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INVENTORY OF ROMANIAN CHEMICAL AND PETROCHEMICAL TECHNOLOGIES*

Prepared by

Gheorghe Ivanus**

* The views expressed in this paper are those of the author and do not necessarily reflect the views of the Secretariat of UNIDO. This document has not been edited.

** Petrochemical process counsellor, IPROCHIM (Romanian Engineering Company for the Chemical Industry).

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I. NOTE

This catalogue is an attempt to promote on a practical basis economic and technical cooperation among developing countries.

This catalogue not only brings out, in a consolidated manner, the export potential of the Romanian chemical and petrochemical industry, but also points out the cooperation possibilities in the above-stated industry.

The catalogue is expected to be an instrument for promoting South-South cooperation at various levels. It would not be possible, at this stage, to have an exhaustive inventory of all chemical and petrochemical industrial capabilities in Romania.

The aim is to up-date it later on, not only in terms of sectors coverage but also in terms of the basic preoccupations and queries faced by the so-called recipient country/partner even at the planning stage, when there is a need to determine which type of industry is desired and all the requirements involved to start negotiations with other potential partners.

This catalogue was carried out by IPROCHIM (Romanian Engineering Company for the Chemical Industry) under the supervision and general guidance of Dr.Eng. Gh.Ivanus, petrochemical process counsellor, specialist in the field of monomers, plastomers and elastomers.

II. SECTORS COVERED BY THE CATALOGUE

The catalogue inventory covers the sectors listed beneath:

1. Petrochemical Industry
   - Synthesis Monomers
   - Plastomers and Elastomers
   - Chemical Fibres
   - Rubber and Plastics Processing

2. Basic Chemical Industry

- Chemical Synthesis Products
- Pharmaceuticals
- Organic Dyestuff
- Chlorinated Products

3. Inorganic Industry

- Fertilizers
- Inorganic Products
- Inorganic Pigments

4. Utility and Services

- Industrial Power Stations
- Water Treatment Facilities
- Solid Materials Loading, Unloading, Storing and Transport Installations
- Maintenance and Repair Facilities

III. HOW TO USE THE CATALOGUE

When an industrial opportunity arises, the entrepreneur or person responsible for administering an interested department should address his inquiry to IPROCHIM - Romanian Engineering Company for Chemical Industry.

To obtain an earlier and more effective reply, inquiries should generally be sent in after certain key parameters have already been defined, such as for instance, raw materials to be used, intended capacity, specifications of final product, etc. In many cases, indeed, the first step of all is precisely that of characterizing the raw material, as in the case of monomers synthesis. There are a number of firms and research institutes in a position to carry out the necessary tests.

If the idea of the industry is still in embryonic stage, the best thing to do is to get in touch with IPROCHIM which has experience in the chemical and petrochemical sector. It will

then be possible to define industrial parameters on the basis of which pre-feasibility and/or feasibility studies would be prepared.

A number of companies from Romania are prepared to send technicians for consulting activities abroad to carry out diagnoses on the spot. They are likewise prepared to receive visitors and draw up a suitable program of technical visits.

Generally speaking, IPROCHIM - Romanian Engineering Company for Chemical Industry is in a position to set up "integrated"or "turn-key" projects capable of meeting the requirements of the developing countries. This does not, however, mean that local organizations could not also be included to perform, for instance, civil works (sheds, buildings, equipment foundations), erection activities and so on.

Some such organizations receive trainees and provide training courses.

Normally, after the cooperation arrangement has been established, suppliers will provide labor training, pre-operational assistance and start-up facilities. Where necessary, moreover, they may also provide technical assistance in operation.

It is advisable, generally speaking, that interested parties in developing countries make their inquiries as specific as possible and indicate precisely what kind of support they look for.

IV. BACKGROUND

IV.1. General

Romania's economy steadily increasing rate of industrialization as well as its interest in developing existing production capacities and creating new ones in the chemical industry have led to the necessity of giving the engineering activity a proper organisational leadership. To this aim, in 1948 the Institute for Chemical Research and Design - IPROCHIM - was set up for carrying out engineering activities in the field of chemical industry.

IPROCHIM trademark was registered with the Design World Organization for Industry in Geneva, in 1976.

In the course of over 38 years this activity has known a constant development rate and underwent important structural changes, determinated by its ever increasing potential.

At present, IPROCHIM stands for an organization performing engineering activity for the whole chemical industry in Romania. It establishes the most efficient processes, carries out process engineering and technological designs for chemical plants, using efficient and modern machines and equipment. It also prepares designs for specific chemical equipment.

IV.2. Specific Activity - Type of Services

IPROCHIM's activity consists of working out technical documentation and providing the required full services for the implementation of chemical and petrochemical plants and factories as follows:

- Opportunity and profile studies
- Plants site studies
- Prefeasibility and feasibility studies
- Technico-economic studies
- Tender specifications for equipment
- Technical reports
- Technical offers for chemical and petrochemical plants
- Licence documentation
- Analyses of offers
- Basic engineering
- Detailed engineering designs for process plants, in the following special activities: process, erection, automation, electric installations, constructions, architecture, heating-ventilating system, utility network, a.s.o.
- Full organization of chemical platforms with utility sources, transport, maintenance and repairing of units and equipment, electric and automation equipment, etc.
- Management organization of operation and maintenance in the chemical plants and factories.

- Organization of manufacture control laboratories of chemical processes.

- Design of specific units other than the standard ones.

- Expertises of operating process plants and re-construction for their up-dating.

- Technical assistance for construction, erection and commissioning of some process plants.

- Assistance for procurement of various units and equipment in case of contracts of licence and basic engineering.

- Replicas, models of units, piping and automation lay-out and erection, at various scales.

IV.3. Technical Potential

Home activity

As regards its technical potential, IPROCHIM employs specialists selected from graduates of the Polytechnic Institutes and State Universities.

Some of its specialists are involved in a rich activity of operation in various specific plants.

IPROCHIM may collaborate with the Central Institute for Chemical Research, laboratories and research organizations from Polytechnic Institutes and Universities, so that when complicated technical problems arise these organizations are contacted for solving them by research works in laboratories or the pilot plants.

Meanwhile, as a State enterprise, IPROCHIM can approach all available technologies and techniques of Romanian chemical plants and make use of their know-how and licences.

All along its activities, IPROCHIM's engineers have specialized in chemical technologies, have always been present at all important events occuring in Romania, in the field of the chemical and petrochemical industry, whenever important technical decisions have been taken.

Technical Cooperation Abroad

It is worth mentioning the cooperation between IPROCHIM and licence-holding companies or well-known engineering companies in order to set up projects of great capacity at a high technical level. Among the licence-holding and engineering companies IPROCHIM has collaborated with, in preparing designs for fertilizer and inorganic industry, petrochemical and organic industry, the following are mentioned:

- Lurgi, Hoechst, Continental, Uhde, BASP - F.R.Germany
- Davy Mckee, Kellogg, Petrotex, Dow-Chemical, Houdry, Scientific Design, Tenneco - U.S.A.
- Grande Paroise, Kaltenbach, Rhone-Poulenc - France
- Chemie Linz, VEW - Austria
- Mitsui, Mitsubishi, Japan Steel Co. - Japan
- Montedison, Snamprogetti, Pirelli, Ballestra, Orontio De Nora - Italy
- I.C.I., Simon-Carves, Petrocarbon, Humphreys and Glasgow - Great Britain
- Badger, Stamicarbon - Netherlands

Considering the experience and technical capability of IPROCHIM a number of UNIDO experts were selected from our multi-specialized staff.

Even before this, Romanian experts were asked to carry out studies for UNIDO, attended simposia (Kiew and New Delhi in 1971, Bucharest - 1972, Warsaw - 1973, Helsinki - 1974, Vienna - 1975 and 1977, Innsbruck - 1978, Vienna - 1985, 1986 and 1987) and prepared and dispatched many technical papers to this organization,

IV.4. Organization of IPROCHIM

In order to make its activity as operational and efficient as possible, IPROCHIM is divided into several departments - as listed below:

IV.4.1. Process engineering department, covering the process design, process erection and laboratories. It has several divisons, such as:

Petrochemicals, rubber and plastics

Steam cracking plants producing ethylene, propylene, butylene, butadiene, isoprene, benzene, toluene and xylene, as raw materials for the industry of:

- monomers (styrene, propylene oxide, propylene glycol, ethylene oxide, ethylene glycol, vinyl chloride etc.)
- plastics (polyolefins, polyvinyl chloride, polyvinyl acetate, polystyrene etc.)
- rubber (polyisoprene, polybutadiene, styrenebutadiene, ethylene propylene, nitrilic thermoplastics)
- artificial and synthetic fibres
- rubber and plastics technical items and different types of tyres

Organic synthesis

- organic products from fine synthesis
- intermediate dyestuffs, pharmaceuticals, cosmetics, resins, paints and varnishes
- chlorosodium products
- pesticides.

Inorganic chemicals and fertilizers

Soda products and inorganic acids and salts, ammonia nitrogen and phosphatic complex fertilizers.

IV.4.2. Detailed engineering department covering: automation, mechanization, specific units, constructions (lay-out and construction-architecture), general installations (water supply and sewer systems, heating-ventilation system), electric installations, thermal installations, technico-economic calculation

Besides the design activity itself, IPROCHIM includes also the following:

Computing center that makes use of -up-dated instruments to achieve calculation of processes, equipment, erection, economic analyses, etc. on the basis of computer programmes carried out by the company's experts.

Modelling section in which process plants are devised to be achieved on the basis of model technique.

Prototype section for studying and testing new equipment designs, meant to obtain basic data for the large-scale equipment.

IV.5. Achievements

During its 4o years old activity, IPROCHIM has implemented a great number of projects in the chemical industry. Hereunder are briefly listed the most important sectors dealt with either in Romania or abroad.

IV.5.1. Petrochemical, rubber and plastics plants

IV.5.1.1. Monomers and basic intermediates

Boasting a tradition spread over several decades in the field of hydrocarbons processing and having its own sources to meet the domestic requirements, Romania focused its strategy on the development of modern chemical and petrochemical industry along two main directions: on the one hand the high processing of methane gas and higher hydrocarbons coming from local sources and on the other hand those resulted from the complex processing of crude.

The complex activity of "Monomers and Basic Intermediates" Department within IPROCHIM ensured the development of a basic structure covering the most important products necessary to the modern chemical and petrochemical industry.

For the progress of the Romanian monomers and basic intermediates industry, a main part was played by the research and design activity under the control of the Central Chemical Institute as well as by the cooperation with renowned companies abroad specialized in the field of chemical engineering and basic processes.

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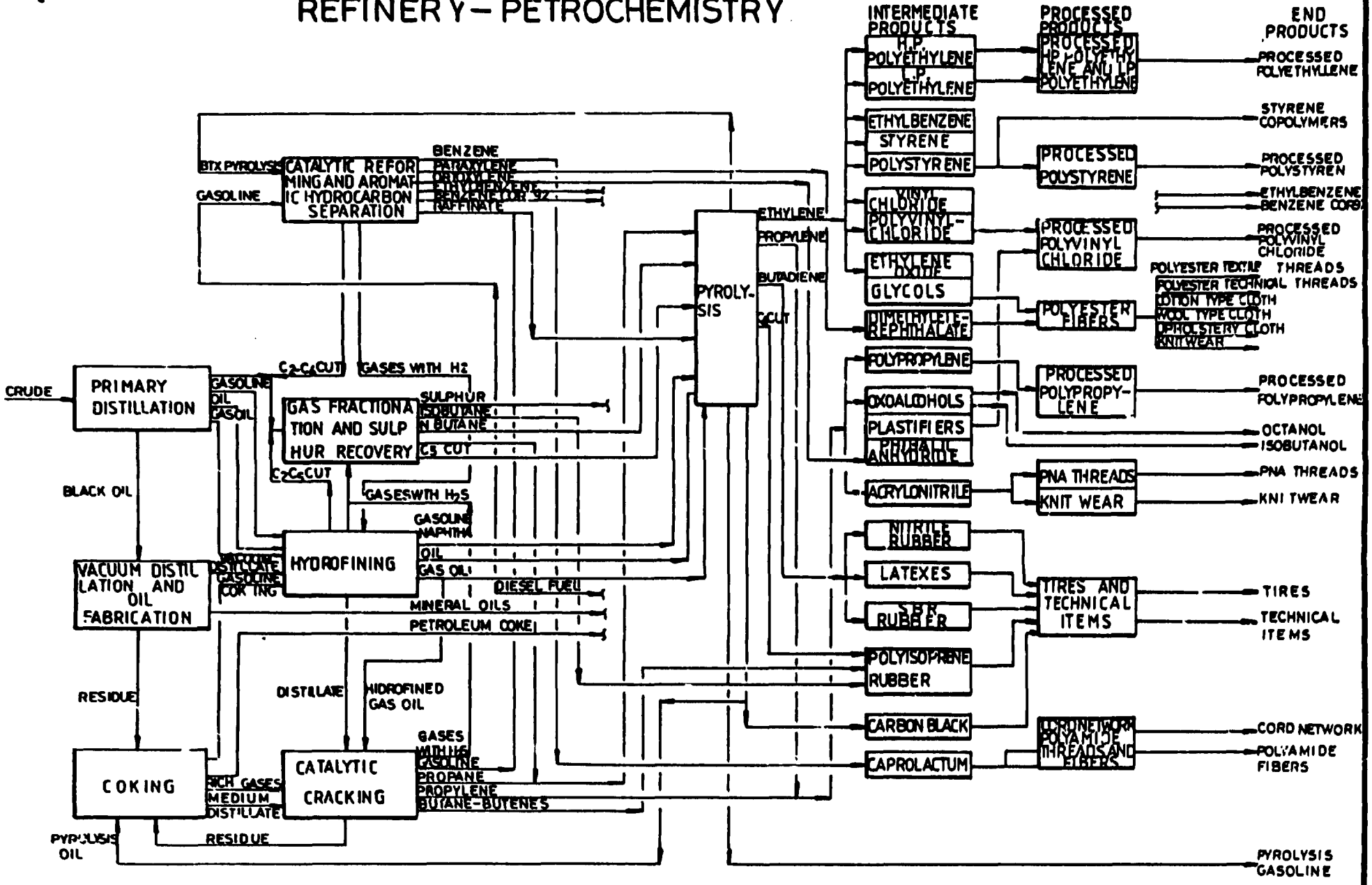
FLOW DIAGRAM OF AN INTEGRATED COMPLEX REFINERY – PETROCHEMISTRY



As this sector represents the border line between the primary energies, raw materials and chemical and petrochemical products, the specialists in this field were particularly concerned to find solutions to the most important questions, critical to the development of other industrial branches too.

This activity made it possible to design and build specific equipment on the basis of high techniques, to grant technical assistance, to train the necessary personnel according to most demanding principles on world market to produce a wide range of monomers and basic intermediates.

At present, the production achieved in this field ensures a wide range of products which lead to the development of synthetic fibres, plastics, elastomers, pesticides, herbicides, pharmaceuticals, stapels, a.s.o. A powerful basis of monomers and basic intermediates was thus achieved meeting, virtually, at present, the demands of all fields of the national economy, part of them being exported to other continents, as they are competitive with similar products made by famous companies throughout the world.

Hereinunder are described the main plants designed and built by this sector in the last 3o years.

Methane gas processing

The fundamental principle laying at the basis of the methane gas processing units was the development of technological and energy integrated complexes aiming at optimizing the balance of primary elements - carbon and hydrogen - by including into the production programme two groups of plants, namely: basic plants and secondary plants (processing semifinished or co-products). The main plants operate or can operate through cooperation assuring the equilibrium between the process and power balance of primary elements by production and consumption of CO, CO_2 and H_2. This group covers the following plants of: methanol, ammonia, acetylene (thermooxidating process), blow-off gas recovery, (from ammonia, methanol, acetylenes), "CO" consuming plants (carbonylations for the fabrication of organic acids, oxo-alcohols, etc.) and other CO_2 consuming plants.

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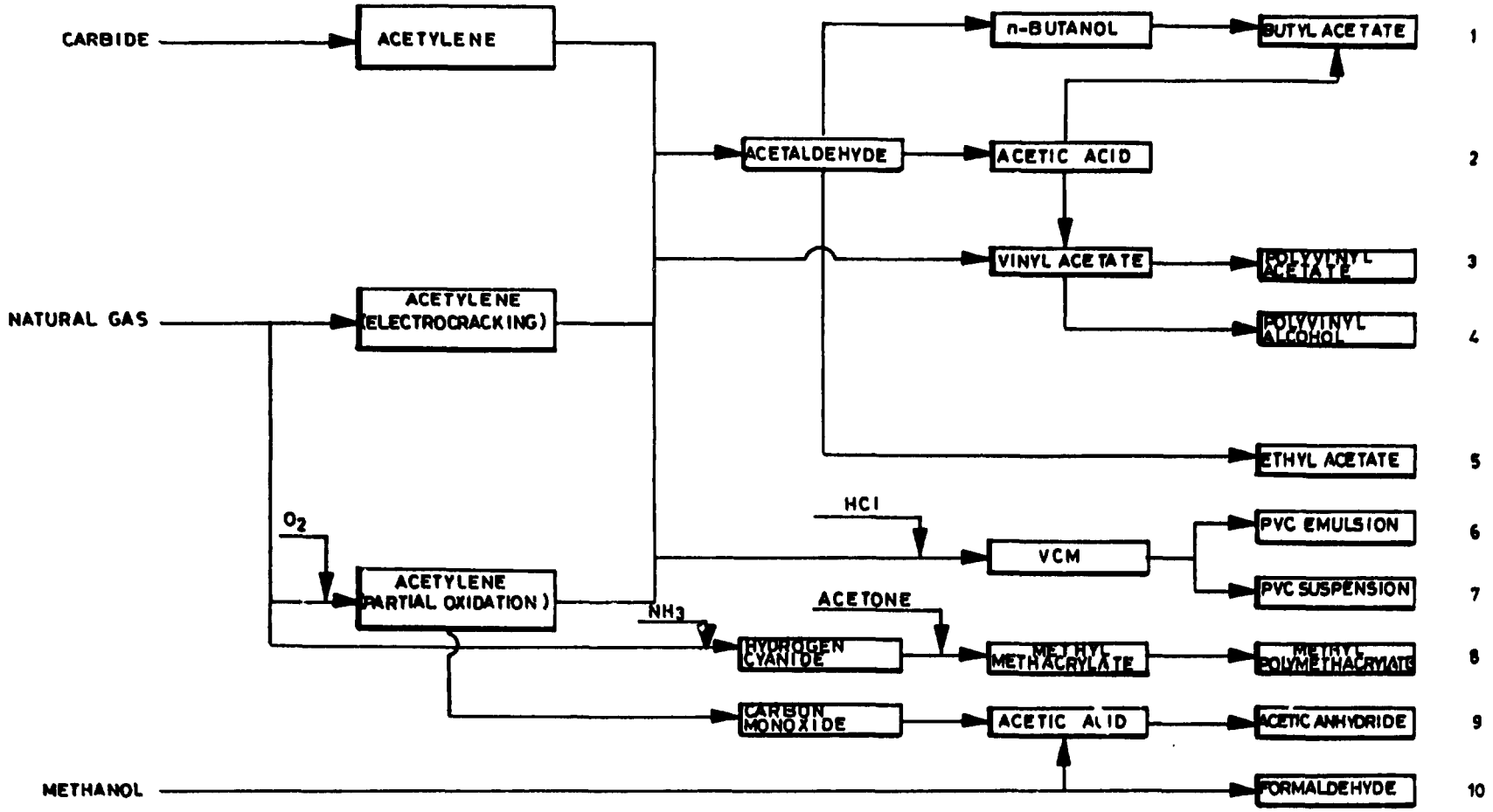
METHANE AND ACETYLENE UTILIZATION



Hereinunder are given the plants designed by "Monomers" department within IPROCHIM.

Acetylene produced by thermal oxidisation processes with controlled combustion according to a Romanian technology. The following products are obtained by successive processings from acetylene:

- vinyl chloride by hydrochloric acid addition
- acetaldehyde by catalytic hydration in the presence of mercury-based catalysts
- acetic acid from acetaldehyde by catalytic oxidation with oxygen
- vinyl acetate by direct catalytic synthesis from acetylene and acetic acid
- polyvinyl acetate and polyvinyl alcohol by vinyl acetate polymerization.

A wide range of products can be obtained from acetaldehyde by industrial processing, of which:

- n-butanol by aldocronization of acetaldehyde
- low tonnage products, namely : methylethylpyridine, nicotinic acid, isonicotinic acid, alphapicoline, a.s.o.

Carbon monoxide used at methanol carbonylation to obtain acetic acid is separated from synthesis gas coproduct from acetylene fabrication by thermo oxidation process. Acetic acid is further processed by vinylacetate synthesis and for the production of the following more important products:

- acetic anhydride by pyrolysis
- acetic esters, such as: methyl acetate, butyl acetate, a.s.o.

The following intermediate products are also obtained from methane gas:

- hydrocyanic acid by Andrusow process used for the fabrication of a wide range of pesticides and herbicides
- carbon black by incomplete burning of methane as such or mixed with various oil or coke-chemical cuts, an essential product for rubber processing industry.
- synthesis gas ($CO + H_2$ mixture) by incomplete burning of methane gas for propylene hydroformilation and oxoalcohol production.

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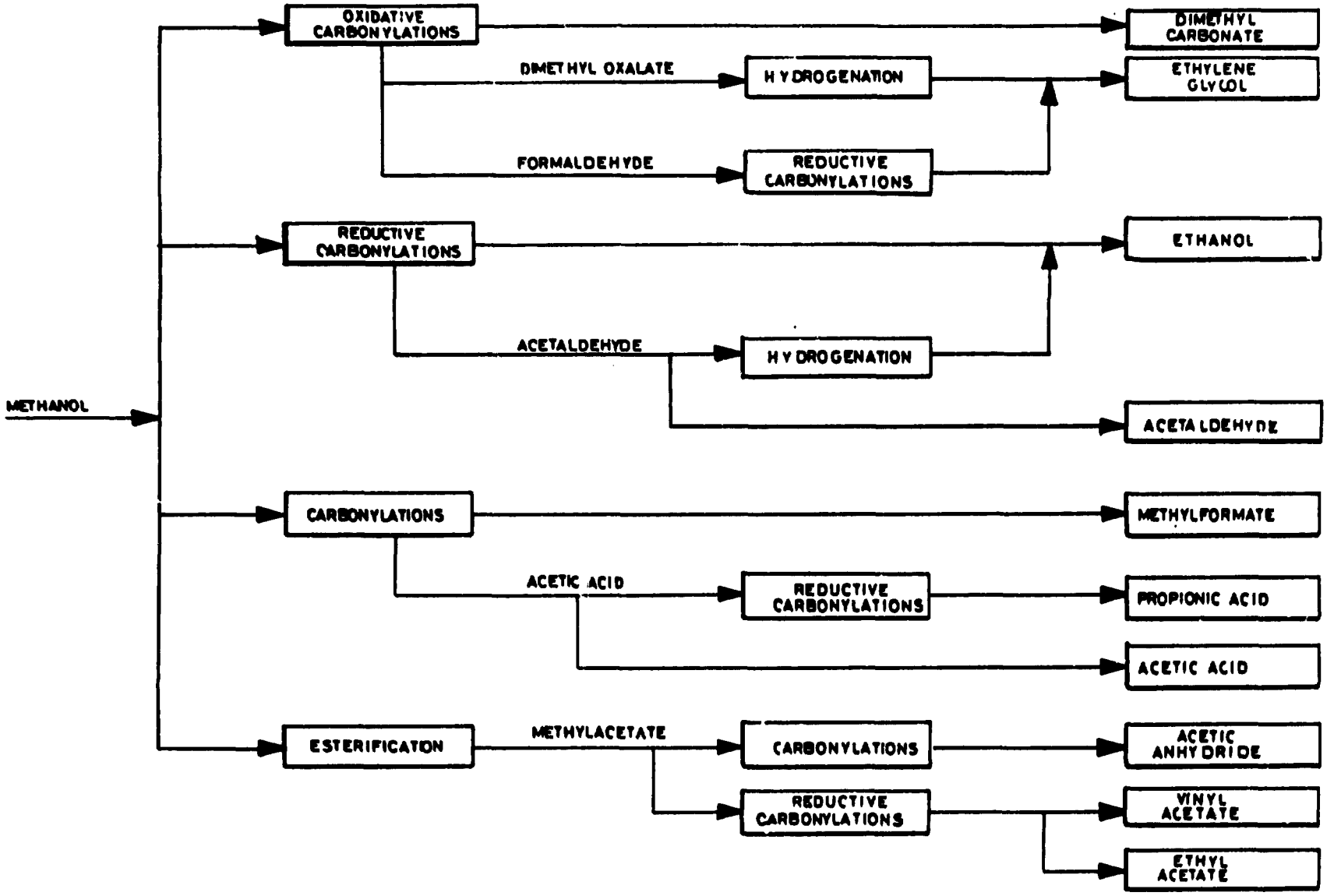
CHEMICALS FROM METHANOL



All the industrial plants implemented in our country for the chemical processing of methane gas are based on Romanian technologies competitive on world scale.

Chemical processing of higher hydrocarbons

Concurrently with the concern for the chemical processing of higher hydrocarbons, the crude oil processing industry was up-dated, reorganized and developed to provide high quality basic intermediates under economically convenient conditions.

The refineries integrated within petrochemical complexes made it possible to obtain main intermediates, as follows:

- by cracking gas and liquid hydrocarbon fractions in the presence of water vapours yielding C_2-C_4 olefines, C_5 and C_6-C_8 fractions, benzene, toluene, xylene. For the last 3o years, the whole basic organic chemical industry knew an unprecedented development on the basis of these leading products thus providing the intermediates necessary for plastics, elastomers, synthetic fibres industries down-streams petrochemicals products and other branches of chemical industry.

Separation, fractionation and chemical processing of associated gases resulted from primary and secondary crude processing which made it possible tc develop the following technological processes and main units:

- n-butane separation and isomerization to isobutane by the processing of which one can obtain alkylate for motor gasoline isoprene, isobutylene by which hydration one obtains tertiary butyl alcohol, copolymers and polymers in rubber industry

- separation and processing of n-butylene as follows:

-oligomerization in order to obtain C_8-C_{12} oligomers, amination and the production of tertiary-butylamine, hydration into butylenes and the production of methyl-ethyl ketone and secondary butyl alcohol.

Phenolalkylation to yield orthosecondarybutylphenol. Oxidation of n-butenes and production of maleic anhydride.

- dehydrogenation of n-butenes and n-butane and separation of butadiene through extractive distillation in order to obtain intermediate butadiene essential for the production of elastomers, latexes and other petrochemical goods.

Hereinfurther are mentioned the main fields to turn these intermediates to better uses by chemical processing in the Romanian industrial plants.

Ethylene derived products

Ethylene processing leads to the production of a wide range of products necessary to various economic branches of which we mention:

- ethylene chlorination to vinyl chloride yields vinyl chloride used in the polymerization and copolymerization processes
- ethylene reaction with benzene yields ethylbenzene, which by dehydrogenation gives styrene, a basic monomer for polymers and copolymers industry, elastomers, synthetic fibres, ion exchangers industry a.s.o.

All these processes are based on Romanian technolgoies and are successfully applied in several industrial plants.

- catalytic oxidation of ethylene yields ethylene oxide basic intermediates in synthetic fibres industry, low tonnage industry and others such as: catalytic condensation of ethylene oxide with carbon dioxide, yields ethylene carbonate; ethylene oxide condensation with various alcohols (ethyl, butyl alcohol, ethyleneglycol and others) yields ethoxylated products required by drilling, detergents, mining, transport industries and other fields.

An important field for ethyleneoxide use is ethanolamine fabrication (mono-di-and triethanolamine) by ammonia synthesis.

The most important field for ethylene utilization is the production of plastics, namely, high pressure and low density polyethylene and low pressure and high density polyethylene.

There are also several other applications of ethylene which could not be mentioned in this chapter.

