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ESTABLISHMENT OF A DEVELOPMENT PLAN FOR THE PHARMACEUTICAL INDUSTRY

UC/ALG/85/062

ALGERIA

Technical Report: Transfer of Technology for the Production of Pharmaceutical Chemicals in a Multi-Purpose Plant*

Prepared for the Government of the Democratic and People's Republic of Algeria by the United Nations Industrial Development Organization

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SUMMARY

1. The pharmaceutical industry in Algeria is confined to the production of pharmaceuticals in dosage form. The local production meets around 8 percent of the country's requirement in value and the balance is met through imports.

2. At present all the bulk drugs and most of the excipients required by the local pharmaceutical industry are imported. A large modern complex for the production of antibiotics is at an advanced stage of establishment at Médéa. This will enable the country to achieve self-reliance with respect to antibiotics in bulk.

3. As regards synthetic drugs, with the exception of Aspirin, Vitamin C and Sorbitol, the individual requirements are rather small even when projected to the year 2000. In view of the limited domestic market, the establishment of a single line production in the case of each pharmaceutical chemical will not be economically viable. In such cases, the establishment of a multi-purpose plant is the logical choice and is, therefore, recommended. Such a plant is ideally suited to produce a number of pharmaceutical chemicals in small quantities, which suits the situation in Algeria. Such a plant has flexibility, can be used for training, adaptation of technology and research and development. The investment in this case is also comparatively low.

4. The proposed multi-purpose plant is designed to produce 17 pharmaceutical chemicals considered essential for the country. The plant is divided into two sections. In Section I, fourteen pharmaceutical chemicals of small volume are produced. In Section II three pharmaceutical chemicals of relatively large volume are produced. The production level in each case is the anticipated demand in the year 1990.

5. The technology for the production of all the 17 pharmaceutical chemicals is such that there are no complicated reactions involved, no high sophisticated equipment required and patents have expired in most of the cases. The processes start at an early stage and the raw materials required are widely available and not bound to any source or country.

6. An important feature of the multi-purpose plant is that it has adequate facilities for research and development. This will facilitate adaptation of the acquired technology to suit local conditions and raw materials. This will also enable the country to have a sound base for the development of new drugs and products to meet its specific requirements.

7. The selection of equipment is such that the equipments are available from several sources and are not bound to any country or source.

8. Training is an important feature of the multi-purpose plant. Algerian engineers and technicians will be trained right from the stage of design of the plant, through construction, installation and operation. Key persons are also trained abroad.

9. Details of investment have been worked out. The proposed multi-purpose plant including the laboratory for chemical technologies will entail an investment of US$ 11.06 million out of which the cost of equipment amounts to US$ 5.12 million, that of civil construction to US$ 5.00 million and the balance being the cost technical know-how and engineering design.

10. The multi-purpose plant project can be implemented in the course of three years.

1.0 INTRODUCTION

The Pharmaceutical Industry in Algeria is confined to the production of pharmaceuticals in dosage form. The local production meets around 8 percent of the country's requirement, in value which amount to US$ 144.1 million in 1988 and the balance is met through imports in the finished form. The production is carried in three units: El Harrach, Pharmal and Biotic and comprises tablets, capsules, creams and suppositories except for two injectables produced by Biotic. The above three units have conventional machinery, some of which is automated and in some cases rather old. Out of the three units, Pharmal plant is the most modern and automated. These three units together produce 56 products with 69 pharmaceutical forms. The plants operate in one shift only.

Each unit has its own quality control laboratory but no Research and Development facilities. These laboratories are reasonably well equipped. They also have well trained staff. The analytical facilities in general are satisfactory. The objective of SAIDAL is to substantially increase the production within the country and gradually decrease the dependence on imports.

The control laboratory is under the Ministry of Health and is situated in the premises of the Biotic plant. This laboratory has a staff of about 30 and has conventional equipment for analysis of formulations. The size of the laboratory is much too small and the equipment rather inadequate to carry out all the studies. The laboratory for Development and Research (LDR) is the only development laboratory of SAIDAL and was established in 1975 for the development of formulations and for providing technical assistance to production units. It has a staff of 40.

As regards production of bulk drugs, a large modern complex for the production of antibiotics is under establishment at Médéa. The plant with a capital investment of approximately $220 million has nine fermentors each of 130 m^3 capacity and is expected to be completed in 1987. When in full operation, the plant is expected to produce Penicillin G 135 t, Penicillin V 29 t, Tetracycline 49 t, Oxytetracycline 15.4 t, Streptomycin 33 t, Semisynthetic Penicillin 61 t and their formulations.

At present all the bulk drugs and most of the excipients required by the local pharmaceutical industry are imported.

The quantities of pharmaceutical chemicals consumed in 1982 and the projected requirements in 1990, 1996 and 2000 are indicated in Annex 1.

2.0 STRATEGY FOR LOCAL PRODUCTION OF PHARMACEUTICAL CHEMICALS THROUGH SYNTHESIS

As already indicated above, a large complex for the production of antibiotics in bulk is at the final stages of establishment at Médéa. As can be seen from Annex 1, a large number of pharmaceutical chemicals is being imported at present to feed the local pharmaceutical industry. In view of this, the feasibility of undertaking the local producion of some of these pharmaceutical chemicals needs to be examined. This aspect has been dealt with in several UNIDO documents some of which have been presented to the second consultation on the Pharmaceutical Industry.[1]

The economic feasibility of local production of pharmaceutical chemicals on an industrial scale depends primarily on:

- Adequate size of domestic market
- Required level of technology which is appropriate
- Availability of skilled manpower and infrastructure, etc.

Based on the above factors, the production of a single pharmaceutical chemical would be feasible if the market demand justifies and production becomes economically feasible given the appropriate technology. However an examination of Annex 1 reveals that with the exception of a few pharmaceutical chemicals, the individual requirements are rather small even when projected to the year 2000. In such cases the idea of multi-purpose plant for the production of essential pharmaceuticals has been recommended.

2.1 CONCEPT OF MULTIPURPOSE PLANT FOR PRODUCTION OF PHARMACEUTICAL CHEMICALS

Depending on the similarity of the production technologies of different synthetic drugs relating to unit processes and unit operations involved, facilities for production of a group of pharmaceutical chemicals can be designed and equipped. Such a facility is termed "Multi-purpose plant" since several synthetic drugs can be manufactured in this plant either sequentially or to some extent simultaneously using a single series of equipment.

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1. Second Consultation on the Pharmaceutical Industry ID/311/1983 Multi-purpose plant for production of UNIDO essential drugs based on raw materials and intermediates ID/WG.393/18

The main advantages of a multi-purpose plant for the production of pharmaceutical chemicals are as follows :

- It is ideally suited to produce a number of different pharmaceutical chemicals and in small quantities.
- Relatively small investment is needed
- At a later date, new products can be introduced with minimum investment
- The production of any particular pharmaceutical chemical can be increased to a certain extent with marginal investment to cope with an increase in the demand

3.0 MULTI-PURPOSE PLANT FOR THE PRODUCTION OF PHARMACEUTICAL CHEMICALS IN ALGERIA

Taking into consideration the market demand and prospects as can be seen from Annex 1, infrastructure facilities and skilled manpower available based on the assessment made recently, the establishment in Algeria of a multi-purpose plant for the production of a group of 17 pharmaceutical chemicals is recommended. The pharmaceutical chemicals and the production level proposed in each case are indicated in Annex 2. As can be seen from the latter annex, the pharmaceutical chemical production is grouped in two sections. Section I contains 14 pharmaceutical chemicals of relatively small quantities with a combined quantity of 53.5 tons. The equipments required for this section are also of relatively smaller size. Section II contains 3 pharmaceutical chemicals with a combined quantity of 500 tons. All these three chemicals are of relatively larger quantities. In fact Sorbitol is also an intermediate for the production of Vitamin C.

3.1 BASIS FOR SELECTION OF PHARMACEUTICAL CHEMICALS

In Annex 1, the demand forecast for the years 1990 and 2000 is given. The production level in the case of each pharmaceutical chemical is the anticipated demand in the year 1990. By the time the multi-purpose plant is established, it is expected that the entire output of the plant will be consumed. As regards the selection of the pharmaceutical chemicals, this is based on their essential nature as well as the fact that these drugs are widely used all over the world, have no known adverse reactions and are not expected to become obsolete in the foreseeable future.

3.2 TECHNOLOGY

Technology is perhaps the key element in the production of pharmaceutical chemicals. The type of technology, the appropriateness , efficiencies at each step, starting materials their price and availability, patent situation and

finally the availability of technology itself and price are important factors to be taken into account while acquiring technology. The technology for the production of pharmaceutical formulations is relatively simple and is well diffused. However the technology for the production of pharmaceutical chemicals is more sophisticated and is held by few sources. It is, therefore, necessary to acquire such a technology which can be adapted to local conditions. The pharmaceutical chemicals indicated in Annex 2 are such that there are no complicated reaction steps involved, no sophisticated equipment required and the patents have expired in most of the cases. So the acquisition of technology and its adaptation should not present problems.

3.3 STARTING MATERIALS

An important consideration in the selection of technology is the starting materials. It is important to start the reaction from as early a stage as possible so that the starting materials are available widely. This will also provide an opportunity to the Algerian technicians to master different unit processes and operations. If the technology is based on late intermediate chemicals, for which there is monopoly, this will restrict the viability of the multi-purpose plant since such intermediates may not be available from a number of sources and their cost may be higher than the finished product itself. Taking into consideration all these factors, the starting materials in the case of each pharmaceutical chemical have been selected and these are indicated in Annex 3.

3.4 REACTION SCHEMES FOR THE PRODUCTION OF PHARMACEUTICAL CHEMICALS

The reaction schemes for the production of pharmaceutical chemicals are given in Annex 4.

3.5 RESEARCH AND DEVELOPMENT

It is important to establish research and development facilities within the multi-purpose plant complex for various reasons. First, it is necessary to adapt the acquired technology to suit local conditions and raw materials. Second, it is also necessary to improve the economics of production. Finally Algeria should be in a position to develop new pharmaceutical chemicals or new products to meet is specific requirements. As already indicated, at present no adequate facilities are available for research and development. In view of this, an area of 868 m^2 has been provided for this purpose along with necessary equipment, sophisticated instrumentation and other facilities.

