CHAPTER 4

INCA's[1] TECHNICAL PROCESS ANALYSIS

This section provides an overview on the PTA technology, production process, equipment, plant capacity and material & utility costs.

In general, the basic oxidation and purification technologies for PTA manufacture have been extensively developed. The "experience curve" for the basic process technology is now approaching diminishing returns, and further major breakthroughs (i.e., new catalyst systems, raw materials and basic unit operations) are not anticipated in the future. The leading producers are expected to have greater extent of optimization and energy integration across the entire CTA/PTA complex and more advanced control schemes. Nevertheless, for the same capacity and location, it is expected that differences in variable costs for the PTA technologies are relatively small. However, obtaining demonstrated technology and operating know how from an established licensor or operator is absolutely critical for a successful PTA project.

(1) INCA means PTA Process Licensor which ATC select their process technology and we use all the data from them in this technical analysis.

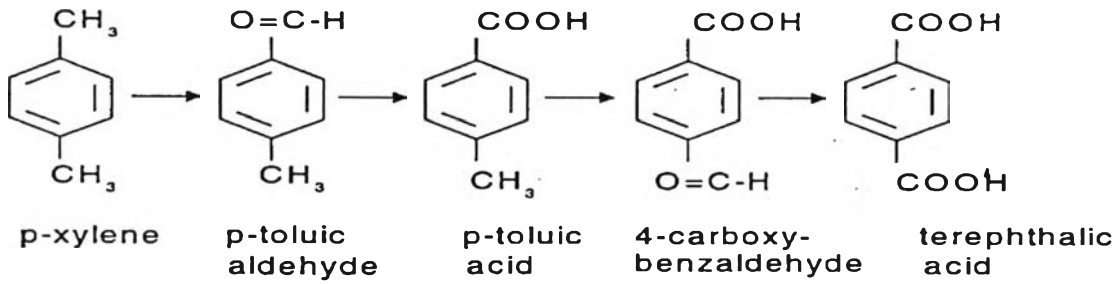
4.1 INCA's PROCESS DESCRIPTION

The technology for manufacturing PTA is comprised broadly of two separate processes including:

- Crude terephthalic acid (CTA) process involving oxidation of para-Xylene to terephthalic acid, recovery and drying of the intermediate CTA product, and purification and recycle of acetic acid solvent

- Purification by hydrogenation of CTA dissolved in water to remove impurities formed in the oxidation step and recovery and drying of the final PTA product

The oxidation of para-Xylene takes place in acetic acid solvent using a homogeneous (liquid phase) catalyst mixture comprised of cobalt and manganese ligand salts (typically acetates) and bromine promoter. The catalyst system selectively oxidizes the methyl groups of para-Xylene by a free radical step-wise mechanism to the desired terephthalic acid product with the important intermediates including para-toluic acid and 4carboxybenzaldehyde (4-CBA). The reaction sequence is highlighted below.



Source: INCA Process Technology for Produce PTA from para-Xylene and Acetic Acid

As a result of its solubility characteristics, 4-CBA co-crystallizes with terephthalic acid at the conditions within the oxidation reactor and occludes within the CTA crystal matrix.

In the purification process, CTA is dissolved in water solution and hydrogenated over a palladium-on-carbon (Pd/C) catalyst to produce a high purity PTA suitable for use as feedstock in the manufacture of poly (ethylene terephthalate) products including polyester fiber and PET resin used to make injection blow molded bottles and custom containers. In the more efficient PTA processes, operating conditions are optimized across the entire

CTA and PTA complex based on operating costs and the desired quality in the PTA product. A simplified process description is provided below for the INCA process.

The overall material balance for a capacity of 350 thousand metric tons per year is provided in Table 4.1. The overall consumption of para-Xylene to produce PTA corresponds to 0.665 wt/wt and the consumption of acetic acid solvent corresponds to 0.06 wt/wt.

TABLE 4.1
OVERALL PTA MATERIAL BALANCE
(thousand metric tons per year)

Raw Material	para-Xylene	232.8
Solvent	Acetic acid	21.0
Product	PTA	350.0

Source: INCA Process Technology Material Balance for PTA

Specifications identified in the INCA licensing package are summarized in Table 4.2 for controlling the combined CTA/PTA operations the principal quality parameters are 4CBA and para-toluic acid concentrations, optical properties and particulate contamination. Acidity (mg KOH) and APHA color are considered to be antiquated and no longer used by the leading producers in the industry.