Propylene-derived products

Propylene processing yields some very important products of which we mention:

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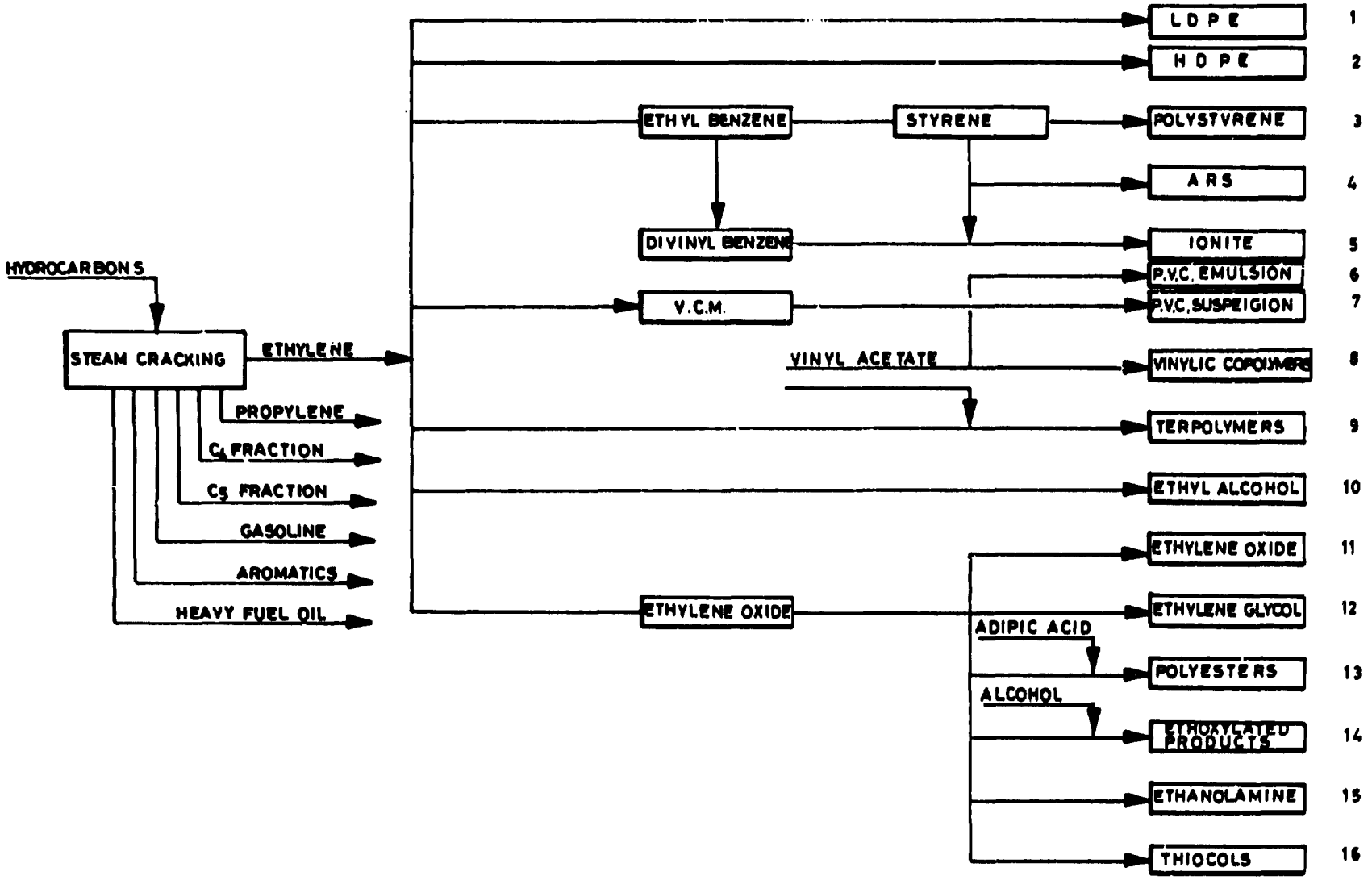
ETHYLENE UTILIZATION



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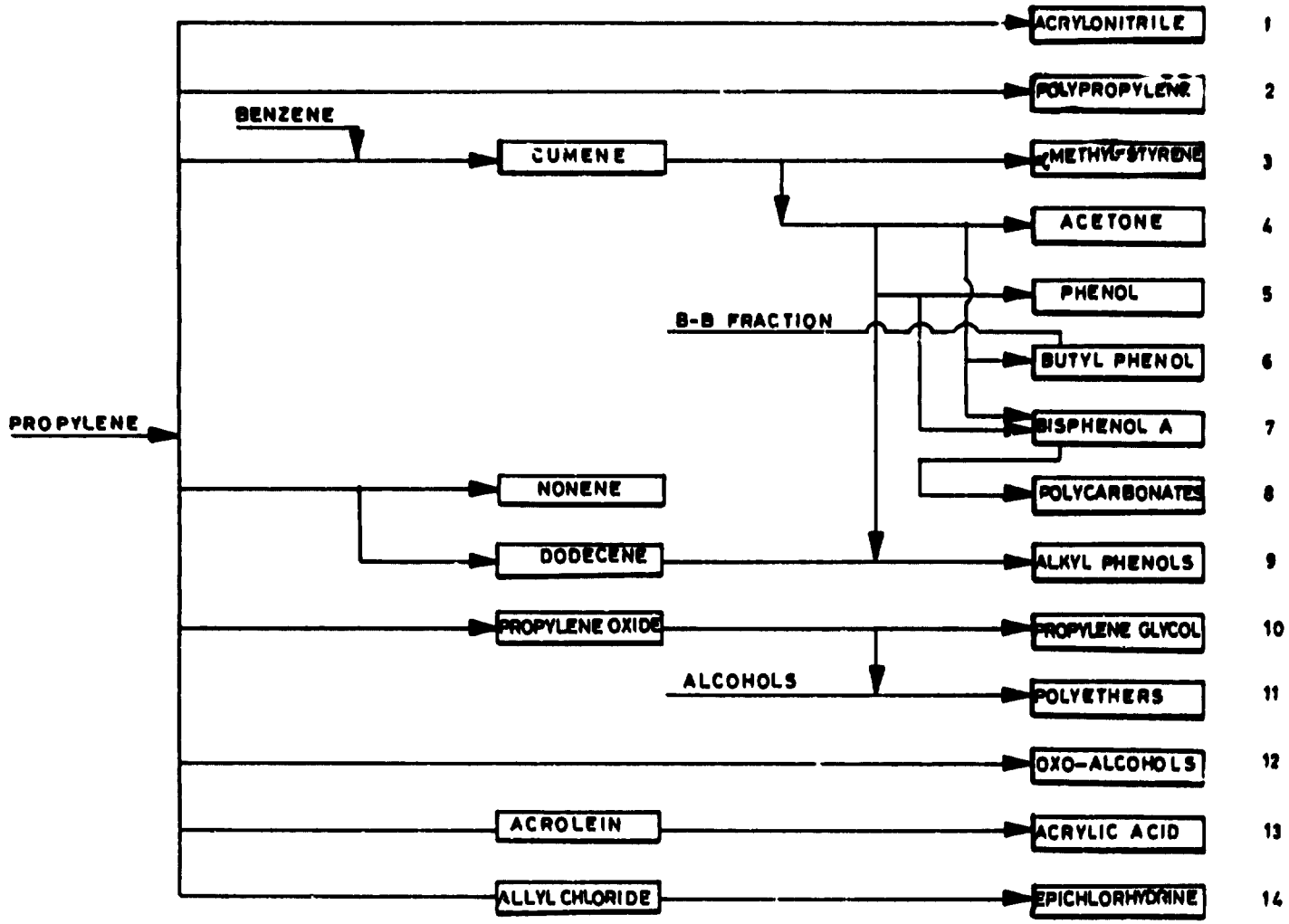
PROPYLENE UTILIZATION



- propylene polymerization in the presence of Ziegller-Natta catalysts represents a significatnt field for the utilization of this valuable raw material.

- the reaction between propylene ammonia and air in the presence of specific catalysts gives acrylonitrile, a basic monomer indispensable to the industry of elastomers, synthetic fibres and many other fields (i.e. acrylamide fabrication)

- benzene alkylation with propylene gives isopropylbenzene which, oxidized to benzene isopropyl hydroperoxide and then further decomposed on phosphoric acid, yields two basic intermediates for a wide range of synthesis products: acetone and phenol with wide application fields in all branches of chemical industry

- phenol alkylation with nonen and dodecen cut in the presence of specific catalysts according to a Romanian process yields alkylphenols, basic intermediates for the synthesis chemical industry.

- propylene hydroformilation with synthesis gas yields n-butanol, iso-butanol and 2 ethyl hexanol (oxoalcohols) indispensable to the industries of plasticizers, varnishes, paints, solvents and esters. Propyleneoxide and further propylene glycol and polyethers, basic components in the synthesis of polyurethane foams may be yielded from propylene. Propylene oxidation to acroleine results in acrylic acid used for the production of acrylic esters and methionine widely used by polymers and copolymers industry, pharmaceuticals and low tonnage industry.

Epichlorhydrin particularly used in epoxy resins industry is fabricated from propylene via allyl chloride and allyl chloride dichlorhydrin.

The thermal chlorination of propylene in gaseous phase yields chlorinated solvents, trichlorethylene perchlorethylene, carbon tetrachlorideethylene.

Products derived from C_4, C_5 cuts

The most important sources for the production of C_4 cut for chemical processing are the pyrolyis, catalytic cracking of vacuum distillate, catalytic reforming of gasoline units.

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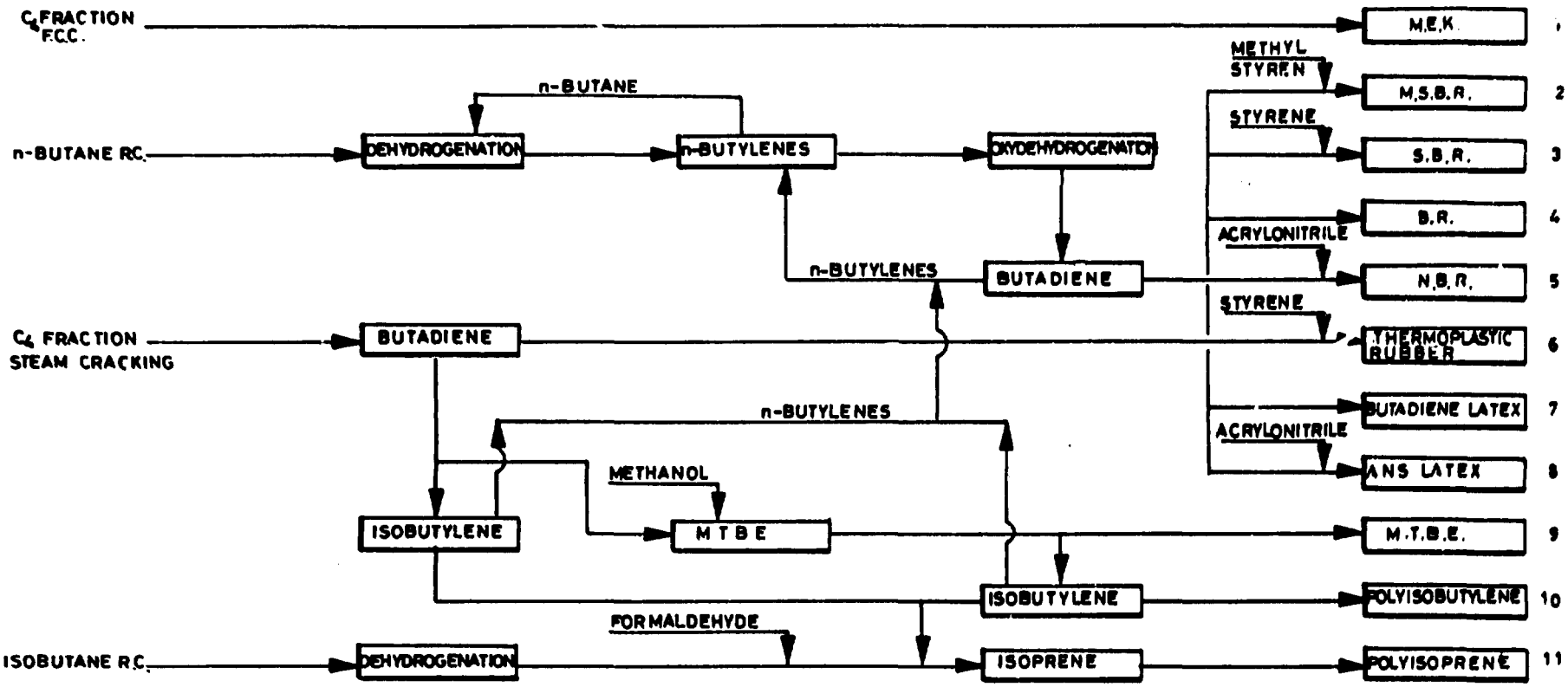
C_4 FRACTION UTILIZATION



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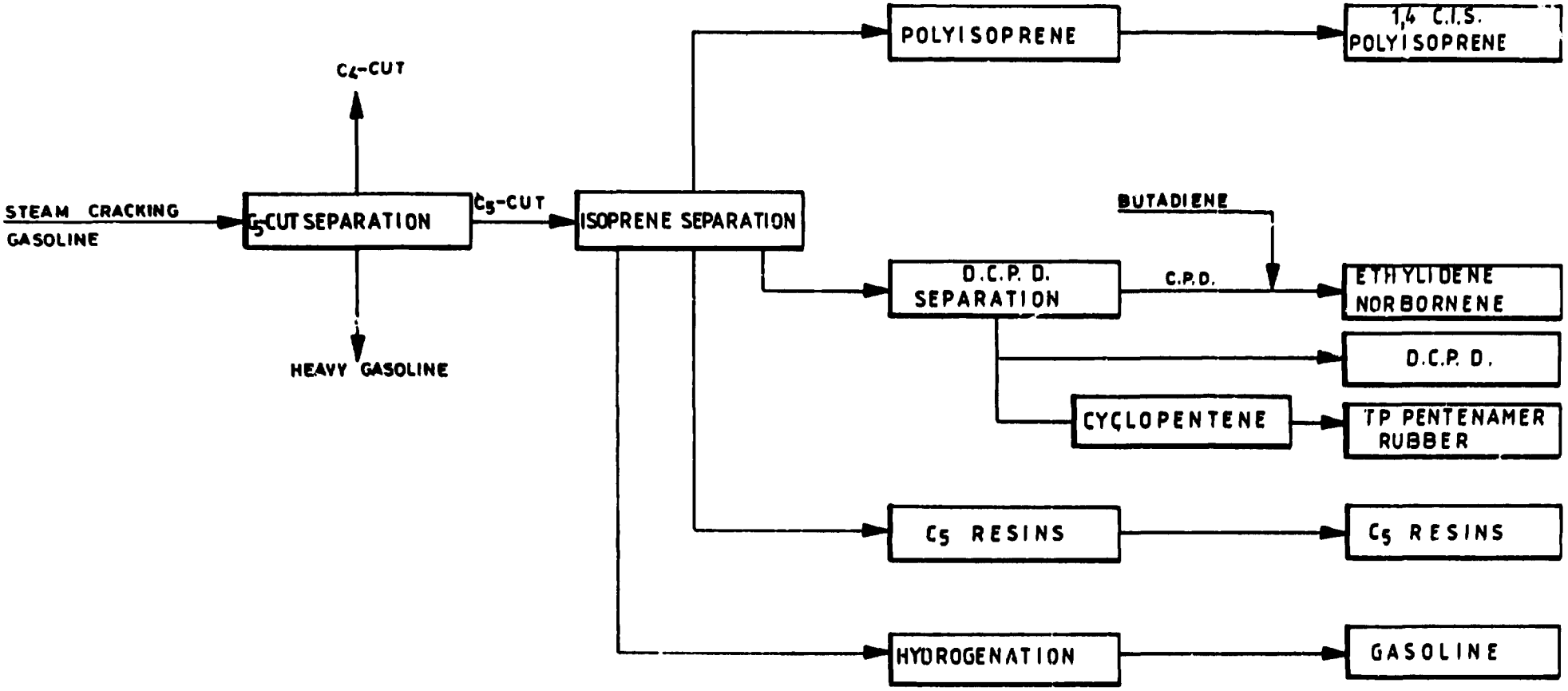
C5 FRACTION UTILIZATION



These cuts are separated by extractive distillation or pure rectification.

- The most important component of C_4 cut is butadiene separated from C_4 pyrolysis cut after dehydrogenation (oxydehydrogenation) of butenes by extractive distillation with a special solvent.

- Butane (iso-and n-butane) separation is performed by extractive distillation with selective solvents.

- Isobutene separation from C_4 cut is carried out by sulphuric acid extraction.

- Dehydrogenation of n-and iso-butane for the production of iso and n-butenes is performed catalytically yielding butenes and isobutenes.

- Dehydrogenation of n-butenes to obtain butadiene is performed catalytically by oxydehydrogenation.

Particular attention is paid to separation and turning to better uses C_5 cut from pyrolysis gasoline in order to recover isoprene and other valuable components from this cut, namely: isoamylenes, cyclopentanes, cyclopentadiene, piperelenes and others.

Products derived from BTX cut

Among the products obtained from the pyrolysis plant, besides olefines, butadiene and isoprene, great importance is given to the aromatic hydrocarbons (BTX cut) as well as to the aromatic cuts coming from the secondary processing of refinery crude. Benzene is the most valuable component. The amount of benzene obtained by BTX cut processing cannot meet the demands of the consumers. Due to this reason, benzene production was increased by building some industrial plants for the dealkylation of the toluene separated from BTX cut (Detol process) and by the dealkylation of the whole BTX cut (Pyrotol process).

The main benzene consuming industrial plants are: caprolactum, ethylbenzene, phenol. The following processes are also obtained from benzene:

- monochlor benzene by benzene chlorination

- linear alkyl benzene by benzene alkylation with n-paraffines.

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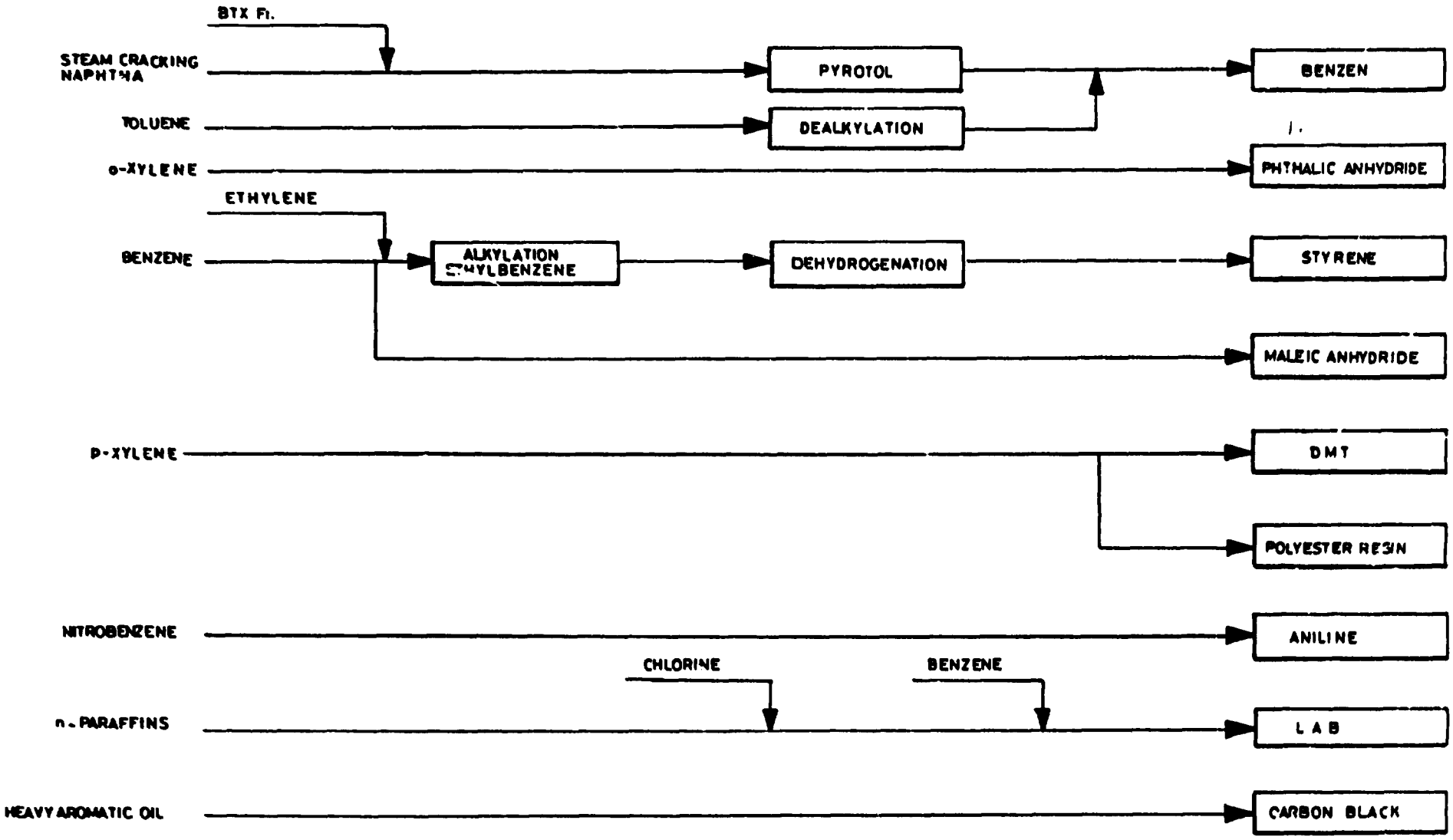
AROMATICS UTILIZATION



- maleic anhydride by catalytic oxidation of benzene (there are several such industrial plants)

- aniline by nitration and hydrogenation of nitrobenzene obtained by nitration.

Among the aromatics separated from BTX cut special importance is given to the paraxylene necessary for DMT production (Dimethylterephthalate) for which there are several plants built in Romania to make the basic intermediate for the production of polyester fibres.

Orthoxylene, also separated from BTX cut is used for the production of phthalic anhydride by catalytic oxidation with air. From phthalic anhydride, a wide range of plasticizes (C_2,C_4,C_7, C_8,C_9 phthalates) can be yielded by condensation with oxo alcohols, polyester resins and alkyl resins.

IV.5.1.2. Polymers Field

In the field of polymers production, the Romanian petrochemical industry acquired a rich experience of over 3o years due to the annual outputs achieved, the applied processes and the numerous plants put into operation.

Based on its own processes as well as on licences purchased from well-known foreign companies, the Romanian petrochemical industry produces the main plastics.

In order to offer a comprehensive view of the Romanian experience in the field of polymers production, herebelow is the list of the main products fabricated:

- Polyvinyl chloride - by suspension and emulsion polymerization yielding PVC in several plants equipped with lines ranging from 18,ooo t/y to 5o,ooo t/y

- Low density polyethylene obtained in several plants equipped with lines ranging from 12,ooo t/y to 6o,ooo t/y making use of high pressure reactors (autoclave type or tubular ones). All types of polyethylene are fabricated including copolymers with special application

- High density polyethylene is produced in several plants running on lines of 3o,ooo t/y and 6o,ooo t/y using the suspension polymerization process with super reactive catalysts of Ziegler-Natta type in autoclave reactors at low pressure. Both homo-and-co-polymers of all grades known in the world are being produced (injection, extrusion, fibres etc.)

- Polypropylene - there are fabrication lines of 60,000 t/y using polymerization reactors of autoclaves type for suspension polymerization at low pressure in the presence of Ziegler-Natta catalysts. All types of homo- and co-polymers are fabricated.

- Polymethyl methacrylate - installed capacity 15,000 t/y It is produced in several plants using suspension or block polymerization processes. Several grades are fabricated among which those with special application (aircraft).

- Polystyrene and styrene copolymers - the process used is suspension or emulsion polymerization (copolymers). Several plants of 15,000 t/y and 25,000 t/y are in operation yielding several grades of polystyrene and copolymers.

IV.5.1.3. Elastomers

Romania has developed a strong industry for the production of synthetic rubbers and main monomers including: butadiene, isoprene, styrene, methylstyrene, acrylonitrile etc. This industry offers a wide range of products coping with the domestic requirements for synthetic rubbers (over 90%) meeting also some export demands and making a good name on the foreign market.

The synthetic rubber industry was set up in Romania in 1963 when the I-st plant for the production of butadiene-methylstyrene type synthetic rubber obtained by emulsion polymerization at low temperature of butadiene with methylstyrene was commissioned. The initial capacity of 50,000 t/y was extended to 100,000 t/y butadiene-methylstyrene rubber. After 1980 a new plant of 50,000 t/y was commissioned producing styrene-butadiene rubber by emulsion copolymerization at low temperature of butadiene and styrene. Polybutadiene rubber production started in 1983 when a 30,000 t/y rubber plant based on solution polymerization of butadiene was commissioned. The butadiene necessary for the production of rubber is obtained by butane-butenes dehydrogenation as well as by C_4 cut separation from pyrolysis.

The plant of 60,000 t/y polyisoprene rubber was commissioned based on solution polymerization of isoprene. The required isoprene is obtained by isobutene condensation with formaldehyde

via dimethyldioxane. Another plant of 30,000 t/y polyisoprene rubber using isoprene by separation of C_5 cut from pyrolysis.

In Romania there is also a plant for the production of ethylene-propylene rubber and a plant for the fabrication of various grades of synthetic latexes (polybutadiene, butadiene-styrene, butadiene-acrylonitrile carboxilated latex).

The butadiene-acrylonitrile and thermoplastic rubber processes are now under way of being put into operation.

IV.5.1.4. Synthetic Fibres

The intense activity of synthetic fibre department within IPROCHIM contributed to the implementation of a strong industry in this field offering thus an efficient way to turn to better uses the products of petroleum industry.

Particular attention was focused on synthetic fibres within the development of Romanian chemical industry acquiring an experience of over 30 years regarding the research, design and building of up-to-date plants making high quality products.

A permanent research activity carried out by a large number of specialists is directed to improving the existing processes as well as to developing new top processes covering, at present, all the range of synthetic fibres types and grades with wide applications.

The design, construction of equipment specific to the synthetic fibre industry, the technical assistance granted, personnel training according to the best techniques in the world represent a guarantee to meet the quality demands required nowdays.

One of the particular features of the activity of synthetic fibres department within IPROCHIM is the dynamism of choosing modern and multifunctional solutions in full agreement with the specific character of synthetic fibres rendering them useful and attractive, economically convenient and fashionable.

Romania produces the following main products:

MELANA

An acrylic fibre fabricated according to an original Romanian technology. The process is based on the use of ethylene carbonate as solvent to prepare fibre solution.

The process originality confers Melana fibres specific aspect and characteristics as well as the opportunity to work in nonpolluting, nontoxic, unflammable and nonhazardous environment.

Melana is characterized by remarkable physical and mechanical properties and easy textile processability. The fibres are light, warm, pleasant to touch, easy to dye in a wide range of colour shades.

The remarkable properties of Melana fibres make it possible to use them widely in the textile industry, either by processing them as such or mixed with other synthetic or natural fibres.

The grades and types of Melana fibres currently produced are:

- cotton type staple fibres for light cloth
- woolen type staple fibres for fabric, furs, sportswear, curtains, upholstery fabric, filter and protection equipment material
- carpet-like staple fibres
- tops high bulk, white or coloured for woven clothes
- acrylic ropes
- yarns processed with metric number ranged between 18/2 and 40/2 white or coloured.

Melana type acrylic fibres started being fabricated in 1979.

A Romanian - Italian joint venture was set up in 1973 to process acrylic staple into higher yarns.

RELON

Polyamide type 6 fibres and yarns are obtained by caprolactum polymerization. Their high properties (tear resistance comparable to that of steel, friction, strength, stability to light and diluted acids, good textile processability) offer a wide range of application.

The grades range covers the following types:

- cotton like staple for sportswear, protection equipment
- woolen like staple for wooven cloths, furs, decoration articles such as upholstery, covering fabric
- monofilaments such as fishing yarns, strings
- polyfilament yarns for light fabric, sportswear
- textures yarns for fine wooven articles, various textiles
- cord and technical yarns for tires, conveying belt, conveyors, filters, sieves and networks.

TEROM, MOLDOSIN, CORAPET, GRULEN

Romanian polyester yarns are recommended for their outstanding quality being an ideal substitute for natural yarns, i.e. silk, wool or cotton.

Polyester yarns can either be processed as such or mixed with other natural, synthetic or artificial yarns. The articles obtained from Romanian polyester yarns by advanced technologies are attractive, have a good stability, can be coloured in a wide range of colours.

The following grades of polyester fibres and yarns can be obtained:

- cotton like staple yarns for fine woven clothes, sportswear
- woven like staple yarns for carpet, upholstery, technical articles, protection equipment
- linen type staple yarns for textile products and upholstery fabric
- twisted textile threads for light clothes, curtains filters
- texturized textile threads for woven articles, sportswear, furs, upholstery, carpet fabric
- technical threads for conveying belts, filters, networks, fishing articles
- copolyester constractabile threads for synthetic leather

- thermally fixed polyester ropes and tops for high bulk threads.

DURATEX PP

Polypropylene threads with specific properties namely low density, high friction strength, negative electric charge, solvents and chemical substance strength are the result of an original technology with high competitivity parameters elaborated by our specialists.

Polypropylene threads are used as such in various fields to obtain filter cloth as well as by textile industry mixed with other fibres to make decoration articles.

IV.5.1.5. Tyres and Rubber Mechanical Goods

The steady growth of the industrialization rate in Romania and the increasing interest in extending the existing plants and in building new ones in the field of rubber and plastics processing industry led to an equal development of the design activity in this field.

During a period of over 40 years of activity, IPROCHIM developed steadily its activity so that at present it is in a position to work out technical documentation and to grant the necessary services for plant implementation in the field of tyres and rubber mechanical goods.

IPROCHIM is organised according to the specific nature of its activity into sections, one of them being responsible for rubber and plastics processing. This section draws up process and assembling drawings and coordinates the activity of all the institutes involved in the preparation of the design works for:

- tyres
- rubber mechanical goods
- plastics processing goods

Owing to the cooperation with specialized institutes as well as with the Research Institute for rubber and plastics

processing due to the direct contact with the industry and research activity, this section meets the demands as to the preparation of documentation requiring high performance equipment with the following advantages:

- great variety, versatility, for a wide range of tyres, rubber mechanical goods, plastic processed goods, sizes and types of products
- operation efficiency and safety
- mechanization and automation of all operations
- environmental protection and adequate microclimate within fabrication buildings.

The experience acquired over a long design activity in this field as well as the high personnel qualification, the close cooperation with the industry, the research and the specialized companies from other countries are a guarantee for the engineering services offered by IPROCHIM.

IPROCHIM succeeded in increasing the existing plant capacities and in building new plants to produce:

- in the field to tyres, all types, i.e. radial for passanger cars, with metal breker , diagonal for trucks with textile cord radial for trucks with textile cord case and metal cord breker all steel diagonal for tractors and farm cars, radial for tractors (rear wheels), giant tyres and recapped tyres for all sorts of autovehicles;
- in the field of mechanical rubber goods, various types of conveying belts, hoses, fitting and V-belt;
- in the field of plastics processed goods; polyethylene blown foil bags, injection goods, ABS or AS plates, polyethylene and polypropylene tubes, PVC tubes (Bergman and Parizer).

IV.5.2. Organic Chemical Synthesis

For over three decades Romania has been producing a wide range of organic chemical products, the variety and quality of which have been increasing steadily from year to year.

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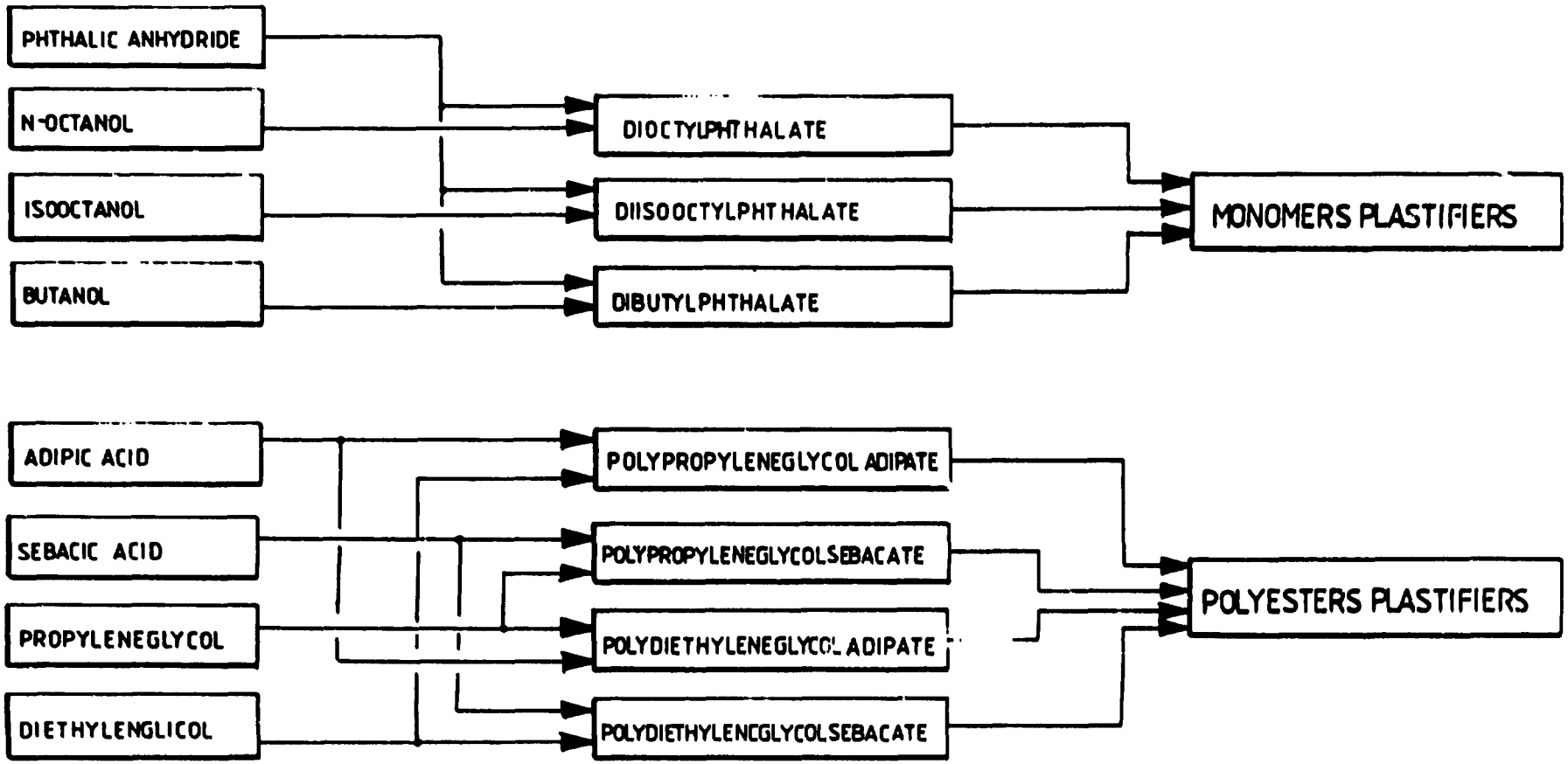
PLASTIFIERS SYNTHESIS



The constant development of Romanian chemical industry has stimulated the research and utilization of domestic processes rendering possible their exportation outside Romania.