3.6 SELECTION OF EQUIPMENT

The proposed multi-purpose plant has been designed to have flexibility, case of operation and facilities for research and development. It has a combined reactor capacity of 37 m^3, and has scale up facilities. The laboratory equipment is designed to facilitate routine in-process control, quality control of raw materials and finished products as well as uptodate facilities for research and development. The equipment details are indicated in Annex 5.

3.7 TRAINING

Training assumes great importance while planning the establishment of basic manufacture of pharmaceutical chemicals. In view of this, training is an integral part of the multi-purpose plant starting right from the desing stage, continuing through the stages of construction, installation of equipment, testing and commissioning and operation and research and development. The personnel requirements are shown in Annex 6. 81 skilled workers, technicians, engineers and scientists are provided. All these personnel are trained at site and 20 out of these are also trained abroad as shown in Annex 7.

3.8 INVESTMENT PARAMETERS

The cost of civil construction is indicated in Annex 8. The cost of installed equipment is shown in Annex 9. The estimated cost of the project is given in Annex 10. As can be seen from the latter annex, the project is estimated to cost US$ 11,060 million out of which 46 percent is the cost of equipment and 45 percent is that of civil construction. This is due to high cost of building.

Annex 1

Market demand of pharmaceutical chemicals

Pharmaceutical Chemicals	Quality	Quantity (in tonnes) 1982	1990	2000
	Presently supported			
Sorbitol		60.0	109	200.0
Vitamin C		100.0	183	360.0
Acetylsalicylic acid		102.0	185	370.0
Tri-acetyl oleandomycin		7.0	12.8	25.0
	To be manufactured			
Dexchlorpheniramine maleate		0.021	0.038	0.075
Sulfamethoxazole		6.5	11.8	23.0
Trimethoprim		1.3	2.3	4.5
Codeine		0.2	0.36	0.7
Codethyline		0.2	0.36	0.7
Cetrimonium bromide		0.2	0.36	0.7
Ibuprofen		2.4	4.4	8.7
Haloperidol		0.02	0.03	0.06
Amitryptyline		1.0	1.83	3.5
Mebeverine		0.6	1.1	2.0
Furosemide		0.4	0.7	1.4
Paracetamol		8.0	14.6	28.0
Fluphenazine		0.005	0.010	0.020
Diclofenac		0.6	1.1	2.0
Glafenine		10.0	18.3	36.0
Allopurinol		1.5	2.7	5.3
Niflumic acid		3.0	5.5	10.0
Piroxicam		0.06	0.1	0.2
Alimemazine		0.25	0.45	0.90
Mebhydrolin		0.2	0.36	0.7
Napadisylate				
Carbamazepine		2.0	3.6	7.1
Phenobarbitone		0.75	1.3	2.5
Phenytoin		0.5	0.9	1.7
Thiobendazole		0.75	1.3	2.5
Pyrantel pamoate		0.4	0.7	1.4
Doxycycline		2.0	3.6	7.1
Nifuroxazide		1.5	2.7	5.4
Tiliquinol		2.0	3.6	7.1
Tibroquinol		0.5	0.9	1.8
Pyrimethamine		0.025	0.045	0.09

Pharmaceutical chemical	Quantity(in tons) 1982	1990	2000
Sulphadoxine	0.5	0.9	1.8
Nalidixic acid	4.0	7.3	14.0
Cephalexine	1.2	2.2	4.0
Metronidazole	1.0	1.8	3.5
Dihydroergotamine	0.036	0.06	0.12
Cyclophosphamide	0.125	0.22	0.4
Trihexyphenidyl	0.040	0.07	0.13
Levodopa	1.5	2.7	5.2
Benzetazide	0.4	0.7	1.3
Acenocumarole	0.025	0.045	0.09
Aminocaproic acid	12.0	22.0	41.0
Methyldopa	5.2	9.5	18.0
Dipyridamol	0.7	1.2	2.1
Ethyl biscoumacetate	1.2	2.2	4.0
Nicetamide	0.4	0.7	1.3
Acebutolol	2.4	4.3	8.0
Quinine phenethylbarbitone	2.0	3.6	7.1
Cinnarizine	0.6	1.0	2.0
Diltiazem	0.6	1.0	2.0
Digoxin	0.004	0.007	0.013
Isosorbide	0.060	0.1	0.2
Phenylindanedione	0.3	0.5	1.0
Ethamsylate	2.5	4.5	8.9
Propranolol	0.6	1.0	2.0
Clonidine	0.3	0.5	1.0
Hexachlorocyclohexane	1.5	2.7	5.3
Betamethasone	0.005	0.009	0.018
Miconazole	1.0	1.8	3.5
Dexamethasone	0.006	0.01	0.02
Spironolactone	0.100	0.18	0.35
Althiazide	0.06	0.1	0.2
Cimetidine	3.0	5.0	10.0
Phloroglucinol	8.0	14.6	28.0
Levonorgestrel	0.2	0.18	0.35
Ethyloestrenol	0.002	0.003	0.007

	Quantity (in tons)		
	1982	1990	2000
Dydrogesterone	0.020	0.0036	0.07
Triamcinolone acetonide	0.050	0.09	0.17
Nandrolone	0.050	0.09	0.17
Saccharine	0.5	0.9	1.7
Dienoestrol	0.005	0.009	0.017
Prednisolone	0.030	0.05	0.1
Glybenclamide	0.030	0.05	0.1
Baclofene	0.150	0.27	0.5
Chlormezanone	1.6	2.9	5.7
Hydrocortisone acetate	0.075	0.13	0.25
Lorazepam	0.025	0.04	0.08
Calcium bromogalactogluconate	180.0	329	600.0
Salbutamol	0.016	0.03	0.05
Terbutaline	0.040	0.07	0.14
Thiamine	0.125	0.228	0.400
Riboflavin	0.125	0.228	0.400
Calcium pantothenate	0.125	0.228	0.400
Nicotimamide	0.625	1.14	2.2
Calcium gluconolactate	30.0	55.0	100.0
Aluminium hydroxide	5.0	9.0	17.0
Magnesium hydroxide	5.0	9.0	17.0
Aluminium phosphate	220.0	400.0	750.0
Indomethacin	0.2	0.5	
Isoniazid	0.1	0.2	
Lidocaine hydrochloride	0.01	0.05	
Diazepam	0.035	0.10	

Annex 2

PROPOSED PRODUCTION LEVEL FOR DIFFERENT PHARMACEUTICAL CHEMICALS

	Serial No.	Pharmaceutical Chemical	Quality Standard	Proposed Annual Production (in tons)
SECTION I	1	Carbamazepine	F.P.	4.0
	2	Clonidine	F.P.	0.5
	3	Diclofenac	F.P.	1.0
	4	Ibuprofen	F.P.	4.5
	5	Indomethacin	F.P./U.S.P./ B.P.	0.5
	6	Metronidazole	F.P./U.S.P./ B.P.	2.0
	7	Nalidixic Acid	F.P./U.S.P./ B.P.	7.5
	8	Nicotinamide	F.P./U.S.P./ B.P.	1.0
	9	Nikethamide	F.P./B.P.	1.0
	10	Paracetamol	F.P./B.P.	15.0
	11	Phenytoin	F.P./U.S.P.	1.0
	12	Propranolol	F.P./U.S.P./ B.P.	1.0
	13	Sulphamethoxazole	F.P./U.S.P.	12.0
	14	Trimethoprim	F.P./U.S.P.	2.5
				53.5
SECTION II	1	Sorbitol		110
	2	Vitamin C	F.P./U.S.P.	200
	3	Acetyl Salicylic Acid	F.P./U/S.P.	190
				500

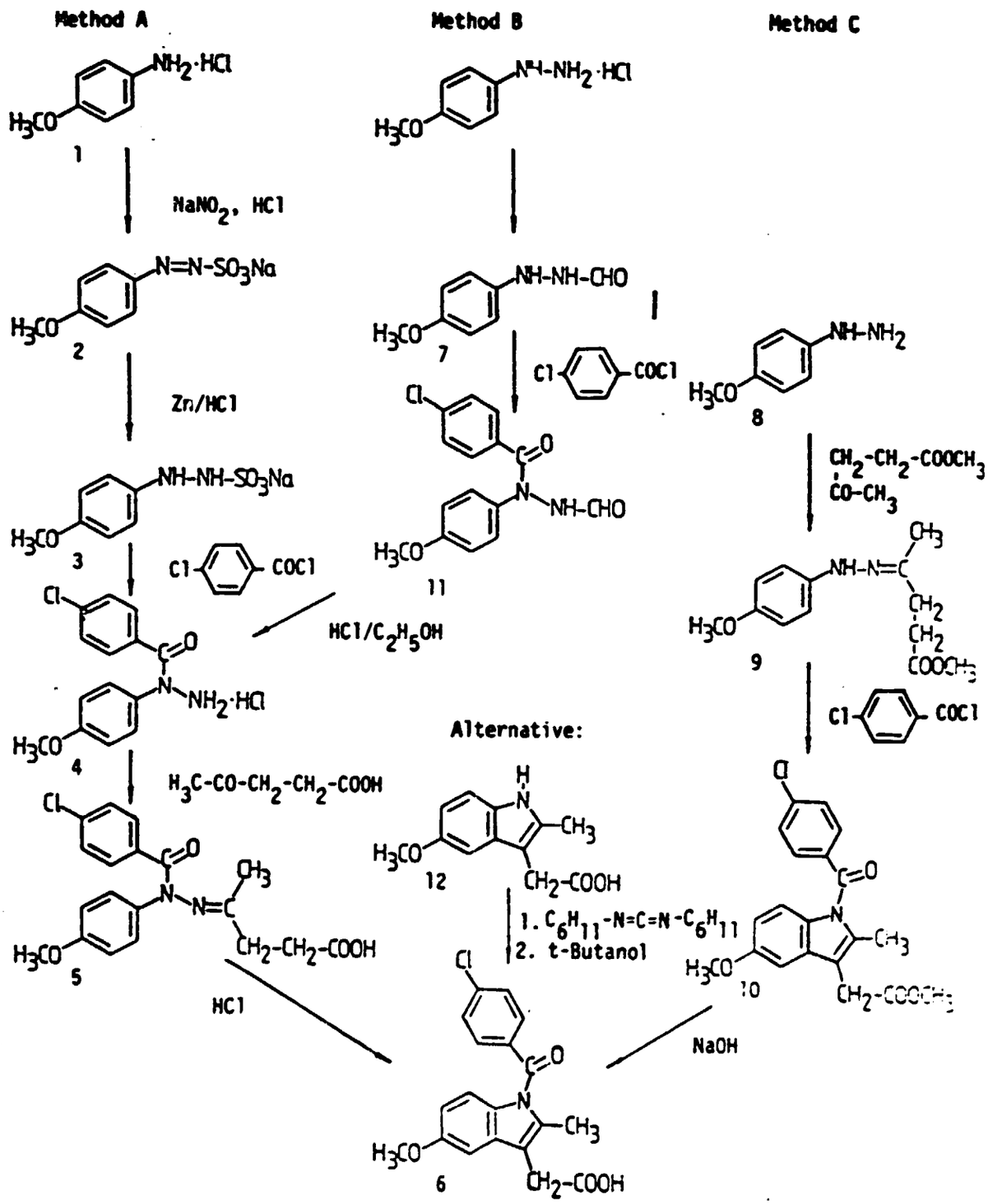
STARTING MATERIALS FOR PHARMACEUTICAL CHEMICALS

