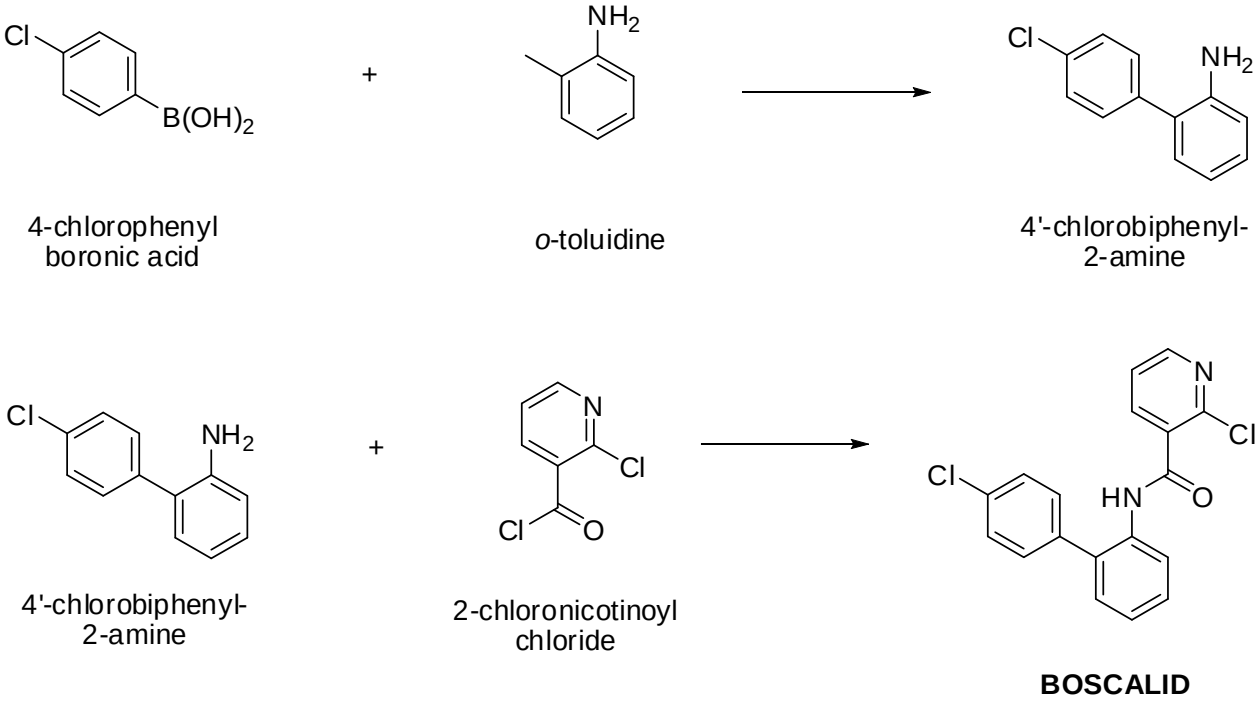
Input	kg		Output	kg
water	500	Reaction		
caustic soda lye 48%	500			
1,2 dihydroxybenzene	300			
Dimethyl sulfate	350			
Dichloroethane	3000	Separation	Aqueous effluent	1200
Aluminium chloride	37	Reaction & Separation	Aqueous effluent	650
4-Chlorobenzoyl chloride	475			
water	500			
1- morpholino ethanone	350	Reaction	Aqueous effluent	47
		Crystallization, Filteration & Distillation	Dichloroethane	2950
			organic residue	50
		Drying & Packaging	Drying loss	115
			Dimethomorph	**1000**
Total	**6012**			**6012**

6. Boscalid

Manufacturing Process:

Charge dichloro ethane, 4-chlorophenyl boronic acid (4-CPBA). Cool to 0°C and add o-toluidine slowly for 3 hours. Add sodium carbonate lot-wise at 0°C for 2 hours. Rise to 30°C and maintain for 4 hours. Add water and separate the aqueous phase. Add 2-chloronicotinoyl chloride for 2 hours and maintain for 2 hours. Rise to reflux and reflux for 4 hours. Cool to 5°C and maintain for 1 hour. Filter the slurry and dry the wet cake to obtain Boscalid technical.

Chemical Reaction:



Mass Balance:

Mass Balance of Boscalid

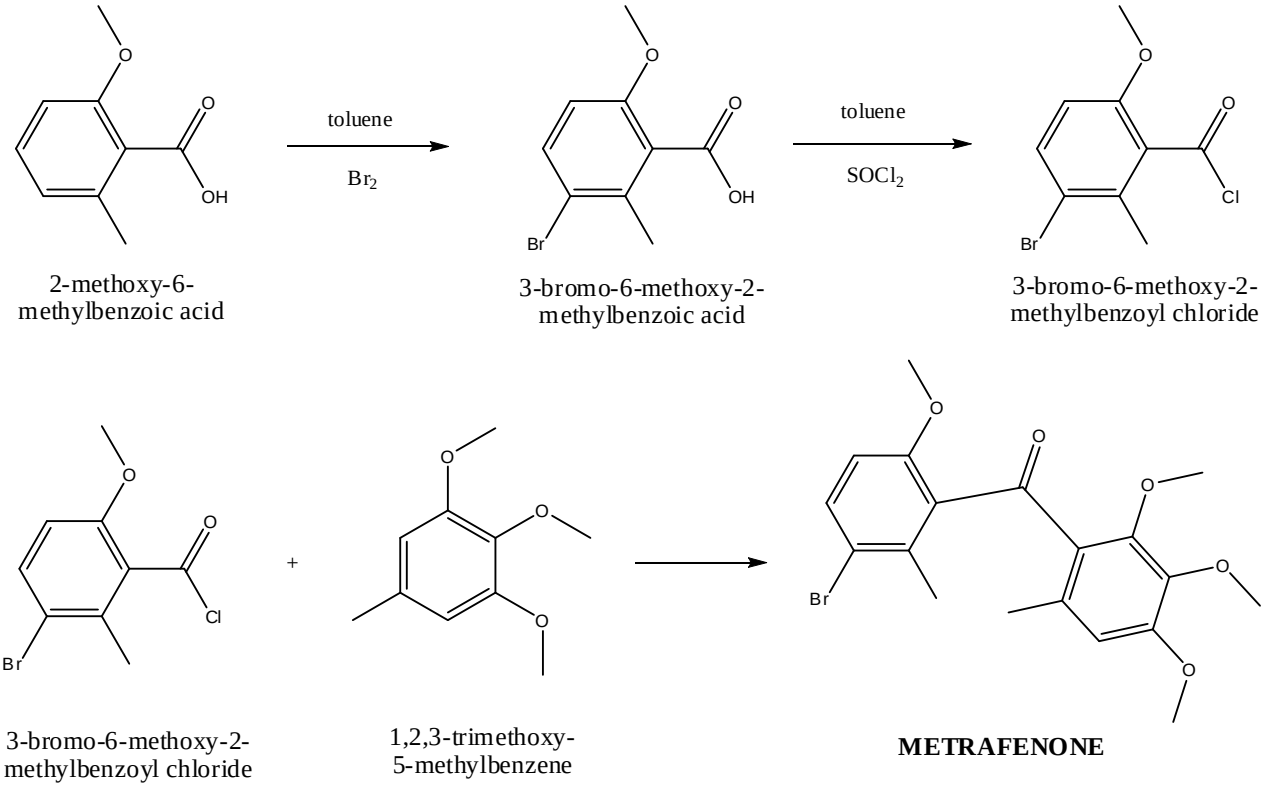
Input	kg		Output	kg
Dichloroethane	2500	Reaction		
4-CPBA	490			
o-toluidine	340			
Sodium carbonate	175			
water	1000	Separation	Aqueous effluent	1310
2-chloronicotinoyl chloride	545	Reaction	ML	110
		Crystallization, Filteration & Distillation	Dichloroethane	2450
			organic residue	50
		Drying & Packaging	Drying loss	130
			Boscalid	**1000**
Total	**5050**			**5050**

7. Metrafenone

Manufacturing Process:

Charge dichloroethane and 2-methoxy-6-methyl benzoic acid (2-MMBA). Cool to 10°C and add bromine slowly for 3 hours. Rise to 40°C and maintain for 4 hours. Add water and separate the aqueous phase. Add thionyl chloride for 3 hours at 30°C. Rise to reflux and reflux for 4 hours. Cool to 30°C and charge 1, 2, 3-trimethoxy-5-methyl benzene (1,2,3-TM-5-MB). Rise to reflux and reflux for 6 hours. Cool to 5°C and filter the slurry. Dry to obtain Metrafenone technical.