The main trends of development of organic synthesis compounds production are focused on products meant for:

- agriculture (herbicides, pesticides and intermediates for their production etc);
- textile industry (auxiliary products, bleaching, softening, wetting agents etc);
- leather industry (intermediates for tanning agents, synthetic tannins, intermediate for synthetic leather etc.);
- rubber and plastics industry (antioxidants, plasticizers, stabilizers for rubber latex, polymerization grade controller, vulcanization accelerators etc.);
- varnishes and dyestuff industry (dyes, solvents, etc.);
- pharmaceutical and cosmetic products industry (intermediates);
- food industry (food preservatives, aroma, dyes etc.)
- pulp and paper industry (binding agents, optical bleaching agents etc.)
- intermediates for the other branches of chemistry (solvents, complexing agents).

The existing plants of which the most usual ones are described in detail in the technical sheets under the speciality volume, are based on Romanian designs protected by patents and may be offered for export.

Thus Romania produces pesticides and intermediates for pesticides (ethylamine, methylamine, diisobutylamine, cyclohexylamine, isopropylamine, orthophenylendiamine, sinoratox, N-ethylcyclohexylamine, carbotox), textile auxiliaries (cation products, acryl copolymers), intermediates for paper industry (bone glue, polyamide, polyacrylamide), selective solvents (ethanol amines, alkylenamine, furfurol, n-butyl acetate etc.) intermediates for polyurethane (polyesters) foames and plastics (plastifiers), fatty materials for detergents (synthetic fatty acids, ethanolamine), antioxidants, intermediates for pharma-

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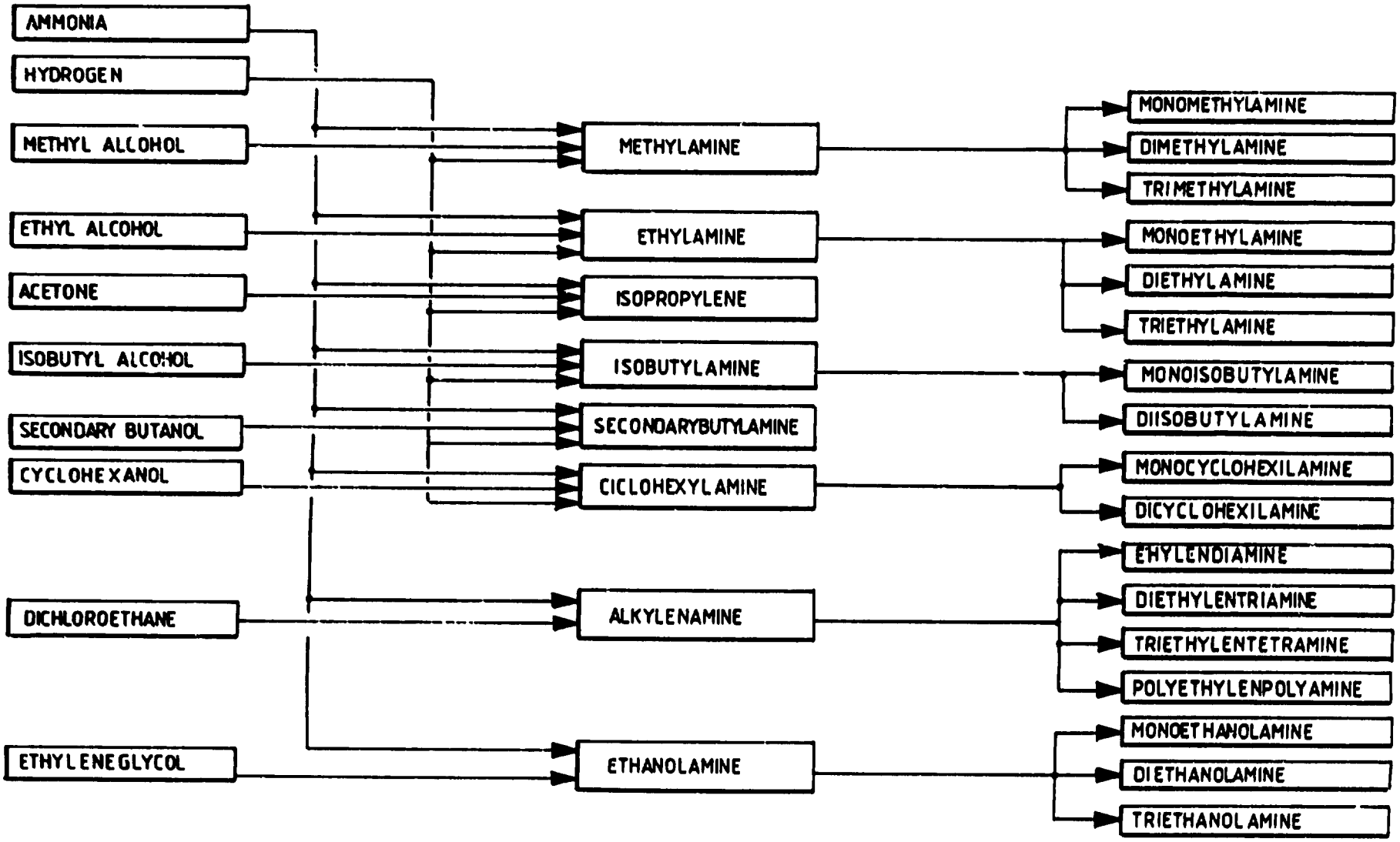
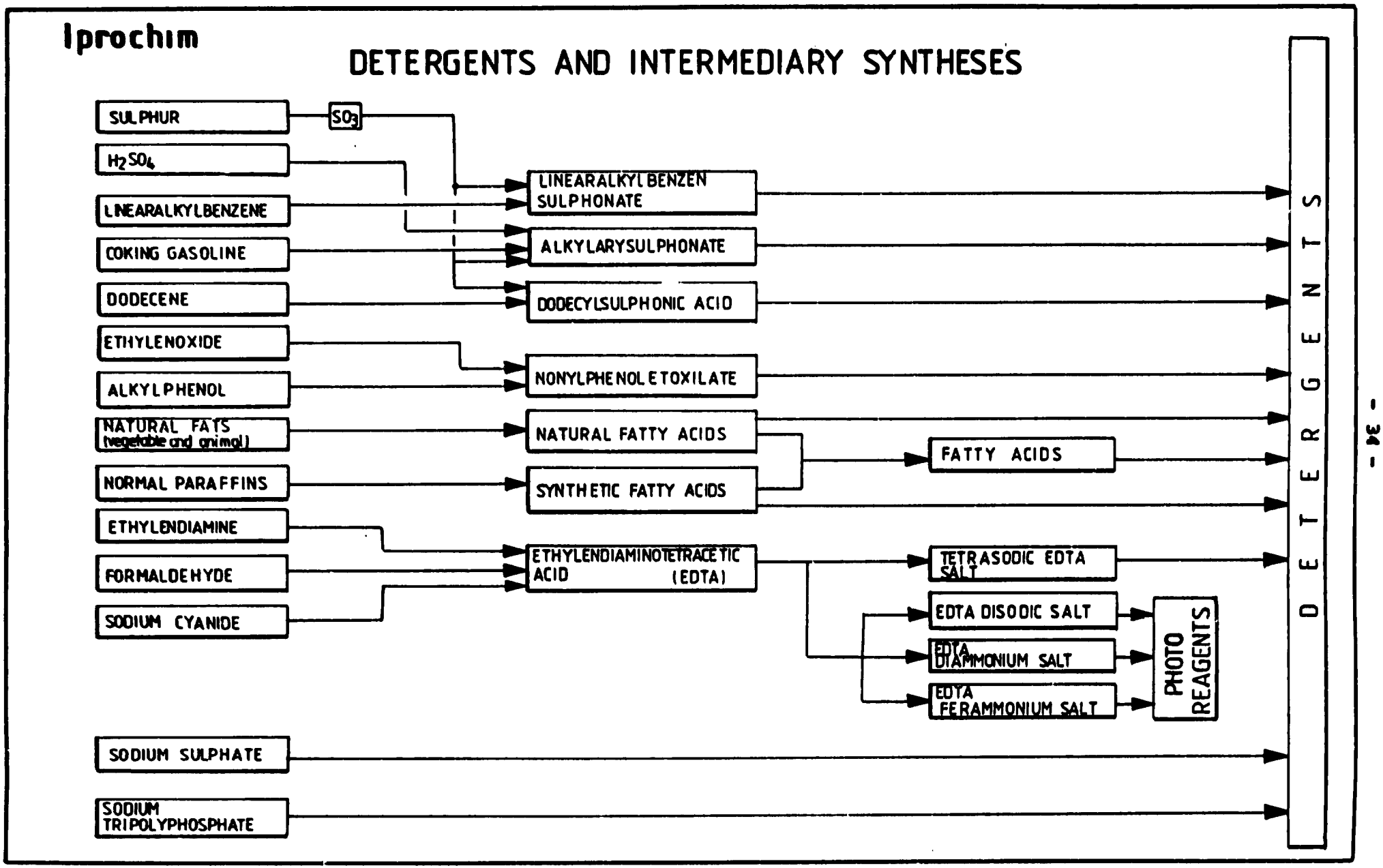
AMINE SYNTHESES

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DETERGENTS AND INTERMEDIARY SYNTHESES
SULPHUR
SO_3
H_2SO_4
LINEARALKYLBENZENE
COKING GASOLINE
DODECENE
ETHYLENOXIDE
ALKYLPHENOL
NATURAL FATS (vegetable and animal)
NORMAL PARAFFINS
ETHYLENDIAMINE
FORMALDEHYDE
SODIUM CYANIDE
SODIUM SULPHATE
SODIUM TRIPOLYPHOSPHATE
LINEARALKYLBENZEN SULPHONATE
ALKYLARYSULPHONATE
DODECYLSULPHONIC ACID
NONYLPHENOLETOXILATE
NATURAL FATTY ACIDS
SYNTHETIC FATTY ACIDS
ETHYLENDIAMINOTETRACETIC ACID (EDTA)
FATTY ACIDS
TETRASODIC EDTA SALT
EDTA DISODIC SALT
EDTA DIAMMONIUM SALT
EDTA FERAMMONIUM SALT
PHOTO REAGENTS
DETERGENTS

ceuticals and dyes (paranitrotoluene, acetyl salicylic acid, benzoic acid, salicylic acid, methyl and ethyl acrylate, butyl and 2-ethylhexyl acrylate), intermediates for leather industry (acryl copolymers), produ cts for food industry (polyacrylamide, food gelatine) complexing agents (ethylendiaminetetracetic and associated sodium salts) and others.

The processes are run continuously (ethylamine, methylamine, ethanolamine, paranitrotoluene, n-butyl acetate, N-ethylcyclohexylamine, cyclohexylamine, isopropylamine, furfurol, alkylenamine) or batchwise and semicontinuously (the balance of plants). Some processes imply catalytic reactions in heterogeneous phase or homogeneous while other processes are noncatalytic ones (The sheets in Appendices show the synthesis processes for the main categories of organic synthesis products).

The offered plants are characterized by safety operation and are based on rich experience.

The initial processes have been steadily subjected to m odernizing to increase their efficiency and for better competitivity.

Chlorinated Products

There has been acquired a rich industrial experience in the fabrication of chlorinated products, such as:

- tetrachlorethane obtained by acetylene chlorination in liquid phase, used as feedstock for trichlorethylene fabrication;

- trichlorethylene by tetrachlorethane dehydrochlorination wihh lime milk; it is used as solvent for degreasing metal parts and as feedstock for monochloracetic acid production;

- monochloracetic acid by trichlorethylene hydrolysis in the presence of sulphuric acid, used as feedstock for various organic synthesis;

- vinyl chloride obtained both by acetylene hydrochlorination and thermal dehydrochlorination of dichlorethane produced by ethylene chlorination in liquid phase and by catalytic oxidation in vapour phase of ethylene; it is mostly used for PVC fabrication;

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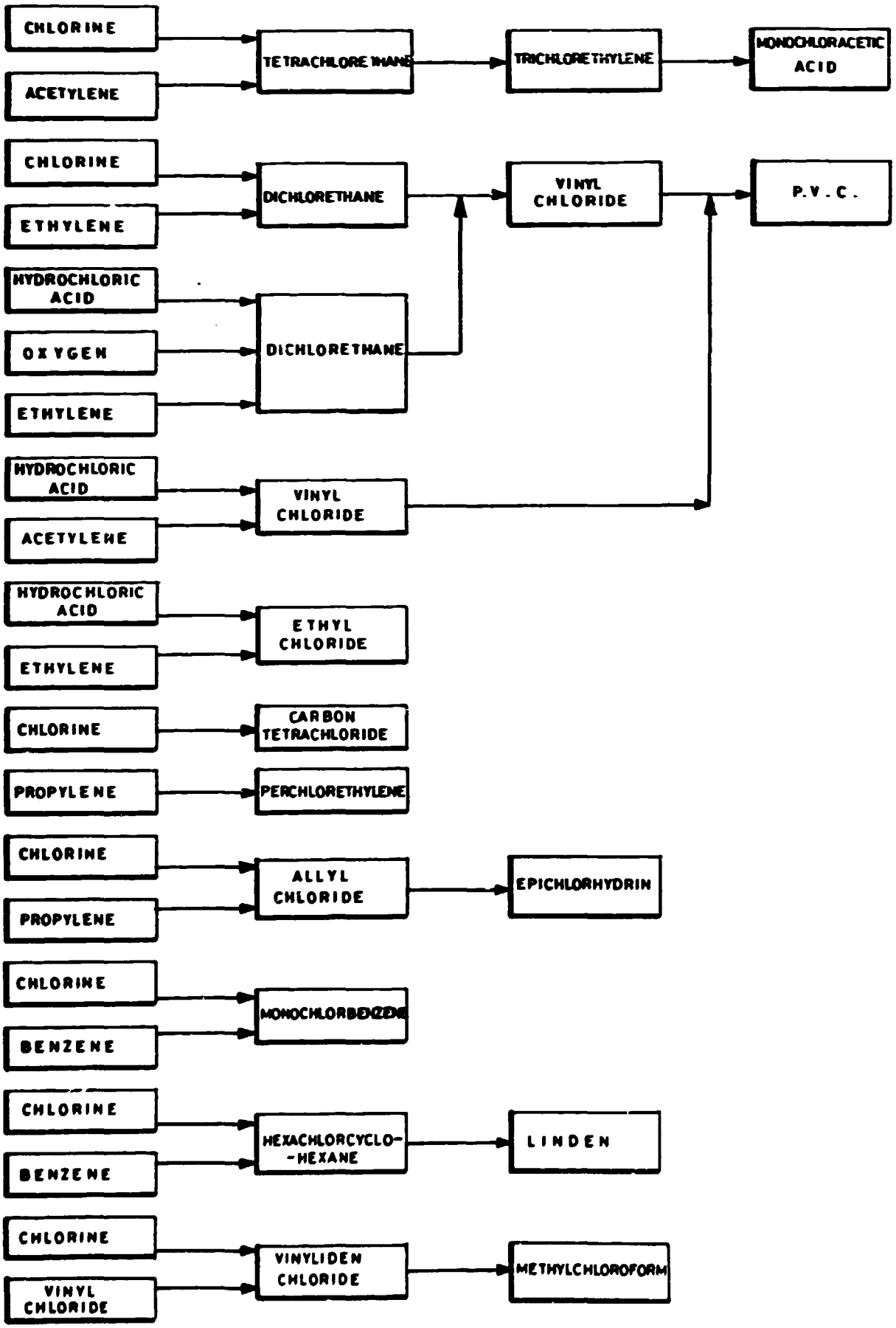
CHLORINATED PRODUCTS



- ethyl chloride by catalytic dehydrochlorination of ethylene

- carbon tetrachloride and perchloroethylene simultaneously produced at the thermal chlorination in vapour phase of propylene; carbon tetrachloride is used for freons 11 and 12 fabrication while perchloroethylene is used as solvent for degreasing of metal parts and clothes cleaning;

- monochlorbenzene by benzene chlorination in liquid phase, used as solvent or feedstock for various organic syntheses;

- lindane by methanol extraction from isomeric mixture of cyclohexane obtained by photochemical chlorination of benzene, a well known pesticide;

- vinyliden chloride by dehydrochlorination with lime milk of 1,1,2 trichloroethane resulted from vinyl chloride chlorination in liquid phase, used for copolymers and methylchloroform fabrication;

- perchlorvinyl by batchwise chlorination of PVC in monochlorbenzene medium, used for varnish and paints fabrication;

- cianuryl chloride by hydrocyanic acid chlorination into chlorcyan followed by catalytic trimerization thereof;it it used at herbicides fabrication;

- 42% chlorinated paraffins by batchwise chlorination in liquid phase of paraffins;

- hydrochloric acid by chlorine and hydrogen reaction in synthesis ovens, used as feedstock for organic synthesis and metal pickling

- phosgene by carbon monoxide chlorination in the presence of active carbon as catalyst; it is used for fabrication of herbicides, polycarbonates, polyurethanes etc.

IV.5.3. Fertilizer Industry

The chemical fertilizers provide basic nutrients that the plants need, namely: nitrogen, phosphorous and potassium

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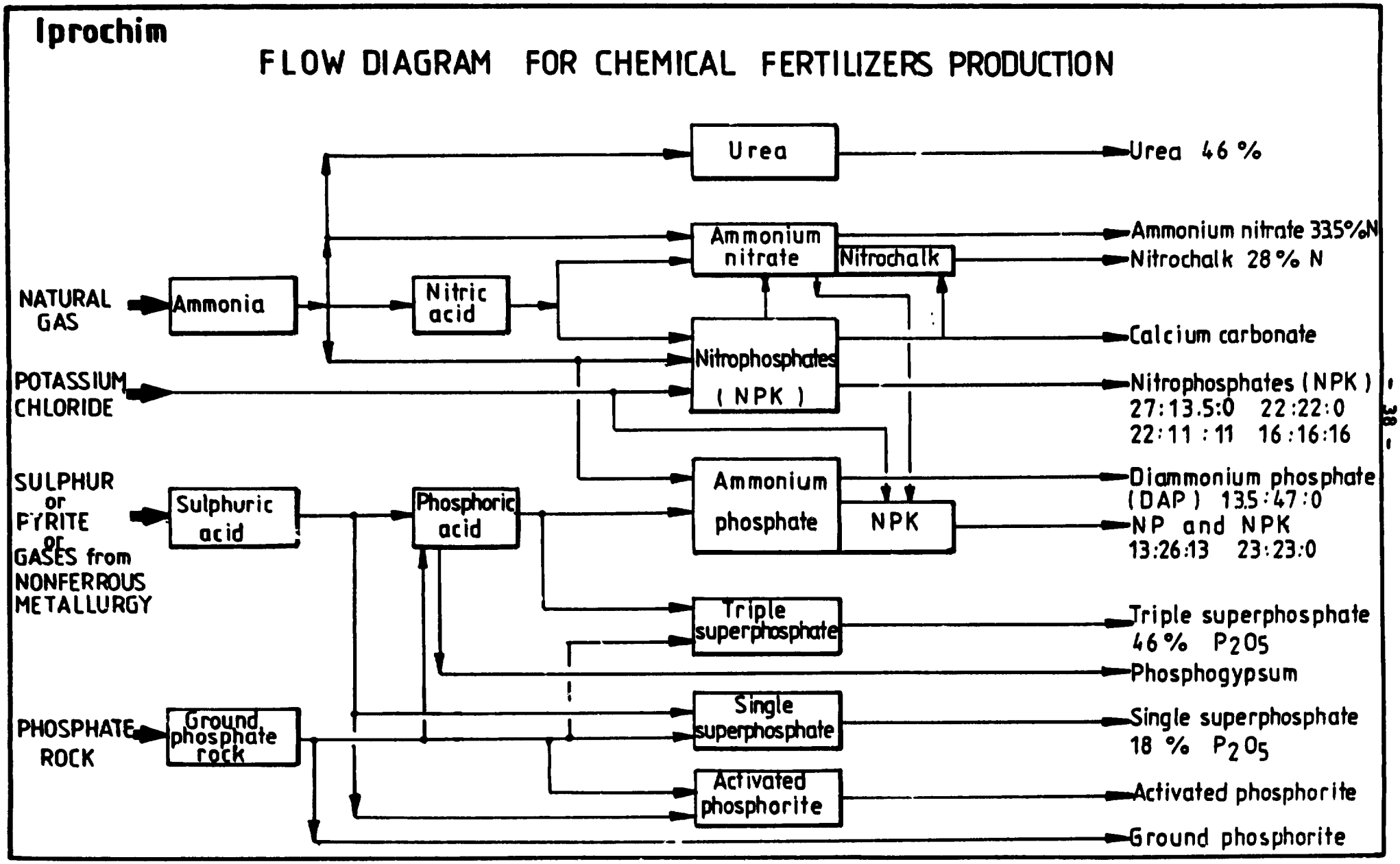
FLOW DIAGRAM FOR CHEMICAL FERTILIZERS PRODUCTION



as well as micronutrients.

In Romania, the soils and agricultural crops require the application of macronutrients in the average ratio: $N : P_2O_5 : K_2O = 1.9 : 1 : 0.4$.

The basic raw materials necessary to manufacture chemical fertilizers are methane gas for nitrogen fertilizer, phosphate rocks and potassium ores for the other two nutrients. Romania owns the necessary methane gas sources, and has developed a strong nitrogen fertilizer industry yielding such fertilizers in excess (as related to the domestic requirements), which means that the extra quantities can be exported, thus making up for the import of raw materials for the phosphorous and potassium fertilizers.

In close connection with the chemical fertilizer production, the sulphuric, phosphoric and nitric acids production has also developed as they are intermediates in the fertilizer manufacture.

The Romanian fertilizer industry has reached a number of 10 large chemical complexes set up at the up-to-date level of technique as regards processes, plant capacity, operation control a.s.o.

The production of chemical fertilizers as 100% nutrient was in 1980 over 1.4 times as compared to 1975 production and over 8.3 times as compared to 1965 production.

The increase in the amount of fertilizers applied has been accompanied by an improvement of their quality in point of a wider range of grades and higher nutrient content. For instance in 1980, more than 20 grades of fertilizers were produced, while some other 30 single and complex grades with or without microelements, solid or liquid, were under research.

The share of complex fertilizers in the total production of chemical fertilizers reached as high as 36% in 1980 while the average nutrient content had increased to reach 37.3% in 1980.

Relating to single nitrogen fertilizers, special attention was paied to urea manufacture which has a high nutrient

content and very good physico-chemical properties.

A higher nutrient concentration of the chemical fertilizers entails important technico-economic advantages, i.e.: smaller costs for packing, handling, transport, storing and field application as well as increase in their efficiency. That is why the complex fertilizers production has been developed.

The development of the chemical fertilizer industry, meant to meet the requirements of modern agriculture, has mainly been done based on our own research design. The specific equipment and unit manufacture has been performed by our machine building industry while specialized companies for constructions and erection erected the plants as well as the whole complexes.

Ammonia is chiefly manufactured in high capacity (900 t/d) modern plants built with Romanian equipment.

Urea is produced in 900 and 1300 tpd plants lately using the stripping process which has energetic and economic advantages as compared to the conventional process applied in the earlier plants.

For the nitric acid and ammonium nitrate manufacture, we have developed new processes, with improved parameters as com pared with those imported earlier, in point of the technico-economic factors.

The sulphuric acid, phosphoric acid, single and triple superphosphates have also been manufactured in plants using our own processes.

Lately, the NPK complex fertilizers have been manufactured based on nitric acid digestion of the phosphate rock.

The Romanian research activity developed within the Research Centre for Chemical Fertilizer - Craiova as well as by the research groups sponsored by the Chemical Fertilizers Complexes, coordinated by our Central Institute for Chemical Research focused on the following aims:

- to develop our own manufacturing processes for fertilizers and catalysts;
- to develop a wider range of fertilizer grades manufactured in our existing plants;
- to improve the quality of products;
- to recover and use the process wastes and

by-products;

- to reduce fuel and energy consumptions;

- to control environment pollution in the chemical fertilizers industry.

The processes experimented in laboratories and industrial pilot plants have been applied on industrial scale.

IPROCHIM in cooperation with the research units developed new processes and licences on the basis of which new plants have been implemented without any licences and/or engineering importation for sulphuric acid plants based on sulphur and non-ferrous metallurgy gas, phosphoric acid plants, nitric acid plants, granular triple superphosphate plants, diamonium-phosphate plants and complex fertilizer plants, ammonium nitrate and nitrochalk plants, fodder dicalcium phosphate plants etc.

A number of patents have been registered in our country and abroad for processes and special equipment.

To the effect of getting a wider range of products, grades of liquid nitrogen fertilizers have been developed for big crops, foliar fertilizers for vegetables, urea containing microelements (borine, zinc, molybdenum) sulphur-coated urea, potassium sulphate, complex fertilizers with potassium sulphate, u rea-ammonium phosphates, urea-ammonium sulphate, nitro-phosphates with microelements etc.

The quality of the products has been improved by conditioning the complex fertilizers by sprinkling Deroplast (Alkyl - aryl - sodium sulphonates) and coating diatomite, as well as conditioning of urea by formaldehyde sprinkling.

Special ammoniators are under experiment in the complex fertilizer manufacture, to make simpler the process and equipment and to decrease the energy consumption.

A special attention has been paid to the chemical fertilizer industry in view of environment pollution control, taking steps to avoid pollution of rivers, air and soil.

Based on research and design activities, new technologies have been developed for special units and apparata, such as:

- nitric acid plant with NO content in the final gas below 100 ppm

- double absorption double catalysis sulphuric acid plant with conversion efficiency up to 99.5 - 99.7%

- improved solutions for gas scrubbing, new and more efficient scrubbers, which make fluorine and powder trapping efficiency higher

- biological treatment process for waste water applied to treat urea, nitric and ammonium ions containing water; technical methods of recirculating the chemically contaminated water in the nitrophosphates, sulphuric acid, diammonium phosphate, triple superphosphate, plants, so decreasing the amount of impurified water discharged to the sewer or to the treatment stations.

Based on the experience gained in designing, implementing and operating the chemical fertilizer plants, as well as on IPROCHIM research and patents, exports of technologies and plants to the developing countries, have started, thus participating in the technology transfer in this field.

It can be mentioned some plants built so far and put into operation abroad, such as:

- sulphuric acid plants at Samsun in Turkey and at Abu Zaabal in Egypt;

- granular single superphosphate plant at Elazig in Turkey;

- fertilizer complex (sulphuric acid, phosphoric acid and triple superphosphate) at Homs in Syria;

- phosphoric acid and DSP fertilizer plants at Tongling, Anhui province, China.

The Romanian experts in fertilizers have greatly contributed to the research, designing and production fields by cooperation with well-known international organizations: United Nations Industrial Development Organization, International Bank for Reconstruction and Development, Food and Agriculture Organization, Arab Federation of Chemical Fertilizer Manufacturers, etc.

IV.5.4. Utility and Services

The chemical and petrochemical industries are big consumers of thermal, electric power, refrigeration, treated and mineralized hot water, compressed air, while at the the same time a great variety of secondary energy resources result from the process. The question of utilities supply systems is rather complex as it requires analyses and studies to provide the proper utilities to secure the best operation conditions and parameters.

Any of the utilities necessary for an industrial site: electric power, thermal power, industrial refrigeration, demineralized water, the recovery of waste secondary power resources, compressed air (technical or instrumental) shall be provided while observing the following minimum criteria:

- aggregates to give operation flexibility
- operation with low power consumption
- parameters of utilities supplied to the process shall be kept constant to the value required by consumers
- the principle of safety and continuity in the operation of utilities sources shall agree with the associated process requirements
- automation and mechanization degree shall meet the requirements of modern technique.

IPROCHIM designed for the chemical and petrochemical industry in Romania and for other countries several systems of sources and distribution of utilities, integrating them in reasonable conditions of economic and energetic efficiency.

Romania designed and operated successfully the following plants:

- over 100 industrial electrical centrals producing and supplying steam, hot water and electric power for chemical and petrochemical industry as well as for other neighbouring consumers
- over 200 systems for recovery and better use of secondary waste power resources from the main processes producing steam, hot water, industrial refrigeration, electric power and mechanical power

- over 150 plants for demineralization of industrial water at a quality level required by consumers (steam boilers, hot water boilers, technological processes)

- over 200 refrigeration units for chemical and petrochemical industry for refrigeration storages at temperature levels ranging between +5°C and -80°C, in factories included (bulk and/or ground)

- over 200 instrumental compressed air units (clean and dry air with dew point below -40°C), technical air and process air

- over 100 thermal units with organic agents (diphyl, marlotherm, organic oils)

- over 100 Diesel units with fast start and charge

- gas compression units (carbon dioxide, methane gas, ammonia)

- piping networks systems for process fluids (specific to chemical and petrochemical industry) for utilities (steam, hot water, liquid and gas fuels, air, water, oxygen, nitrogen) both from within the plant site (for connections between various factories, units, buildings) and for other industrial plants or houses in the neighbourhood of the industrial sites.

IV.5.5. Solid Materials Loading, Unloading, Storing Bagging and Transport Installations

IPROCHIM is provided with a department with experience in the field of loading, unloading, storing, bagging and transport installations for solid materials. This department provides documentation promoting the latest processes as well as technical assistance during the stage design, commissioning and fulfilment of design parameters.

The main aspects of this department activity are:

- Loading and unloading systems from transportation means of solid materials specific to the chemical industry to terminus and harbour facilities, including for unloading of sea or river vessels equipped with large unloading capacities and

a high mechanization or automatization degree.

- Stores for all the materials specific to chemical industry, in bulk or packed in bags, tanks, barrels, boxes, parcels etc.

For pallet products, in case of a large variety, high storages with 8-12 overlapped storing rooms with high automation degree up to full robot and compute controlled operation may be built.

For bulk products, several storing solutions are applicable at ground level or elevated, including silos in the open or inside the buildings depending on nature and characteristics of products with discharge rate up to 2000 cu.m/h or even higher.

Weighing, metering and packing installations, automatic or semiautomatic ones, including palletizing lines of bags and packing without pallets with shrinkable foil and containerizing lines.

Packing lines are equipped with equipment with high efficiency and automation degree depending on the characteristics of packed material, on required capacity, type of bags and product destination. Optionally, the packing stations whose capacity amounts to 3000 bags per hour and per line, can be provided with automatic devices for forming and introduction of bags into loading halls. Their automation degree can reach full electronization and robot control.

Palletizing installations securing capacities in agreement with those of packing stations can be coupled with foil making units and contraction furnaces in order to consolidate the load on the pallets in view of transportations.

On request, packing facilities in foils may be provided without use of pallets resulting in stable and tight packages, easily handled by fork piler or other similar devices.