Serial No.	Pharmaceutical Chemical	Starting Material/Intermediate
SECTION I		
1	Carbamazepine	Iminostilbene
2	Clonidine	Dichloroformanilide
3	Diclofenac	Dichloroaniline
4	Ibuprofen	Isobutylbenzene
5	Indomethacin	P-Anisidine
6	Metronidazole	2-Methyl-5-Nitro-imidazole
7	Nalidixic Acid	6-Amino-2-Picoline
8	Nicotinamide	3-Cyanopyridine
9	Nikethamide	Nicotinic acid
10	Paracetamol	P-Aminophenol
11	Phenytoin	Benzil
12	Propranolol	Alpha-naphthol
13	Sulphamethoxazole	3-Amino-5-Methyl-isoxazole
14	Trimethoprim	3,4,5-Trimethoxy-benzaldehyde
SECTION II		
1	Sorbitol	D-glucose
2	Vitamin C	D-glucose
3	Acetyl Salicylic Acid	Salicylic Acid

REACTIONS SCHEMES AND PROCESS DESCRIPTION *

Annex 4

INDOMETACIN



* Please note that only a few reaction schemes and brief process description as illustration.

METRONIDAZOLE

Chemical Name : 2-methyl-5-nitroimidazole-1-ethanol

Uses : Antiprotozoal

Brief Description of Process

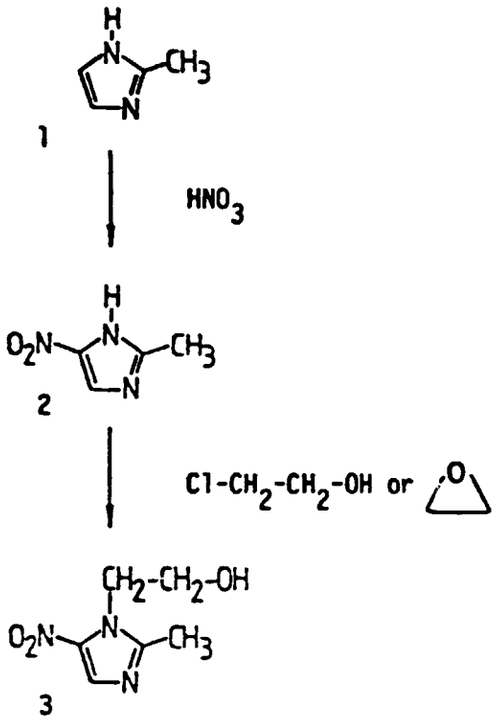
2-Methyl-5-nitroimidazole is heated with an excess of ethylene chlorohydrin for several hours at 130°C. The excess ethylene chlorohydrin is then distilled over under reduced pressure. The residue is slurried in water and filtered. The filtrate is made alkaline by addition of sodium hydroxide sclution and extracted with organic solvent. The organic extract is concentrated under reduced pressure and the residue recrystallised from ethyl acetate to give metronidazole.

Intermediates : 1. 2-methyl-5-nitroimidazole

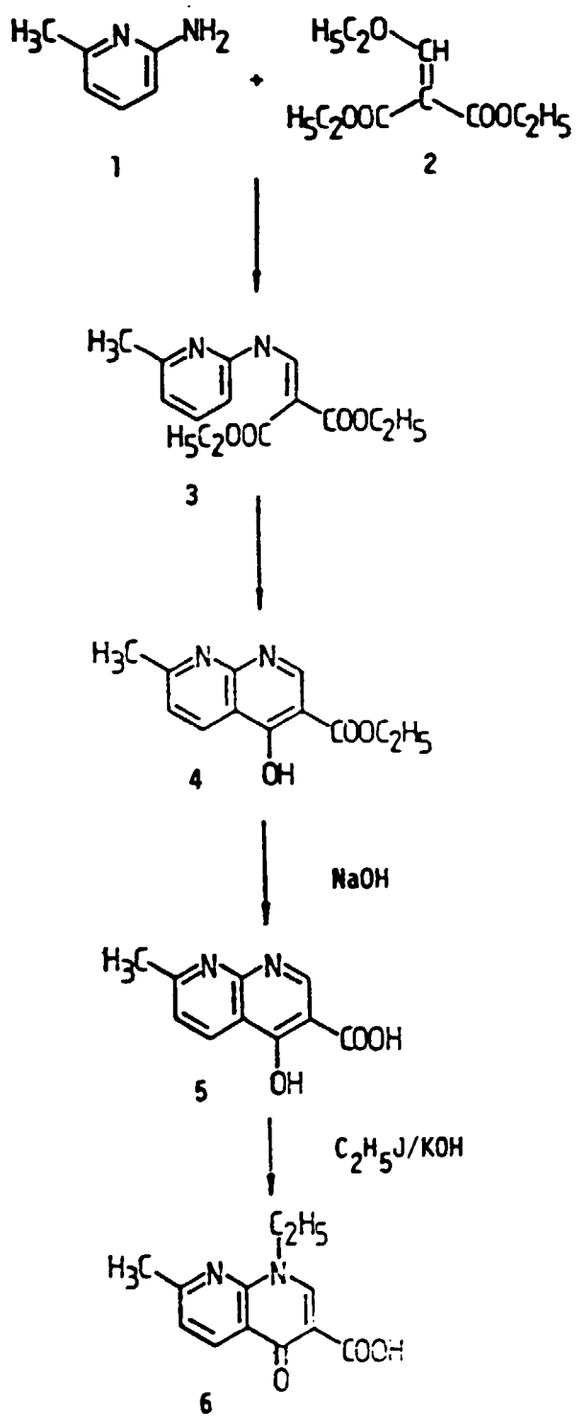
2. Ethylene chlorohydrin (or ethylene oxide)

Notes : Handling of ethylene chlorohydrin or ethylene oxide is hazardous and involves carefully designed storage and manufacturing equipment.

METRONIDAZOLE



NALIDIXIC ACID



NICOTINAMIDE

Chemical Name : Nicotinamide

Use : Enzyme co-factor vitamin

Brief Description of Process :

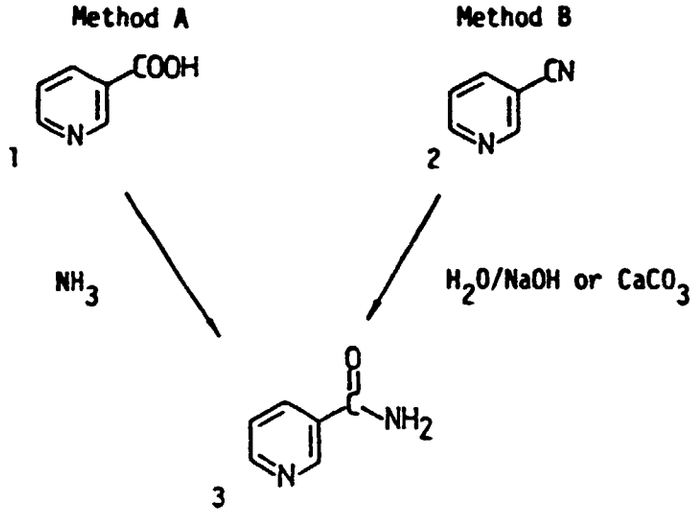
1. 3 Cyano pyridine is heated with aq. sulphuric acid for 12 to 15 hours to give nicotinamide. Alternately reaction of 3-Cyanopyridine with aq. ammonia at 200°C to 260°C also gives nicotinamide.

Intermediates : 1. 3-Cyano pyridine
2. Nicotinic acid

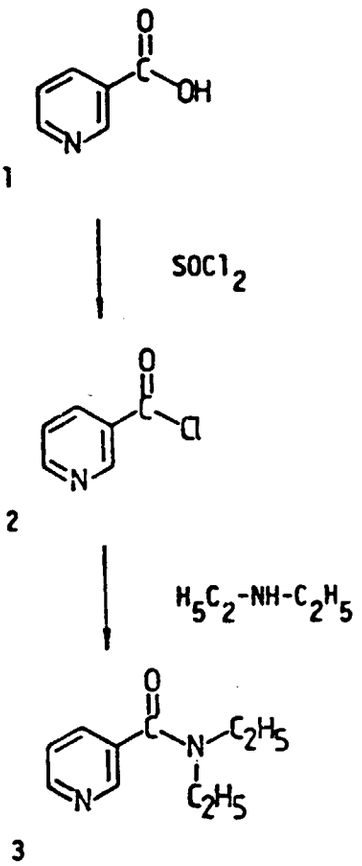
Notes : 1. Involves handling of ammonia under high pressure and temperature.