Chemical Reaction:



2-methoxy-6-methylbenzoic acid

3-bromo-6-methoxy-2-methylbenzoic acid

3-bromo-6-methoxy-2-methylbenzoyl chloride

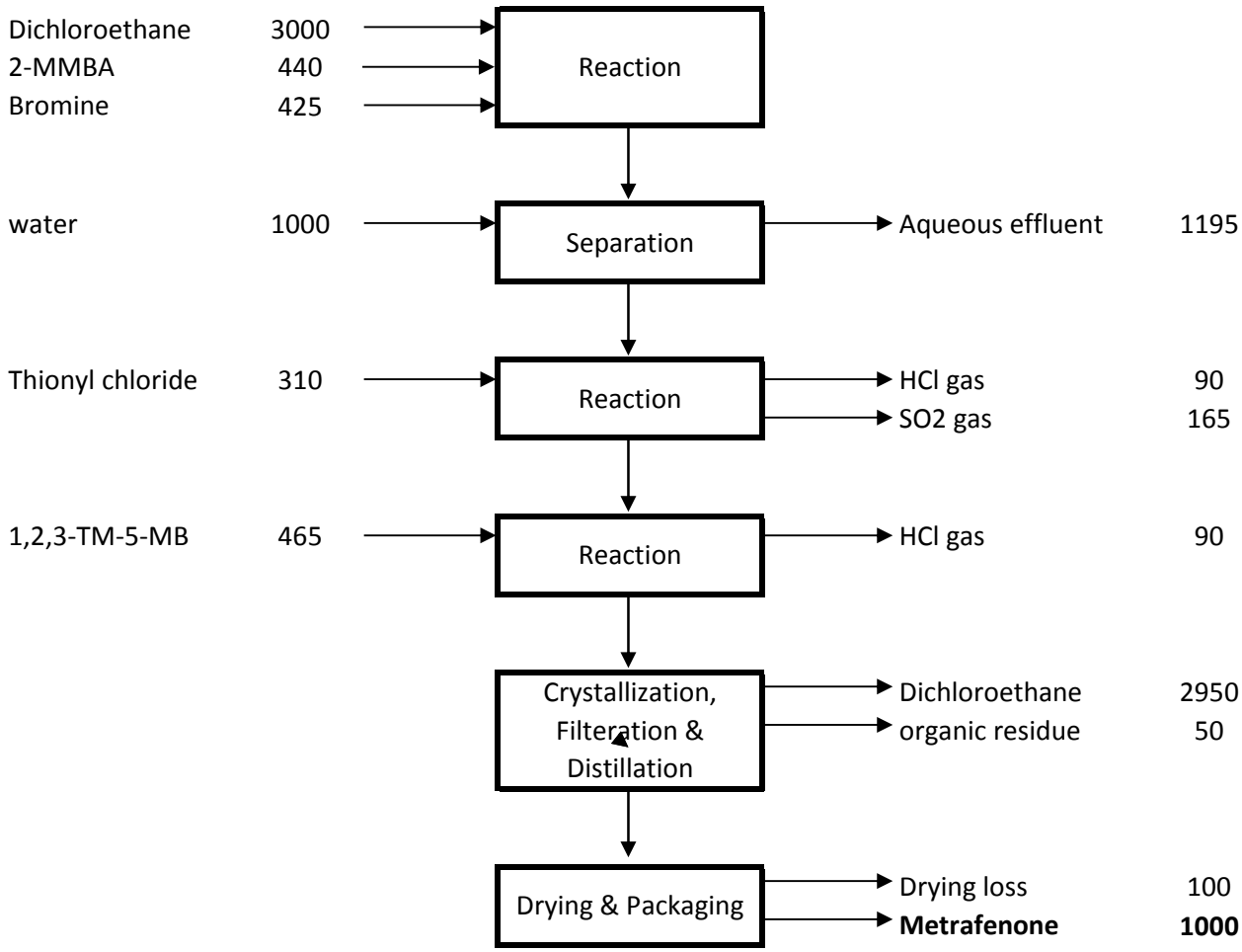
3-bromo-6-methoxy-2-methylbenzoyl chloride

1,2,3-trimethoxy-5-methylbenzene

METRAFENONE

Mass Balance:

Mass Balance of Metrafenone

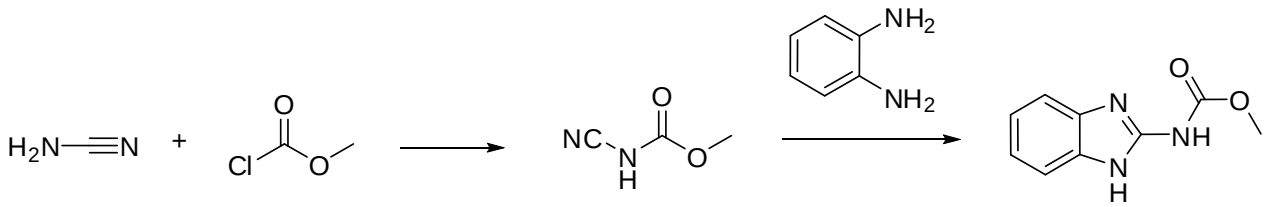


8. Carbendazim

Manufacturing Process:

Charge water, caustic lye solution and 50% cyanamide. Rise to 50°C and add methyl chloro formate for 3 hours. Maintain for 3 hours at 50°C. Cool to 30°C and add 1,2-diaminobenzene and hydrochloric acid. Rise to 90°C and maintain for 6 hours. Cool to 20°C and filter the slurry. Dry to obtain Carbendazim technical.

Chemical Reaction:

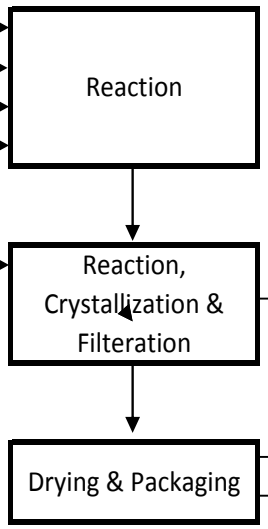


cyanamide | methylchloro formate | Carbamic acid, N-cyano-, methyl ester | 1,2-diamino benzene | **CARBENDAZIM**

Mass Balance:

Mass Balance of Carbendazim

Input	kg	Output	kg
Water	500		
caustic lye 48% soln	460		
Cyaniamide	460		
methylchloroformate	520		
1,2-diaminobenzene	585		
HCl 30%	670	Aqueous effluent	2070
		Drying loss	125
		Carbendazim	**1000**
Total	**3195**		**3195**