Transportation and loading installations into transport means, including terminus sea or river stations for the chemical products in bulk or packed in individual packages or grouped in packages or containers.

In case of individual packages delivery, one can provide on request palletizing facilities directly into transportation means.

The loading installations into wagons of bulk materials ensure a high mechanizing and electronic degree with capacities usually amounting to 1,500 t/h.

V. LIST OF AVAILABLE TECHNOLOGIES

The following tables list the process plants and the services that IPROCHIM can export.

Each plant is described briefly by quotation of capacity, applied process and end product quality.

Further to the said tables a few examples of technical sheets are presented for some process plants that are outstanding in IPROCHIM's field of activity.

Should potential clients be interested in a certain chemical/petrochemical plant, IPROCHIM can make available informative technical sheets for all of the plants herein listed.

Furthermore IPROCHIM can work out, within 1-2 months from order receipt, technical reports, preliminary offers, technical offers for any of the listed plants and services that may be of interest to clients.

V. LIST OF AVAILABLE TECHNOLOGIES

Ref. no.	Project	Capacity t/y	Brief description of technologies	Quality of products or services
0	1	2	3	4
		V.1. PETROCHEMICAL INDUSTRY		
		V.1.1. Synthesis Monomers		
1.	PHENOL-ACETONE	Phenol plant: - min: 25,000 - max: 50,000	Benzene alkylation with propylene with formation of: isopropylene benzene, oxidation of isopropylene benzene hydroperoxide and its decomposition against sulphuric acid into acetone and phenol.	- colour, Hazen:5 - freezing point: +40.8°C
2.	NONYLPHENOL	8,000 ÷ 12,000	Phenol alkylation against ion exchange catalyst in fixed bed reactor	- phenol content:max.0.2% - colour, Hazen: 80 - water content:max.0.16%
3.	NONENE (TRIMERPROPYLENE)	5,600 ÷ 8,900	Nonene manufacturing plant is based on catalytic oligomerization of propylene by adiabatic process.	Nonene: raw material for the manufacture of nonylphenol and dinonyldiphenylamine.

0	1	2	3	4
4.	ETHYLBENZENE	40,000 60,000 120,000	Benzene alkylation with high purity ethylene (99%) against catalyst	- ethylbenzene %g min: 99.7% - other hydrocarbons: %g max:0.3% ethylbenzene is used in styrene manufacturing
5.	ETHYLETHER	400	Ethyl ether is obtained by etherification reaction of ethyl alcohol in the presence of sulphuric acid	- specific gravity at 20°C; 0.719 g/cm^3 - aldehydes:max.0.05 g/100 ml Used as solvent in explosives industry
6.	ANILINE	25,000	Catalytic reduction of nitrobenzene vapours at 260°C and atmospheric pressure	- aniline content:99% min. - water: 500 ppm - nitrobenzene:220 ppm
7.	STYRENE	50,000	Adiabatic catalytic dehydrogenation of ethyl benzene	- concentration, % min.99.6 - density at 20°C, g/cm^3 0.904 - 0.905 - colour (APHA scale), max.15

0	1	2	3	4
8.	OXETHYLATED PRODUCTS	2,000	Oxethylated products are obtained by ethylene oxide condensation with various products with reactive groups (hydroxyl, amino)	As there is a large range of products, their properties differ in point of: manufacture acceptance, nature of chain initiator
9.	PROPENOXIDE	10,000	Propenoxide is obtained by propylene chlorohydrination and saponification of chlorohydrides obtained with lime milk	- propene oxide content % min.99 - colour (APHA scale), max.10
10.	PROPYLENE GLYCOL	9,000	Propenoxide hydration reaction	- boiling temperature (760 mm Hg) ^{o}C - 187.4 - specific gravity (20^{o}C) - g/cm^3:1.0381 - colour, Hazen units, max.% - 20 - water (Karl Fischer), max.% - 0.25
11.	VINYLCHLORIDE	40,000	Acetylene hydrochlorination When the reaction is over, hydrochloric acid is separated	- acetylene 90 ppm max. - vinylacetylene 30 ppm max. - butadiene 1.3 100 ppm max.

0	1	2	3	4
			by washing with water and by vinyl chloride rectification	- aldehydes 60 ppm max. - acidity 100 ppm max. - methylalcohol 3500 ppm max. - 1.1 dichloroethane trans 1.2 dichloroethylene 125 ppm max.
12.	ACETIC ACID	30,000	Acetaldehyde oxidation reaction against manganese catalyst	- concentration 99.6% - formic acid 0.1% max. - acetaldehyde 0.004% max. - mercury nil
13.	VINYL ACETATE	20,000	Obtained from acetylene and acetic acid by heterogeneous catalysis reaction in gaseous state, against Zn acetate catalyst laid on active carbon	- distillation range, °C:71-73 - water, max.% - 0.1 - aldehydes, max.% - 0.05 - evaporation residue max.% - 0.05
14.	POLYETHERS	3,000	Propenoxide anionic polymerization, using glycerine as chain initiator and potassium hydroxide as catalyst	- polyurethane foam for cars upholstery - conventional block polyurethane foams for furniture industry, mats

0	1	2	3	4
15.	BUTANOL	30,000	Aldochrotonization reaction from acetaldehyde against sodium hydroxide	- colour, ^{o}Hazen max.10 - acidity, % max. - 0.0064 - water, % max.0.25
16.	ACETALDEHYDE	80,000	Acetylene hydration reaction against mercury catalyst in acid medium	- acetaldehyde % 99-99.8 - acetic acid, % max. - 0.2 - water % max. - 0.2
17.	PETROCHEMICAL-ACETYLENE OBTAINED BY THE THERMO-OXIDATION PROCESS	70,000	Obtained by the thermo-oxidation process. Acetylene from the reaction gas is separated and concentrated with ammonia (selective solvent)	- Acetylene, % by vol. 99.0 - 99.6 Used for: - organic synthesis vinyl acetate, vinyl chloride, acetaldehyde, drugs - welding
18.	ACETYLENE VIA CARBIDE	50,100,150 Nm^3/h	Carbide in water, type wet process to obtain acetylene and bottling on request at the pressure of a about 20 bar	Acetylene, % by vol. 99.0-99.6 Used for: - organic synthesis vinyl acetate, vinyl chloride, acetaldehyde, drugs - welding

0	1	2	3	4
19.	FATTY-ALCOHOLS	6,000	Fatty alcohols from fatty acids of animal or vegetal origin or from synthetic fatty acids are obtained by direct hydrogenation	Acid index mg kOH/g - 0.1 min.
20.	EPICHLOROHYDRIN	15,000	Obtained from propylene and chlorine through alyl chloride, by its chlorohydration followed by dichlorohydrines dehydrochlorination with lime milk	- epichlorohydrin content % min. - 99.9 - chlorinated products content, % max. 0.09 - water content % max. - 0.01 - density kg/dm^3 1.181-1.184
21.	FURNACE CARBON (HAF,ISAF,FEF, SRF,TYPE)	100,000	Heavy hydrocarbons mixtures dehydrogenation reaction against methane gas and air	- specific surface BET, mg/g - iodine absorption index, mg/g - residue on screens 325% - volatiles, % Different values for many types of products

0	1	2	3	4
22.	HYDROCYANIC ACID	12,000	Methane, ammonia and air synthesis on Pt/Rh catalyst (Andrussow)	HCN 95-98% CH_3COOH 0.1-0.3% water 1.7-4.9%
23.	BISPHENOL A	5,000	Phenol condensation with acetone against ion exchangers	Melting point, °C min.156 phenol content % g 0.1 max. ash content % g max. 0.02
24.	METHYL METHACRYLATE	12,000	Synthesis of acetone cyanhydrine and methyl alcohol	Purity 98.5% boiling temperature 100.6°C density 0.943 kg/l
25.	BUTYL ACETATE	10,000	Methyl acetate ester exchange with butanol against sulphuric acid catalyst	butyl acetate 92% butanol 8% acidity 0.04%
26.	METHANOL	200,000	Modern methanol synthesis process at low pressure and temperature using a copper catalyst	Methanol content 99.5% by wt. Water 0.02% by wt. Acetone content 0.001% by wt.

0	1	2	3	4
27.	FORMALDEHYDE	42,000 82,000	By methanol oxidation with air against silver catalyst	Concentration, % g 37 - 50 methanol content, % g 1 - 2.5 acidity, % g max. 0.02
28.	FUFURYL ALCOHOL	5,000	Furfurol hydrogenation with synthesis gas or hydrogen or hydrogen against catalyst	furfuryl alcohol content % min. 98.5 water content % max. - 0.5 furfurol content % max. 1.0
29.	METHYL TERTIARY BUTYL ETHER (MTBE)	15,000 45,000 75,000	Selective addition reaction of methanol to isobutene, catalysed addition of highly acid ion exchange resins	MTBE content 98.5 - 99.5 methanol content % max.0.5 dimers content, % max. 0.5 tertiary butanol content % max. 0.2
30.	BUTADIENE FROM C_4 PYROLYSIS CUT	50,000 100,000	From pyrolysis C_4 cut by extractive distillation with a selective organic solvent	butadiene: concentration % g min. 99.5 butadiene content, % max. 0.2 acetylenes content, ppm max.50
31.	BUTENE SEPARATION FROM BUTANE CUT	60,000 100,000	Technology of butenes separation from butane-butene cut, by extractive distillation with selective organic solvent	butenes cut n+i butene content %g 97-98 butane cut n butane content % g 97 -98 isobutane cut i butane content % g 80-90

0	1	2	3	4
	V.1.2. Plastomers and Elastomers			
1.	GENERAL PURPOSE POLYSTYRENE (CRYSTAL)	10,000	Polymerization in charge suspension	food, pharmaceuticals, aromatic packs, electrotechnical items, toys
2.	GRAFTED HIGH IMPACT POLYSTYRENE	11,000	Polymerization in charge suspension	food, pharmaceutical and cosmetic packs, electronical items, toys, car industry
3.	A.B.S. COPOLYMER	7,000	grafted copolymerization in emulsion	food, pharmaceutical and cosmetic packs electrotechnical items, toys, civil works, refrigeration, car industry.
4.	HIGH-IMPACT POLYSTYRENE	11,000	Mechanical and chemical grafting	food, pharmaceutical and cosmetic packs, electrotechnical items, toys, car industry, hydrotechnica, refrigeration industry.
5.	STYRENE-ACRYLONITRILE COPOLYMER	2,500	Polymerization in charge suspension	food, pharmaceutical and cosmetic packs, electrotechnical optical items, toys

0	1	2	3	4
6.	GENERAL PURPOSE AND FIREPROOF POLYSTYRENE FOAM (PEX)	2,500	Expansion of gasified beads by means of steam	food packs, shells, plates, toys, thermal insulations, hydroinsulations and phonoinsulations
7.	GENERAL PURPOSE AND FIREPROOF GASIFIED-EXPANDABLE BEADS	7,000	polymerization in charge suspension	food packs, casing, plates, toys, thermal insulations, hydroinsulations, mould processing, phonoinsulations
8.	PVC SUSPENSION	50,000 150,000	Polymerization in suspension in reactors 20-80 m^3	K-value = 64-74 intrinsic viscosity=0,8-1,15 plastifier absorption = 80-105%
9.	PVC EMULSION	25,000	Continuous polymerization in emulsion, atomizer drying	k value = 55-70 sulphated ash = max.2% thermal stability at 180°C = min.15
10.	METHYL-POLYMETHACRYLATE	1,500	Block (mass) polymerization	Plane windshield manufacture protection glass, watch and optic glass, prothesis manufacture

0	1	2	3	4
11.	POLYCARBONATE	400 1,000	Transesterification and polycondensation of bisphenol A with diphenyl carbonate in melt	molecular weight = 25,000 - 35,000 shock resistance $\geq$ 470 kg cm/cm^2 Martens test $\geq$ 116°C
12.	C_5-RESINS	5,000 15,000	Cationic oligomerization in solution of piperilenic cut	Softening point = 75-115°C Iodine number 150-200 g I_2/100 g applications: replace colophony, plastifiers for PVC varnish industry.
13.	INDENE RESINS	2,500	Cationic polymerization, in solution of C_9+cut	Component for car tyres, technical rubber items Organic filling and plastifier Varnish industry.
14.	POLYVINYL ALCOHOL	3,500	Polymerization in solution and saponification	K_{value} = 35 - 90 hydrolysis degree = 98% ash content = max. 1.5% max.

0	1	2	3	4
15.	POLYVINYL ACETATE AND COPOLYMERS	25,000	Polymerization in emulsion	- erection material industry - food industry - paint and varnish industry - adhesive
16.	LIQUID THIOCOLS	1,500	Formal condensation with sodium polysulphite	- construction putties, adhesives - airplane sealing materials, boat decks
17.	SOLID POLYACRYLAMIDE	1,000	Polymerization on a metallic strap	- molecular weight = $4,9 \cdot 10^6$ Used in secondary oil extraction, water treatment, mining industry, paper industry and food industry.
18.	POLYESTERS FOR POLYURETHANE FOAMS	2,200	Polyesterification of adipic acid with a glycol	Used for vinyl resins rubber plastifiers, manufacture of pipe, fittings, gaskets electric cables, tanks oil and solvent-resistant floors

0	1	2	3	4
19.	ACRYLIC COPOLYMERS	8,000	Emulsion and solution copolymerization	- binder in textile industry - leather industry - cellulose and paper indust - adhesive
20.	STYRENE BUTADIENE RUBBER	50,000-100,000	Emulsion copolymerization in cold emulsion in the presence of a redox initiating system	Types: 1500, 1502, 1507, 1508, 1712
21.	POLYISOPRENE RUBBER	30,000-60,000	Solution polymerization with tetra component catalyst	- CIS content 1,4-min.96% - ash content - max. 0.6% - Mooney = 75-85
22.	CIS 1,4 POLYBUTADIENE RUBBER	30,000 - 60,000	Solution polymerization with stereospecific catalysts based on Al and Ti	- cis content 1,4 - 88-93% - jelly content, max.1.5% - ash - max. 0.5% - Mooney - 40-50
23.	TERPOLYMERS	3,000 - 5,000	Solution polymerization with Na and Al catalysts	- Used for technical rubber items manufacture

0	1	2	3	4
24.	BUTADIENE ACRYLONITRILE CARBOXILATED LATEX (PERBUNAN)	1,500	Emulsion copolymerization of butadiene with methacrylic acid and acrylonitrile	- concentration - min.40% - acrylonitrile content 35% Used in synthetic leather manufacture
	V.1.3. Chemical Fibres			
1.	CAPROLACTAM	25,000	Oxime synthesis from cyclohexanone and hydroxylamine by Beckman transposition to lactam	Pure crystallized caprolactam is in keeping with international standards for fine textile yarns, tyre cord and industrial yarns as far as its quality is concerned.
2.	ADIPIC ACID	7,000	Catalytic oxidation of cyclohexanol with 65-68% nitric acid	White, colourless crystals 100±60 containing 99.5% adipic acid. The adipic acid can be mainly used for the manufacture of synthetic fibres polyester fibres, preparation of softeners for plastic synthesis of polymers of foam

0	1	2	3	4
				polyurethane type synthesis of polyester plastics synthesis of hexamethylene diamine
3.	POLYNITRILE ACRYLIC FIBRES	25,000	Copolymerization of acrylonitrile, -methyl styrene and vinyl acetate in redox system	Staple fibre - title, den - 1.5,3,6,12 - tenacity gf/den min.2.5 - shrinkage, % max.2 - breaking elongation % 26-30 - whiteness, % min.75 Top (HB) - title, den 3 - tenacity gf/den min. 2.5 - nominal weight, gr/m - 21 - breaking elongation, %16-20 - whiteness % min.77
4.	POLYESTER FIBRES	35,000	DMT ester interchange with ethylene glycol and polycondensation of resulted diethylene glycol tere-	Polyester fibres 1.3 den cotton type 3x4 den wool type 6 den flax type

0	1	2	3	4
			phthalate	Title 1.3 den 3x4 den 6 den Tenacity gf/den 5.5 4.6 4.6 Elon- gation 20 35-40 25-50
5.	POLYESTER TEXTILE YARNS	8,000	Classical spinning of poly-ethyleneterephthalate chips, drawing and textile processing of yarns	White, twisted (200-2000 twists /m) textile yarns: title dtex 50-167: tenacity g/dtex min.4.6; breaking elongation, % 26 ±4; shrinkage at 200°C,% 8±1.5
6.	POLYESTER TEXTURIZED YARNS	15,000	High speed spinning from poly ethylene terephthalate chips melt and drawing texturizing of obtained yarns	Texturized yarns, white or dyed, twisted (40 twists/m) or nontwisted title, dtex 70-167; tenacity g/dex 3 breaking elongation,% 25±5 shrinkage at 110°C, % max.10

0	1	2	3	4
7.	POLYAMIDIC STAPLE FIBRES	4,000	Continuous polymerization of caprolactam, spinning, drawing and fibres packing in bales	Staple fibres: - cotton type, fineness 1.2+ 2.5 dtex and cutting lengths of 30 - 60 cm - wool type:fineness 3.5+ 6.6 dtex, and cutting lengths 60 - 160 mm - flax type:fineness 8-15 dte cutting lengths 60-150 mm The number of crimps ranges from 3 to 10 cm for all cases
8.	POLYESTER INDUSTRIAL YARNS	3,000	High speed spinning of polyethylene terephthalate melt and further processing of filaments and yarns	Industrial yarns 1100/200dte; multiplied twisted, post-treated;titre, dtex 1100-990C tenacity g/d tex, min.8; breaking elongation, % 13 ±5; shrinkage at 160°C, % 3

0	1	2	3	4
9.	POLYETHYLENE GLYCOL ADIPATE	300	Esterification of adipic acid with ethyleneglycol and discontinuous polycondensation of resulted monomer	Appearance: white flakes, molecular weight 2000; viscosity at 70°C, cst 428-590; acidity index max.2
10.	POLYAMIDIC TEXTILE YARNS	5,000	Continuous polymerization of caprolactam, yarn spinning by extrusion of molten polyamide chips and their textile processing	Fineness, dtex 22/6 - 110/20; fineness variation factor, % max. 2.5; tenacity, g/tex min. 3.2; elongation, % 30-40
11.	POLYAMIDIC TYRE CORD	7,000	Continuous polymerization of caprolactam, yarn spinning from molten polyamide chips and their textile processing	Fineness, dtex 1400 1866 Nominal dtex for final yarn and fabric 1400/390x2 1866/330x2 Breaking load, daN min. 21 21 Tenacity, gf/dtex 8.3 8.1 Yarn strength, kgf, min. 20 25 Breaking elongation, % 20 20

0	=1	2	3	4
12.	DMT RECOVERY FROM POLYETHYLENE-TEREPHTHALATE WASTES	1,500-25,000	Thermo-catalytic decomposition of polyethylene terephthalate wastes against methyl alcohol	The recovered DMT is fed back to the basic process for polyester fibre manufacture. The quality of recovered DMT is:appearance, white flakes;appearance, colourless melt; solidification temperature, °C 110.63; acidity index, max.0.07; volatiles % max.0.1;iron content,%less than 0.0001.
13.	POLYESTER WASTES RECOVERY BY GLYCOLYSIS	2,600	Polyethylene terephthalate wastes destruction by boiling with ethylene glycol in excess and polycondensation of obtained glycolysis product	Black polyethyleneterephthalate chips specific viscosity 830±30;COOH groups, max.45, diethyleneglycol, % 3.5; softening point, °C min.251 Chips are used for polyester fibre manufacture.

0	1	2	3	4
14.	LACTAM RECOVERY FROM SOLID POLYAMIDIC WASTES AND FROM MONOMER WATERS	4,000	Depolymerization of solid polyamidic wastes and caprolactam separation by distillation from the extraction water	Caprolactam appearance: - solid- white, cristalline - molten transparent liquid, - free of visible impurities - solidification point: ^{o}C, 68.6
15.	POLYAMIDE CARPET YARNS	3,000	Continuous caprolactam polymerization, spinning by yarn extrusion of polyamide chips and yarns textile processing	Fineness,dtex 1330 1330 x2 1330 x3 Tex deviation, % max. ±12 ±10 ±8 Tow strength, kg min. 3.5 6.5 9.5
	V.1.4. Rubber and Plastics Processing			
1.	TYRES MANUFACTURING PLANT	To be established depending on requirements and economic efficiency	Manufacturing process is suitable for tyre destination (car,truck,tractor) and their construction (diagonal or radial, textile/textile, textile/metal or all steel)	According to international standards

0	1	2	3	4
2.	RUBBER CONVEYER BELTS PLANT	To be established depending on requirements and economic efficiency	Manufacturing process is suitable for the production of textile fabric, or steel cord reinforced conveyer belts	max.width 2000 mm max.tensile strength: 4000 kg/cm
3.	RUBBER HOSES PLANT	Ditto	Textile and/or wire reinforcement, braiding or spiraling are used depending on the hoses range of application (pressure, temperature handled fluids)	Low and high pressure hoses according to international standards
4.	RUBBER PRESSED GASKETS PLANT	Ditto	Manufacturing process is suitable for compression curing of rubber or rubber-metal gaskets for various destinations	According to the international standards requirements
5.	RUBBER V-BELTS PLANT	Ditto	Manufacturing process is suitable for the production of industrial or vehicle V-belts	Length 600-5000 mm
6.	HD AND LD POLYETHYLENE BLOWN FILM PLANT	Ditto	HD and LD polyethylene chips extrusion and blowing	According to international standards

0	1	2	3	4
7.	INJECTION MOULDING PLASTIC PRODUCTS PLANT	To be established depending on requirements and economic efficiency	HD and LD polyethylene, polypropylene, polyamide, polystyrene ABS, PVC etc. chips are fed in the injection machine and moulded	According to international standards
8.	POLYETHYLENE AND POLYPROPYLENE PIPES PLANT	Ditto	The pipes are manufactured from polyethylene and polypropylene chips by extrusion process	Ditto
9.	A.B.S. OR POLYSTYRENE SHEETS PLANT	Ditto	The sheets are manufactured from A.B.S. or P.S. chips by wide die extrusion and sheets calendering	Ditto
10.	P.V.C. TUBES PLANT FOR I.P.Y. (BERGMAN) AND I.P.E.Y. (PANZER) ELECTRIC INSULATION	Ditto	The tubes are manufactured from P.V.C. chips by extruction process	Ditto
11.	PLAIN OR PRINTED HD AND LD POLYETHYLENE SACKS AND BAGS PLANT	Ditto	The manufacturing process consists of the HD-PE and LD-PE chips by extruding and	Ditto

0	1	2	3	4
			blowing	
		V.2. BASIC CHEMICAL INDUSTRY		
		V.2.1. Chemical Synthesis Products		
1.	ACRYLAMIDE	1,000	The acrylamide is prepared by successively passing a mixture of water-acrylonitrile through three reactors where a Cu catalyst in water suspension is continuously recirculated. The raw acrylamide solution is concentrated by evaporation and is purified by passing it through ion exchanger columns	Acrylamide, solution, 40-48% It is used for polyacrylamide manufacture in organic synthesi industry
2.	ACETYLSALICYLIC ACID	400	The acetylsalicylic acid is obtained by salicylic acid acetylation with acetic anhydride using a process of our own conception	The obtained 99.5% acetylsalicylic acid is used in pharmaceutical industry

0	1	2	3	4
3.	BENZOIC ACID	400	The benzoic acid is obtained by catalytic toluene oxidizing in air using a process of our conception	Benzoic acid is utilized as intermediate agent for dyestuff, drugs and food industry
4.	FURFUROL	5,000	Manufacture of furfurol by acid hydrolysis of pentosanes contained by the raw materials used and distillation of resulting furfurol containing water	Furfurol used for furfurol alcohol, furanic resins, solvent refining of oil and gas oil etc.
5.	FURFUROL AND CELLOFODDER	50,000	Furfurol and cellofodder are obtained by using a process of our own conception	Furfurol used for furfurol alcohol, furanic resin, solvent refining of oil and gas oil
6.	SALICYLIC ACID	1,200	The salicylic acid is obtained based on Kolbe-Schmidt synthesis, by means of a carboxylating reaction of phenol with carbon dioxide, using a process of our own conception	The salicylic acid is utilized in paints and drugs industry Salicylic acid, % min.99.2

0	1	2	3	4
7.	MALATHION	400	Malathion is an emulsifiable concentrate, obtained from dimethyldithiophosphoric acid and dimethylmaleic ester, using a process of our own conception	Active substance content 37% Malathion is used as pesticide in agriculture
8.	SINORATOX	3,200	Sinoratox is an emulsifiable concentrate based on dimethonate, obtained from dimethyldithiophosphoric acid and monochloroacetamide, using a process of our own conception	Active substance content 35% Sinoratox is used as pesticide in agriculture
9.	PARANITROTOLUENE	3,000	Paranitrotoluene is obtained by toluene nitration and obtained isomers mixture distillation	Paranitrotoluene 96-99% Paranitrotoluene is an intermediate agent for paints and drugs industries

0	1	2	3	4
10.	HIGH ALCOHOLS MONOMERS BUTYL ACRYLATE, 2-ETHYL-HEXYL ACRYLATE	8,000	The products are obtained from the esterification of acrylic acid with butylalcohol, 2-ethyl-hexyl alcohol respectively, against sulphuric acid as a catalyst and under moderate temperature	Purity %: Butyl-acrylate = 98 2-ethyl-hexylacrylate: 98.5 These monomers are utilized to obtain acrylic polymers and copolymers as well as in dyestuff industry
11.	ETHYL AND METHYL ACRYLATE	8,000	The ethyl and methyl acrylate are obtained by acrylic acid esterification with ethanol or methanol under catalytic and temperature conditions	- ethyl-acrylate 98% - methyl-acrylate min. 98% These products are required in the polymerization and copolymerization processes
12.	TECHNICAL n-BUTYL ACETATE PLANT	10000	Catalytic esterification of acetic acid with n-butyl alcohol	- N-butyl acetate concentration = 92-98% - distillation reange: 116-128°C 120-127°C

0	1	2	3	4
13.	EDIBLE GELATINE MANUFACTURING PLANT	500	Manufacture of edible gelatine from degreased cattle bones	Edible gelatine: Appearance:plates Colour:yellow Moisture:max.15% Ash:max.2%
14.	EMULSIFIERS FOR PHYTOPHARMACEUTICAL PRODUCTS	1000	Dodecyl benzene sulphonic acid is neutralized with hydrated brine in hydrobutanolic solution followed by settling concentration up to 70% and standardizing with various ingredients	Appearance at 20°C; viscous liquid Colour: brown pH: 6 ÷ 8 Application:emulsifier for phytopharmaceutic substances
15.	CATIONIC PRODUCT	2000	Discontinuous process consisting in tertiary amine synthesis from short amines and Na salt of fatty sulphated liquid phase at average pressure and high temperature, followed by quaternization with methyl or benzyl chloride in acqueous or alcohol medium	Quaternary ammonium salts solution with 38-40% active substance, in water or butanol

0	1	2	3	4
16.	ETHYLENDIAMINOTETRA ACETIC ACID AND ITS DI- AND TETRASODIUM SALTS	2000	Raw Na_4 EDTA is obtained from the reactions of NaCN solutions:CH_2O, EDTA acid 25% solution of NaCN. The resulted ammonia is absorbed and delivered as 25% bution. EDTA is precipitated by treating it with H_2SO_4, then is filtrated and dissolved in NaOH	EDTA acid:purity min.% 99.5 Na_2EDTA:purity % min. 99.5 Na_4EDTA:purity % min. 98
17.	PLASTICIZERS	54,000	The manufacturing process consists of an acid component (phthalic anhydride, adipiric acid) esterification with an alcohol (octanol or butanol) against catalyst, followed by the obtained product neutralization. The purification is done to retouch the colour and remove the volatiles.	Dioctylphthalate:purity, min.% 99.5 volatiles, max.% 0.4 Dibutylphthalate:purity, min.% 98.5 volatiles:0.5 Dioctaladipate:purity, % min. 98 voltatiles, % max. 0.6

0	1	2	3	4
18.	BONE GLUE MANUFACTURING PLANT	7000	The bones are crushed, cleaned, degreased with extraction gasoline, desinfected and subjected to alternating steam and hot water treatments to extract the glue. The resulted glue polutions are filtered, concentrated and refrigerated. The refrigerated glue is chopped, dried with hot air and packaged.	The bone glue is used in wood industry, textile industry, paper and matches industry
19.	ANTIOXIDANT H (FLECTOL TYPE)	800	Flectol is obtained by acetone polycondensation with anilines	Antioxidant H - Similar to the foreign product Flectol is used as antioxidant, in rubber compounds providing them with resistance against oxidizing ozone, a.s.o.