2. Involves handling of concentrate sulphuric acid at high temperatures.

NICOTINAMIDE

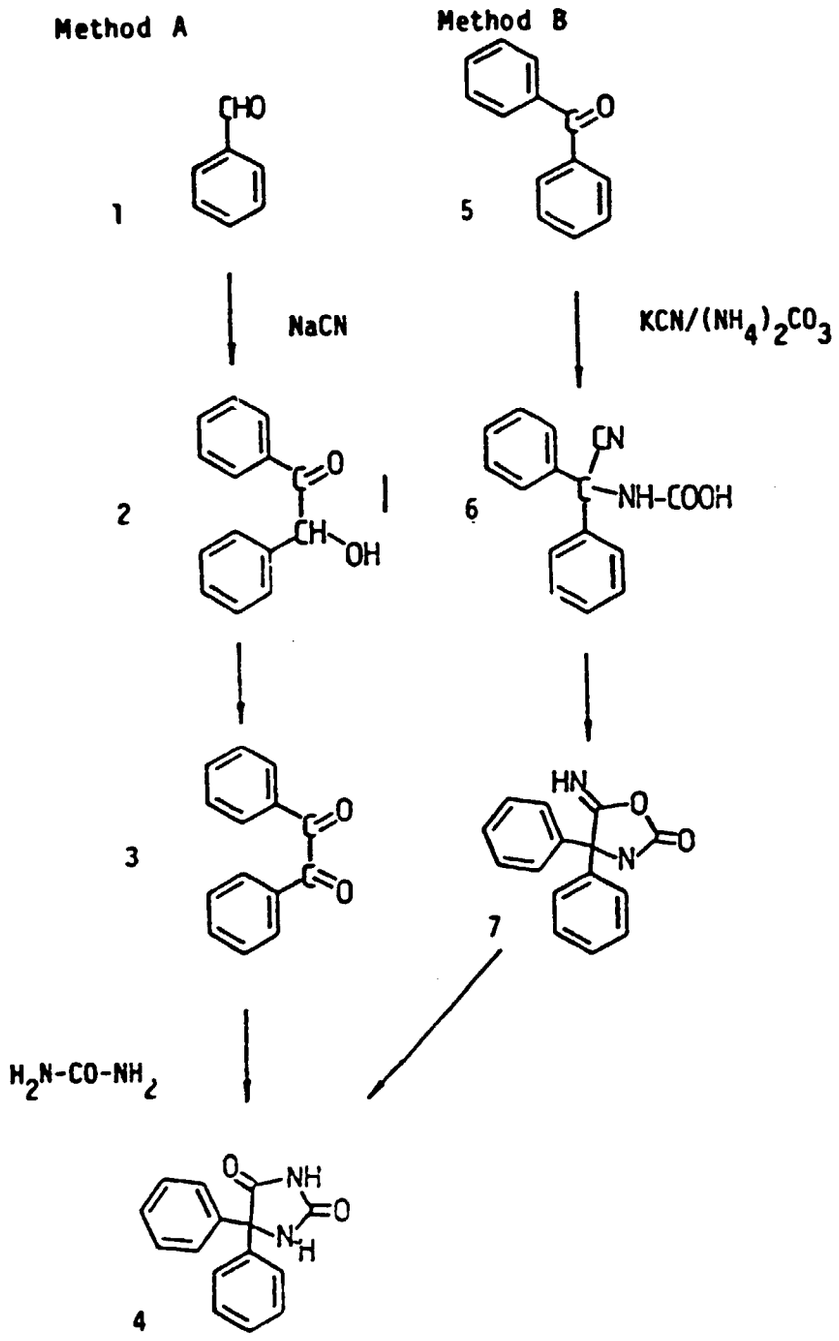


NIKETHAMIDE



DIPHENYLHYDANTOIN

(PHENYTOINE)



PARACETAMOL (ACETAMINOPHEN)

Chemical Name : N-(4-Hydroxyphenyl) acetamide

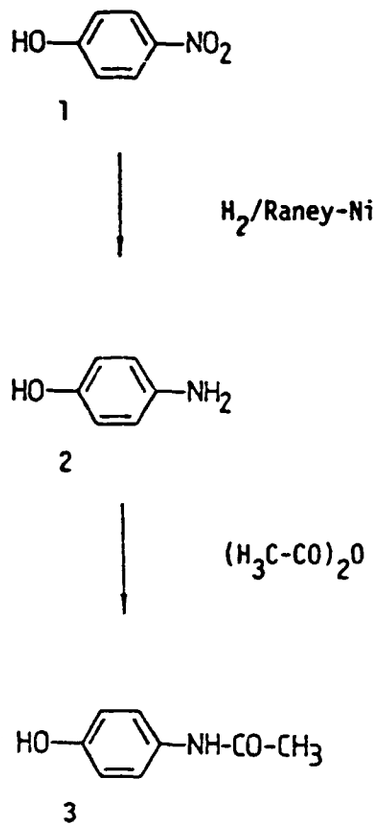
Uses : Analgesic, Antipyretic

Brief description of process:

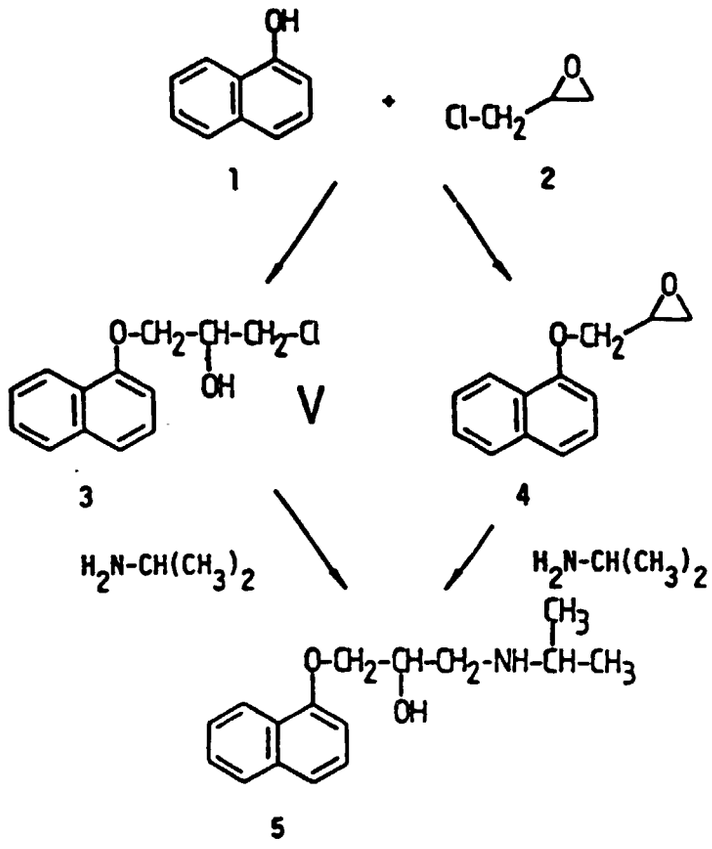
p-Aminophenol is acetylated with acetic anhydride in presence of anhydrous sodium acetate and trace of sodium hydrosulfite or sodium sulfite. The reaction mixture is then chilled to 8° to 10°C with stirring to crystallise out paracetamol.

Intermediates : 1) p-Aminophenol

PARACETAMOL



PROPRANOLOL



SULPHAMETHOXAZOLE

Chemical Name : 4-Amino-N-(5-methyl-3-isoxazolyl) benzene--sulfonamide

Use : Antibacterial

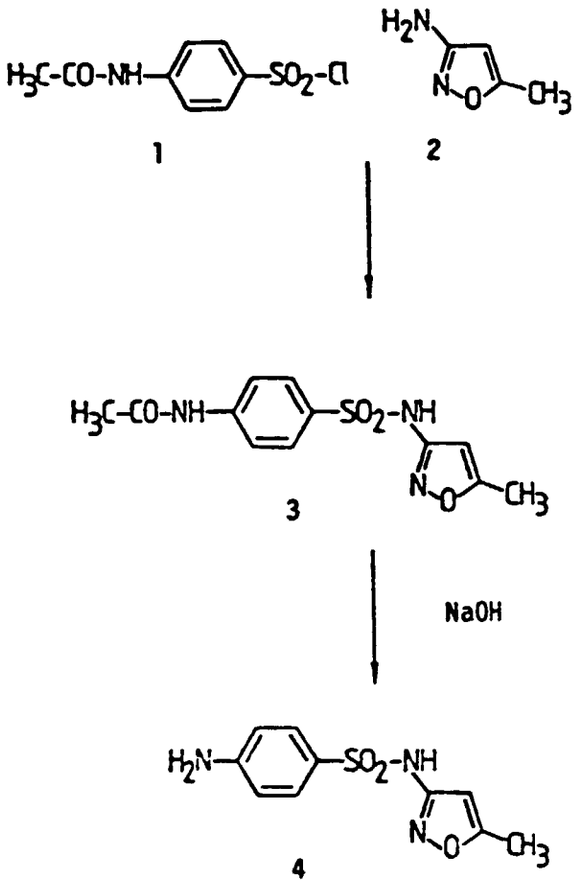
Brief description of process :

3-Amino-5-methylisoxazole solution in pyridine is reacted with acetyl sulfanil chloride. After the exothermic reaction is over water is gradually added to the reaction mixture to precipitate 3-Acetylsulfanilamido-5-methylisoxazole. The crude product is recrystallised from alcohol. The pure 3-acetylsulfanilamido--5-methylisoxazole is heated with aq. sodium hydroxide solution for an hour and then the reaction mixture is acidified by addition of acetic acid. The precipitate is filtered and recrystallised from dilute alcohol to give sulphamethoxazole.