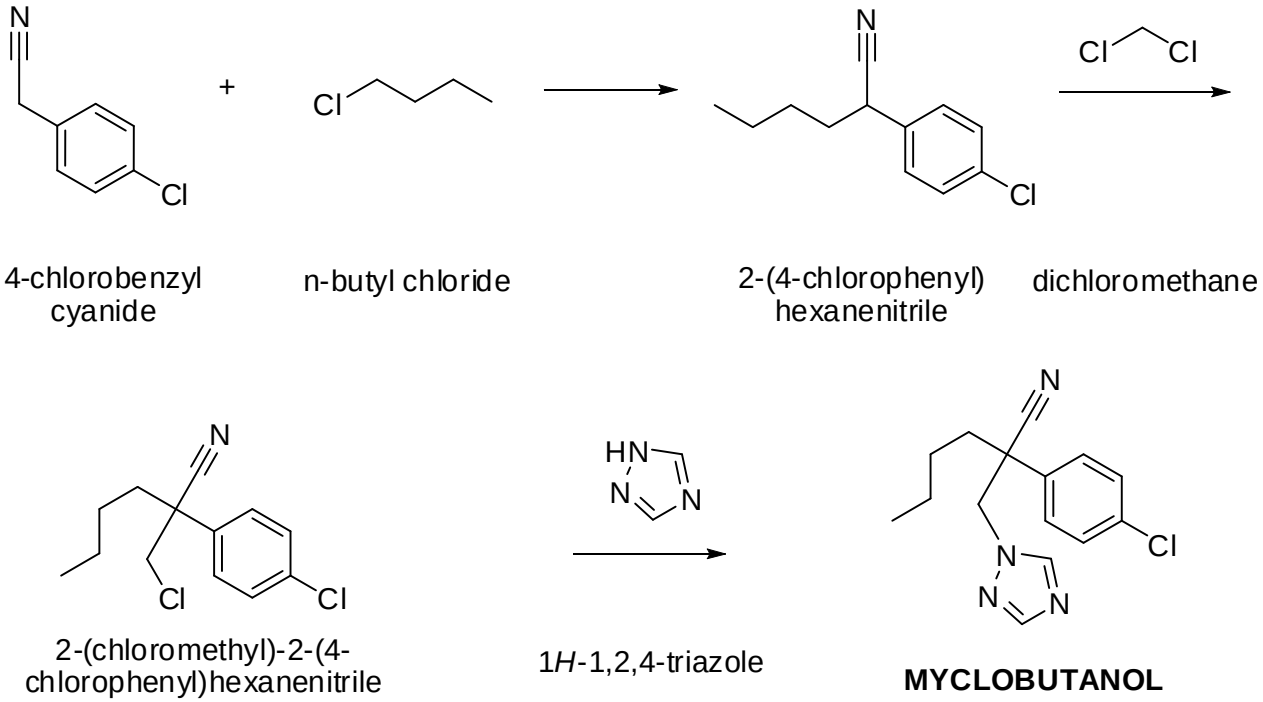


9. Myclobutanil

Manufacturing Process:

Charge dichloroethane, 4-chloro benzyl cyanide, caustic lye solution and n-butyl chloride. Rise to 80°C and maintain for 4 hours. Cool to 40°C and separate the aqueous phase. Charge water, caustic lye solution and dichloromethane. Rise to reflux and reflux for 6 hours. Cool to 50°C and separate the aqueous phase. Charge water, caustic lye solution and 1, 2, 4-triazole. Rise to reflux and reflux for 6 hours. Cool to 50°C and separate the aqueous phase. Cool the organic phase to 0°C and filter the slurry. Dry to obtain Myclobutanil technical.

Chemical Reaction:



Mass Balance:

Mass Balance of myclobutanil

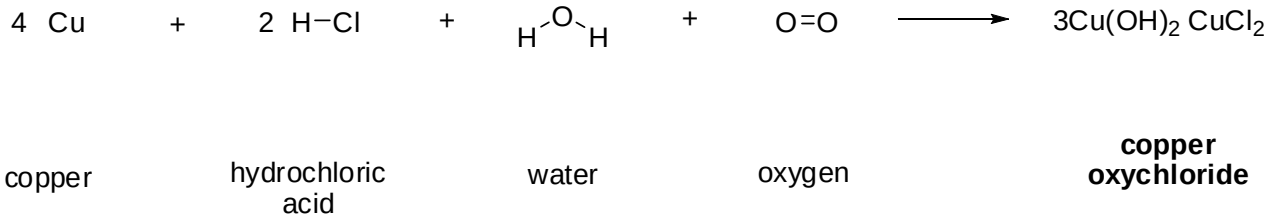
Input	kg		Output	kg
Dichloroethane	2500	Reaction & Separation	Aqueous effluent	450
4-chlorobenzyl cyanide	560			
caustic soda lye 48% soln	310			
n-butyl chloride	345			
water	500	Reaction & Separation	Aqueous effluent	875
caustic soda lye 48% soln	305			
Dichloromethane	310			
water	500	Reaction	Aqueous effluent	905
caustic soda lye 48% soln	300			
1,2,4 triazole	250			
		Crystallization, Filteration & Distillation	Dichloroethane	2450
			organic residue	50
		Drying & Packaging	Drying loss	150
			myclobutanil	**1000**
Total	**5880**			**5880**

10. Copper Oxychloride

Manufacturing Process:

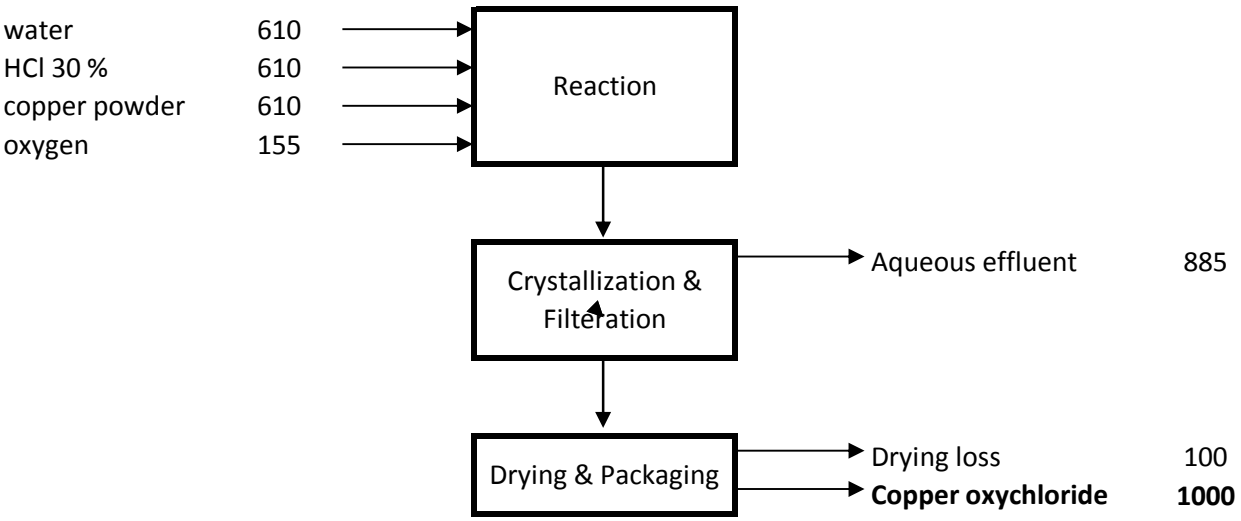
Charge water, hydrochloric acid and copper powder. Rise to reflux and pass oxygen or air for 12 hours. Cool to 0°C and filter the slurry. Dry to obtain copper oxychloride.