0	1	2	3	4
20.	SYNTHETIC FATTY ACIDS PLANT	5,000	The synthetic fatty acids are obtained by catalytic oxidizing of paraffin at average temperatures and low pressures	Saponification index C_5-C_6 - 387 C_7-C_9 - 417 C_{10}-C_{14} - 260-290 C_{14}-C_{18} - 230-260 C_{19}-C_{22} - 195. over C_{22} - 40-96
21.	METHYLAMINE	6,000 yielding monomethylamine, dimethylamine, trimethylamine	The process is based on mixing the methylalcohol using a dehydrating function catalyst in fixed layer for reaction. The reaction process is continuous and a variety of ratios can be obtained between the end products depending on the process	End product quality purity % MMA DMA TMA 99 99.5 99.5
22.	ETHYLAMINES	4,800	The process is based on the syn-	End product quality

0	1	2	3	4
			thesis between ammonia and ethyl alcohol against a nickel - based catalyst in fixed layer for the reaction. The reaction process is continuous monoethylamine being quantitatively predominant	MEA DEA TEA purity, % 99.2 99 99.2
23.	ISOPROPYLAMINE	6,000	The process is based on the synthesis between ammonia with acetone and hydrogen using a dehydrating catalyst based on nickel on fixed layer for the reaction. The reaction process is continuous, yielding monoisopropylamine. The whole diisopropylamine is recirculated to the synthesis in mixture with unreacted acetone	Isopropylamine - purity = 99.5% - boiling point= 33°

0	1	2	3	4
24.	ALKYLENAMINE	3,600	The process is based on the liquid phase reaction between ammonia and ethylene dichloride at average pressure and temperature	Used as intermediate agents in organic processes and industries such as paper, epoxi-resins, detergents
25.	CYCLOHEXYLAMINE AND DICYCLOHEXYL-AMINE	CHA 3,000 DCHA 200	Cyclohexylamine synthesis is done by cyclohexanol ammonolysis in gaseous phase against catalyst in fixed layer at abt. 150-180°C and average pressure. The reaction is followed by synthesis condensation and components separation by distillation	CHA DCHA purity,% min. 96 95 boiling point °C 133-135 253-256

0	1	2	3	4
26.	N-ETHYLCYCLOHEXYL-AMINE	3,000	N-ethylcyclohexylamine is obtained from the reaction between cyclohexylamine and ethyl chloride against 50% NaOH	Used as intermediate agent in pesticides manufacturing 98% purity 847 kg/m^3 dnesity (20°C) 167°C boiling point
27.	DIISOBUTYLAMINE	2,400	The process uses the catalytical section in gaseous phase at average temperature and pressure between ammonia and isobutanol	Used as intermediate agent for organic synthesis and herbicides preparation 98% purity
28.	ORTHOPHENYLEN-DIAMINE	600	27% ammonia solution in excess reacts with orthonitrochlorobenzene and by ammonolysis, orthonitroaniline results, this being separated from the reaction mass and reduced with sodium sulphide to orthophenylendiamnie	Used as intermediate agent for pesticides manufacture 98% purity

0	1	2	3	4
29.	ETHANOL-AMINES	3,500	The process uses the reaction between ammonia and ethylenoxide at average temperature and light pressure	Used for purifying the gases is inhibitor for detergent industry for cooling mixture, photo industry 98% MEA purity 97.5% DEA purity 98% TEA purity
	V.2.2. Pharmaceuticals			
1.	VITAMIN F		Vitamin F is obtained from sunflower oil by saponification splitting, esterification, neutralization and distillation	Vitamin F is in accordance with Romanian and international quality regulations

0	1	2	3	4
2.	RAFOXANIDE	2 O	The manufacturing process starts from dichloronitrobenzene and para-chlorophenol which, by condensation turns into nitro-diphenylether;this is reduced to aminodiphenyl ether, that, by condensation with salicylic acid and iodination turns into 3.5 diiodine-3-chlorine-4-(p--chlorphenoxi) salicylanide-rafoxanide	Content in rafoxanide is 98% Size of particles:below 5 Melting point:172÷176°C
3.	SILIMARINE	2	Silimarine is obtained by extraction with solvent from fructus sillybum marianum, followed by concentration and precipitations	Silimarine powder is in accordance with the international regulations

0	1	2	3	4
4.	CONDITIONING OF PERFUSABLE SOLUTIONS IN GLASS BOTTLES	150 thou. bottles of 250-500 ml/y 2 million bottles of 100-500 ml/y	Preparation of perfusable solutions is made by dissolution of drugs in distilled water, filtration on sterile filters, filling and closing of bottles, sterilization, control, labelling, packing	The products comply with Romanian and/or U.S.P., B.P. pharmacopeias
5.	INJECTABLE SOLUTIONS CONDITIONED IN PHIALS	400 million phials/y	The drugs to be administered through injections are made by active substances conditioning in phials under severe purity conditions	Phials with pharmaceutical products complies with Romanian Pharmacopoeia IXth edition and the international pharmacopoeias USP, B.P.
6.	SODIUM SALICYLATE	500	The manufacture of sodium salicylate consists in the neutralization of salicylic acid with sodium salicylate	Sodium salicylate complies with internal and international quality standards

0	1	2	3	4
7.	VITAMIN PP	300	The manufacturing of vitamin PP consists in amidation of nicotinic acid with ammonia	Vitamin PP complies with international quality standards
8.	LIDOCAINE	10	The manufacture of lidocaine consists in chloroacetilation of dimethylaniline, followed by the condensation with dietnylamine	Lidocaine complies with international standards
9.	UNIVERSAL PLANT FOR CONDITIONING DRUGS INTO PILLS (TABLETS) AND DRAGEES	500÷5,000 mil.tablets/y	The process consists in homogenization wet granulation, grain drying, tabletting (and coating) and packing All these operationsare mechanized.	Products comply with the Romanian Pharmacopoeia IX-th edition, and with International Pharmacopoeias (B.P. USP)

0	1	2	3	4
10.	UNIVERSAL VEGETABLE EXTRACTS PLANT	200	Vegetable extracts can be obtained from herbs by treating them with a solvent to extract the active principle, followed by entraining concentration, settling and filtration	Vegetable extracts comply with the Romanian Pharmacopoeia and International Pharmacopoeias (USP, B.P)
11.	UNIVERSAL VEGETABLE TINCTURES PLANT	100	Tinctures are liquid preparations obtained from herbs by the extraction of active principles	The tinctures comply with the Romanian Pharmacopoeia and with International Pharmacopoeias
12.	UNIVERSAL PLANT FOR PRODUCTION OF SOLUTIONS FOR INTERNAL AND EXTERNAL USE	60 million bottles/y	Drug solut ion of internal and external use can be prepared by the dissolution of the substances that make up the active principle, addition of preservatives, flavouring substances, filtering and packing of the solutions	The solutions of internal and external use comply with Romanian and International Standards of Quality

0	1	2	3	4
13.	LECITHINE	50	Lecithine is obtained by extraction with solvent from sunflower or soya groats, followed by concentration, precipitation, filtration and drying	The lecithine powder complies with Romanian and/or U.S.P., B.P. Pharmacopoeias
14.	NORAMIDOPYRINUM METASULFONICUM NATRICUM	70	The noramidopyrinum metasulfonicum natricum manufacturing process lies in a sequence of chemical reactions starting with pyrazolone methylation and continuing with nitration, reduction, sodation, hydrolysis, condensation, purification	The product complies with Romanian and/or U.S.P., B.P Pharmacopoeias
15.	DEXTRAN	50	The manufacture of dextran is based on sugar fermentation followed by hydrolyses and repeated fractioning	The products Dextran 70,000 Dextran 40,000 and 2,000÷ 5,000 comply with international standards

0	1	2	3	4
16.	ASCORBIC ACID (VITAMIN C)	150	The ascorbic acid (Vitamin C) process starts from glycose or sorbitol as feedstock and develops along the Rischstein stages	Ascorbic acid (Vitamin C) complies with Romanian and/or U.S.P., B.P. Pharmacopoeias
17.	INSULIN	50 kg/y	Insulin can be obtained from beef pancreas by repeated extractions with ethyl alcohol followed by purification	The product complies with Romanian and/or B.P. Pharmacopoeias
18.	PARAACETYLAMINO PHENOL (PARACETAMOL)	100	The manufacture of product consists in nitrosation, followed by reduction and acetylation.	The product complies with Romanian and/or B.P. Pharmacopoeias

0	1	2	3	4
19.	AMINOPHENAZONUM	100	Aminophenazonum is obtained starting with the methylation of pyrazolone, followed by nitrosation, reduction, hydrolysis, formilation and purification	The product complies with Romanian and/or B.P. Pharmacopoeias
20.	PLANT FOR METFORMIN	16	Metformin is obtained by condensation of dimethylamine hydrochloride with cyanguanidine	Ditto
21.	QUAIPHENESINUM	6	The process includes esterification and condensation	The product complies with quality standards
22.	HEPARIN SODIUM SALT	1	Heparin is obtained from beef lungs by acqueous extraction, acidulation precipitation and purification	Ditto

0	1	2	3	4
23.	PYRAZOLONE	500	Pyrazolone is obtained by a succession of reactions:diazotization, reduction, synthesis, condensation, cyclization	Application:intermediary for aminophenazonum
24.	ATROPINE SULPHATE	110	Atropine is obtained from Radix Belladonnae by extraction and purification	Atropine sulphate is in accordance with Romanian and/or B.P., U.S.P. Pharmacopoeias
25.	CONDITIONING OF PERFUSABLE SOLUTIONS IN NON-TOXIC P.V.C. BAGS	4 million bags per year (250 ml, 500 ml)	Preparation of perfusable solutions filtration on sterile filters, filling of bags with solutions and their tight seaming, sterilization, assembling of perfusion instruments sterilization etc.	Perfusable solutions are pharmaceutical products of "prc-injection" grade, complying,with the Romanian Pharmacopoeia IX and with International ones (USP, BP)

0	1	2	3	4
26.	SODIUM GLUTAMATE	100	Sodium glutamate is obtained from glutamic acid and sodium hydroxide	Sodium glutamate complies with international standards Application:in food industry
27.	CALCIUM GLUCONATE	500	Calcium gluconate can be obtained by electrochemical oxidizing of glucose, after crystallization, filtration, recrystallization calcium gluconate for tablets or injections is obtained	Calcium gluconate complies with Romanian and international standards
28.	RACEMIC CALCIUM PANTOTHENATE	100	The racemic calcium pantothenate manufacturing consists in pantolactone and sodium beta-alanine preparation followed by condensation of these two intermediate products	The product complies with USP provisions

0	1	2	3	4
29.	ISONICOTINIC ACID HYDRAZIDE	10-20	The Manufacturing process consists of the following stages: - Esterification of isonicotinic acid with butanol - Butyl ester of isonicotinic acid condensation with hydrazine hydrate	Isonicotinic acid hydrazide complies with Romanian and international pharmacopoeias (R.P; U.S.P.;B.P.)
30.	DIETHYLMALONIC ESTER (INTERMEDIATE FOR BARBITURIC SYNTHESIS)	500	Diethylmalonic ester is manufactured starting from monochloroacetic acid by cyaniding hydrolysis and saponification. Sodium malonate obtained is atomized then esterified with ethyl alcohol and rectified	The product complies with Romanian and international standards
31.	Multipurpose plant for morphine derivates (base codeine hydrochloric or phosphate codeine, and dionine)		By morphine methylation or ethylation morphine derivates (codeine, dionine, respectively) are obtained	Products quality comply with R.P.;U.S.P. or B.P provisions

0	1	2	3	4
34.	UNIVERSAL PLANT FOR ODOURS SYNTHESIS PRODUCTS MANUFACTURING	70	The manufacture consists in esterification condensation and rectification	Products quality meets the international norms
35.	UNIVERSAL PLANT FOR VOLATILE OILS	100	Volatile oils are obtained from seeds or fruit of some medicinal herbs by extraction with solvents followed by concentration	Volatile oils meet the Romanian and international quality norms and are used as adjuvants in drugs, food industry and cosmetics
36.	PLANT FOR CALCIUM GLUCONOLACTATE	200	Calcium gluconolactate is obtained by calcium gluconate condensing with calcium lactate and atomization	The product complies with Romanian and/or USP; BP pharmacopoeias

0	1	2	3	4
	V.2.3. Organic Dyestuff			
1.	ORGANIC PIGMENTS OF AZOIC AND CHROMOPHTHAL TYPE	pigment manufacturing of 900 azoic and chromophthalic type 700 line	Consists in diazotization of intermediates containing an amino group and in coupling with other intermediates	- HR yellow pigment quality of Permanent yellow HR, $C_{36}H_{32}Cl_4,N_6O_8$ yellow powder, insoluble in solvents of any kind - G orange pigment according to G orange pigment $C_{32}H_{24}O_2N_8Cl_2$ orange powder, insoluble in water, soluble in concentrated H_2SO_4 - FB red pigment, quality according to foreign standard FB carmine pigment $C_{30}H_{31}O_7H_4$ SCL reddish powder - BR red chromophthal pigment, quality according to Gegnale light red BRA, $C_{38}H_{22}O_4N_6Cl_5$ red powder, very good resistance, insoluble in water

0	1	2	3	4
2.	OPTICAL BLEACHING AGENTS	1,700	Can be obtained by the reaction of 4,4-diamino stilbenzene-2, 2-disulphonic acid (DAS acid) and cyanuryl chloride (2,4,6 trichloro 1,3,3 triazine) followed by the replacement of remaining chlorine atoms in cynuryl chloride by the amino group, alcoxy or phenoxi	The quality of optical stilbenzene-triazinic bleachers is similar to the foreign products
3.	SPECIAL (CATIONIC) BASIC DYESTUFF	1100	Process consisting of the following main stages: - diazotization - coupling - alkylation - filtration - drying	These dyestuffs have higher tinctorial qualities:strong dyeing intensity, various and shiny shades (from yellow to green) very good light wetness dry friction fastness From the range of special

0	1	2	3	4
				basic dyestuffs produced below are given those of type: - Maxilonrot GRL - Maxilongelb 2RL - Maxilonblau GRL
4.	DISPERSION DYESTUFF	1,000	Two processes: - condensation of aniline with various organic compounds and acidulation of resulting product; - diazotization and coupling	The products are used to dye polyester -triacetate fibres Product I corresponds to Terasildunkenblau RB-Ciba-Geigy Product II corresponds to Cibacet Blue 2R (CIBA), setacil Blue RS(Gy) Artisil Blue (Sandoz) Product III corresponds to Fovonmarinenblau 2Gl (Sandoz) Samaronmarinenblau G(Hoechst) Terasilmarinenblau GL (Ciba-Geigy)

0	1	2	3	4
	V.2.4. Chlorinated Products			
1.	SIMAZIN	3,000 as wettable powder with 50% active substance	Simazin results from cyanuryl chloride condensation with ethylamine in aqueous medium against a hydrochloric acid acceptor	End product quality: - active substance 97%min. - moisture 1%max. - sodium chloride 1%max. - hydroxiderivates+ chlorotriazines 1%max.
2.	CHLORINE AND SODIUM HYDROXIDE	50,000 100000	Chlorine and caustic soda are obtained by electrolysis in electrolysis cells with titanium diaphragm and anodes of CMDT type	End product quality: - Chlorine - CL_2 97-99% v/v - H_2 0.1-0.5% v/v - O_2 0.5-2% v/v - Electrolytic lye - NaOH 120-140 g/l - NaCl 160-120 g/l

0	1	2	3	4
3.	ATRAZIN	2,000 5,000 as active substance	Atrazin is obtained by cyanuryl chloride condensation in organic solvent (xylene) medium with ethylamine and isopropylamine against a hydrochloric acid acceptor	End product quality: - active substance content 97%min. - moisture 1%max. - sodium chloride 1%max. - other derivatives 1%max.
4.	PHOSGENE	5.000 10.000	Catalytic synthesis of phosgene from Cl_2 and CO under specific conditions of temperature and pressure	End product quality: - phosgene 99%min.by wt - chlorine 0.04%max. by wt - HCl 0.1%max. by wt
5.	CARBON TETRACHLORIDE AND PERCHLORETHYLENE	40,000	Propylene thermal chlorination	End product quality: Carbon tetrachloride: - distillation range (ASTM) 76.7 $\pm$0.5°C

0	1	2	3	4

- acidity neutral
- humidity 50 ppm
- C_2Cl_4 100 ppm
- $CHCl_3$ 350 ppm

Perchloroethylene

- distillation range (ASTM) 121 ±0.5°C
- humidity 50 ppm
- APHA colour 25 max.
- turbulence nil

0	1	2	3	4
		V.3. INORGANIC INDUSTRY		
	V.3.1. Fertilizers			
1.	AMMONIA	900 t/day	Basic Kellogg conventional process	- NH_3 99.9% by weight - H_2O max. 0.1% by weight - oil max. 5 ppm - Carbon dioxide is obtained as secondary product with a purity of 98% by vol. CO_2 as against dry gas
2.	AMMONIUM NITRATE	300,000	Consists in 48-62% nitric acid neutralization with ammonia gas at 4.7 ata pressure	Ammonium nitrate with 34.5%N: Aspect: prills; Grain size: 90% between 1-4 mm; Humidity: 0.7% max. Ammonium nitrate with 26-28%N (nitrochalk): prills; 85% between 1-5 mm; 1% max.

0	1	2	3	4
3.	UREA	420,000	STAMICARBON stripping process	- nitrogen content: 46.3% by wt. min. - humidity: 0.3% by wt. max. - biuret 0.9% by wt. max.
4.	SUPERPHOSPHATES	SSP 30,000 t P_2O_5/y TSP 80,000 t P_2O_5/y	The process applied is classical dry one, using a superphosphate reactor	SSP contains 18% P_2O_5 active substance and TSP 45% P_2O_5, active substance Superphosphates grain size ranges between 1-6mm
5.	NITROPHOSPHATES (NP, NPK)	100,000	NORSK-HYDRO process	NP grade 0.75 - 2:1:0 NPK grade 0.75-2:1:0,35* (*) K_2O - optional
6.	DIAMMONIUM PHOSPHATE (DAP)	100,000 t/y P_2O_5	Phosphoric acid neutralization by ammonia	DAP grade: 13.5:47:0

0	1	2	3	4
	V.3.2. Inorganic Products			
1.	DILUTE NITRIC ACID	240,000	Catalytic burning of ammonia and absorption in water of nitrogen oxides	65% HNO_3
2.	SULPHURIC ACID FROM SULPHUR	100,000 200,000	Double catalysis	min. 96% H_2SO_4
3.	SULPHURIC ACID FROM PYRITE	100,000 200,000	SC-SA and DC-DA process (single catalysis, single absorption, double catalysis-double absorption)	- min.96% H_2SO_4
4.	SULPHURIC ACID FROM NON-FERROUS METALLURGY FLUE GASES	50,000 235,000	SC-SA process	- min.96% H_2SO_4

0	1	2	3	4
5.	PHOSPHORIC ACID	110,000	Wet dihydrate process from phosphate rock	- 52-54% P_2O_5
6.	BORIC ACID	5,000	Saturated borax solution treating with sulphuric acid	- technical - min.98% H_2BO_3 - pharmaceutical - min. 99% H_2BO_3
7.	SODA ASH	50,000 500,000	Ammonia process	- min. 99% Na_2CO_3
8.	CAUSTIC SODA	25,000 100,000	Soda ash solution causticizing lime lumps	- min.98% NaOH
9.	SODIUM BI-CHROMATE	10,000 25,000	Chrome ore alkaline oxidation	- min.99% $Na_2Cr_2O_7 \cdot 2H_2O$

0	1	2	3	4
10.	SODIUM PERBORATE	5,000	Decahydrate borax alkalinization followed by oxidation of metaborate formed	- active oxygen content min.10
11.	BARIUM SALTS $BaCO_3$ $BaCl_2 \cdot 2H_2O$ $BaSO_4$ $Ba(OH)_2 \cdot 8H_2O$ Na_2S	1,000 10,000	Baryta reduction with coke, followed by different reagents reactions (HCl, H_2SO_4, Na_2CO_3 etc)	min.98% $BaCO_3$ min.92-96% $BaCl_2 \cdot 2H_2O$ min.96% $BaSO_4$ 90-95% $Ba(OH)_2 \cdot 8H_2O$ 58-62% Na_2S
12.	BORAX	10,000	Dissolution of borax ore and re-crystallization of borax	min.99,5% $Na_2B_4O_7 \cdot 10H_2O$
13.	SODIUM SILICATE	5,000 20,000	Soda ash and quartz sand mixture are melted in a variable ratio	min.98%n$Na_2O \cdot m\ SiO_2$

0	1	2	3	4
14.	ALUMINIUM SULPHATE	10,000 100,000	Aluminium hydroxide with sulphuric acid reaction	min. 8-15% Al_2O_3
15.	TECHNICAL, EDIBLE AND PHARMACEUTICAL SODIUM BICARBONATE	5,000 20,000	Carbon dioxide reaction with sodium carbonate solution	- technical min.97.5% $NaHCO_3$ - edible min.98.5% $NaHCO_3$ - pharmaceutical - min.99.5% $NaHCO_3$
16.	POTASSIUM CARBONATE	6,000 12,000	Carbon dioxide reaction with potassium hydroxide solution	- min.99% K_2CO_3
17.	PRECIPITATED CALCIUM CARBONATE	10,000 20,000	Lime milk carbonation	- min.99% $CaCO_3$
18.	SILICA GEL (IONOSIL)	1,000 2,000	"Ion-exchange" process from sodium silicate solution	- water absorption capacity 30-60%

0	1	2	3	4
19.	SODIUM TRI-POLYPHOSPHATE	10,000 20,000	Purified phosphoric acid neutralization with sodium carbonate	
20.	SODIUM SULPHITE	20,000	Sodium carbonate solution reaction with SO_2 gases	- 87-94% Na_2SO_3
21.	SODIUM SULPHATE FROM PHOSPHO-GYPSUM	100 t/day	Phosphogypsum (from H_3PO_4 production) reaction with sodium carbonate	- min.97.5% Na_2SO_4
22.	CHLOROSULPHONIC ACID	35 t/day	Sulphuric anhydride reaction with hydrochloric acid	- min.94% HSO_3Cl
	V.3.3. Inorganic Pigments			
1.	YELLOW IRON OXIDE	500 1,000	Air oxidation of iron scraps over a ferrous sulphate solution	- min.82% as Fe_2O_3

0	1	2	3	4
2.	RED OXIDE	500 1,000	Yellow iron oxide calcination	min.97% as Fe_2O_3
3.	IRON BLACK	200	Precipitation and partial oxidation of ferrous sulphate solution	min.95% as Fe_2O_3
4.	IRON BLUE	300	Potassium ferrocianyde and ferrous sulphate reaction followed by oxidation with potassium chlorate	min.18% $Fe(CN)_6$
5.	CHROME YELLOW	500 1,500	Precipitation of sodium bichromate with lead basic acetate	min.48% $PbCrO_4$
6.	MOLYBDENUM RED	200	Precipitation of lead compounds with sodium chromate, molybdate and sulphate mixture	min.15% CrO_3

0	1	2	3	4
7.	CHROME GREEN	500 1,000	Coprecipitation of blue iron, basic lead acetate and sodium bichromate	min.8% $Fe(CN)_6$ min.8.5% BaO min.11.5% CrO_3 min.50% PbO
8.	CHROMIUM GREEN OXIDE	500	Reduction of sodium bichromate with sulphur	min.90% Cr_2O_3
9.	ZINC YELLOW	500 1,000	Zinc oxide and hydrochloric acid reaction followed by precipitation with sodium and potassium chromate mixture	min.35% ZnO min.42% CrO_3
10.	WHITE ZINC OXIDE	5,000 10,000	Zinc vapours oxidation with air	min.99% ZnO
11.	CADMIUM PIGMENTS	100	Reaction of cadmium with nitric acid, followed by cadmium sulphide precipitation	min.96% CdS

0	1	2	3	4
		V.4. UTILITIES AND SERVICES		
	V.4.1. Industrial Power Plants			
1.	Auxiliary plant for controlled extraction of hot gas heat with large content of SO_2 and SO_3 for energetic steam production	3-25 Gcal/h according to capacity of technological plant	Combinations of recovery units with forced circulation. Mixing of boiler water with make up water and special starting methods can avoid acid dew point	Through automatic control we can assure energetic parameters of steam or technological agent.
2.	Thermal plant for combined production of steam hot water and/or warm water for technological processes	Modules of steam boiler hot water boilers and units for conditioning of steam between 0.1-100 Gcal/h	Boilers with recovery line on the exhaust gas circuit producing thermal energy in economical conditions	Thermal energy is furnished through auxiliary installations automatically controlled for assuming the needs of user

0	1	2	3	4
3.	Power plant for combined production of electric power and thermal power for technological processes	Modules of boilers and turbines from 5 t steam/h to 300 t/steam/h processed for technology in a range of 0.15 MPa-6MPa	Boilers with solid, liquid and gaseous fuels for producing steam of medium and high parameters with turbogeneration proce ssing steam from source parameters to those required by consumer	Steam parameters are automatically controlled between the limits required by the standards of thermal energy fur - nishing
4.	Plants with organic, mineral oil and dowtherm heat transfer fluids for technological processes heated with standard fuels	Modulated units of 300,450,750,1170, 1400,1750 and 3500 kW with temperature difference of 20,30,40,50 K	Heating of thermic agents is done through standard fuel combustion with guaranteed efficiency of 85%	Temperature of heat carrier is controlled in a ±2 K range with increased reliability

0	1	2	3	4
5.	Plants with organic mineral and dowtherm heat transfer fluids for technological processes with electrical heating	Modules of 60, 90 kW combinations of modules to 270 kW. Temperature difference 20,30, 40, 50 k	Heat is produced through electrical resistors	Temperature of thermal agent is controlled in a ±0.5 k
6.	Thermal utilities plant for tyre curing presses	Depends on requests number and size of curing presses (i.e car, truck, tractor and OTR giant tyre)	Heating of hot water with steam in installations with heat storage and recycling	Water pressures are controlled in a ±0.2 MPa range; water temperatures are controlled automatically in a ±2 K range
7.	Heating and cooling water plant for curing rubber endless belt presses	Modules of heating and storage for 1, 2,4,6 and 8 standard curing and repairing presses Modules for con-	Heating through mixing with steam in heat storage units; cooling with recycling water at cooling towers	Water temperature is automatically controlled around 458 ±2 K. Pressure is controlled in a 1.8÷2.2 MPa

0	1	2	3	4
		trolled cooling of one or two pieces		
8.	Thermoregulation units for calenders and extruders compressing alternate phases of cooling heating	0.1 - 1 G cal/h	Secondary heat carrier (water) circulates through coolers and heaters and is returned to technological equipment. Operations are automatically controlled depending on the technological needs.	Temperature and pressure for extruder or calender is kept in the limits imposed by the technology
9.	Thermoregulation units for calenders and extruders comprising alternate phases of cooling-heating	0.1-1 Gcal/h	Secondary heat carrier (water circulates successively through a cooler and a heater. In cooling phases electrical heater is not in function	Temperature and pressure for extruder or calender is kept in the limits imposed by the technology

0	1	2	3	4
10.	Fuel oil department	20-100 m^3	Discharge storage and expedition of liquid fuels	
11.	Refrigerating plant with Lithium bromide (solution absorption)	Units of 0.9 or 2 Gcal/h	Absorption, desorption water vapours in lithium bromide solution	Cooled water t ≥ 278 K
12.	Refrigerating plant with compression	Modules of 0.05; 0.1;0.3;0.4 Gcal/h	Cooling of secondary carrier is done through evaporation of ammonia (freon) liquefied through mechanical compression and condensing with cooling water	Salts in water t ≥ 238 K
13.	Instrument air unit	Units of 45,90, 150,500,1200,1800 4,000 and 10,000 Nm^3/h	Mechanical compression followed by cooling and raw separation of condensed water and finishing on adsorbent materials or expansion and electric heating	Dew point 243K at atmospheric pressure

0	1	2	3	4
	V.4.2. Water Treatment Facilities			
1.	WATER TREATMENT	Clarified water output up to 30,000 cu.m/h	Water clarific ation in recirculated and suspended sludge settling tanks with additional coagulants and flocculents and in pressure mechanical sand filters	Clarified water can be used for any industrial purposes i.e. make up water for cooling towers as well as drinking water
2.	FULL WATER DEMINERALIZATION FACILITY	Module units of 10 cu.m/h to 150 cu.m/h	The solved salts contained in water are removed by cationic and anionic ion exchangers, anionic stage can include also a CO_2 degasifier	Electrical conductivity of demineralized water 2-0.2 S/cm SiO_2 20-50 ppm
3.	PARTIAL WATER DEMINERALIZATION FACILITY	Modules of 10 cu.m/h to 150 cu.m/h	Ca^{2+} and Mg^{2+} ions contained in water are removed by weak acid cationic and strong acid. Na-cationic ion exchangers. CO_2 is removed in the degasifier	Total hardness m-equivalent/l 0.05

0	1	2	3	4
4.	WATER COOLING TOWERS	Units of 20-100 cu.m/h 500 cu.m/h,1000 cu m/h 4500 cu.m/h,. Total capacity up to 36,000 cu.m/h	Water is sprayed in the cooling tower and cooled in air-stream supplied by high capacity fans. The temperature of the warm water is reduced by a gradient of 10°C	Cooled water can be used for any kind of industrial heat exchangers
5.	RECOVERY OF OIL PRODUCTS FROM UNDERGROUND WATER	Oil output about 1,200 t/y per base hole	In the oil-contaminated underground water baseholes have to be drilled. Water is boosted in special oil separators when the oil products are recovered	Recovered oil products can be used as fuel or recycled in oil refinery and water can be sent to industrial consumers or back in the underground deposits
6.	FIREFIGHTING SYSTEM	Foam output up to 50,000 cu.m/h	The mechanical foam is made of water and foaming liquid by means of foam generators. Mechanical foam extinguishes any oil products fire in industrial spaces in about 10 minutes	Fire extinguishing foam for oil products fire.

0	1	2	3	4
	V.4.3. Solid Materials Loading, Unloading, Storing, Bagging and Transport Installations			
1.	UNLOADING RAMP FOR RAILWAY WAGONS WITH BULK MATERIALS	up to 3,000 t/h	Unloading of bulk granular or powder materials from railway wagons with gravitational automatic unloading outside the rails	
2.	STOREHOUSE FOR BULK MATERIALS	Any storing capacity according to Buyer's request	Storing of bulk granular or powder materials in closed areas	
3.	SILO	up to 10,000 m^3 for one cylindrical column	Storing of powdery or small grain size, easily running materials which do not agglomerate or cake.	
4.	STOREYARD WITH OVERHEAD TRAVELLING CRANE	Any capacity according to Buyer's request	Storing of materials which are not weather sensitive and have a large and/or uneven granulation	

0	1	2	3	4
5.	AUTOMATIC BAGGING LINE AND RAILWAY WAGONS LOADING	up to 1,200 bags/h	Packing of powder or grain products in open bags and loading the full bags in railway wagons	
6.	BAGGING PALLETIZING AND SHRINK WRAPPING LINE	up to 3,000 bags/h and up to 100 pallets/h	Packing and shrinkwrapping in shrink-film in order to store and dispatch the powder or granular products in open or valve bags	
7.	LINE FOR PREPARATION OF SHRINKWRAPPED PALLETLESS UNIT LOADS	up to 2 t/collective package and up to 80 collective packages per hour	Separate packages are conveniently arranged in successive rows and strenghtened with shrinkable foils so that the collective package should be afterwards lifted and transported by a fork-lift truck without needing a pallet	

0	1	2	3	4
8.	HIGH WAREHOUSE FOR PALLETIZED MATERIALS	Any capacity according to Buyer's request	An efficient, completely automatic solution for storage of different various materials stacked on pallets or boxpallets in racks with direct access	
9.	BULK MATERIALS LOADING PLANT INTO RAILWAY WAGONS	up to 1,800 t/h	Powder or granular bulk materials, automatic weighing and leading into railway wagons	
10.	SHIPLOADER FOR BAGGED PRODUCTS AND BULK MATERIALS	Up to 2,500 bags/h or, for bulk materials, up to 1,000 t/h	Bagged or bulk products loading into sea or river ships, bringing at the same time the bags and the bulk materials to the storing place of each within the ship cargo hold	

0	1	2	3	4
11.	HARBOUR TRANSFER PLANT FOR BULK MATERIALS	Any capacity according to Buyer's request	Bulk materials unloading from sea or river ships, intermediate storage and dispatch to consumers by land transport means, or the same in the reverse way	
	V.4.4. Maintenance and Repair Facilities			
1.	REPAIR SHOP	Determined by the volume and complexity of mechanical, electrical and automation equipment	Classical	After the achieving of the planned repairs the technological equipment in question is brought to initial functional parameters
2.	CHARGING STATION FOR ACCUMULATORS FOR ELECTRIC VEHICLES	Determined by the design, number and duty of electric vehicles on the platform in question	with or without the detachment of the electric vehicles	The maintenance in normal operating condition of the accumulators with which the electric vehicles in question are equipped

0	1	2	3	4
3.	PROTECTIVE EQUIPMENT LAUNDRY	Determined by quantity, type and working ambience of the protective equipment	Normal Chemical	The laundry has to keep the protective equipment of the personnel working in the unit or industrial complex as clean as required by hygienic norms

VI. REFERENCE LIST

IPROCHIM engineering potential in the implementation of chemical plants and in providing various consulting services has been materialized in many achievements listed in a separate Reference List.

The experience gained over its long practice in designing chemical and petrochemical plants, the close co-operation with research scientists and wide co-operation with well-known companies in other countries are warrants for good consulting engineering services for which IPROCHIM takes full responsibility.