Intermediates : 1) 3-Amino-5-methylisoxazole

2) Acetyl sulphanil chloride

SULFAMETHOXAZOLE



TRIMETHOPRIM

Chemical Name : 5-[(3,4,5-trimethoxyphenyl) methyl]-2,4-pyrimidine diamine

Use : Antibacterial

Brief description of process:

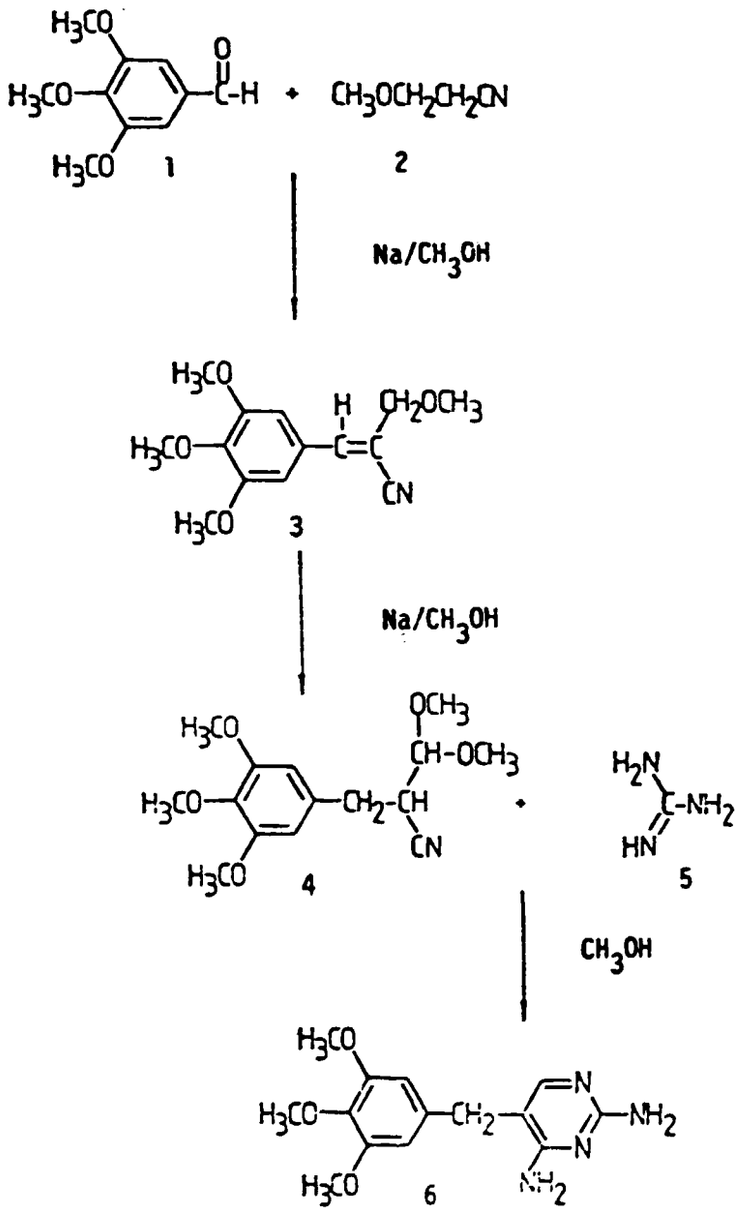
3,4,5 trimethoxybenzaldehyde is reacted with B-methoxy propionitrile in presence of sodium methoxide in methanol. After refluxing for 4 hours, the reaction is chilled and water is carefully added. The crude product is filtered and recrystallised from methanol to give 3,4,5 trimethoxy-2-methoxy methylcinnamonitrile. This is reduced by sodium in methanol to give 3,4,5 trimethoxy-2'-cyano--dihydrocinnamaldehyde dimethyl acetal. The recrystallised product is refluxed with a solution of guanidine base in methanol for two hours, the excess methanol removed by distillation and the crude product isolated after chilling the reaction mixture.

The crude product is purified by dissolving in aq.acid, charcoaling the solution and basifying the clear filtered solution to give pure trimethoprim.

Intermediates :

1) 3,4,5-Trimethoxy benzaldehyde
2) B-Methoxypropionitrile
3) Sodium / Sodium methoxide
4) Guanidine base.

TRIMETHOPRIM



ASPIRIN

Chemical Name : 2-(Acetoxy) benzoic acid

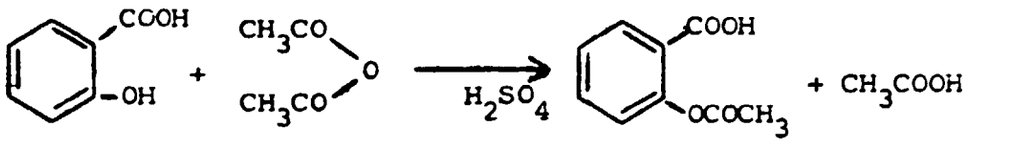
Use : Analgesic, antipyretic, anti-inflammatory

Brief description of process:

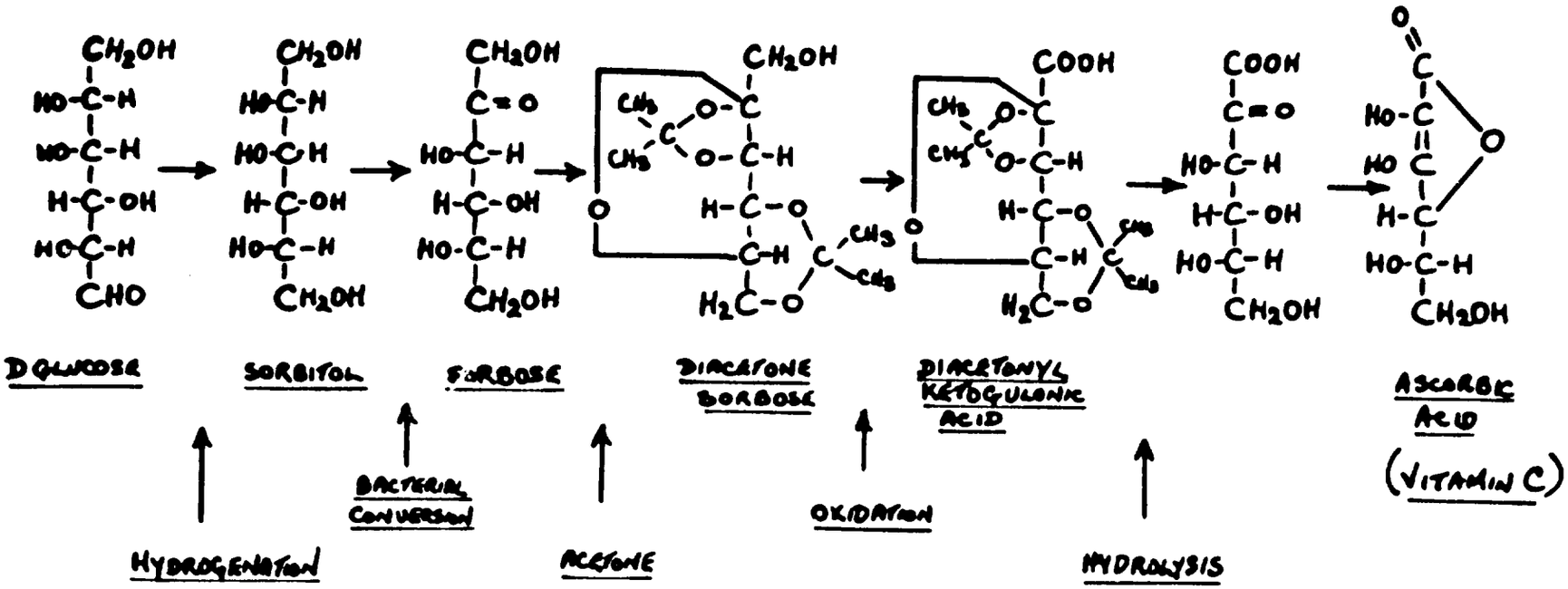
Salicylic acid is heated to 90°C with excess of acetic anhydride in toluene medium. After several hours of heating the reaction mixture is allowed to cool and the crystallised product is centrifuged and washed with water until the product is free from acetic acid to give the pure product.

Intermediates : Salicylic acid

ACETYL SALICYLIC ACID



Salicylic Acid	Acetic Anhydride	Aspirin	Acetic Acid
138	102	180	60



VITAMIN C PROCESS.

Annex 5

PROPOSED LIST OF EQUIPMENT - PROCESS EQUIPMENT

Serial No.	Equipment	Capacity	Quantity	Material of Construction
1	2	3	4	5
1	Jacketed reactor with agitator	1600 l	2	Enamelled
2	Condenser	8 m^2	3	Glass lined
3	Charging tank	250 l	1	Polyester with glass fibres
4	Receiver tank	500 l	4	Glass lined
5	Balance	500 kg	1	Steel
6	Balance electronic	250 kg	2	Steel
7	Pump	10 m^3/h	3	Teflon coated
8	Centrifuge with under-evacuation	Ø 1250 m/m	2	Coated with Halar
9	Collecting tank for centrifuge liquid	630 l	6	Coated with Halar
10	Collecting tank	630 l	2	Rubber coated
11	Pump	10 m^3/h	6	PP
12	Gas suction injector	H = 60m	1	PP
13	Jacketed tank with cooling	1000 l	1	Glass lined
14	Jacketed reactor with agitator	3000 l	3	Enamelled steel
15	Condenser	12,5 m^2	2	Glass lined

1	2	3	4	5
16	Feeding tank	250 l	1	Stainless steel
17	Balance electronic	500 kg	2	Steel
18	Jacketed reactor with agitator	3000 l	2	Glass lined
19	Condenser	12,5 m^2	1	Glass lined
20	Bag filter	0,5 m^2	2	Enamelled steel
21	Condenser	12,5 m^2	1	Glass lined
22	Charging tank	250 l	1	Stainless steel
23	Receiver tank with cooling	1000 l	2	Stainless steel
24	Water ring vacuum pump	60 m^3/h	2	Steel
25	Pump	10 m^3/h	5	Stainless steel
26	Centrifuge with under-evacutation	Ø 1000 m/m	3	Stainless steel
27	Collecting tank for centrifuge liquid	630 l	10	Stainless steel
28	Collecting tank	500 l	1	Stainless steel
29	Pump	6 m^3/h	2	Stainless steel
30	Jacketed reactor with agitator	500 l	2	Glass lined
31	Condenser	8 m^2	1	Glass lined