Chemical Reaction:



Mass Balance:

Mass Balance of Copper oxychloride



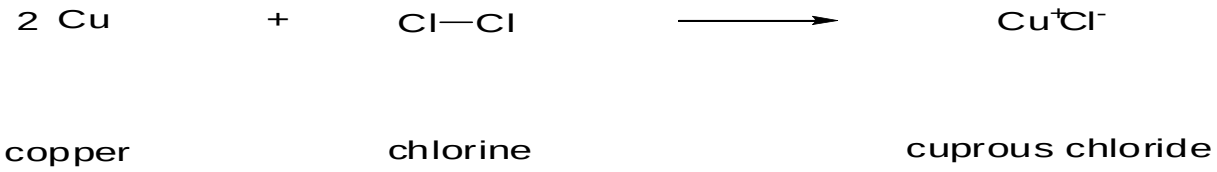
Total	**1985**		**1985**

11. Cuprous Chloride

Manufacturing Process:

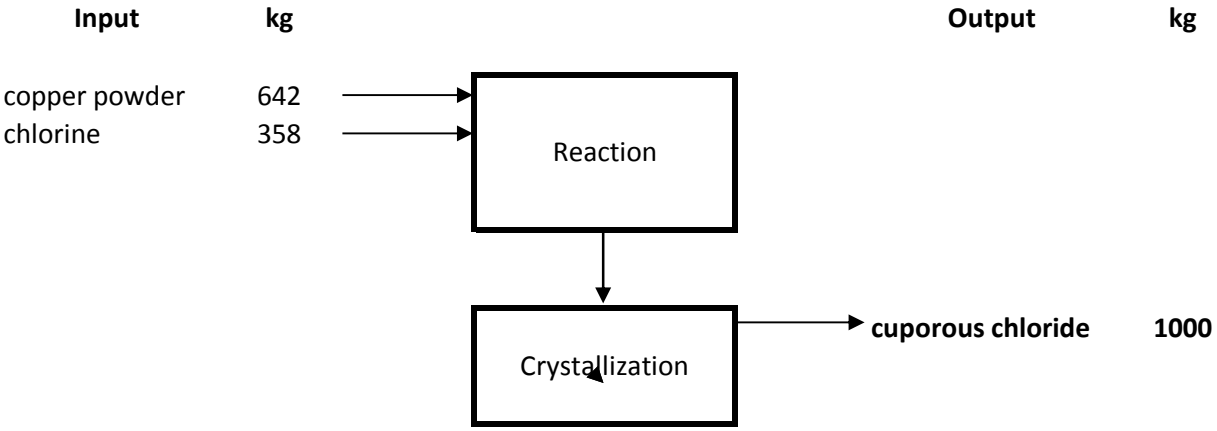
Charge copper powder and melt. Pass chlorine gas till saturation. Cool the molten mass to 30°C to obtain cuprous chloride technical.

Chemical Reaction:



Mass Balance:

Mass Balance of cuporous chloride

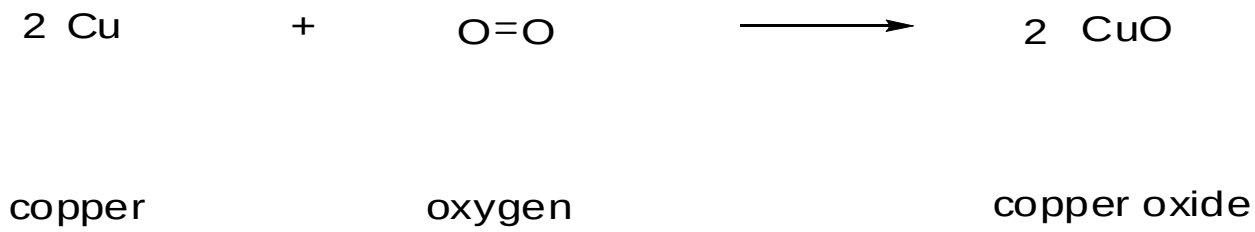


12. Cuprous Oxide

Manufacturing Process:

Charge copper powder and melt. Pass oxygen gas till saturation. Cool the molten mass to 30°C to obtain cuprous oxide technical.

Chemical Reaction:



Mass Balance:

Mass Balance of cuporous oxide

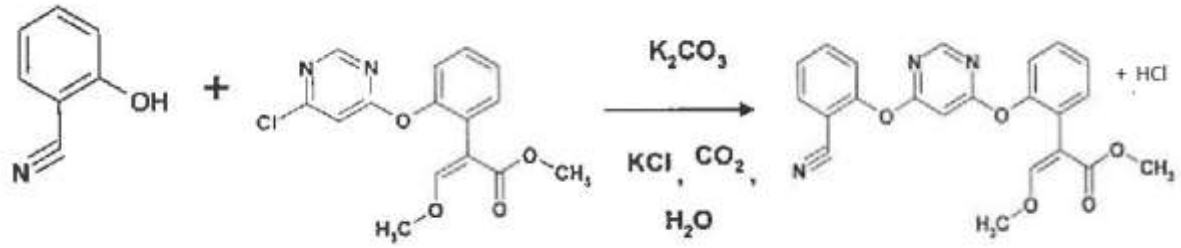
Input	kg	Output	kg
copper powder	799		
oxygen	201		
		cuporous oxide	1000
Total	**1000**		**1000**

13. Azoxystrobin

Manufacturing Process:

The Methyl-3-methoxy {2-(2[6-chloropyrimidin-4-yl)oxy]phenyl} acrylate (MMCP) in dimethyl formamide (DMF) is reacted with potassium carbonate and 2-cyano phenol. The mass is maintained at high temperature for completion of the reaction. The sample is checked for unreacted MMCP by HPLC. The mass is filtered and the filtrate is distilled under vacuum to recover DMF. dichloroethane is added tO the residue and the mass is washed two times with water. Distill out dichloroethane completely under vacuum and then methanol is added. It is then heated to reflux and filtered. The filtrate is cooled slowly over a period of time to crystallize the product. The product is filtered and the wet cake is dried at 75.C to get the finished product. It is then analyzed for the Azoxystrobin content.

Chemical Reaction:



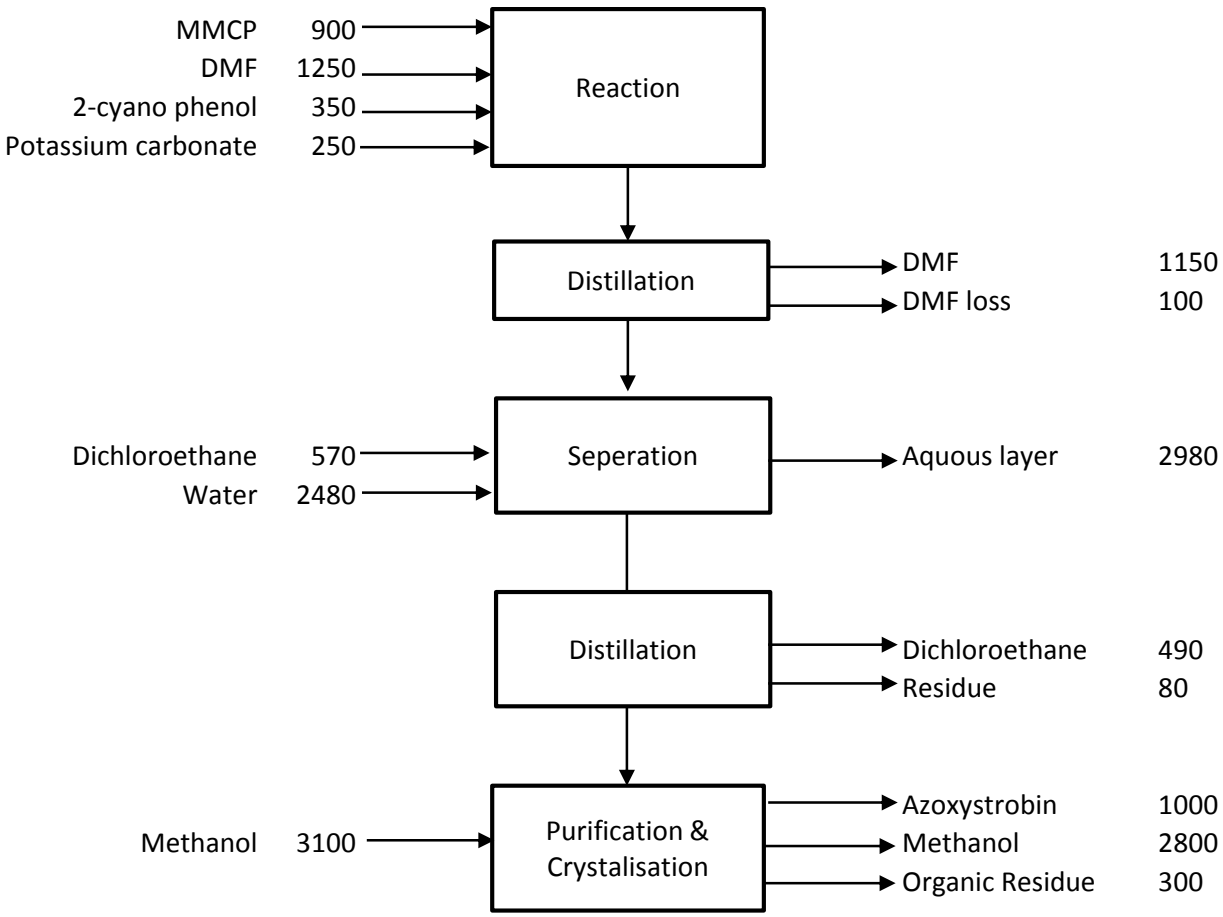
2-cyano phenol

Methyl-3-methoxy,{2-(2[6-chloropyrimidin-4-yl)oxy]phenyl}acrylate (MMCP)

Azoxystrobin Technical

Mass Balance:

MASS BALANCE OF AZOXYSTROBIN



TOTAL	**8900**		**8900**

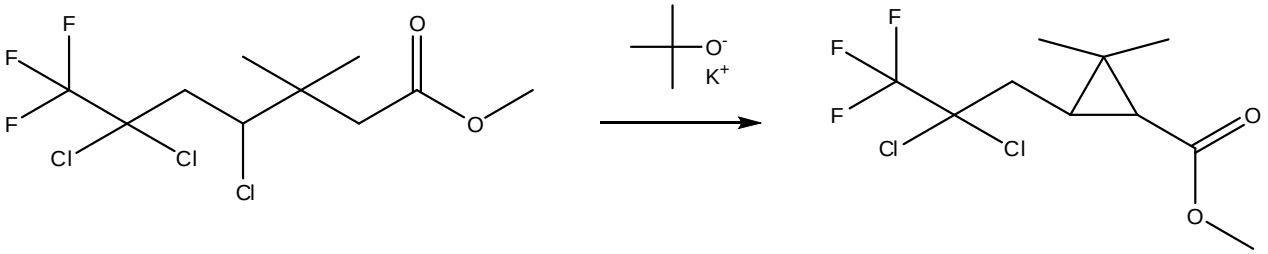
D. INTERMEDIATE CHEMICALS

1. Lambda Acid

Manufacturing Process:

Charge t-butanol, potassium t-butoxide and cool to -15°C. Add methyl 4,6,6-trichloro-7,7,7-trifluoro-3,3-dimethylheptanoate (MTCTFDMH) and maintain for 8 hours. Charge potassium hydroxide and reflux for 6 hours. Cool to 20°C and add water. Add 50% sulfuric acid to pH 2 and separate the aqueous phase. Cool the organic phase to 0°C and filter the slurry. Dry the wet cake to obtain Lambda acid.

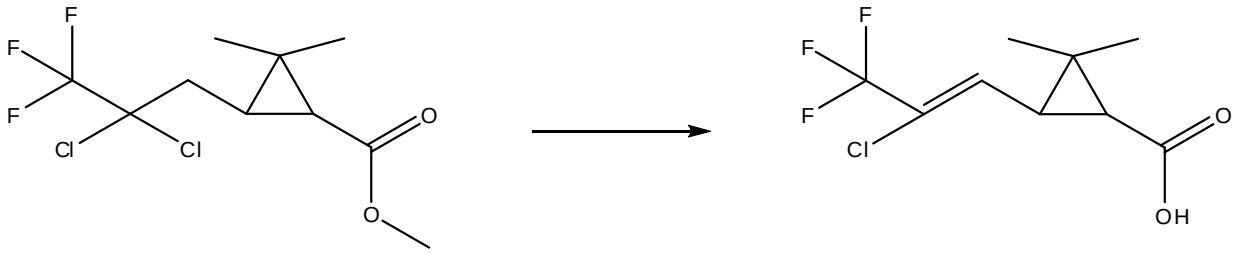
Chemical Reaction:



methyl 4,6,6-trichloro-7,7,7-trifluoro-3,3-dimethylheptanoate

potassium t-butoxide

methyl 3-(2,2-dichloro-3,3,3-trifluoropropyl)-2,2-dimethylcyclopropanecarboxylate



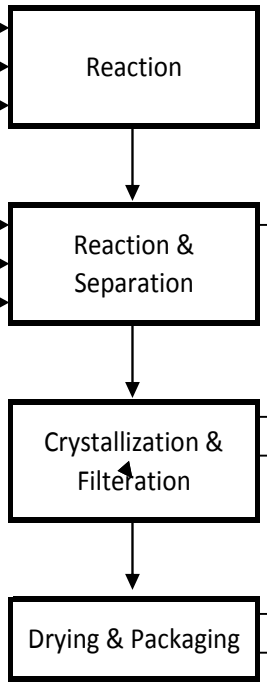
methyl 3-(2,2-dichloro-3,3,3-trifluoropropyl)-2,2-dimethylcyclopropanecarboxylate

LAMBDA ACID

Mass Balance:

Mass Balance of lambda acid

Input	kg	Output	kg
t-butanol	3000		
potassium t-butoxide	100		
MTCTFDMH	1400		
water	4000	Aqueous effluent	4625
sulfuric acid 50%	100		
potassium hydroxide	140		
		t-butanol	2800
		organic residue	200
		Drying loss	115
		lambda acid	**1000**
Total	**8740**		**8740**



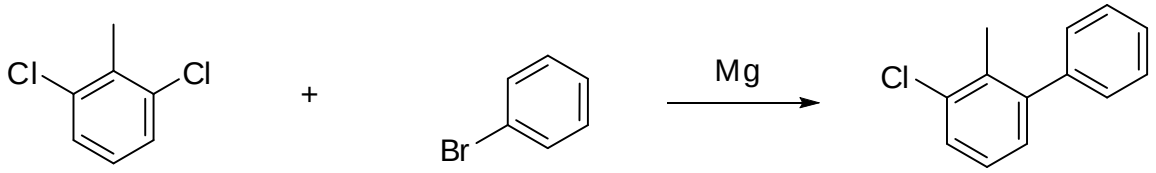
2. Bifenthrin Alcohol

Manufacturing Process:

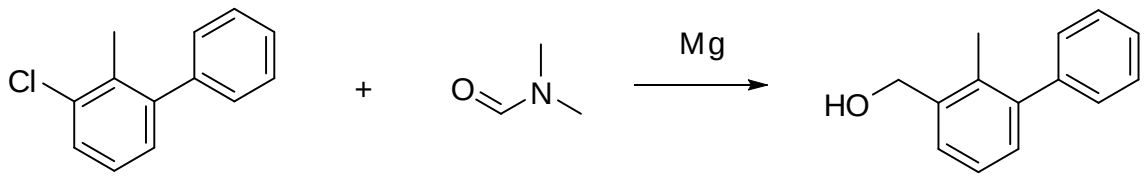
Charge tetrahydrofuran, magnesium powder and 2,6-dichlorotoluene. Rise to 50°C and add bromobenzene for 4 hours. Rise to reflux and reflux for 6 hours. Cool to 40°C and add water and hydrochloric acid to pH 2. Distil out under reduced pressure to recover tetrahydrofuron. Cool and separate the aqueous phase.