REFERENCE LIST

IPROCHIM'S ENGINEERING ACTIVITY OUTSIDE ROMANIA

Ref. no.	Project denomination profile, capacity	Location	Year	Remarks
0	1	2	3	4
	A. Projects set up overseas			
1.	Acetylsalicylic acid plant, 90t/y, Sun Cion	P.D.R. Korea	1958	
2.	Sulphuric acid plant on pyrite, 215,000t/y, Samsun	Turkey	1971	
3.	Single superphosphate plant (18% P_2O_5), 229,000t/y, Elaziq	Turkey	1971	
4.	Sodium products complex, El-Mex-Alexandria - Sodium carbonate, 100,000t/y - Caustic soda, 45,000t/y - Soda ash (dense) 32,500t/y - Sodium carbonate technical 4,000t/y pharmaceutical 1,000t/y	Egypt	1973	
5.	Sodium products complex, Shiraz - Soda ash (dense) 53,000t/y - Edible sodium bicarbonate, 10,000t/y	Iran	1973	
6.	Sulphuric acid plant on sulphur 100,000t/y, Abu Zabaal	Egypt	1973	
7.	Polynitril acrylic fibres plant, 10,000t/y, Haeju	P.D.R. Korea	1979	
8.	TSP Complex-Homs (turn-key delivery): - sulphuric acid 560,000t/y - phosphoric acid 165,000t/y P_2O_5	Syria	1980	

0	1	2	3	4
	- TSP (47%P_2O_5) granulated 450,000t/y - Aluminium fluoride 3,000t/y - Auxiliary sections			
9.	Extension on Zarqa Thermal power plant, 12 MW+150t/y steam	Jordan	1982	
10.	Aniline plant, 50,000t/y	USSR	1982	
11.	Formaldehyde plant I-II-III 120,000t/y (each)	USSR	1983	
12.	Vitamin C plant, 500t/y Guadalajara	Mexico	1984	
13.	Vitamin C plant, 100t/y Chongjin	P.D.R. Korea	under construction	
14.	Sodium bichromate plant, 10,000t/y, Elazig	Turkey	ditto	
15.	Fertilizer Complex Tongling Anhui - phosphoric acid, 61,200t P_2O_5/y - DAP, 60,000t P_2O_5/y	China	ditto	
16.	Extension of sodium products Complex, Shiraz: - Soda ash 100,000t/y - Absorption-distillation for 100,000t/y calcinated soda ash - Carbonation for 100,000t/y soda ash	Iran	1981 under construction ditto	
17.	Ammonia storage, Alkhaim 1,500t	Iraq	ditto	
18.	Bone glue plant, Karachi 1,200t/y	Pakistan	ditto	
19.	V-belt factory, 5 mil.pcs./y	Nigeria	contracted	

0	1	2	3	4
20.	Active substances extraction unit from plants	Ruanda	1984	delivered through UNIDO
21.	Active substances extraction from plants	Tanzania	under construction	
22.	Vinyl polyacetate complex	Greece	contracted	
	B. Studies and designs			
1.	Feasibility study for a phosphorous fertilizer complex	Chile	1971	
2.	Equipment drawings specific for sodium products electrolysis plant	Hungary	1974	
3.	Equipment drawings specific for a sodium products electrolysis plant, Pancevo	Yugoslavia	1975	
4.	Feasibility study on the fluorine turning to account from the phosphoric acid plants in Gabes	Tunisia	1982	
5.	Feasibility study for a fertilizer complex	Mozambique	1979	
6.	Feasibility study for a chlorosodic products complex	Mozambique	1979	
7.	Feasibility study for a PVC complex	Bangladesh	1980	
8.	Feasibility study for a fertilizers complex (ammonia, urea sulphuric acid, phosphoric acid MAP/DAP, NP (NPK)	Thailand	1983	
	C. Expertize and Technical Assistance			
1.	Technical assistance for pesticides industry	Thailand Philippines Indonesia Malaesia Nepal, India, Afganistan	1973 1974	by UNIDO

0	1	2	3	4
2.	Technical assistance for pesticides industry	Algeria	1977	by UNIDO
3.	Technical assistance for petro-chemical industry	Nigeria	1978	ditto
4.	Technical assistance for the utilization of Qiwu lake natural gas	Ruanda	1980	ditto
5.	Expertize for the Muldem nitro-phosphates plant	Pakistan	1980	by UNIDO
6.	Technical expertize for the up-dating of gypsum conversion to ammonium phosphate complex Dauchel	Pakistan	1981	
7.	Start-up and operation of the PVC plant built up by KHD-W Germany	Libya	1982-1984	
8.	Technical-economic expertize of the basis of a national petro-chemical industry	Zambia	1973	by UNIDO
9.	Designing and teaching activity assignement at CURER (Centre Universitaire de Recherches)	Algeria	1974	
10.	Consultant of the government in industrial electro-energetics	Niger	1977	by UNIDO
11.	Technical assistance for the State controlling Organisme de Controle Technique de la Construction	Algeria	1975 1983	
12.	Technical assistance for establishing a petrochemical complex.	Argentine	1982	by UNIDO

VII. ADDRESS FOR ADDITIONAL INFORMATION

1. CHEMICAL AND PETROCHEMICAL MINISTRY
   Splaiul Independenţei 206. Phone: 49.26.20; 70039
   Bucharest-Romania

2. IPROCHIM - ROMANIAN ENGINEERING COMPANY FOR CHEMICAL INDUSTRY
   19-21 M.Eminescu Street; Phone: 11.79.40; Telex 11907; 79637 Bucharest - Romania.

VIII Annex - EXAMPLES OF TECHNICAL SHEETS

Year	Edition	Origin	Engineering
1988	1	Ro	IPROCHIM

PROJECT PHENOL-ACETONE

Process

Benzene alkylation with propylene with formation of isopropylene benzene, oxidation of isopropylene benzene to isopropylene benzene hydroperoxide and its decomposition against sulphuric acid to acetone and phenol.

Feedstock

Benzene: density at 20°C, g/cm^3 - 0.876 - 0.88; solidification point - °C +5, distillation - initial °C - 79.4
- final °C - 80.4
5 - 96% distills within a degree range of maximum - 0.6;
propylene: propylene, % min. - 80, propane % max. - 20; sulphur, ppm max. - 10.

Description

Phenol and acetone manufacturing process applied in plants in Romania covers the following main stages:
- benzene alkylation with propylene in the presence of catalyst at 230°C and 35 atm;
- separation of propane, benzene and isopropylbenzene in a 3 column system;
- isopropylbenzene oxidation to isopropylbenzene hydroperoxide against catalyst at 100°C and 6 atm;
- isopropylbenzene hydroperoxide decomposition against sulphuric acid to acetone and phenol;
- acetone and phenol separation and purification in a 7 column system;
- phenol recovery from phenolic tars.

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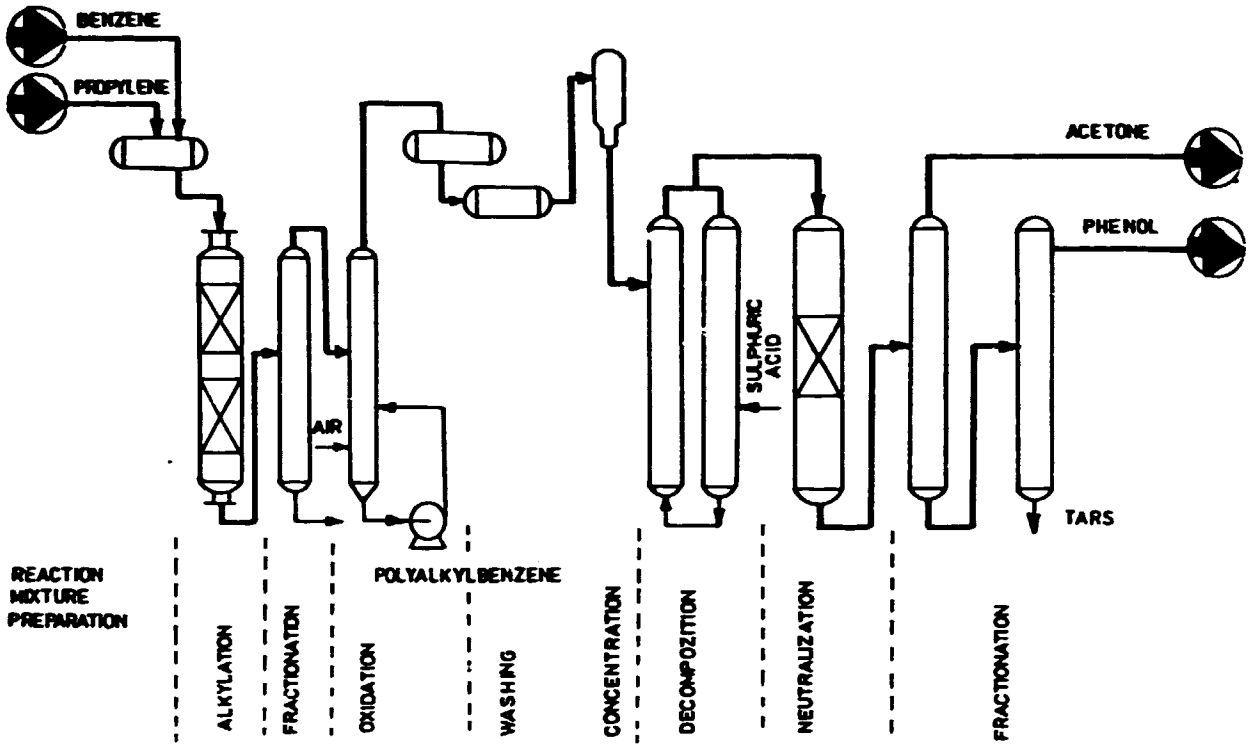
PHENOL ACETONE FLOW SHEET



Specific Consumptions

The specific consumptions are given per 1,000 kg phenol:

- benzene t - 0.968
- propylene 100% - 0.548
- cooling water (28 - 38°C) m^3 - 700
- electrical power, kwh - 295
- thermal power, kcal - 1.135×10^6

End Product Quality

Phenol:

- appearance white crystals
- colour Hazen 5
- congelating point °C - + 40.8
- miscibility with water, 1p phenol at 13p water at 15.5°C

Phenol is an important intermediate product for fibre industry based on caprolactam to obtain nonylphenol, bisphenol, etc.

Acetone:

- appearance: clear colorless liquid
- specific gravity g/cm^3 - 0791 - 0795
- distillation range at 760 tarr, ^oC - +55.6 - 56.6 (98% by vol.)
- resistance at permanganate, - 8

Acetone is a solvent with a wide application field.

Commercial Installations

Romania has implemented and operated plants of the following capacities : 45,000t/y phenol, 25,000t/y and 50,000t/y phenol.

Ecological Aspects

Phenol and acetone manufacturing plant does not cause pollution of air, ground or water.

The plant could yield gaseous effluents made of accidental discharges of safety valves, effluents which contain propane, propylene or their mixture with benzene. This brings about the flare system following that recovery of flare gases is achieved at the level of the whole platform.

Phenolic acid and chemically contaminated waters are processed in a treatment unit and further sent to biological treatment station.

Kind of Project: Engineering Turn-key Others

Additional Information

Phenol plants of minimum capacity 25,000t/y phenol or of medium capacities 25,000t/y and 50,000t/y can be offered.

Year	Edition	Origin	Engineering
1988	1	Ro	IPROCHIM

PROJECT ETHYLBENZENE

Process

Benzene alkylation with high purity ethylene in the presence of catalyst.

Feedstock

Benzene: density at 20°C, g/cm^3 - 0876 - 0880; congelating °C - 5.47; distillation °C, initial - 79.4, °C
final - 80.4
5-96% distills within one degree range, max. 0.6
high purity ethylene (99%g)

Description

Benzene, previously dried to a water content of 2 - 30ppm is sent to alkylation. The alkylation reaction occurs in a column type reactor at the pressure of 1 - 3 ata and the temperature of 90-130°C. When alkylation is over the reaction product is subjected to neutralization and washing traetment which yields a concentrated solution with $AlCl_3$ used as flocculating agent in the biological treatment stations.

The reactions product after washing and neutralization is subjected to distillation in a system of 3 distillation columns.

In the first column, which operates at P=1.3 - 6 ata benzene is separated and recycled to the process.

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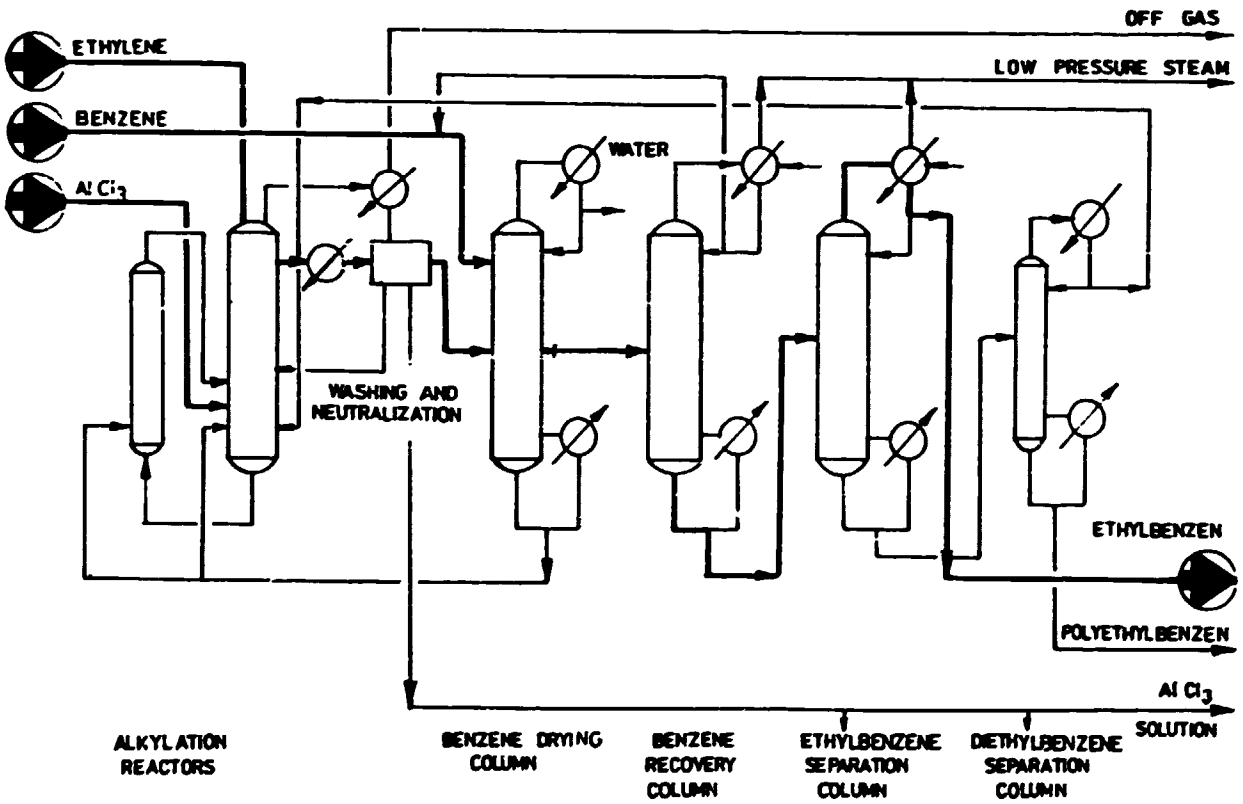
In the second column which operates at P = 1 - 6 ata ethylbenzene , plant end product is obtained.

In the third column which operates at 300 - 5 mm Hg diethylbenzene cut is separated and recycled to transalkylation in the reactor and heavy products (polyethylbenzene) which are used as fuels..

ETHYLBENZENE FLOW SHEET



Specific Consumptions

Specific consumptions are given per 1,000 kg ethylbenzene:

- benzene (1//%)	t - 0.760
- ethylene (100%)	t - 0.273
- cooling water, cu.m	63
- electrical power	kwh - 20
- steam, 25 ata	t - 1.62

End Product Quality

- ethylbenzene, % g min. - 99.7%
- other hydrocarbons , % g. max. 0.3 out of which
- diethylbenzene, ppm max. - 40; chlorine, ppm - 5

Ethylbenzene is used in styrene manufacturing.

Commercial Installations

Based on the Romanian process given above plants of the following capacities have been implemented in Romania: 40,000; 60.000 and 120,000t/y.

Ecological Aspects

Ethylbenzene manufacturing plant does not pollute the environment.

Aluminium chloride is fed into the system by an original system which prevents hydrochloric acid releases to the atmosphere.

Acid waters with $AlCl_3$ are sent to the biological treatment station.

Kind of Project: Engineering Turn-key Others

Additional Information

Plants with capacities lower than 40,000t/y can be offered while for higher capacities, modules of capacities given above can be offered.

Year	Edition	Origin	Engineering
1988	1	Ro	IPROCHIM

PROJECT C_5 RESINS

Process

C_5 resins are obtained by cationic oligomerization (copolymerization) in solution of a complex mixture of monomers contained in C_5 piperilenic cut resulted as secondary product from the separation of isoprene from C_5 of pyrolysis benzines.

Feedstock

The raw material for C_5 resins manufacture is C_5 piperilenic cut, a mixture of: unsaturated dienic C_5 hydrocarbons (cis and transisomers of piperilene, isoprene, cyclopentadiene, dicyclopentadiene); unsaturated olefinic C_5 hydrocarbons (n-pentene, trans and cis-pentene 2,2 methylbutene 2, cyclopentene); saturated C_5 hydrocarbons (n-pentane, cyclopentane).

Description

The process consists of the following stages:

- raw material conditioning
- preparation of soluble catalytic complex based on aluminium chloride
- polymerization in solution
- disactivation of catalytic complex and phases separation
- atmospheric distillation for the removal of unreacted C_5 hydrocarbons
- C_5 resins conditioning

Specific Consumptions

The main specific consumptions expressed per 1000 kg resins are:

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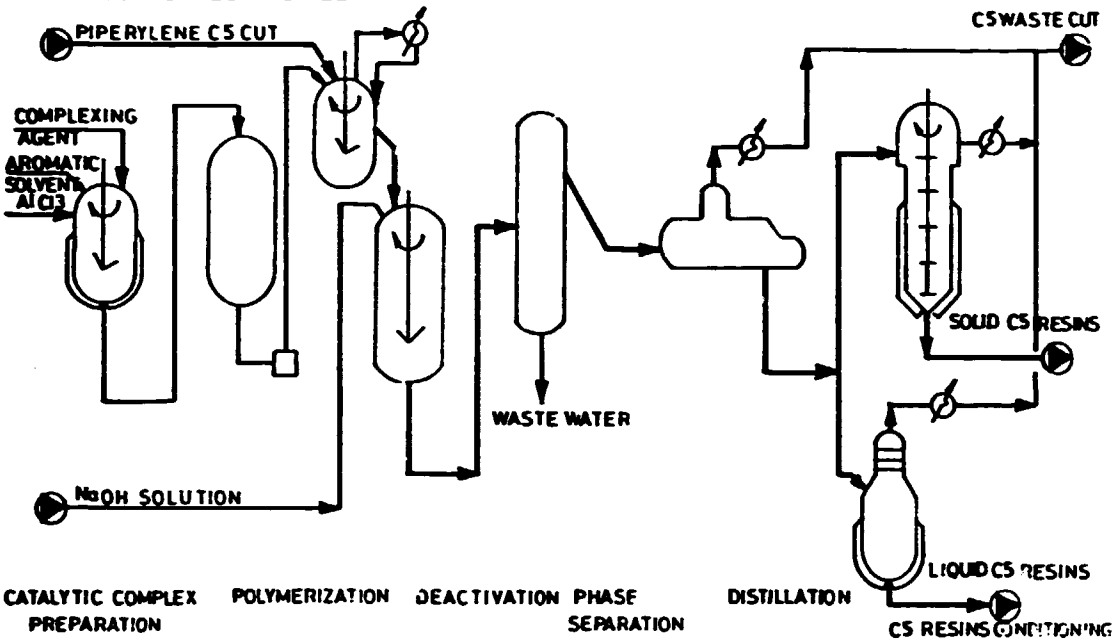
C5 RESINS FLOW SHEET



	Solid C_5 resins	Liquid C_5 resins
- piperilenic C_5 cut, t -	2.72	2.27
- aluminium chloride, t -	0.028	0.092
- aromatic solvent, t -	o.o38	0.246
- high, medium and low pressure steam t -	5.5	5.2
- cooling water (28°C) m^3 -	130	130
- electric power kwh-	120	200

End Product Quality

C_5 resins pertain to hydrocarbons resin class.

Quality characteristics of solid C_5:

- softening point	°C	75 ±5	95 ±5	110 ±5
- aspect: solid thermoplast, yelow-amber colour				
- softening point, (ring and ball)	°C	75 ±5	95 ±5	110 ±5
- iodine number	gI_2/100gr	150-200	150-200	150-200
- ash content	%gr	max. 02	max. 02	max. 02

Quality characteristics of liquid C_5 resins

- iodine number, gI 2/100gr max. 130
- ash content, % g max. 02
- viscosity at 20°C, P max. 550

C_5 resins have a wide application range such as:

- they replace natural colophony in rubber and plastics manufacture industry;
- they replace certain plasticizers in some plastics - nufacture (P.V.C.)
- components of formulas for automobile grease and other uses and varnish industry, etc.

Commercial Installations

Based on a Romanian continuous manufacture process a 15,000t/y capacity plant has been commissioned.

Ecological Aspects

The process does not release gases or vapours that could pollute the environment. The equipment vents where hydrochloric acid traces could appear, are passed through a gas washing column for neutralizing and retaining of acid emissions before being exhausted to the atmosphere. The waste water resulting from the plant is fed before being sent to the emissary to the biological treatment station to diminish the acid content and to fulfil the discharge requirements (as per the international standards).

Kind of Project: Engineering Turn-key Others

Additional Information

Any production capacity can be offered upon Buyer's request.

Year	Edition	Origin	Engineering
1988	1	Ro	IPROCHIM

PROJECT STYRENE BUTADIENE RUBBER

Process

The process is based on an original Romanian Technology consisting of butadiene and styrene copolymerization in "cold" emulsion in the presence of a redox initiating system.

Feedstock

- Butadiene, with a concentration of % (gr), min. 99; styrene, with a concentration of % (gr), min. - 99.7.

Description

The process consists of several important stages:
- Additive solutions preparation - emulsifier (resin and/or fat acids), initiator, activator, inhibitor, etc.
- Monomer emulsion preparation in emulsifier solution, observing the prescribed ratio between butadiene, styrene and water;
- Butadiene and styrene copolymerization at 5 - 8°C;
- Latex degasifying obtained in view of unpolymerized monomers recovery;
- Latex coagulation with salt and acid followed by rubber particles separation;
- Rubber drying and packing.

Specific Consumptions

For 1,500 type SBR the main specific consumptions for 1,000 kg product are:

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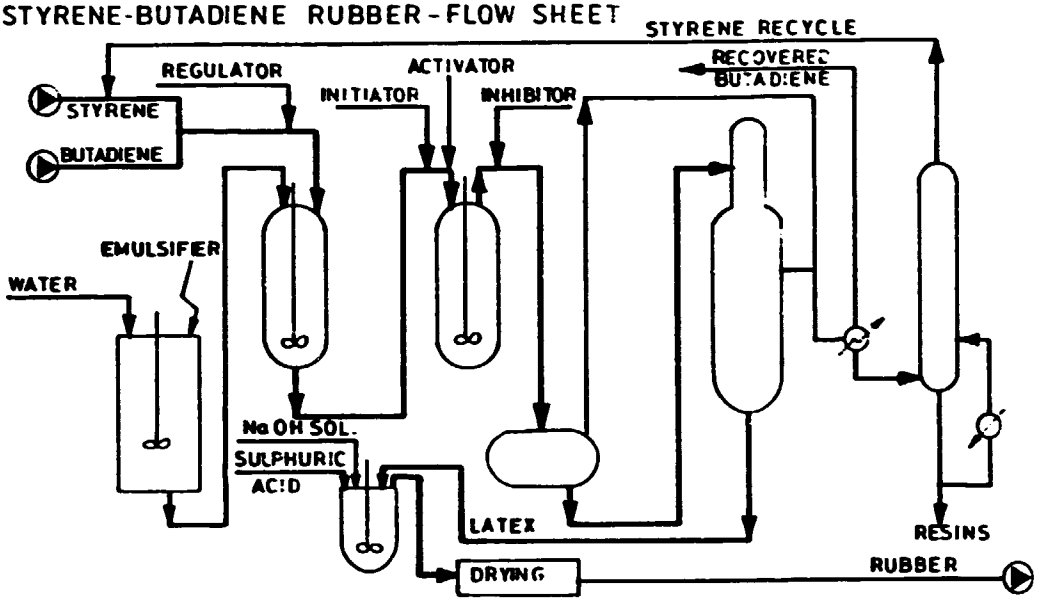
STYRENE-BUTADIENE RUBBER - FLOW SHEET



- butadiene t - 0.742
- styrene t - 0.245
- steam t - 6
- electric power - 0.4

End Product Quality

Butadiene styrene rubber is manufactured in a wide range of types and assortments and has the following main characteristics:

	1.500	1.502	1.507	1.508	1.712
- emulsifier	AR	AG+AR	AG+AR	AG	AG+AR
- stabilizer	S	NS	NS	NS	S
- coagulation	S+A	S+A	S+A	S+A	S+A
- Mooney viscosity ML(L-4) 100°C	46-58	46-58	30-38	46-58	46-58
- 300% elongation mode at 145°C curing,					
- 25 minute daN/cm^2	21-45	24-46	21-53	25-45	15-35
- 50 minute daN/cm^2	56-84	56-39	50-85	56-84	36-65
-100 minute daN/cm^2	84-110	80-110	70-116	75-120	55-85

Commercial Installations

In Romania the process is applied in two industrial plants, one of 100,000t/y and the other of 50,000t/y. The first plant has been operating since 1963, its operation up to the present time having enabled the production, design and research specialists to improve the process many times.

Ecological Aspects

Waste water results from process both at the latex degasifying and coagulation stages.

The improved process applied in Romania ensures the treatment of water so that to recirculate it partially in the process, the rest of the quantity being discharged to the biological treatment station.

Rubber waste resulted from equipment cleaning are partially processed to obtain rubber of less important applications and are partially burnt in a special unit.

Kind of Project: Engineering Turn-key Others

Additional Information

Any production capacities can be offered upon buyer's request.

Year	Edition	Origin	Engineering
1988	1	Ro	IPROCHIM

PROJECT POLYISOPRENE RUBBER

Process

The process is based on an original Romanian technology consisting of solution polymerization of isoprene with three-component and tetra-component catalyst.

Feedstock

Isoprene - stereospecific polymerization degree.

Description

Isoprene polymerization in solution with three-component and tetra-component catalyst, polymerization reaction stopping, polymer stabilization, solvent removal with recovery and unreacted monomer and solvent recirculation, drying and packing of polyisoprene rubber.

Specific Consumptions

The typical specific consumptions for 1000 kg of product are:

- isoprene t - 1.025
- solvent t - 0.07
- steam t - 19
- refrigerent Gcal - 0.9

End Product Quality

- cis content 1.4 % min. - 96
- Mooney Viscosity, (ML 1+4) 100°C - 75 - 85
- volatiles, at 105°C % max. 0.6
- ash content % max. 0.6

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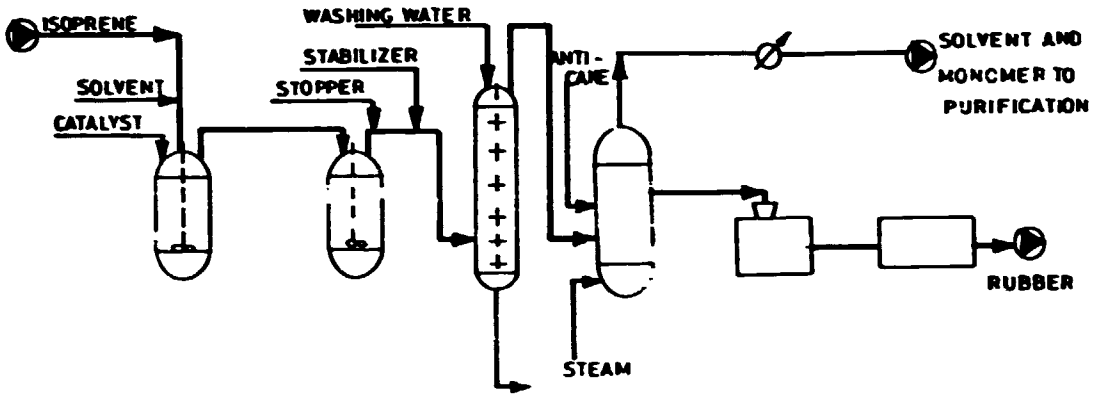
POLYISOPRENE RUBBER – FLOW SHEET



Commercial Installations

The offered process is based on our own experience of industrial operation of a 30,000t/y plant and a 60,000t/y plant.

Ecological Aspects

The manufacturing process in keeping with the offered process, due to the imposed measures, does not yield gaseous, liquid or solid effluents with pollution character to the environment.

Waste water is treated within the plant in view of recovering the useful components, being afterwards discharged to the biological treatment station.

Kind of Project: Engineering Turn-key Others

Additional Information

In principle, any production capacities can be offered, but it should be nevertheless that the economical ones are higher than 30,000t/y.

Year	Edition	Origin	Engineering
1988	1	Ro	IPROCHIM

PROJECT CAPROLACTAM

Process

Oxime synthesis from cyclohexanone and hydroxylamine by Beckman transposition to lactam.

Feedstock

Technical liquid ammonia, sulphur, technical cyclohexanone.

Description

The process stages are:

- Hydroxylamine sulphate obtained by successive absorption of ammonia, carbon dioxide, nitrogen oxides, sulphur dioxide followed by hydrolysis;
- Cyclohexanone oximation with hydroxylamine sulphate solution and ammonium sulphate separation;
- Beckman transportation of oxime, lactam sulphate neutralization, solvent extraction followed by distillation purification;
- Evaporation and crystallizing of ammonium sulphate solution resulted as by-product.

Specific Consumptions

To obtain 1,000 kg of caprolactam:

- cyclohexanone (99.9%)	t	0.98
- ammonia (liquid, technical)	t	1.7
- carbon dioxide (80% by vol.)	m^3	400
- sulphuric acid (oleum), 20% SO_3	t	1.56
- sulphur dioxide (12-14 % by vol.)	t	1.61
- steam (13 bar, 180°C)	t	6
- electric power (380 KW, 50 Hz)	KW	1200

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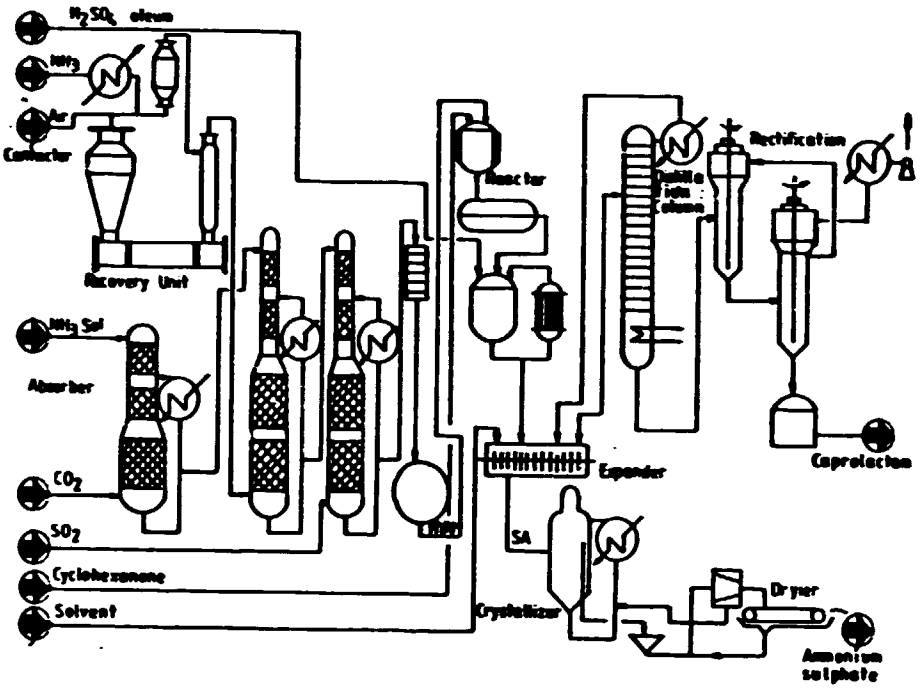
CAPROLACTAM
FLOW-SHEET



- demineralized water	(s)	m^3	12
- recycled cooling water (30^oC, t 10^oC)		m^3	12,000

End Product Quality

Pure crystallized caprolactam is in keeping with international standards for fine textile yarns, tyre cord and industrial yarns as far as its quality is concerned.