TABLE 4.2
TYPICAL PTA PRODUCT QUALITIES [1]

	Specification	Expected
Acidity (mg KOH/g)	675+/-2	Same
Moisture, wt%	< 0.2	0.1
Ash, ppm	< 15	8
4- Carboxybenzaldehyde (4-CBA), ppm	< 25	10
APHA Color (5 dimethyformamide solution)	<10	5
b-value	0.5-1.2	n/a
Iron (as Fe), ppm	< 1	1
para-Toluic acid, ppm	< 150	60
Total metals (Mo, Cr, Ni, Co, Fe, Ti, Mn), ppm	< 8	6

Source: INCA Process PTA Specification

(1) From INCA licensing information

4.1.1 CTA Process

(a) Oxidation Section

Para-Xylene is continuously fed to the feed mix drum and mixed with acetic acid solvent and catalyst solution (Figure 4.1). The feed mixture is continuously pumped to the oxidation reactor, and compressed air is sparged and distributed by the agitator and reactor internals. The absorption of oxygen is rapid, and an "oxygen-starved" condition leads to formation of undesirable by-products, some of which are colored. Oxygen must be supplied and well distributed to the reaction zone in excess of the stoichiometric requirements.

Operating conditions for the oxidation (temperature, pressure, acetic acid to para-Xylene ratio (or solvent ratio), catalyst concentrations, and vent oxygen concentration) determine the severity of the reaction and are optimized along with the conditions in the PTA purification process based on final PTA product quality and overall cost. Operating conditions in the CTA process are controlled on 4-CBA concentration in the CTA product (typically 2500 to 3500 ppm) and optical properties.

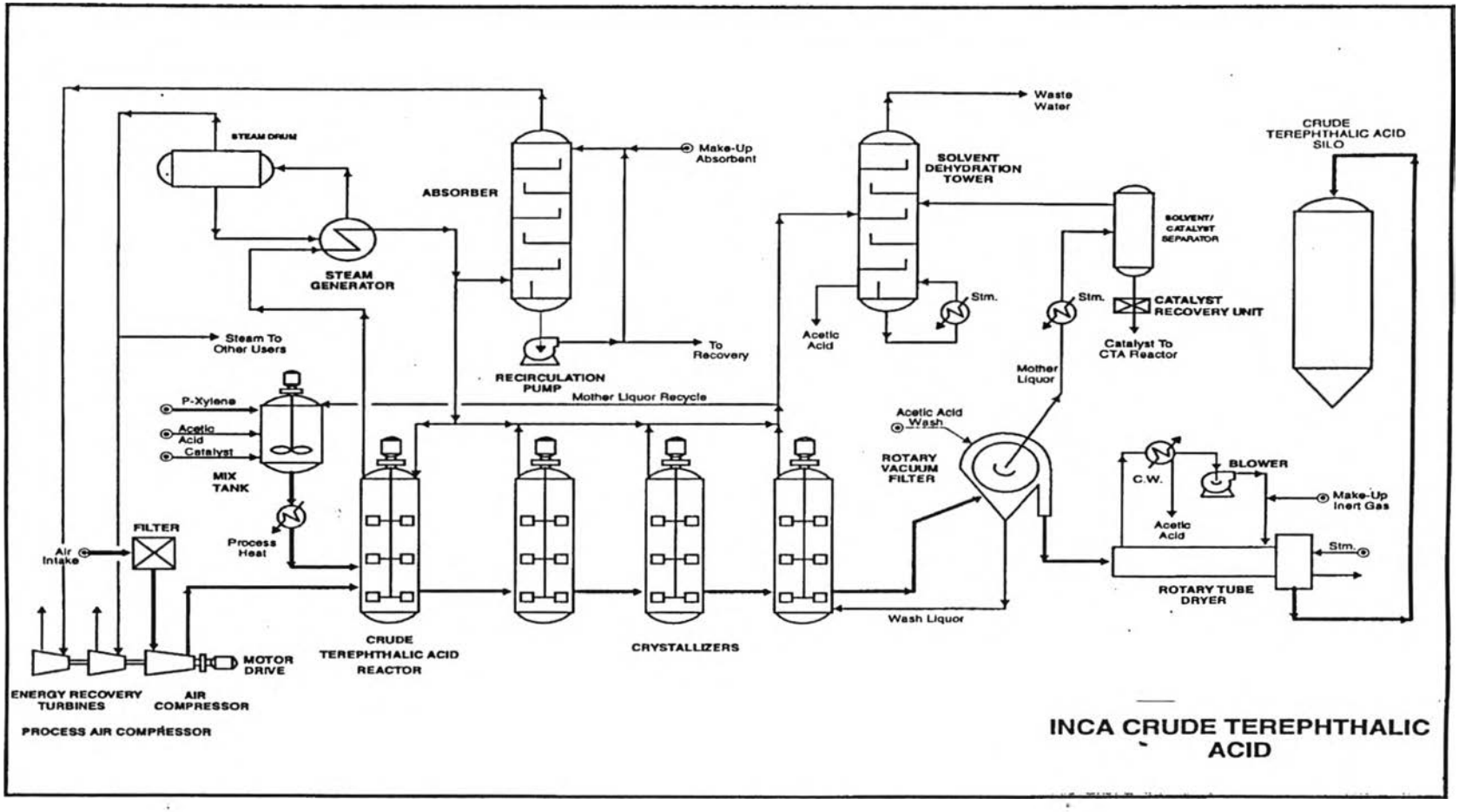
Conversion of para-Xylene to terephthalic acid in the oxidation reactor is essentially complete. As a result of the limited solubility of terephthalic acid in the acetic acid solvent at the reactor conditions, more than 90 percent of the terephthalic acid in the reactor is crystallized and discharged in the form of a hot slurry. The crystallized CTA contains 4-CBA and other intermediates and byproducts in combined concentrations of 0.4-0.5 percent on CTA. The same intermediates are present in the mother liquor at their corresponding solubility levels.