Charge tetrahydrofuran and magnesium powder to the organic phase. Rise to 50°C and add N, N-dimethylformamide for 4 hours. Rise to reflux and reflux for 6 hours. Distil to recover tetrahydrofuran under reduced pressure and add diluted sulfuric acid and dichloroethane. Separate the aqueous phase and cool the organic phase to 0°C. Filter the slurry and dry to obtain Bifenthrin alcohol.

Chemical Reaction:



2,6-dichloro toluene bromobenzene 3-chloro-2-methylbiphenyl



3-chloro-2-methylbiphenyl N,N-dimethyl formamide **BIFENTHRIN ALCOHOL**

Mass Balance:

Mass Balance of Bifenthrin alcohol

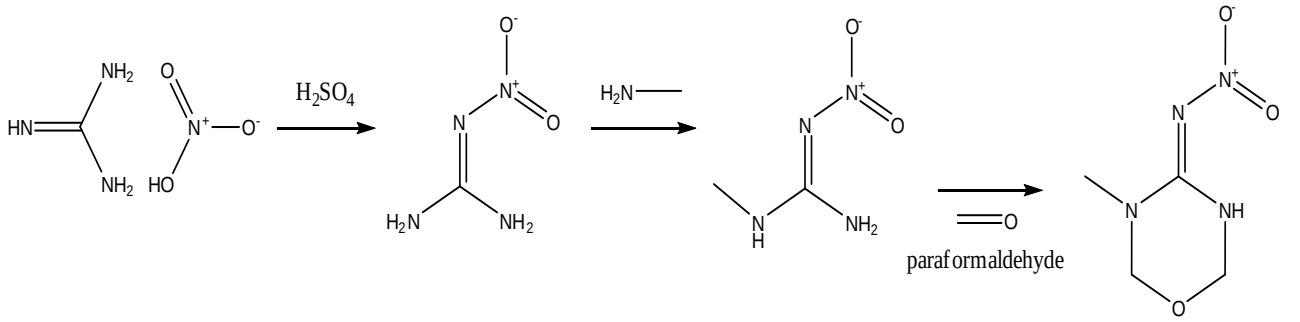
Input	kg		Output	kg
tetrahydrofuran	3000	Reaction		
magnesium powder	135			
2,6-dichlorotoluene	900			
bromobenzene	875			
water	1000	Distillation & Separation	tetrahydrofuran	2950
HCl 30%	350		Residue	50
			Aqueous effluent	2100
tetrahydrofuran	3000	Reaction		
magnesium powder	130			
N,N-dimethylformamid	400			
water	1000	Distillation & Separation	tetrahydrofuran	2950
HCl 30%	350		Residue	50
Dichloroethane	3000		Aqueous effluent	1910
		Crystallization, Filteration & Distillation	Dichloroethane	2950
			organic residue	50
		Drying & Packaging	Drying loss	130
			Bifenthrin alcohol	**1000**
Total	**14140**			**14140**

3. MNIO (3-methyl-4-nitroimino perhydro 1,3,5-oxadiazine)

Manufacturing Process:

Charge sulfuric acid and guanidine nitrate. Maintain at 30°C for 6 hours. Charge the mass into water at 10°C. Filter the slurry to obtain wet cake of 2-nitroguanidine (NG). Charge water and hydrochloric acid. Add 40% methylamine and wet nitroguanidine. Maintain at 50°C for 6 hours. Cool to 0°C and filter the slurry to obtain 1-methyl-2-nitroguanidine (MNG). Charge water, formic acid and MNG. Rise to 50°C and add paraformaldehyde. Maintain for 6 hours and distil to recover formic acid. Cool to 30°C and add 30% sodium hydroxide to neutral. Cool to 0°C and filter the slurry. Dry to obtain MNIO.

Chemical Reaction:



GN
guanidine nitrate

NG
2-nitroguanidine

MA
methylamine

MNG
1-methyl-2-nitroguanidine

MNIO
3-methyl-4-nitroimino
perhydro-1,3,5-oxadiazine

Mass Balance:

Mass Balance of MNIO (3-methyl-4-nitroimino perhydro 1,3,5-oxadiazine)

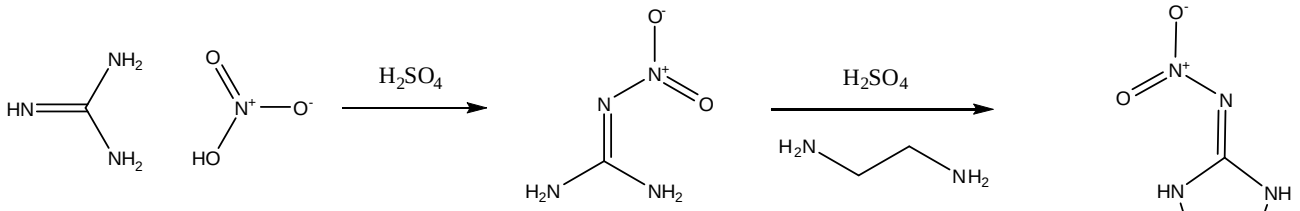
Input	kg		Output	kg
sulfuric acid	700	Reaction & Filteration	Aqueous effluent	2370
guanidine nitrate	830			
water	1600			
water	500	Reaction & Filteration	Aqueous effluent	900
HCl	100			
Methylamine 40%	525			
Formic acid	1000	Reaction & Distillation	Formic acid	950
paraformaldehyde	400		Residue	50
NaOH 30%	500	Neutralization, Crystallization & Filteration	Aqueous effluent	755
		Drying & Packaging	Drying loss	130
			MNIO	**1000**
Total	**6155**			**6155**

4. 2-(Nitroimino) Imidazolidine (NII)

Manufacturing Process:

Charge sulfuric acid and guanidine nitrate. Maintain at 30°C for 6 hours. Charge the mass into water at 10°C. Filter the slurry to obtain wet cake of 2-nitroguanidine (NG).
Charge water and ethylene diamine. Rise to 80°C and add sulfuric acid. Add wet NG and maintain at 80°C for 6 hours. Add 30% sodium hydroxide solution to neutral and cool to 30°C. Filter the slurry and dry to obtain 2-(nitroimino) imidazolidine (NII).