1	2	3	4	5
32	Receiving tank/cooled	8 m^2	2	Stainless steel
33	Cooled tank	1000 l	1	Steel
34	Absorption injector		1	PP
35	Tank	6300 l	1	Enamelled steel
36	Vacuum-Puffer tank	250 l	1	Steel
37	Water ring vacuum pump	250 m^3/h	2	Steel
38	Pump/mud	10 m^3/h	2	Stainless steel
39	Tank with cooling	250 l	1	Stainless steel
40	Fluid dryer	250 kg/h	1	Stainless steel
41	Balance electronic	50 kg	2	Steel
42	Turmix sieve		1	Stainless steel
43	Homogenizer	1000 l	1	Stainless steel
44	Jacketed reactor with agitator	1600 l	1	Glass lined
45	Condenser	8 m^2	2	Glass lined
46	Feeder tank	250 l	1	Stainless steel
47	Balance electronic	500 kg	3	Steel
48	Balance electronic	250 kg	2	Steel
49	Bag filter	0,5 m^2	2	Enamelled steel
50	Tank	6300 l	3	Glass lined

1	2	3	4	5
51	Dryer with 40 trays		1	Stainless steel
52	Condenser	8 m^2	2	Glass lined
53	Receiving tank/cooled	500 l	4	Enamelled steel
54	Receiving tank/cooled	1000 l	3	Enamelled steel
55	Water ring vacuum pump	60 m^3/h	2	Steel
56	Gas-absorption injector		2	PP
57	Cooled tank	1000 l	2	Glass lined
58	Condenser	12,5 m^2	2	Glass lined
59	Feeding tank	250 l	1	Polyester with glass fibres
60	Condenser	12,5 m^2	2	Glass lined
61	Feeding tank	250 l	1	Stainless steel
62	Receiving tank/cooled	1000 l	4	Stainless steel
63	Bag filter	0,5 m^2	2	Glass lined
64	Condenser	8 m^2	2	Glass lined
65	Feeder tank	250 l	1	Stainless steel
66	Receiver tank with cooling	500 l	4	Stainless steel
67	Water ring vacuum pump	60 m^3/h	2	Steel
68	Collecting tank	500 l	2	Stainless steel

1	2	3	4	5
69	Hot water boiler	2000 l	1	Stainless steel
70	Dryer with 40 trays		1	Stainless steel
71	Vacuum distillations unit complete	p = 0,5 Hgm/m t = 200°C	1	Stainless steel
72	Condenser	4 m^2	2	Glass lined
73	Receiver tank with cooling	100 l	2	Stainless steel
74	High-vacuum pump/oil		2	Steel
75	Water ring vacuum pump	60 m^3/h	2	Steel
76	Jacketed reactor with agitator	1250 l	2	Glass lined
77	Condenser	4 m^2	2	Glass lined
78	Feeder tank	100 l	1	Stainless steel
79	Balance electronic	100 kg	1	Steel
80	Filter press	2 m^2	2	Stainless steel
81	Jacketed reactor with agitator	1250 l	1	Enamelled steel
82	Condenser	4 m^2	2	Glass lined
83	Feeder tank	100 l	2	PP
84	Receiver with cooling	250 l	4	Glass lined
85	Water ring vacuum pump	60 m^3/h	2	Steel

1	2	3	4	5
86	Gas absorption injector		1	PP
87	Tank with cooling	500 l	1	Enamelled Steel
88	Receiver tank	500 l	2	Stainless steel
89	Tank with cooling	250 l	2	Stainless steel
90	Filter press	0,5 m^2	2	Glass lined
91	Vacuum dryer unit with agitator	0,5 m^3	1	Stainless steel
92	Balance Electronic	100 kg	1	Steel
93	Turmix sieve		1	Stainless steel
94	Pulveriser		1	Stainless steel
95	Homogenizer unit with 200 l barrels		1	Stainless steel
96	High pressure hydrogenator for Sorbitol		1	Stainless steel

TANK FARM EQUIPMENT

Serial No.	Equipment	Capacity	Quantity	Material of Construction
1	2	3	4	5
1	Tank for HCL	10 m^3	1	Polyester with glass fibre
2	Tank for mother liquor acidified with HCL	10 m^3	1	Polyester with glass fibre
3	Tank for sulfuric acid	10 m^3	1	Steel
4	Tank for sodium hydroxide	10 m^3	1	Steel
5	Tank for ammonium hydrixide	10 m^3	1	Steel
6	Tank for ion free water with electrical heating	10 m^3	2	PP
7	Tank for softened water with electrical heating	10 m^3	2	PP
8	Underground tank for ethanol	10 m^3	1	Steel
9	Underground tank for regenerating ethanol	10 m^3	1	Steel
10	Underground tank for benzene	10 m^3	1	Steel
11	Underground tank for regenerating benzene	10 m^3	1	Steel
12	Underground tank for methanol	10 m^3	1	Steel

1	2	3	4	5
13	Underground tank for mixture of ethanol-methanol	10 m^3	1	Steel
14	Underground tank for toluene	10 m^3	1	Steel
15	Underground tank for regenerating toluene	10 m^3	1	Steel
16	Underground tank for regenerating acetone	10 m^3	1	Steel
17	Underground tank for regenerating acetone	10 m^3	1	Steel
18	Underground tank for iso-propanol	10 m^3	1	Steel
19	Underground tank for regenerating iso-propanol	10 m^3	1	Steel
20	Underground tank for ethylacetate	10 m^3	1	Steel
21	Underground tank for regenerating ethylacetate	10 m^3	1	Steel
22	Underground tank for ethylenechloride	10 m^3	1	Stainless steel
23	Underground tank for regenerating ethyl-enechloride	10 m^3	1	Stainless steel
24	Tank for acetic acid, heated	10 m^3	1	Aluminium

1	2	3	4	5
25	Tank for regenerating acetic acid	10 m^3	1	Aluminium
26	Tank for Diesel-oil	10 m^3	2	Steel
27	Pump for several solvents	5 m^3/h	14	Steel
28	Pump for several solvents	6 m^3/h	4	Steel
29	Pump for acids	6 m^3/h	2	PP
30	Pump for sulfuric acid	6 m^3/h	1	Steel
31	Pump for alkali	6 m^3/h	2	Steel
32	Pump for Diesel-oil	6 m^3/h	1	Steel
33	Pump for demineralized water	3 m^3/h	2	PP

EQUIPMENT FOR UTILITIES

Boiler Plant

4,5 t/h steam capacity, maximum pressure 12.0 bar gauge, 1 piece of 2 HD type, oil fired boiler, with a degasification feed tank of 5 m^3 volume, with feed pumps and feed-water preheater.

Fuel Oil Supply

Unloading station, discharge and storage facilities with 2 pieces of 40 m^3 volume storage tanks.

Demineralized Water Supply

Peak requirement 9.0 m^3/h demineralized water for the boiler plant, for the cooling water make up and for the process water. Water softener, type DH-1000 HOH with quick strainer type KSz-IV.

3 pieces of 15 m^3, type V-56-11 cylindrical storage tank for raw, filtered and demineralized water.

2 pieces of 10 m^3 storage tank for chemicals.

Pumps for the demineralizing equipment.

Refrigeration Unit

Capacity : 2 x 290 KW, for the cooling of water solution with 40% propylene glycol.

2 pieces type KWS 560-2 h refrigeration aggregate .

2 pieces 50 m^3/V-56-11 type/vertical cylindrical tank.

1 piece 15 m^3/V-56-11 type/vertical cylindrical tank.

Circulation and feed pumps, fittings.

Mini-cooling Tower

For the cooling of maximum 400 m^3/h cooling water, 2 pieces, type 4 x H40 with pumps and underground lines.

Solid Waste Incinerator

Capacity 400-500 kg/h solid waste to be burned.

Pipeline Network

Mounted on piperacks on steel structure for the distribution and collection of steam, condensate, basic materials and fuel oil. The loading of the pipe-rack is about 1.0 t/running meter.

POWER SUPPLY

In normal operation, No. 1 transformer of 1.000 KVA capacity, voltage reduction 10/0,4 KV, serves for the power supply. In case of failure from the mains, the generator of a 400 KVA Diesel-electrical unit starts automatically and is connected to the common busbar of 0,4 KV voltage.

The aluminium-wound dry transformer/insulated with synthetic resin/ is located in a container Mod. 1CC, meeting the ISO standard as per dimensions, lifting and fixing facilities. The same container houses also the 0,4 KV switching equipment of the transformer station.

Several shop distributors serve to supply power to the consumer units in the plant hall. These distributors are located in separate cabins built aside the hall. A distributor unit located on level ± 0.00 m of the service wing of the building supplies power to the consumers within the service building and to the external consumers. The said distributors will be fed from the transformer station in the container.

The Diesel-electrical reserve power source will be located - also incorporated in a container - in vicinity of the transformer station.

An electric lefting-truck charging station should also be installed on the plant area, suitable to charge simultaneously accumulators of two trucks. Charging will be done outside the building, under a rain-shield cover whereas the charging units themselves will be located within the building/on level ± 0.00 mm of the service wing.