The ammonium sulphate crystallized and dried to 1% humidity with nitrogen content of 21% is used as fertilizer for calcarous soils.

Commercial Installations

There are plants in operation whose capacities range between 6000t/y and 25,000t/y.

Ecological Aspects

Efficient solutions for environment protection have been

applied in the existing plants, i.e:
- recovery of ammonium sulphate, by-product resulted from synthesis;
- scrubbing of purge gases with nitrogen and sulphur oxides;
- incineration of organic wastes;
- biological treatment of waste waters.

Kind of Project Engineering Turn-key Others

Additional Information

4.5. t ammonium sulphate are recovered from 1 ton caprolactam. Manufacturing lines of desired capacity can be offered.

Year	Edition	Origin	Engineering
1988	1	Ro	IPROCHIM

PROJECT ADIPIC ACID

Process

Catalytic oxidation of cyclohexanol with 65-68% nitric acid.

Feedstock

Cyclohexanol, 99,93 % nitric acid 65 - 68%

Description

- Preparation of raw materials, purification and concentration of nitric acid;
- Batching of a suitable amount of catalyst;
- Cyclohexanol oxidation with nitric acid at 55°C; the intermediate product is hydrolized at 90°C, there resulting adipic acid with a high temperature release;
- Separation and purification of adipic acid in the reaction mass by successive crystallization and recrystallization operations;
- Product centrfuging and washing;
- Adipic acid crystals drying in fluidized bed drier;
- Recovery of unspent nitric acid from the waste waters by vacuum concentration operations and its recycling to the raw materials preparation process;
- Recovery of adipic acid dissolved in acid and waste waters by concentration, crystallization and centrifuging, the recovered adipic acid is recycled to the crystallization stage;
- Recovery of adipic acid entrained by drying agents and its recycling in the process;
- Recovery of nitrogen oxides resulted in the oxidation process;
- Recovery of glutaric acid from the waste waters.

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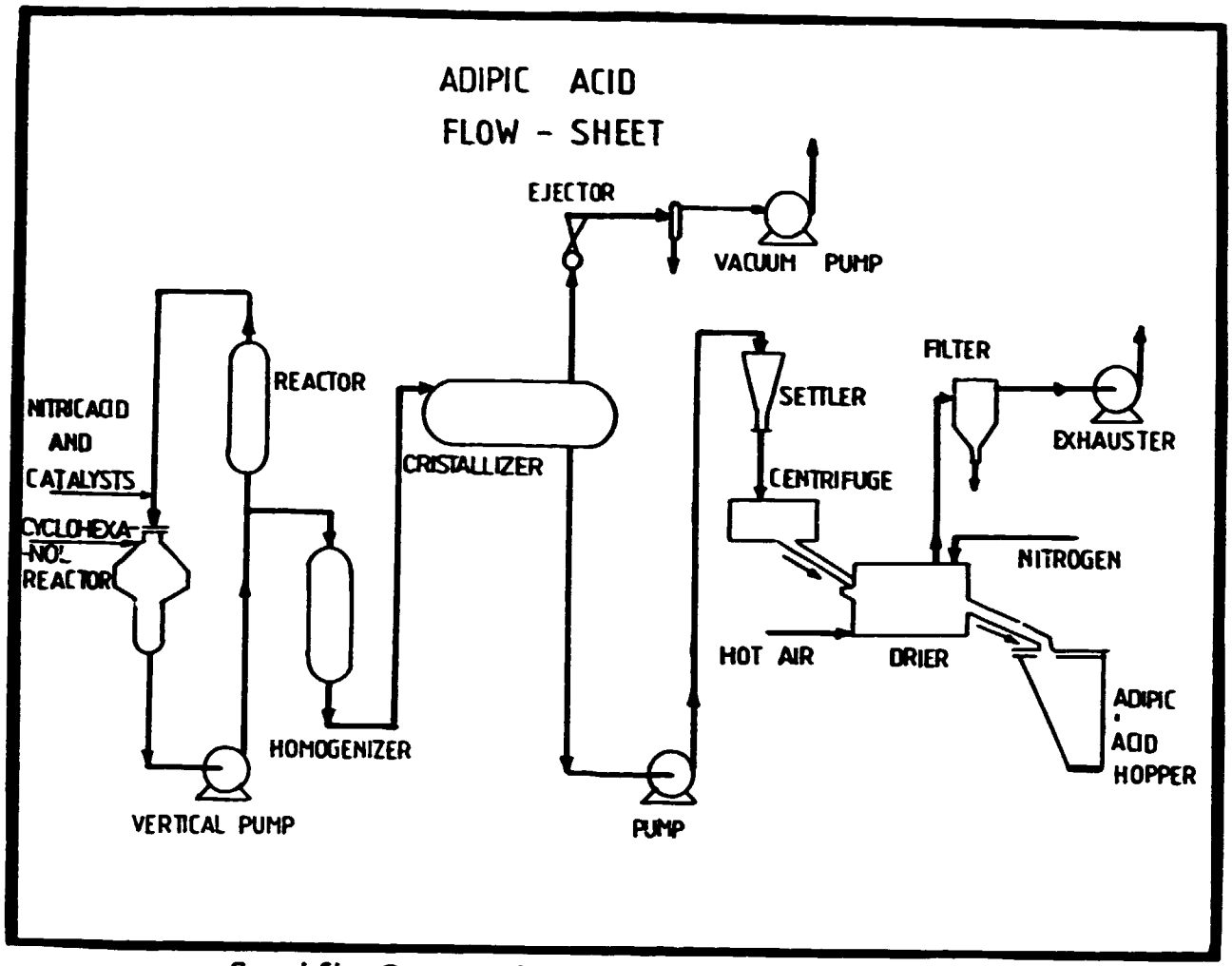

Specific Consumptions

For 1,000 kg of adipic acid:

- 99.92 % cyclohexanol	t	0.800
- 65% nitric acid	t	2.068
- steam	t	12
- electric power	thous. MWh	0.675
- refrigerant	Gcal.	0.350
- demineralized water	m^3	12
- recycled water	m^3	100

End Product Quality

White, colourless crystals 100 + 60 containing 99.5% adipic acid.

The adipic acid can be mainly used for the manufacture of synthetic fibres, polyester fibres, preparation of softeners for plastics; synthesis of polymers of foam polyurethane type; synthesis of polyester plastics, synthesis of hexamethylene diamine.

Commercial Installations

Plants of 3,000t/y and 7,000t/y are operating in Romania.

Ecological Aspects

The process results in:

- gases containing traces of nitrogen oxides taken over by a dispersion tower of 40 - 60 m in height designed according to the local conditions;
- the weak acid waste water with a maximum 1% adipic acid and inferior bibasic acids are neutralized in the treatment station related to the plant, so that when discharged in the local emissary they observe the purity requirements.

Kind of Project: Engineering Turn-key Others

Additional Information

Upon request, the process can be completed with an initial stage of air catalytic oxidation of cyclohexane to cyclohexanol.

Manufacturing lines of desired capacity can be offered.

Year	Edition	Origin	Engineering
1988	1	Ro	IPROCHIM

PROJECT TYRES MANUFACTURING PLANT

Description

The main phases of the manufacturing process are:

- preparation of rubber compounds;
- preparation of semi-fabs (tread, sidewalls, beads, rubberized textile or metallic cord, plies, breakers, chaffers, rubber sheets etc.)
- tyre building;
- tyre curing ;
- finishing and painting of the end product;
- inspection, marking and packing

Production capacity (t,pcs)per year	To be established depending on the requirements and economic efficiency		
Kind of Project	Engineering	Turn-key	Others
Ecological Aspects:	It does not contaminate the environment		

Additional Information

The manufacturing process differs depending on both tyres destination (car, truck, tractor) and construction (diagonal or radial, textile/textile, textile/metal or all steel).

The plant capacity depends on the requested production profile.

Technical and commercial clarifications have to be carried out with Buyer.

The production process requires skilled personnel.

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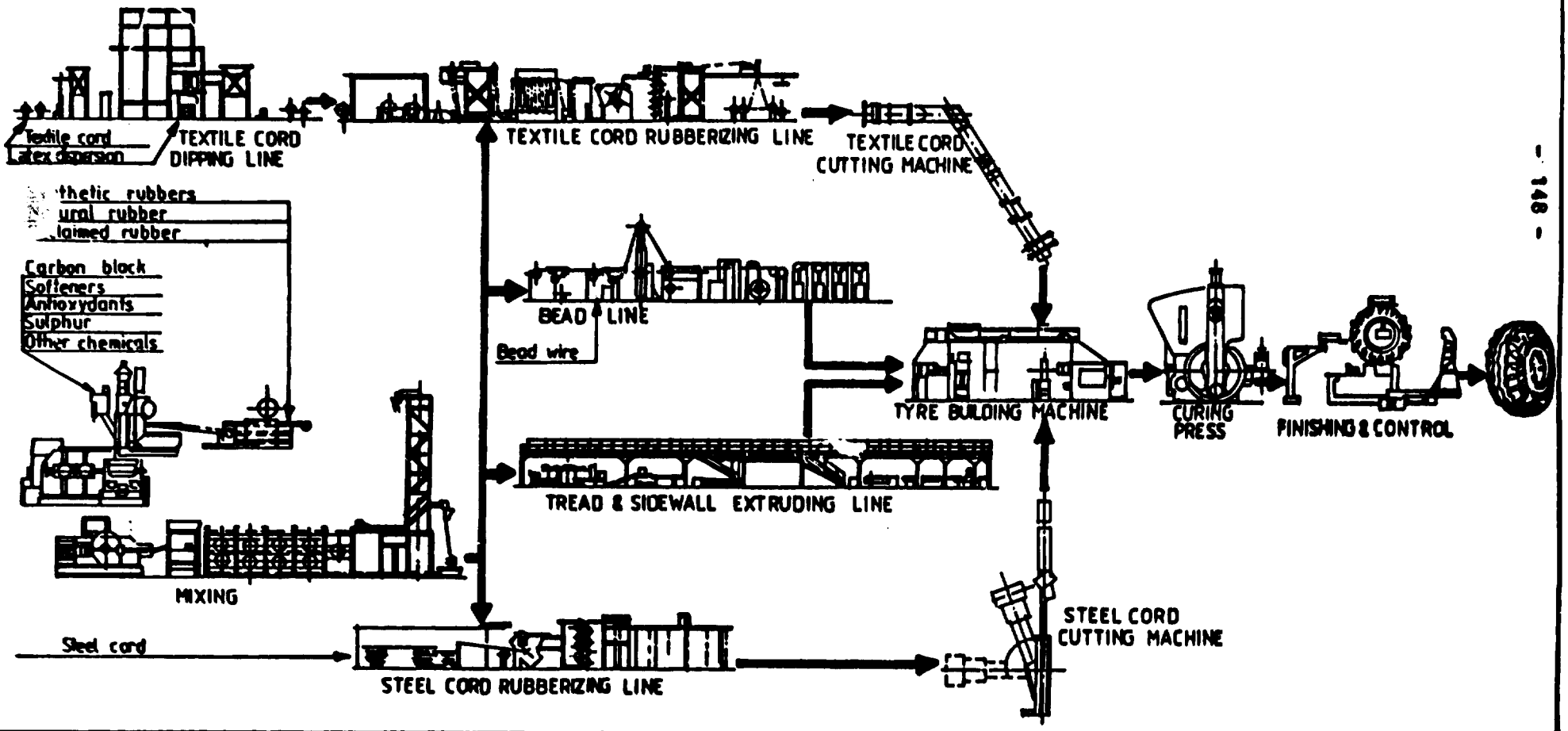
TYRE MANUFACTURING PROCESS



Year	Edition	Origin	Engineering
1988	I	Ro	IPROCHIM

PROJECT ACRYLAMIDE

Process

The acrylamide is prepared by successively passing a mixture of water - acrylonitrile through three reactors where a Cu catalyst in water suspension is continuously recirculated.

The raw acrylamide solution is concentrated by evaporation and is purified by passing it through ion exchangers columns.

Feedstock

Designation and quality" Acrylonitrile, 94-99%, Demineralized water: Catalyst expressed as Cu.

Description

The acrylamide manufacturing process consists of the following main operations and stages. Acrylamide hydration by successively passing a mixture of acrylonitrile and water through three reactors filled with suspension of Cu in water catalyst at 12o°C and atmospheric pressure, and filtration of reaction mixture though the filter immersed in each reactor.

Acrylamide solution concentration in Luwa type reactors at 5o-6o°C and atmospheric pressure up to abt.4o-48%.

Concentrated acrylamide solution purification by passing through ion exchangers column.

Specific Consumptions

The following are required for 1,ooo kg of end product:

- Acrylonitrile	o.36 - o.4 t/t
- Demineralized water	1.8 - 1.85 t/t
- Catalyst expressed as Cu	0.15 - 0.16 t/t
- Water	3.2 - 3.5
- Steam	0.04 - 0.05

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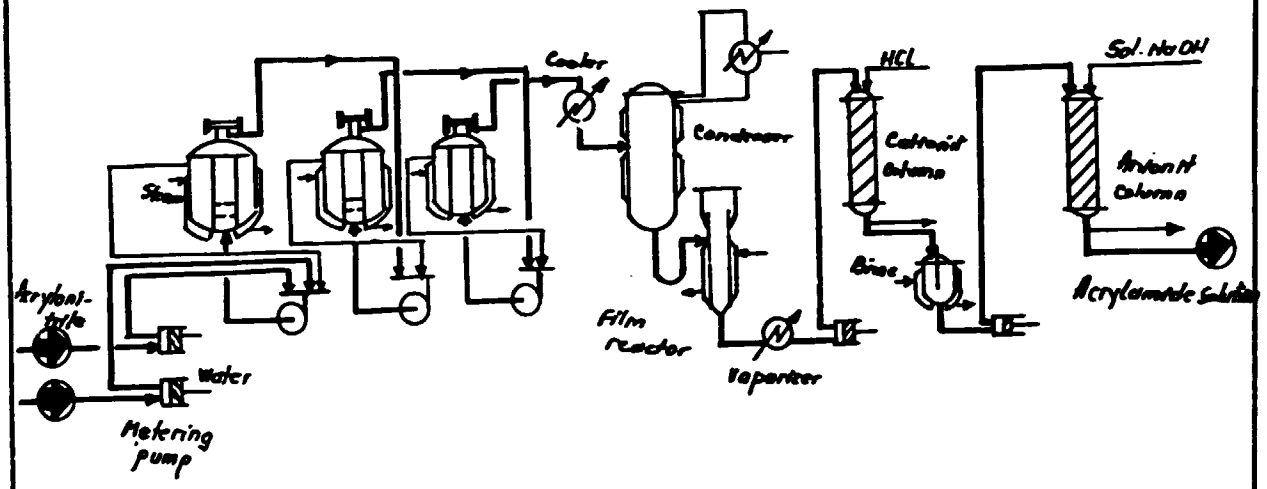
ACRYLAMIDE-FLOW SHEET



End Product

Acrylamide, solution 40 - 48%

It is used for polyacrylamide manufacture in organic syntheis industry.

Commercial Installations

There is a plant in operation in Romania with a capacity of 1000 t/year.

Ecological Aspects

No waste water results from the plant.

Noxious gas collecting is provided.

Kind of Project Engineering Turn-key Others

Additional Information

Upon Buyer's request, any production capacities can be offered.

Year	Edition	Origin	Engineering
1988	I	Ro	IPROCHIM

PROJECT ACETYLSALICYLIC ACID

Process

The acetylsalicylic acid is obtained by salicylic acid acetylation with acetic anhydride.

Feedstock

Designation and Quality: Acetylsalicylic acid, 99.5% acetic anhydride 90%.

Description

Salicylic acid is acetylated with acetic anhydride at abt.70°C then the reaction mass is cooled down to abt.20°C to allow the acetylsalicylic acid to crystallize. It is centrifuged and washed with acetic acid, and the resulted product is dried at bt.40°C.

Specific Consumptions

The following is required for 1000 kg of end product:

- salicyclic acid	t	0.860 - 0.865
- acetic anhydride	t	0.71 - 0.720
- steam	t	11 - 13
- recirculated water	m^3	150 - 170
- electric power	kWh	2,000 - 2,100

End Product Quality

The obtained 99.5% acetylsalicyclic acid is used in pharmaceutical industry.

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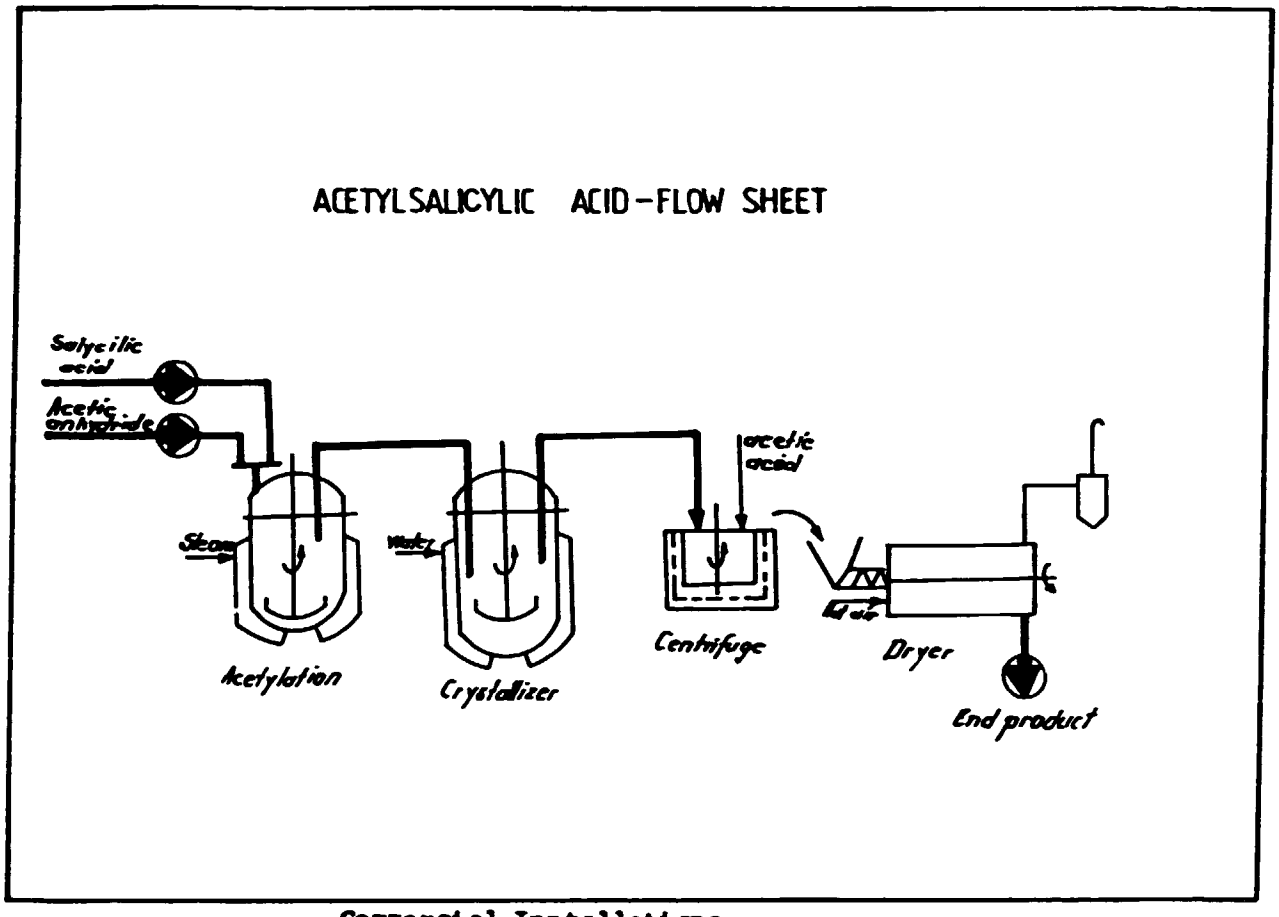

Commercial Installations

There are 2 industrial plants in operation in Romania, each having a capacity of 400 t/year.

Ecological Aspects

All environment protection steps have been taken within the plant. The tail gas is neutralized and the waste water is chemically treated.

Kind of Project Engineering Turn-key Others

Additional Information

Any production capacities can be offered upon Buyer's request.

Year	Edition	Origin	Engineering
1988	I	Ro	IPROCHIM

PROJECT RAFOXANIDE

Process

The manufacturing process starts from dichloronitrobenzene and parachlorophenol which, by condensation turns into nitrodiphenyl ether. This is reduced to aminodiphenyl ether, that, by condensation with salicylic acid and iodination turns into 3,5 diiodine 3 chlorine 4(p-chlorophenoxi) salicylanide (rafoxanide).

Feedstock

99% synthesis methanol; 96% refined ethyl alcohol; Sodium hydroxide 40% solution; 98% toluene; 98% anhydrous sodium carbonate, technical grade; Phosphorous trichloride, 98%; Metallic iodine, 98%; Parachlorphenol 98%; dichloronitrobenezene 90%; Salicylic acid, 99%; hydrogen peroxide 34-36%; monochlorobenzene 95%

Description

p-chlrophenol condensates with dichloronitrobenzene in ethylene glycol in hot conditions, it is cooled when nitrodiphenylether crystallizes, and then it is centrifuged.

The nitrodiphenylether is reduced at the reaction pressure and temperature resulting the aminodiphenylether which crystallizes and is separated by filtration, then it is dried.

The aminodiphenylether condensates with salicylic acid in the presence of phosphorous trichloride resulting salicylanilide.

This is treated with iodine in phenyl chloride and hydrogen peroxide, the layers are separated, crystallized and the raw product is obtained that is isolated by filtration.

The raw product is purified in methanol and in ammonia solution when the purified rafoxanide results.

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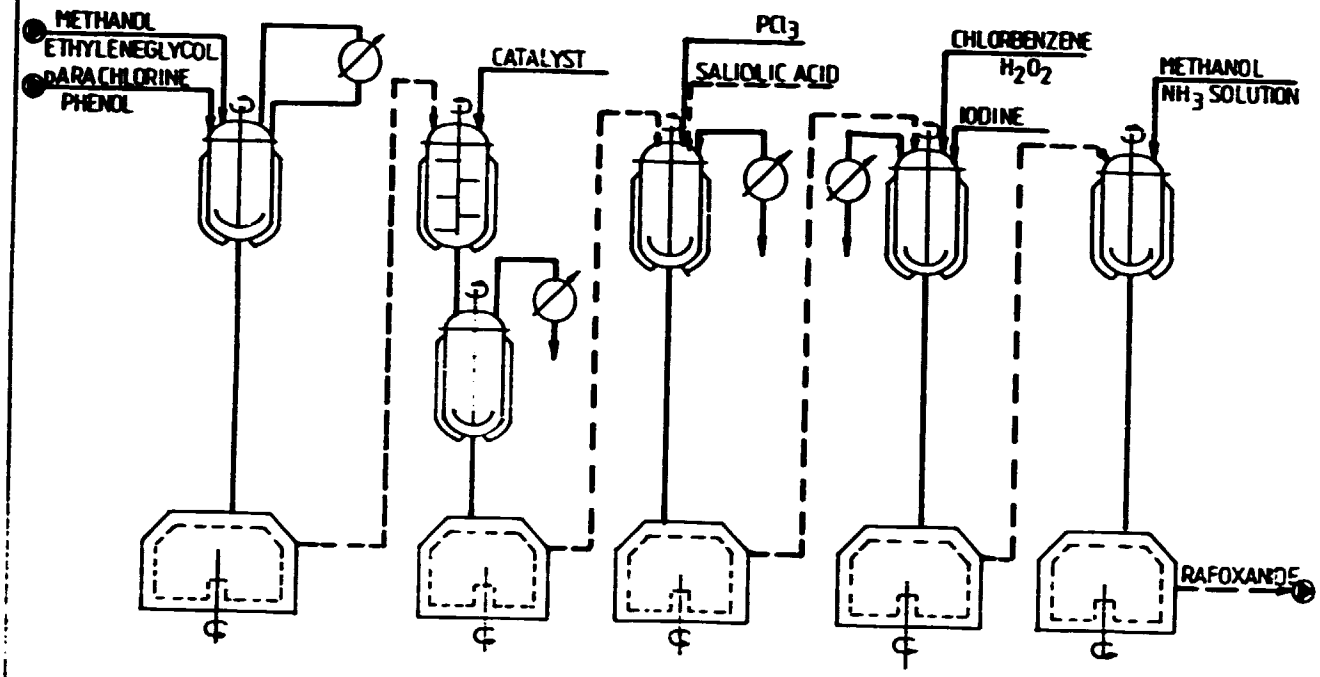
RAFOXANIDE - FLOW SHEET



Specific Consumptions

For 1,000 kg of rafoxanide the following are necessary:

- ethyl alcohol	96%	t	7.2
- phosphorous trichloride	98%	t	0.42
- metallic iodine	99%	t	0.73
- parachlorophenol	98%	t	2.5
- dichloronitrobenzene	90%	t	2.0
- monochlorbenzene	95%	t	5.62

For a plant with a capacity of 20 t/year the following consumptions are necessary:

- recycled water	m^3/h	15
- 3 ata steam	t/h	0.5
- electric power	kWh	100

End Product Quality

Rafoxanide is white or grey-yellowish, odourless, water insoluble, hardly soluble in alcohol, soluble in acetone, phenyl chloride and toluene, melting point 172-176°C.

Content in rafoxanide is 98%. Size of particle: below 5

Commercial Installations

Romania has industrial experience in rafoxanide substance production at a capacity of 2o tons per year.

Ecological Aspects

The present process ensures solvents recovery and recirculation into the process.

Within the process, gas releases occur and are absorbed in neturalizing solutions and sent to the treatment stations.

Kind of Project Engineering Turn-key Others

Additional Information

At Buyer's request other capacities suitable to his needs may be offered.

Year	Edition	Origin	Engineering
1988	I	Ro	IPROCHIM

PROJECT A M M O N I A

Process

Basic Kellogg conventional process.

Feedstock

Natural gas.

Description

The main stages of the process are the following:

- Raw synthesis gas preparation
  - a - natural gas desulphurization
  - b - primary and secondary reforming
  - c.- carbon oxide shift (high and low temperature)
- Gas purification
  - a - carbon dioxide removal with hot potassium carbonate solution
  - b - carbon oxides removal by methanation
- Ammonia synthesis
  - a - synthesis gas compression
  - b - ammonia synthesis
  - c - ammonia separation

Specific Consumptions

- natural gas	9.9×10^6	Kcal/t
- electric power	4.26	kWh/t
- demineralizes water	2.76	m^3/t
- recycled water (t=10°C)	395	m^3/t

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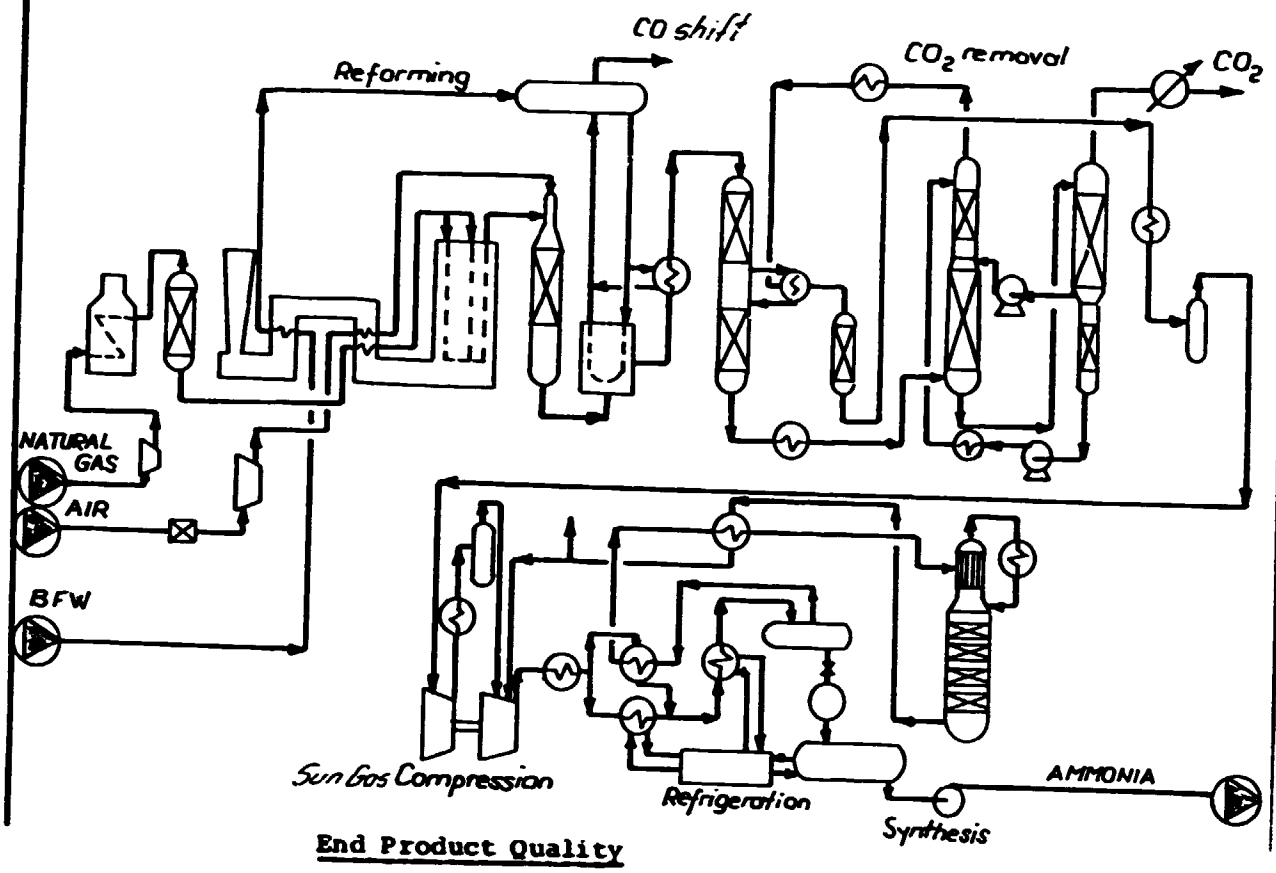
AMMONIA FLOW SHEET



End Product Quality

- NH_3 99.9% by weight
- H_2O max. 0.1% by weight
- oil max. 5 ppm

Carbon dioxide is obtained as secondary product with a purity of 98% by vol. CO_2 as against dry gas.