Chemical Reaction:



GN
guanidine nitrate

NG
2-nitroguanidine

EDA
ethylenediamine

NII
2-(nitroimino)imidazolidine

Mass Balance:

Mass Balance of 2-(Nitroimino) Imidazolidine (NII)

Input	kg		Output	kg
Sulfuric acid	800	Reaction & Filteration	Aqueous effluent	1950
Guanidine nitrate	975			
Water	1000			
Water	1000	Reaction & Filteration	Aqueous effluent	1890
Sulfuric acid	250			
ethylene diamine	475			
NaOH 40%	500	Drying & Packaging	Drying loss	160
			NII	**1000**
Total	**5000**			**5000**

5. 2-Chloro-5-(Chloromethyl) Thiazole (CCMT)

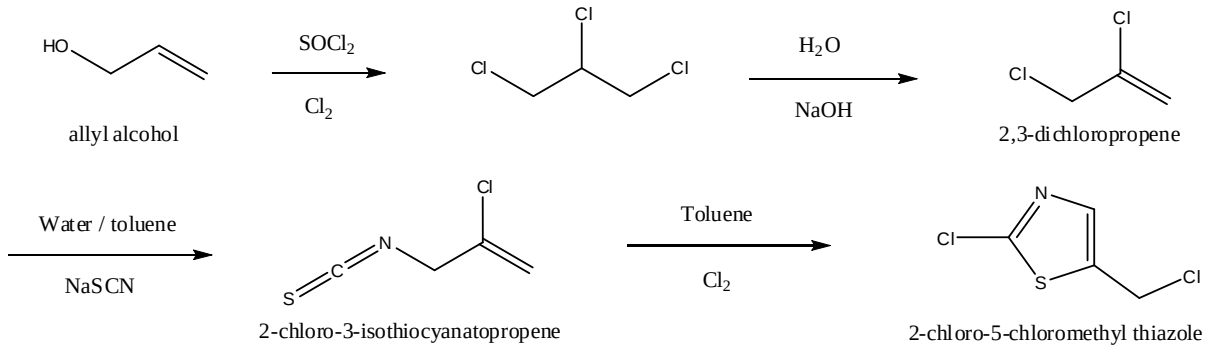
Manufacturing Process:

Charge dichloro ethane and allyl alcohol. Rise to 50°C and add thionyl chloride. Rise to reflux and reflux for 4 hours. Cool to 40°C and purge chlorine for 4 hours. Rise to reflux and reflux for 4 hours. Cool to 30°C to obtain 1,2,3-trichloropropane in dichloro ethane.

Charge water and add 48% sodium hydroxide solution. Reflux for 3 hours and cool to 30°C. Separate the organic phase of 2,3-dichloro propene in dichloroethane. Charge sodium thiocyanate to the organic phase. Reflux for 4 hours and cool to 30°C. Add water and separate the aqueous phase and organic phase of 2-choro-3-isothiocyanate propene in dichloroethane.

Add chlorine to the organic phase and maintain at 50°C for 6 hours. Distil out the mass under reduced pressure to recover dichloroethane and to obtain CCMT.

Chemical Reaction:



Mass Balance:

Mass Balance of 2-Chloro-5-(Chloromethyl) Thiazole (CCMT)

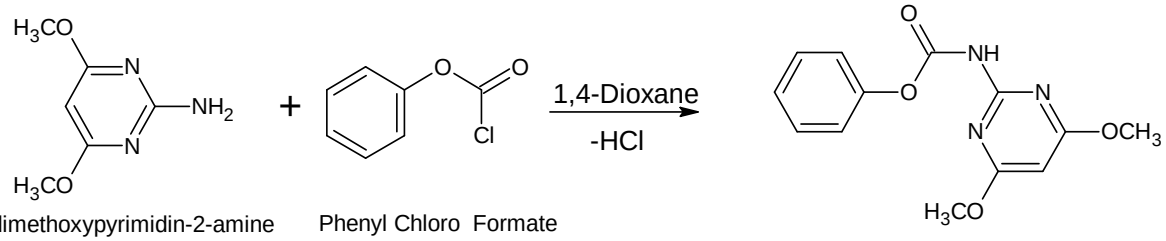
Input	kg		Output	kg
Dichloroethane	3000	Reaction	HCl & SO2 gas	613
Allyl chloride	375			
Thionyl chloride	775			
chlorine	460			
water	550	Reaction & Separation	Aqueous effluent	1280
NaOH 40%	550			
Sodium thiocyanate	515	Reaction & Separation	Aqueous effluent	2050
water	1500			
Chlorine	450	Distillation & Separation	HCl gas	232
			Dichloroethane	2950
			Residue	50
			CCMT	**1000**
Total	**8175**			**8175**

6. Phenyl 4,4-dimethoxy pyrimidine-2yl-carboxilate

Manufacturing Process:

Charge 1,4-dioxane and 4,6-dimethoxy pyrimidine-2-amine (ADMP) in a reactor. Maintain at room temperature. Start adding phenyl chloroformate and cool the mass. Maintain for 12 hours and check the reaction for completion. Drown the reaction mass in water and stir for 4 to 5 hours. Filter and wash the wet cake trice with water and two times with cooled isopropyl alcohol. Dry the solid by vacuum drier to give ADCP (final product) as free flowing powder.

Chemical Reaction:



4,6-dimethoxypyrimidin-2-amine
CAS No. 63315-01-2
F. Wt.= 155.15
ADMP

Phenyl Chloro Formate
CAS No. 1885-14-9
F. Wt.= 156.56
PCF

CAS No. 89392-03-0
F. Wt.= 275.26
ADCP

Mass Balance:

Mass Balance of Phenyl 4,4-dimethoxy pyrimidine-2yl-carboxilate

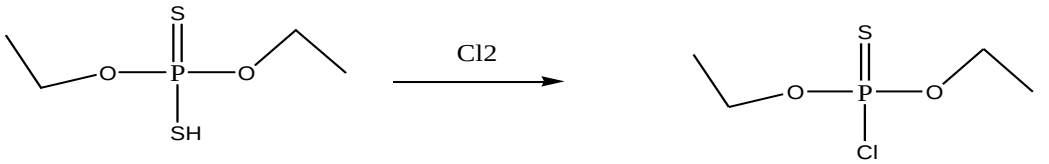
Input	kg		Output	kg
ADMP	564	→ Reaction		
1,4-dioxane	364	→ Reaction		
Phenyl Chloroform	567	→ Reaction		
Water	2000	→ Filteration	Aqueous effluent	2250
water	2000	→ Washing with water	Aqueous effluent	2245
IPA	1450	→ Washing with IPA	IPA	1380
			Residue	70
		→ Drying	Product	**1000**
Total	**6945**			**6945**

7. Diethyl Thiophosphoryl Chloride (DETCL)

Manufacturing Process:

Take 500 Kg of diethyl thiophosphoryl acid (DETA) in a reactor and keep the temperature 20 degree centigrade. Purge chlorine gas at the rate 50 kg per hour for 4.0 hour, temperature 20-25^{0}C. Maintain the mass at 25^{0}C for 4 hours. Raise the temperature of reaction to 50^{0}C and purge nitrogen gas to escape extra chlorine from the reaction mass. Add sodium sulfide solution to remove HCl formed during the reaction.

Chemical Reaction:

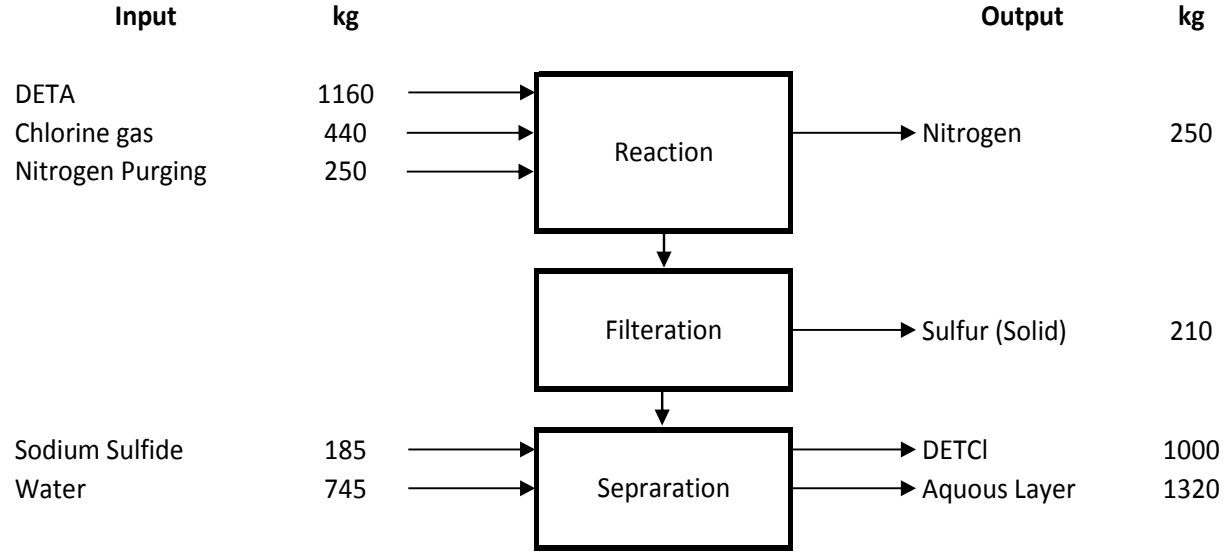


O,*O*-diethyl *S*-hydrogen phosphorodithioate
$C_4H_{11}O_2PS_2$
Mol. Wt.: 186.23