Laboratory Equipment

I. For Pilot Plant Laboratory:

		No.
1.	Stainless Steel (SS) Reactor 50 Lit.	1
2.	S.S. Reactor 100 lit.	1
3.	Glass lined Reactor 50 ltr.	1
4.	Glass lined Reactor 100 Lit.	1
5.	Fluid Bed Drier 50 Kg.	1
6.	S.S. Centrifuge 24"	1
7.	All Glass Reactors-cum-distillation Unit 10 lit.	2
8.	All Glass Reactors-cum-distillation Unit 25 Lit.	2
9.	All Glass Reactors-cum-Distillation Unit 50 lit.	1
10.	Vacuum pumps industrial	4
11.	High pressure autoclaves - 1 lit & 10 lit.	
12.	Solvent Recovery Unit	1
13.	Filter: Nutsche	1
	Sparkler	1
	Rotavacuum	1
14.	Centrifuge - Basket type	1
	Sparkler	1
15.	Crystallisers - 250 lit.	2
16.	Soxhlit Extraction with distillation unit 250 lit	1
17.	Climbing film cyclon evaporator	1

		No.
II.	For Chemical Technology Laboratory:	
1.	Heating mantles for 100 ml to 1000 ml Flasks	12
2.	Mechanical stirrors	6
3.	Magnetic stirrers	6
4.	Melting point apparatus	2
5.	Water Baths	12
6.	Balances, semimicro and analytical	4
7.	Flash Evaporators	4
8.	TLC Unit	1
9.	Flash Chromatography apparatus	1
10.	Laboratory Centrifuge	1
11.	Glass distillation unit	2
12.	Hydrogenation pressure-Low pressure	1
13.	High Pressure hydrogenation pressure on lit. capacity	1
14.	High pressure steel bombs 100 & 250 ml	2
15.	Ovens	2
16.	Vacuum pumps	4
17.	Laboratory Glassware - miscellaneous	
III.	For Pharmacology Laboratory:	
1.	4 Channel Polygraph with preamplifiers and transducers	1
2.	Electronic stimulators	2
3.	2-Unit Isolated Organ Bath	1
4.	Respiration Pump	1
5.	Columbus activity monitor	1
6.	Rota Rod	1
7.	Electroconvulsometer	1
8.	Analgesiometer	1
9.	Paw Plethysmography	1

10.	Operation table Shadowless lamp and other related equipment	1
11.	PH meter, Flame Photometer, Spectrophotometer, etc.	1 each
12.	Electronic thermometer with thermistor Probes	1
13.	Binocular microscope	1
14.	E.K.G. Machine	1
15.	Desktop Computer	1
16.	Dissolution simulator and Absorption simulator with artificial gastric and intestinal barrier Kits for Bioavailability studies	1
17.	Pipette centrifuge "Analysette" - 21 for particle size analysis (0.01-5 μm)	1

IV. Instruments for Central Laboratory for Instrumentation

		No.
1.	High Resolution Mass Spectrometer with Chemical Ionisation, Field Desorption capability.	1
2.	100 & 220 Mz NMR Spectrometer with Liquid Helium liquification and liquid nitrogen plants. Antianalyser for (C,H,N,O)	2
3.	Elemental Autoanalyser for (C,H,N,O)	2
4.	High performance liquid chromatographs (analytical and preparative)	2
5.	Gas liquid Chromatograph	1
6.	Fourier IR Spectrophotometer	1
7.	Infra Cord	1
8.	Recording UV Spectrophotometer	2
9.	ORD/CD Spectrometer	1
10.	Spectropolarimeter	1
11.	Spectrophotoflorimeter	1

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11.	Annals of New York Academy of Sciences	The New York Academy of Sciences, 2 East Sixty-three Street New York, NY 10021, U.S.A.
12.	Annals of Nutrition & Metabolism	Watt Publishing & Co., Sandest Buildings Mount Morris Illinois 81054, U.S.A.
13.	Annual Drug Data Report	JR Prous, J.A. Provenza, 385 -387 Barcelona 25 SPAIN
14.	Antibiotics & Chemotherapy	Antibiotics & Chemotherapy, Hermes Press, Inc., 82 Morningside Drive, New York, NY 10027, U.S.A.
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18.	Arzneimittel Forschung	Editio Cantor KG D - 7960 Auldendorf Postfach, P.O. Box: 1310 West Germany
19.	Bacteriological Reviews	American Soc. for Microbiology, 1912, 1st Street, N.W. Washington DC 2006 U.S.A.
20	Biochemical Pharmacology	The Fulfillment Manager Pergamon Press Limited Headington Hill Hall Oxford OX3 OBW, England
21.	British Jr. of Clinical Pharmacology	Macmillan Journal Ltd. Brunel Road, Basignstoke, Hants RG21 2ZS, U.K.
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27.	Chemical Abstracts	Chemical Abstracts Services, The Ohio State University Post Box No. 3012 Columbus, OHIO 43210, U.S.A.
28.	Chemical Engineering News	American Chemical Society, 1155 Sixteenth Street N.W. Washington DC20036, U.S.A.
29.	Chemist & Druggist	Chemist & Druggist Benn Publications Ltd. 25 New Street - 89 London EC4A 3JA, England,
30.	Chemistry & Industry	The Chemical Society Distribution Centre Blackhourse Road Latchwarth, Hert 506 1 HN.
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35.	Drugs of the Future	Drugs of the Future Apartado de Correos 1179 Barcelona, Spain
36.	Drugs Under Experimental Research	Drugs under Experimental & Clinical Research Bioscience Ediprint 8 Rue Wirkelried, rue Winke, 8, 1211 Geneva 1 Switzerland.
37.	General Pharmacology	IPC Science & Technology Press Limited IPC House 32 High Street, Guild Ford England, U.K.
38.	Helvetica Chimica Acta	Verlag Helvetica Chemica Acta P.O. Box: 273 4002 Basel Switzerland
39.	Heterocycles an Intl. Journal	Sendai Inst. of Heterocyclic Chemistry Sendai Pakusokan Kayaku Kenkysho, Japan

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45.	Journal of Pharmaceutical Asson	American Pharmaceutical Asson 2215 Constitution Avenue N.W. Washington DC20037 U.S.A.
46.	Journal of Antimicrobial Chemotherapy	Academic Press Ltd., 24-28, Ouar Road, London NW 17 DK, UK.
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48.	Journal of Chemical Society	American Chemical Society 1155 Sixteenth Street N.W. Washington DC. 20036 U.S.A.

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52.	Journal of Parasitology	American Society of Parasitologists 1041 New Hampshire P.O. Box - 368, Lawrence, Kanas 66044, U.S.A.
53.	Journal of Pharmaceutical Sciences	American Pharmaceutical Asson 2215 Constitution Avenue N.W. Washington DC 20036, U.S.A.
54.	Journal of Pharmacy & Pharmacology	The Pharmaceutical Press High Street Lembeth London SE1 7JN. England, UK.
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58.	Package Engineering	Package Engg. 270 St. Paul St., Denver, Coloredo 80206 U.S.A.
59.	Packaging	Morgan-Grampian Ltd., 30 Calderwood Street London WC1X 8RP, U.K.
60.	Packaging Review	IPC Industrial Press Ltd. 33-39 Bowling Green Lane London ECI, England
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62.	Science	American Asson for the Advancement of Science 1515 Massachusetts Ave. N.W. Washington DC 20005 U.S.A.
63.	Synthesis	George Thieme Publishers Postfach No. 732 D-700, Stuttgart - 1 Harweg, West Germany
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29.	Textbook of microbiology	Burrow
30.	Principles of microbiology and immunology	Davis, Bernard D. et-al.
31.	Difco manual of dehydrated culture media and reagents for microbiological and clinical laboratory procedures	Difco Laboratories
32.	Methods in microbiology	Norris, J.R. (ed.)
33.	Essays in microbiology	Norris, J.R. and Richmond, M.G. (eds.)
34.	Advances in applied microbiology	Perlman, D. (ed.)
35.	Quality control in microbiology	Prier, James E. et-al.
36.	Microbiology	Schlessinger, David (ed.)
37.	Microbiology	Davis, D.B. et-al
38.	Microbiology	Pelcsar, Michael Jr.
39.	Actinomycetes the boundary micro-organisms	Aral, T. (ed.)
40.	Teratology-principles and techniques	Wilson, James G. and Josef, Warkang
41.	Chamber's dictionary of science and technology	Chamber
42.	Recent advances in medicine	Baron, D.N. (ed.)
43.	Stedman's medical dictionary	Stedman
44.	Clinical pharmacological evaluation in drug control	World Health Organisation

SR. NO.	TITLE	AUTHOR
45.	Second symposium on the clinical pharmacological evaluation in drug control	World Health Organisation
46.	Third symposium on clinical pharmacological evaluation in drug control	World Health Organisation
47.	Chemical sterilization	Borick, Paul, M. (ed.)
48.	Lectures in sterilization	Brewer, John H. (ed.)
49.	Sterilization of medical products	Gaughran, Eugane, R.L. and Kereluk, Kari
50.	Industrial sterilization	Phillips, G. Briggs and MIller, William S. (eds.)
51.	Introduction of industrial sterilization	Richards, J.W.
52.	How to remove pollutants and toxic materials from air and water, 1977.	Sitting, Marshall
53.	Environmental pollution and human health-proceedings of the International symposium on industrial toxicology	Zaidi, S.H. (ed.)
54.	Water and water pollution handbook	Ciaccio, Leonard L.
55.	World directory of pharmaceutical manufacturers	IMS World Publications
56.	The Merck Index	Merck & Co.
57.	Drug design	Ariens, E.J. (ed.)
58.	British pharmacopeia	Her Majesty's Stationery Office

SR. NO.	TITLE	AUTHOR
59.	British National formulary	(The) Pharmaceutical Press
60.	European pharmacopeia	Maisonneuve, S.A.
61.	The extra pharmacopeia	Martindale
62.	Formulation and preparation of dosage forms	Polderman
63.	Annual reports in medicinal Chemistry	Cain, Cornelius K.
64.	Bently and Driver's textbook of pharmaceutical chemistry	Bentley and Driver
65.	Medicinal Chemistry	Burger, Alfred
66.	Microencapsulation	Nixon, J.R. (ed.)
67.	Design of biopharmaceutical properties through pro drugs and analogs	Roche, Edward B.
68.	Textbook of organic medicinal and pharmaceutical chemistry	Wilson, Charles O. (ed.)
69.	Chemistry in medicine	American Chemical Society
70.	Synthetic antidiarrheal drugs synthesis-preclinical and clinical pharmacology	Bever, Wllem Van and Lal. Harbans (eds.)
71.	Antibiotics-mechanism of action of antimicrobial and antitumour agents	Corcoran, John W. and Hahn, Fred (eds.)
72.	Topics in antibiotic chemistry	Sammers, P.G. (ed.)
73.	Bentley's textbook of pharmaceutics,	Bentley
74.	Unit processes in pharmacy	Ganderton, David
75.	The theory and practice of industrial pharmacy	Lachman, Leon, et-al (ed.)