Commercial Installations

Nine ammonia plants are operating in Romania each having a capacity of 907 t/day.

Ecological ASpects

The liquid and gas effluents continuously resulting during normal operation of the plant do not raise environmental pollution problems; they are either used in the process or chemically treated within the plant.

Kind of Project Engineering Turn-key Others

Year	Edition	Origin	Engineering
1988	I	Ro	IPROCHIM

PROJECT SODIUM TRIPOLYPHOSPHATE

Process

Purified phosphoric acid treatment with soda.

Feedstock

Wet phosphoric acid 30-32% P_2O_5; soda ash 98%.

Description

Filtered phosphoric acid 30-32% P_2O_5 obtained by wet process is sent to the purification unit where the purification takes place following several stages, namely:

- desulphatization by adding phosphorite and barium carbonate;
- defluorination by adding concentrated soda.

After each operation the phosphoric acid is filtered to remove the precipitates.

Purified phosphoric acid is then neutralized with soda ash until a sodium orthophosphate mixture is yielded.

Sodium orthophosphate solution is filtered and further concentrated and introduced into a sprayer where the orthophosphate mixture is dried and then calcined in a calciner.

Drying and calcining are performed by means of hot gases; the end product (sodium tripolyphosphate) is then cooled, screened stored and packed.

Ecological Aspects

The chemically contaminated water is neutralized and the gases are purified before being sent to atmosphere or to emissary.

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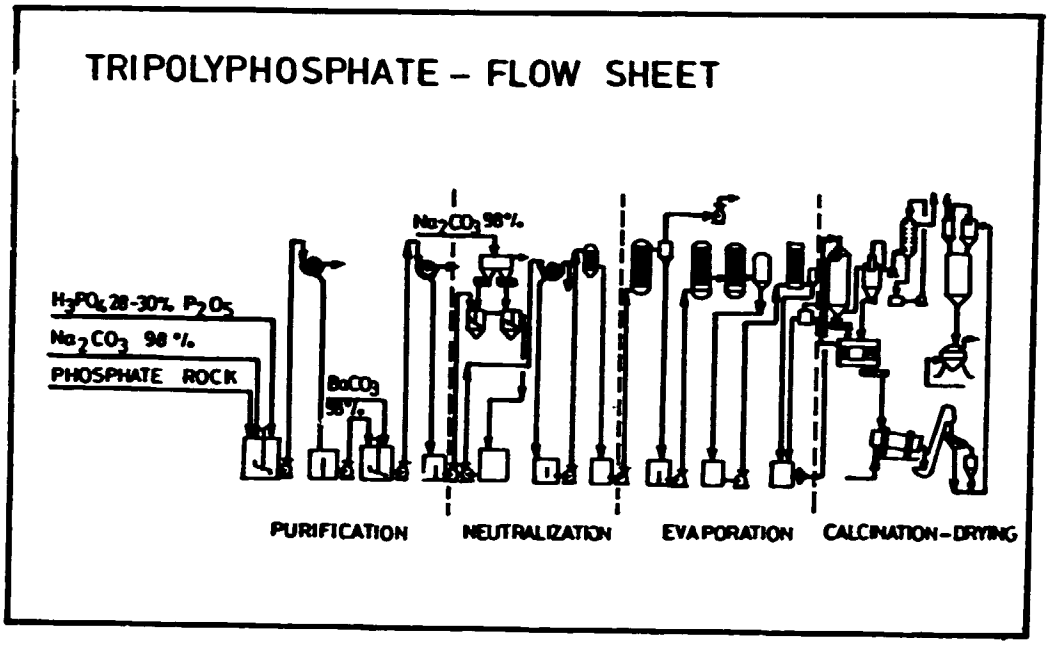

Kind of Project Engineering Turn-key Others

Additional Information

Any production capacities can be offered upon Buyer's request.

Year	Edition	Origin	Engineering
1988	I	Ro	IPROCHIM

PROJECT THERMAL POWER STATIONS

Process

Steam and warm/hot water are obtained in steam and warm/hot water boilers by fuel burning.

Feedstock

Fuel oil or natural gas (or combined by alternating operation), chemically treated water (softened or demineralized).

Production Capacities

Thermal plants can be designed for various capacities as required by the process user.

The production equipment (boilers) intended for the plant has the following characteristics:

- steam boilers: p = 0.4 MPa; 0.8 MPa; 1.6 MPa
  T = 453°K; 473°K; 523°K; 623°K
  Q = 0.055 kg/S - 28 kg/S
- warm water boilers 363/343°K
  - thermal unit power 0.1 - 5 MW
- hot water boilers 423/343°K
  - thermal unit power 5 - 50 MW

Specific Consumptions

- Natural gas: 80 Nm^3/t steam or 125 Nm^3/MW thermal power
- Fuel oil : 70 kg/t steam or 110 kg/MW thermal power
- Treated water: 1.25 m^3/t steam

Kind of project Engineering Turn-key Others

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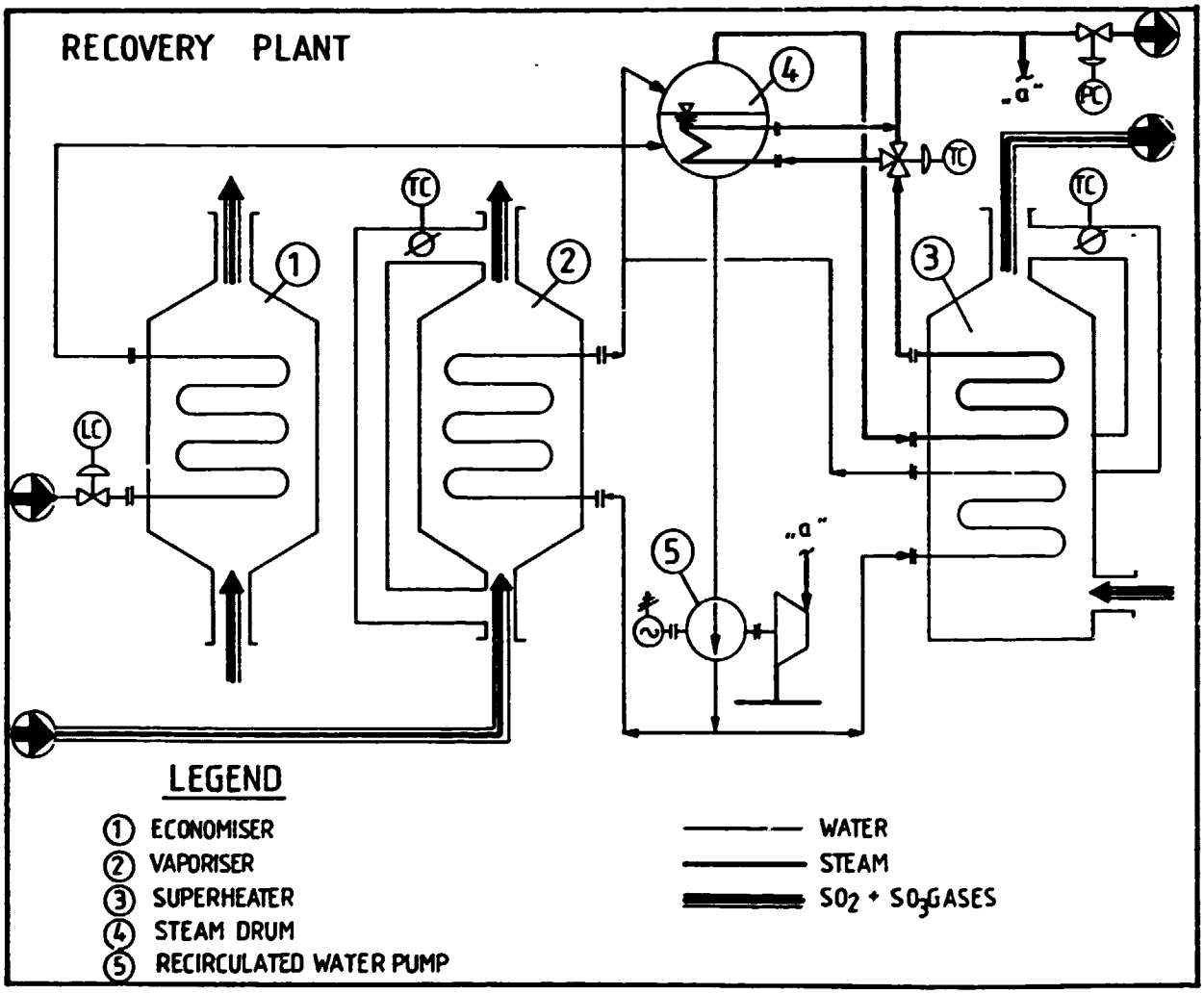
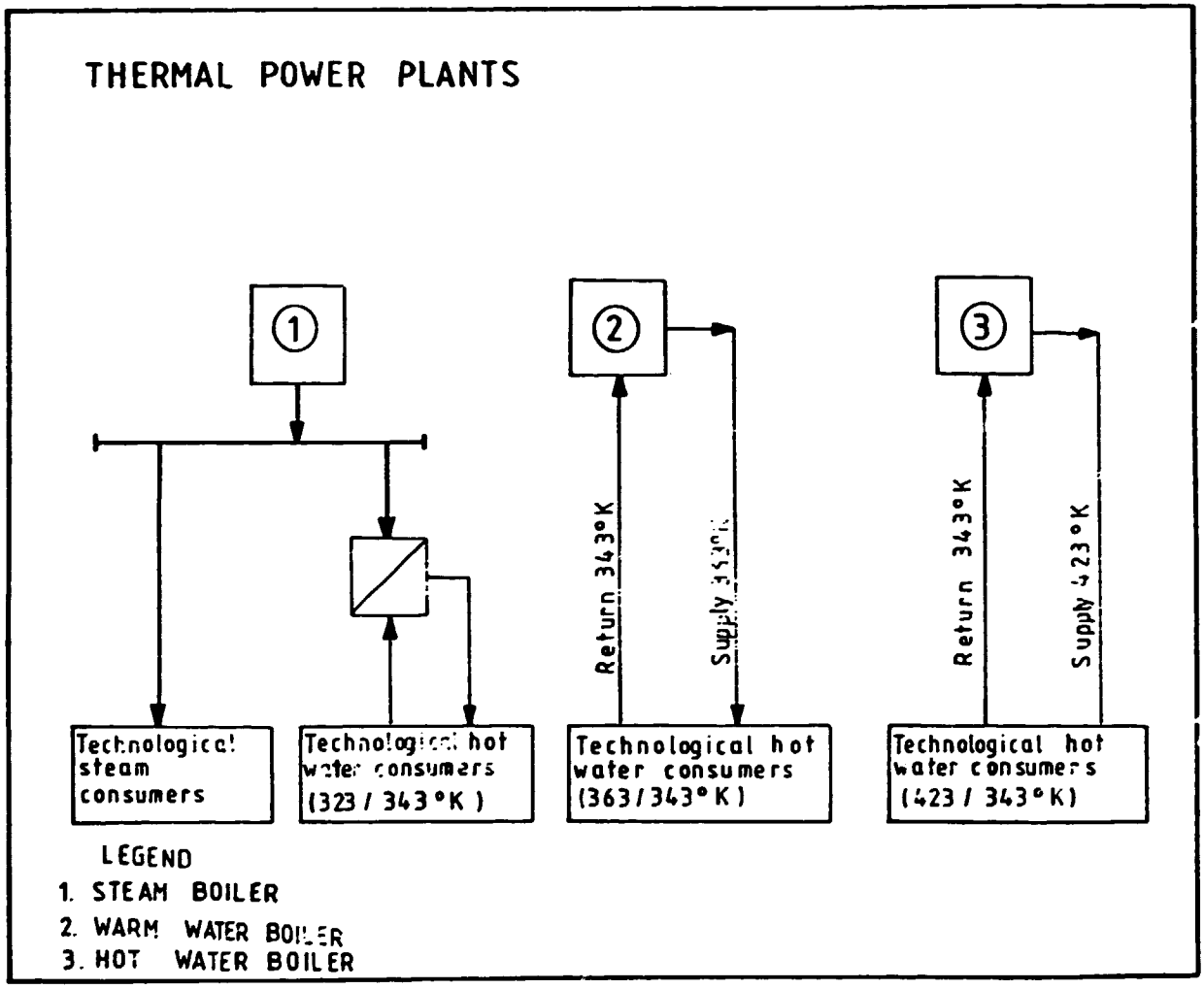
Additional Information

On Buyer's request other capacities can be offered to cope with his requirements.




THERMAL POWER PLANTS
1
2
3
Return 343°K
Supply 423°K
Return 343°K
Technological steam consumers
Technological hot water consumers (323 / 343°K)
Technological hot water consumers (363/343°K)
Technological hot water consumers (423 / 343°K)
LEGEND
1. STEAM BOILER
2. WARM WATER BOILER
3. HOT WATER BOILER

Year	Edition	Origin	Engineering
1988	I	Ro	IPROCHIM

PROJECT THERMOELECTRIC POWER STATIONS

Process

Steam is produced in high pressure steam boilers by fuel burning.

Power is obained in turbounits with extraction and back pressure :or with condensation.

Warm or hot water is prepared in low pressure steam boilers tapped at extraction steam turbine generators.

Feedstock

Fuel oil or natural gas (or a combination there of by alternating operation), demineralized water.

Production Capacities

Thermal power plants can be designed for various capacities as required by the process user.

The production equipment (boilers and turbounits) intended for the thermoelectric power stations has the following characteristics:

- Steam boilers: p = 3.6 MPa; 4.o MPa; 1o.5 MPa
  T = 723°K; 8o8°K
  Q = 14 kg/S; 33.3 Kg/S
- Turbounits with adjustable steam intake of 1.5 MPa and o.5 MPa backpressure, with unit powers of 3 MW; 6 MW; 12 MW; = 5o Hz
- Turbounits with condensation and adjustable steam intakes of 1.5 MPa and o.5 MPa, with unit powers of 3 MW; 6 MW; 12 MW; = 5o Hz.

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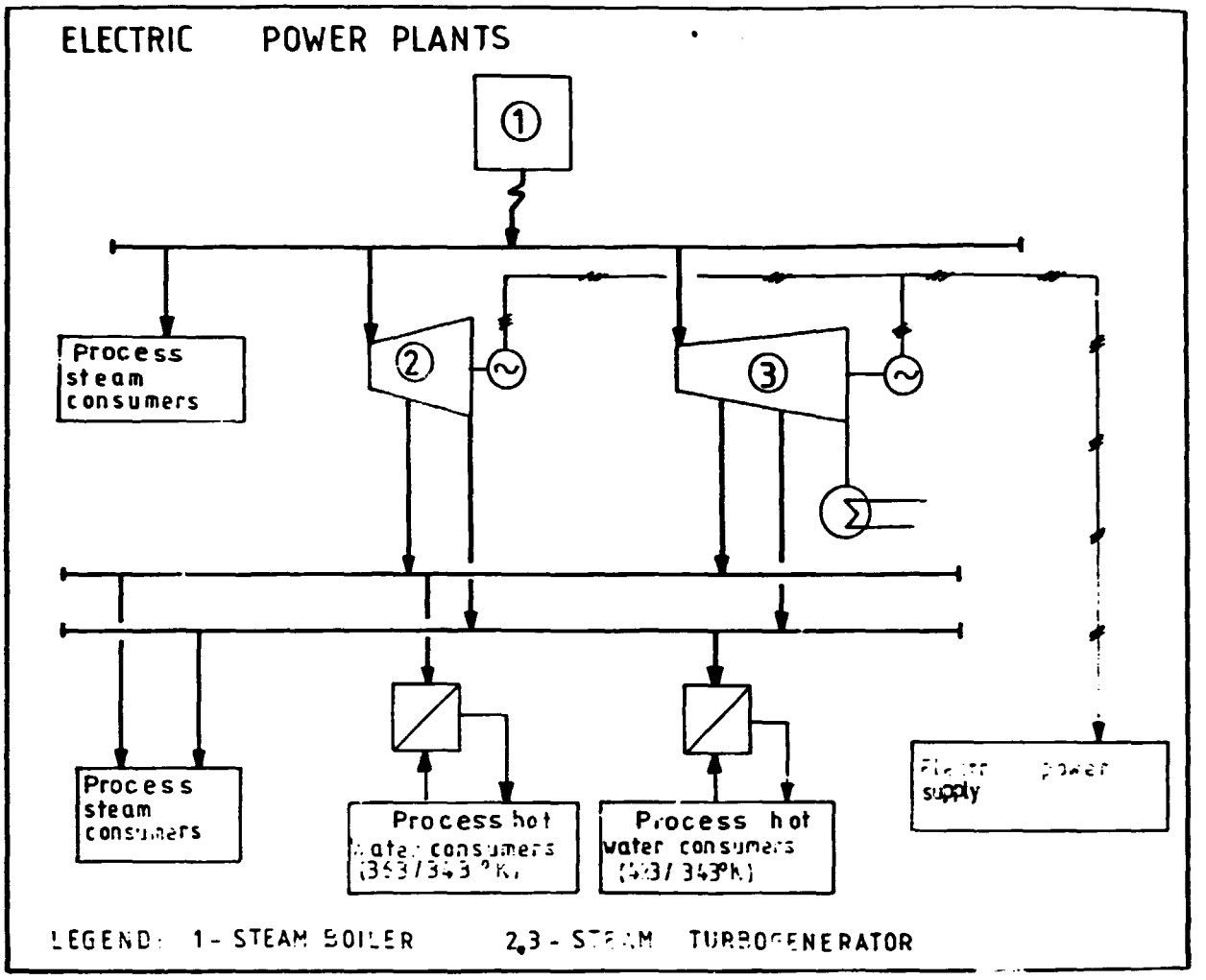

Specific Consumptions

Natural gas: Nm^3/t steam 82

Fuel oil: kg/t steam 72

Demineralized water: m^3/t steam 1.2

Kind of Project Engineering Turn-key Others

Additional Information

On Buyer's request other capacities can be offered to cope with his requirements.

Year	Edition	Origin	Engineering
1988	I	Ro	IPROCHIM

PROJECT WATER TREATMENT

Process

Water treatment with coagulants, flocculents, alkaline products and possibly sterilizants and water clarifying in settlers with sludge recirculation and filtering on fast sand pressure filters.

Feedstock

Raw water - from superficial sources (rivers, lakes)

Coagulants - the choice covers:
Aluminium sulphate $Al_2(SO_4)_2 \cdot 18H_2O$ in bulk or bagged
Ferrous sulphate $FeSO_4 \cdot 7H_2O$ bagged
Ferric chloride $FeCl_3 \cdot 6H_2O$ bagged or solution

Flocculents - there is a choice between
Organic polyelectrolytes;
Active silica prepared from sodium silicate ($Na_2SiO_3 \cdot 5H_2O$ or $Na_2SiO_3 \cdot 9H_2O$) activated with a coagulant or a strong acid (sulphuric or hydrochloric)

Alkadine products - lime (CaO) in bulk or bagged
- hydrated lime or
- barrelled soda (NaOH)

Sterilizing agents - chlorine gas (Cl_2) in containers or cylinders, or
- ozone prepared at electric spraking

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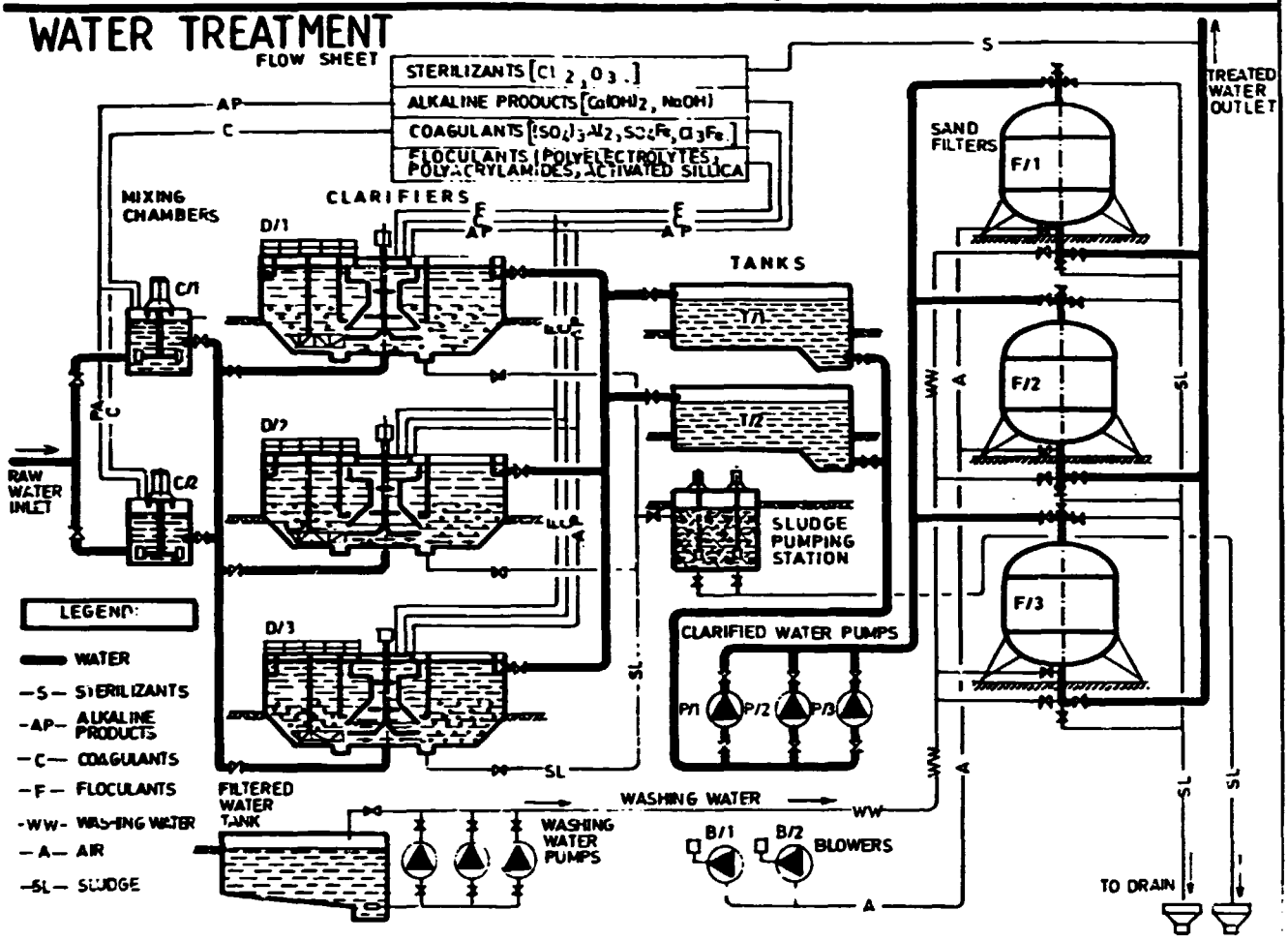

Description

High turbidity raw water is fed to the mixing chambers from which it is distributed to the sludge recycling settlers. To the mixing chambers and/or reaction chambers of the settlers are added chemicals such as coagulants, flocculents and alkaline products.

The sludge deposit is discharged automatically by means of the electric valves to the sludge pumping station, wherefrom it is discarded into the river or to the drying platforms. The clarified water is discharged from the collecting chutes to the filtered water tanks and from it is sent, through the pressure filters directly to the consumers. The clogged filters are flushed with filtered water and compressed air.

Specific Consumptions

The specific consumptions are given per 1,000 l treated water:

- Raw water	m^3	1.1
- Aluminium sulphate	g	15 - 100
- Ferrous sulphate	"	5 - 30

- Ferric chloride	g	5-35
- Polyelectrolytes	g	1 - 5
- Active silica	g	2 - 8
- Lime	g	o - 35
- Soda	g	o - 2o
- Chlorine	g	o - 3
- Ozone	g	o - 5

End Product Quality

Below 1o mg/l suspended solids or turbidity degrees.

Commercial Installations

Plants of capacities ranging between 2oo - 15,ooo m^3/h are highly operational in Romania and Syria (TSP Homs).

Ecological Aspects

Liquid effluents with slurry concentration of 1% to 3% result from the station. The slurries are completely unnoxious and can be returned to the river or dried on sludge drying platforms.

Kind of Project Engineering Turn-key Others

Additional Information

On Buyers'. request any other processing capacities can be offered to meet their demands.

Year	Edition	Origin	Engineering
1988	I	Ro	IPROCHIM

PROJECT FULL WATER DEMINERALIZATION FACILITY

Process

Demineralization of river water previously pre-treated by coagulation and possibly decarbonatation to obtain water of conductivity in the range of 2 to o.2 s/cm depending on the physical and chemical properties of the raw water.

Feedstock

Industrial water pre-treated with coagulants and lime, followed by settling with an ion balance of max. 1o m equival/l.

Description

Industrial water at 5o m WG pressure flows in sequential order through the treatment stages shown on the flowsheet to have any mechanical contaminants, cations and anions and cation and anion leaks from previous stages retained.

In dependence on the particulars of the raw water, the cationic stage consists of one or two underwater filters with highly acid resin, or of a couple of filters highly and weakly acid.

In the case of a high bicarbonate content, the anionic stage can be completed with a CO_2 degasifier.

For the resin regeneration HCl and NaOH are used. Depending on local conditions, HCl can be replaced by either H_2SO_4 or HNO_3. Reagents dosing is effected with ejectors or proportioning pumps.

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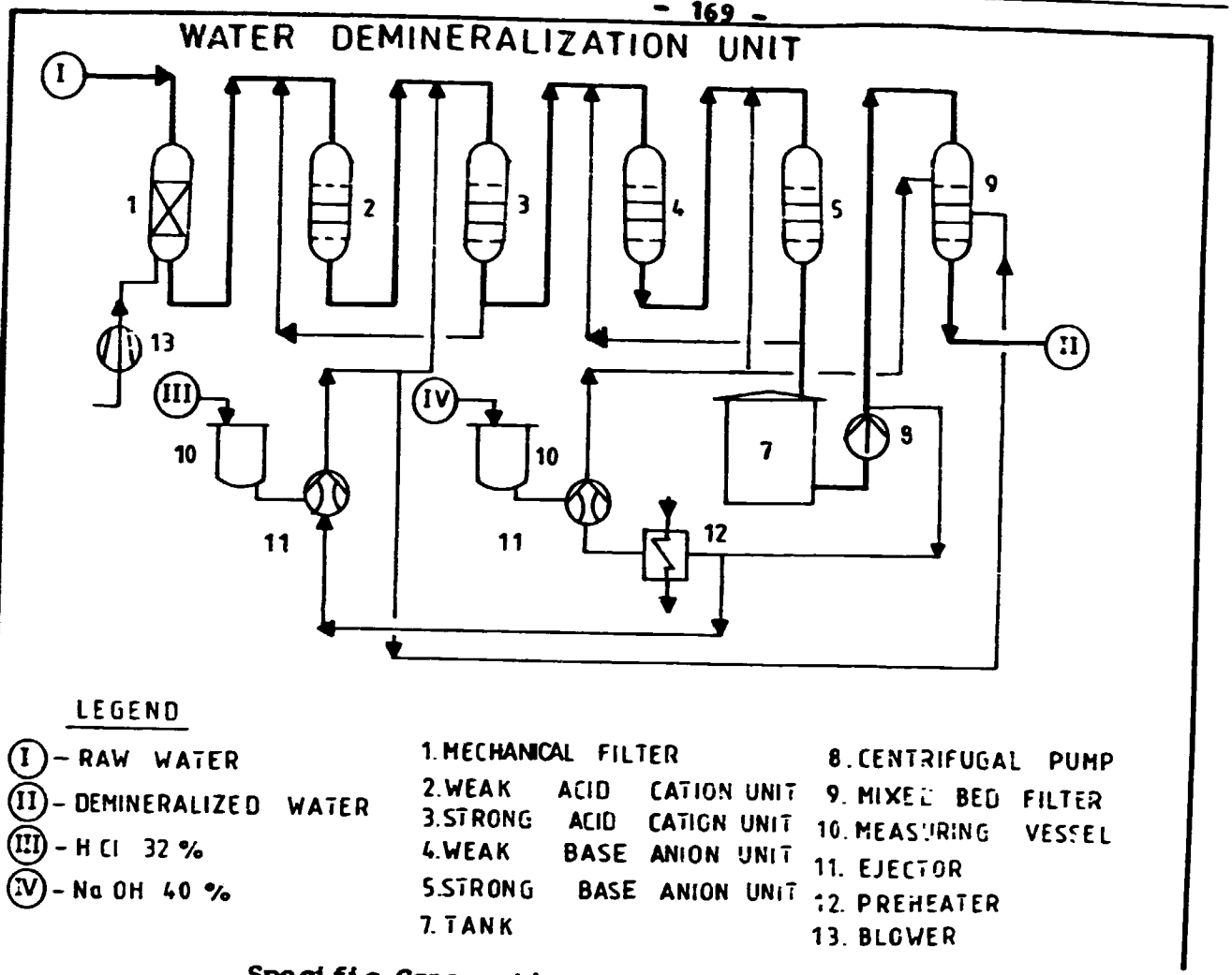

LEGEND

(I) - RAW WATER
(II) - DEMINERALIZED WATER
(III) - H Cl 32 %
(IV) - Na OH 40 %

1. MECHANICAL FILTER
2. WEAK ACID CATION UNIT
3. STRONG ACID CATION UNIT
4. WEAK BASE ANION UNIT
5. STRONG BASE ANION UNIT
7. TANK
8. CENTRIFUGAL PUMP
9. MIXED BED FILTER
10. MEASURING VESSEL
11. EJECTOR
12. PREHEATER
13. BLOWER

Specific Consumptions

The consumptions per m^3 demineralized water range within the following limits:

- industrial water	m^3	1.3 - 1.5
- 100% hydrochloric acid	kg	o.9 - 2.5
- 100% sodium hydroxide	kg	o.8 - 2.o
- 4 ata steam	kg	1 - 2.o
- electric power	kWh	o.5 - 1.5

End Product Quality

The demineralized water has the following characteristics:

- conductivity	s/cm	2 - o.2
- SiO_2	g/cm	2o - 5o

Commercial Installations

There are such demineralization stations in operation in Romania and abroad namely Syria, Jordan, Egypt.

Ecological Aspects

Acid and alkaline waste water from the regeneration of ionic resins are collected in a basin where, after being mixed for a primary neutralization, pH is corrected down to the neutral.

Year	Edition	Origin	Engineering
1988	I	Ro	IPROCHIM

PROJECT: UNLOADING RAMP FOR RAILWAY WAGONS WITH BULK MATERIALS

Designation

The ramp is used for unloading bulk granular or powder materials from railway wagons with gravitational automatic unloading outside the rails.

Description

The unloading ramp is a covered construction, having two rows of bunkers below the railway level. By handling special devices at the bottom of bunkers materials gravitationally unloaded from wagons into bunkers are discharged from them on two belt conveyers sending them to consumer or storage.

Capacities

Ramp unloading capacity is equal to the flowrate provided by the two belt conveyers discharging materials from the bunkers.

The flowrate is usually between 3oo and 6oo t/h but, if necessary, it may become higher or lower.

Kind of project Engineering Turn-key Others

Additional Information

The ramp is also designed for wagonswith gravitational automatic unloading between the two railways.

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UNLOADING RAMP FOR RAILWAY WAGONS WITH BULK MATERIALS