Phosphorochloridothioic acid, O , O -diethyl ester
$C_4H_{10}ClO_2PS$
Mol. Wt.: 188.61

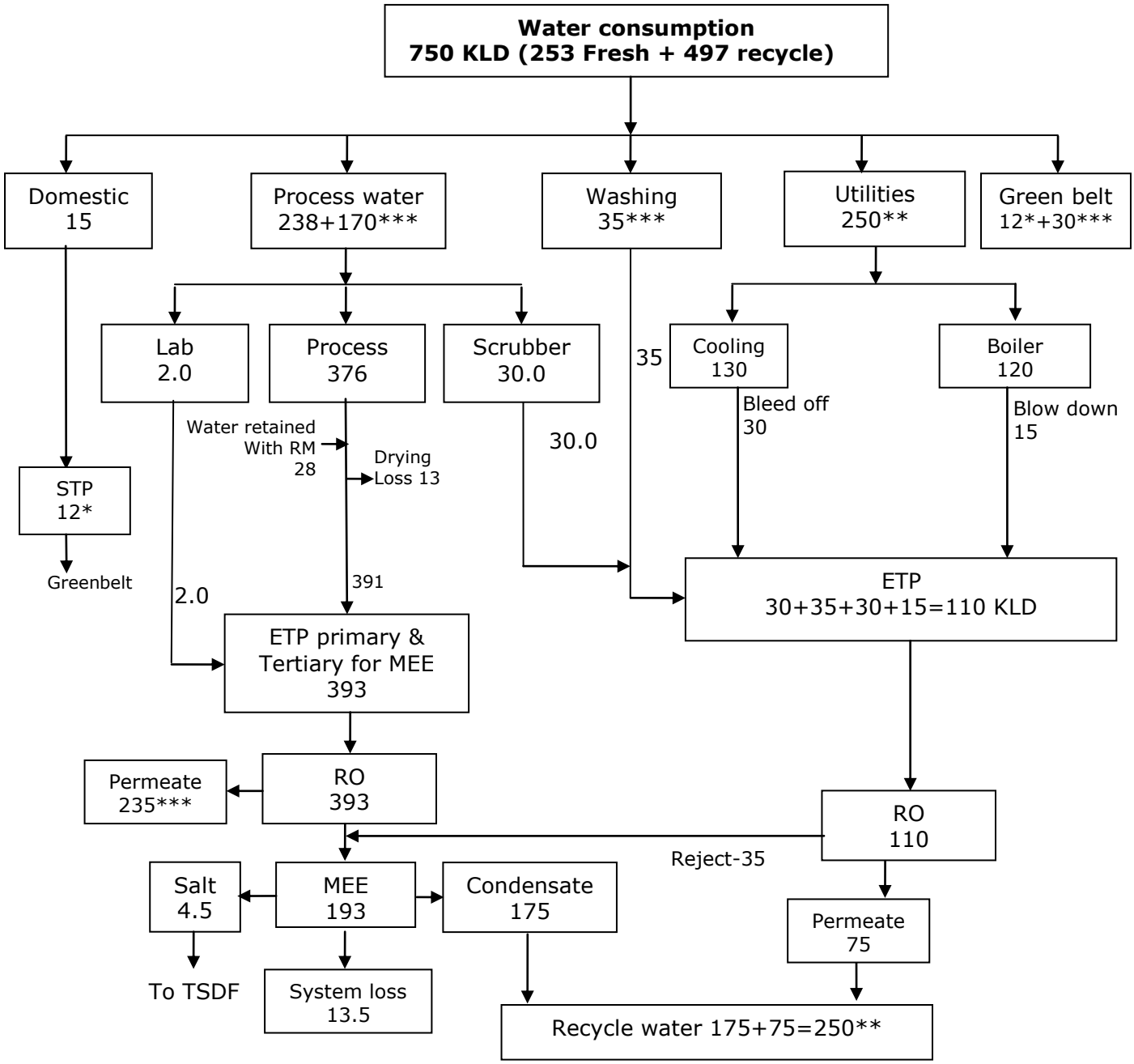
Mass Balance:

Mass Balance of DETCl



Annexure-III

WATER BALANCE DIAGRAM



Water Balance-Water Consumption

Sr. No.	Source	Water Consumption (KL/day)	W/w Generation (KL/day)
1.	**Domestic**	15	12
2.	**Green Belt**	42	0.0
3.	**Industrial**		
A	Process	376	391
B	Lab	2.0	2.0
C	Scrubber	30	30
D	Cooling	130	30
E	Boiler	120	15
F	Washing	35	35
Total Industrial		**693**	**503**
TOTAL (1 +2 + 3)		**750**	**515**
Recycle Water		**497**	**--**
Fresh water requirement		**253**	**--**

Annexure-IV
Source of Air Emissions

Sr. No.	Stack attached to	Fuel Type	Stack Height (m)	APC measures	Probable emission
➢ **Flue Gas Stacks**					
1.	Boiler (8 TPH)- 2 Nos.	Furnace Oil 30 Kl/Day	30	Cyclone & Bag Filter	PM<150 mg/NM^3 SO_2<100 ppm NO_x<50 ppm
2.	TFH (10 lac K Cal)	Furnace Oil 3.5 Kl/Day	21	Cyclone & Bag Filter	PM<150 mg/NM3 SO2<100 ppm NOx<50 ppm
3.	D.G. set (1000 KVA)	Diesel-175 lit/Hr	11	-	PM<150 mg/NM3 SO2<100 ppm NOx<50 ppm
Process Stacks					
1.	Reaction/ Process vessels (3 sets)	--	15	Water Scrubber + Caustic scrubber	HCl<20mg/m3
2.	Reaction/ Process vessels (5 sets)	--	15	Two stage water and one stage Alkali scrubber	HCl<20 mg/m3 SO2<40 mg/m3

Annexure V

Details of Hazardous/Solid waste

Sr. No.	Type of Waste	Sources	Category of Waste as per HWM Rules 2016	Quantity in MTPM	Disposal facility
1.	ETP Sludge	ETP	35.3	75	Collection, Storage, Transportation & Disposal at TSDF site approved by GPCB.
	MEE salt	MEE		115	
2.	Process Waste	Process	29.1	100	Collection, Storage, Transportation & Disposal at TSDF site approved by GPCB.
3.	Process Residue	Process	20.3	275	Collection, Storage, incineration at CHWIF or send to cement industry for co-processing in cement industries.
4.	Discarded containers/ liners	Process	33.1	Drum:2500 Nos./month Liner:1.5 MT/month	Being used for packing of ETP sludge; in case of excess, it will be sold to approved recycler or traders.
5.	Used Lubricating Oil	Driving unit & D.G. set	5.1	1.0 Kl/Year	Collection, Storage, Transportation & disposal by selling to Registered Recyclers