SR. NO.	TITLE	AUTHOR
76.	Remington's pharmaceutical Sciences	Remington
77.	Principles of drug action the basis of pharmacology	Goldstein, Avram, et-al.
78.	Drug interactions	Grahame-Smith, D.G.
79.	Progress in drug research	Jucker, Ernst (ed.)
80.	Laboratory manual of biopharmaceutics and pharmacokinetics	Ritschel, W.A.
81.	Cardiovascular drugs-B-Adrenoceptor blocking drugs	Avery, Graeme S
82.	Cardiovascular drugs-B-Adrenoceptor blocking drugs, Antiarrhythmic, antihypertensive and lipid lowering drugs.	Avery, Graeme S.
83.	Advances in drug research	Harper, NJ, and Simmonds, L.B. (eds.)
84.	Manual of clinical microbiology	Lennette, Edwin H. (ed.)
85.	Benzodiazepines in clinical practice	Grennblatt, David J. and Shader, Richard I.
86.	Textbook of adverse drug reactions	Davies, D.M. (ed.)
87.	Analytical profiles of drug substances	Florey, Klaus (ed.)
88.	Clinical trials protocol	Maxwell, Cyril
89.	Dermato-toxicology and pharmacology	Marzulli, Francis N. & Maibach, Howard I. (eds.)
90.	Advances in parasitology	Dawes, Ben (ed.)

SR. NO.	TITLE	AUTHOR
91.	The corrosion and oxidation of metals	Evans, Ulick R.
92.	Gas encyclopedia	Liquide, L'air
93.	Antifungal compounds	Siegel, Malcolm R. and Sisler, Hugh D. (eds.)
94.	Environmental pollution by pesticides	Edwards, C.A. (ed.)
95.	Pesticides process encyclopedia	Sitting, Marshall
96.	Analytical methods for pesticides and plant growth regulators	Zweig, Gunter and Sherma JOseph (eds)
97.	Farm chemicals handbook	Meister Publishing Co.
98.	British Pharmacopoeia (veterinary)	Her Majesty's Stationary Office
99.	Optimization techniques for chemical engineers,	Husain, Asghar and Gangian, Kota.
100.	Encyclopedia of chemical technology	Kirk and Othmer
101.	Encyclopedia of chemical processing and design	Mc Ketta, John J. (ed.)
102.	Process plant and equipment cost estimation	Kharbanda, O.P.
103.	Industrial chemicals	Faith
104.	British Pharmaceutical Codex	Pharmaceutical Soc. of G.B.
105.	U.S. Pharmacoepia with supplements	U.S. Pharmacoepial Convention
106.	Dictionary of Organic compounds	Heilbron (Chapman & Hall)
107.	Synthetic methods of organic chemistry	Theilheimer
108.	Cephalosporins & penicillins (Chemistry & Biology)	Flynn, Edwin, H. (ed.)

Personnel Requirement for the Multi-Purpose Plant

	Production	Laboratory	Maintenance	Administration	Purchase	Finance	Services
Plant Manager, Chemist and high-level personnel	10	6	2	1	1	1	-
Operators Technicians, Clerk	8	6	3	3	2	3	1
Skilled Workers	12	12	6	1	1	1	1
Unskilled Workers	20	15	3	-	-	-	6
Total	50	39	14	5	4	5	8

Total need: 125

The personnel requirement of pilot multi-purpose plant and laboratory of chemical technology is 65 and 60, respectively. The maintenance personnel is included in the personnel of pilot plant, which the administrative personnel is included in the laboratory personnel.

Training Requirement Outside the Country

	Number	Month
Production Director	1	6
Factory Chief	1	3
Financing Supervisor	1	1
Personnel (Quality Control) (Chemist, Toxiologist)	3	6
Production Manager, Chemist and Operator	9	18
Chemical Engineer (Designer)	1	3
Mechanical Engineer and Technicians	4	8
Total:	20	45

Cost of Civil Construction *

Particulars		Cost US$
A.	Process building Basement/Ground floor each 1300 sq.m.(= 2,600 sq.m) Mezzanine floor 600 sq.m. ($ 880/sq.m.)	2,816,000
B.	Office accommodation 100 sq.m.($ 1,000/sq.m)	100,000
C.	Warehouse for raw materials 450 sq.m.($760/sq.m)	342,000
D.	Warehouse for finished products 200 sq.m.($760/sq.m)	152,000
E.	Building for utilities 570 sq.m.($840/sq.m)	478,800
F.	Workshop, cafeteria, time office, etc. 300 sq.m. ($ 840 sq.m.)	252,000
G.	Research and Development Laboratory 860 sq.m. ($ 1,000 sq.m.)	860,000
	Total cost of buildings	5,008,000

COST OF INSTALLED EQUIPMENT

	US$
A. Process equipment	2,564,250
B. Laboratory equipment	250,000
C. Equipment for utilites	328,250
Reserve for unforeseen equipment	187,500
Reserve for spare parts	75,000
Installation materials	387,500
Cost of equipment F.O. B.	3,792,500
Cost of equipment C.I.F. (25 percent F.O.B. cost)	4,740,625
Handling charges in Algeria	125,000
Installation charges	250,000
Total installed cost of equipment	5,115,625

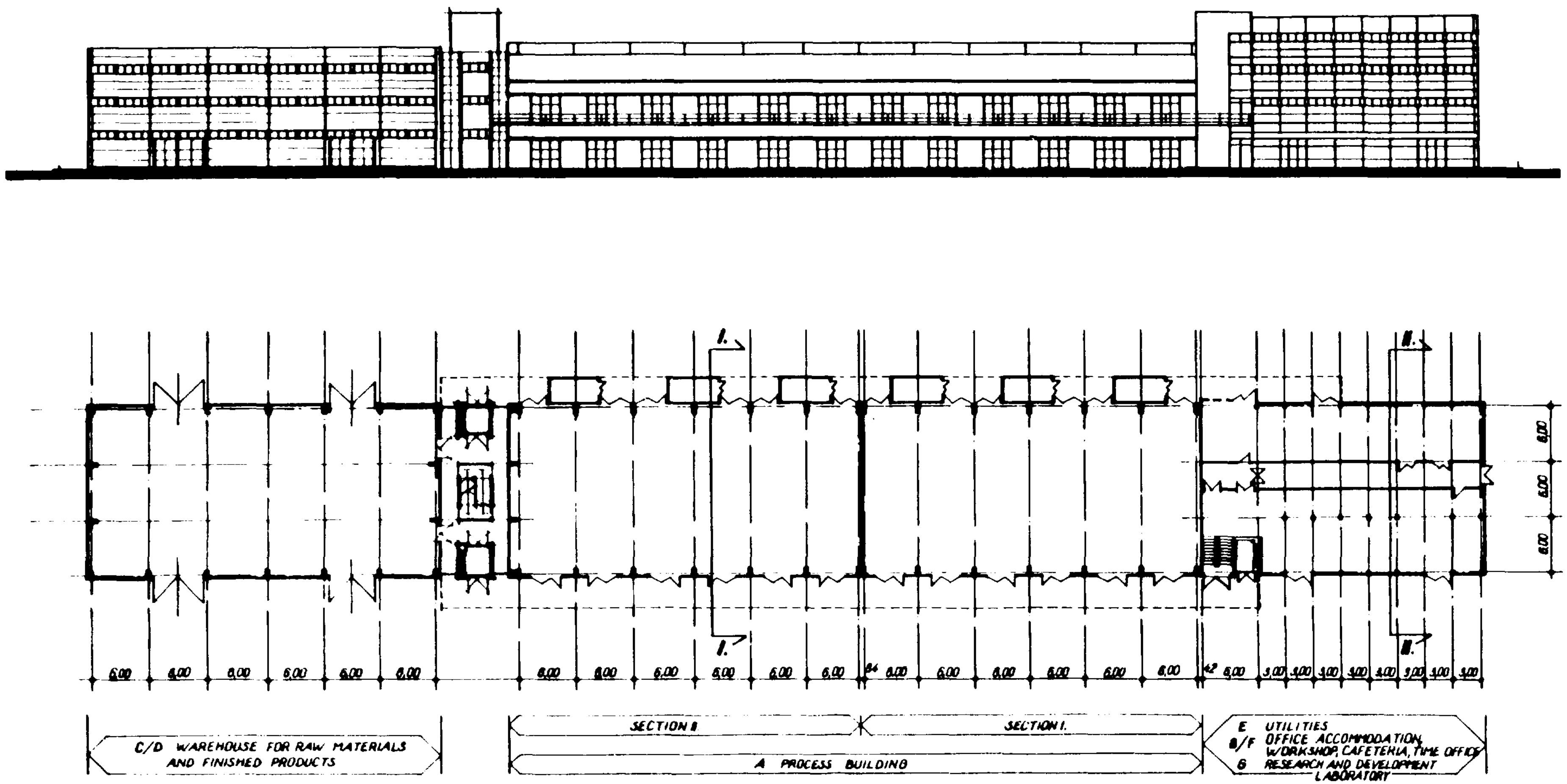
Annex 10

ESTIMATED COST OF THE PROJECT

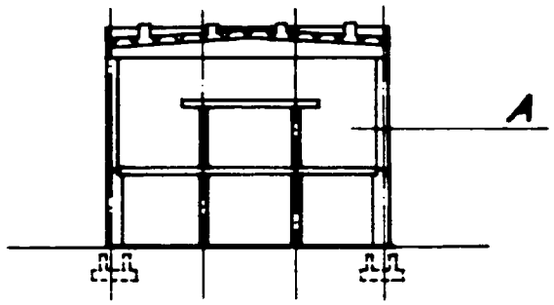
Particulars		US $
Installed cost of equipment		5,115,625
Cost of civil construction		5,008,000
Transfer of Technology - technical know how		944,375
	Total	11,068,000

Multipurpose Pharmaceutical Hall

Lay-out



SECTION I.



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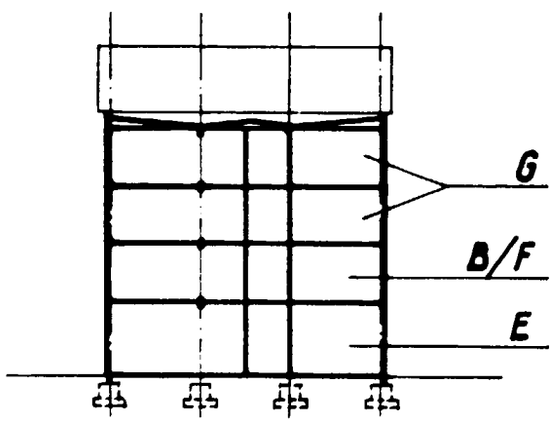

Multipurpose Pharmaceutical Production Plant
Site plan