The oxidation of para-Xylene to terephthalic acid produces three units of water for each unit of para-Xylene oxidized. In addition, small amounts of acetic acid solvent, para-Xylene and reaction intermediates are unavoidably oxidized to carbon oxides, methyl acetate and water. The acetic acid solvent in the reactor solvent contains water produced by the reaction.

The oxidation reaction is highly exothermic. Temperature is controlled by controlling the reactor pressure, and heat is removed by continuous evaporation of large volumes of the acetic acid/water solvent. Evaporated solvent is condensed in overhead condensers, and part of the condensate is removed and transferred to the solvent recovery section for purification and recovery of acetic acid. The remainder of the condensate is refluxed to the reactor. The amount of condensate removed effectively controls the reactor water concentration which affects the catalyst activity. The condensers produce medium pressure steam (e.g., 6 bar) and low pressure steam (e.g., 2 bar); medium pressure steam is used in the acetic acid purification section and PTA dissolver preheaters, and low pressure steam is used for miscellaneous purposes, e.g., OSBL and building heat. The vent gas and some of the medium pressure steam may be used to drive turbines in the first stage of the air compressor.

Vent gas discharged from the reactor condenser system is usually treated in catalytic oxidation units to remove hydrocarbons and bromine, and the cleaned gas is used as pneumatic conveying gas, dryer inert gas or other services.

FIGURE 4.1
INCA CRUDE TEREPHTHALIC ACID



Source : INCA Process Technology for Produce PTA from para-Xylene and Acetic Acid

(b) Crystallization and Product Recovery Sections

Crystallization of terephthalic acid is completed in a series of crystallizers (e.g., two or three). The pressure and temperature are reduced stepwise to atmospheric conditions to complete the crystallization. A small amount of air may be added to the first crystallizer ("secondary oxidation") to minimize the occurrence of oxygen-starved conditions leading to formation of undesirable byproducts (e.g., ring-coupled compounds which can promote color). Crystallized terephthalic acid from the final crystallizer is concentrated and washed using solid-liquid separators, e.g., rotary vacuum filters or centrifuges. The recovered "cake" containing roughly 30 to 50 percent moisture is transferred by screw conveyer and dried in rotary steam tube dryers. Dried CTA is stored in intermediate silos.

(c) Solvent Recovery Section

A major portion (e.g., 50 percent to 90 percent) of the recovered liquid from the solid/liquid separation or "mother liquor" may be recycled directly to the reactor which significantly reduces the make-up catalyst requirement. A purge stream is removed and flashed, and the overhead acetic acid/water vapor is passed to the acetic acid dehydration column. The flashed residue "bottoms" contains valuable catalyst along with unusable byproducts. This residue may be treated to recover catalyst and the remaining residue incinerated, or alternately the entire residue may be incinerated.

A one-stage conventional (thermal) distillation for acetic acid recovery is used by some producers, e.g., Amoco and ICI. INCA and Mitsui use azeotropic distillation, which reduces energy consumption but requires additional equipment for recovery of the azeotroping agent, typically isopropanol and butyl acetate. Purified acetic acid (e.g., 95 wt percent) is recovered as the bottoms product and recycled to the feed mix section. The overhead water product is condensed and discharged from the plant.

4.1.2 PTA Process

(a) Feed Preparation and Hydrogenation

Hydrogenation of CTA reduces key impurities to more soluble forms and the resulting terephthalic acid is purified by recrystallization across a series of crystallizers. 4-CBA is hydrogenated to para-toluic acid which is removed during the recrystallization. 4-CBA levels in the final PTA product range from 5 to 25 ppm depending on the process technology.

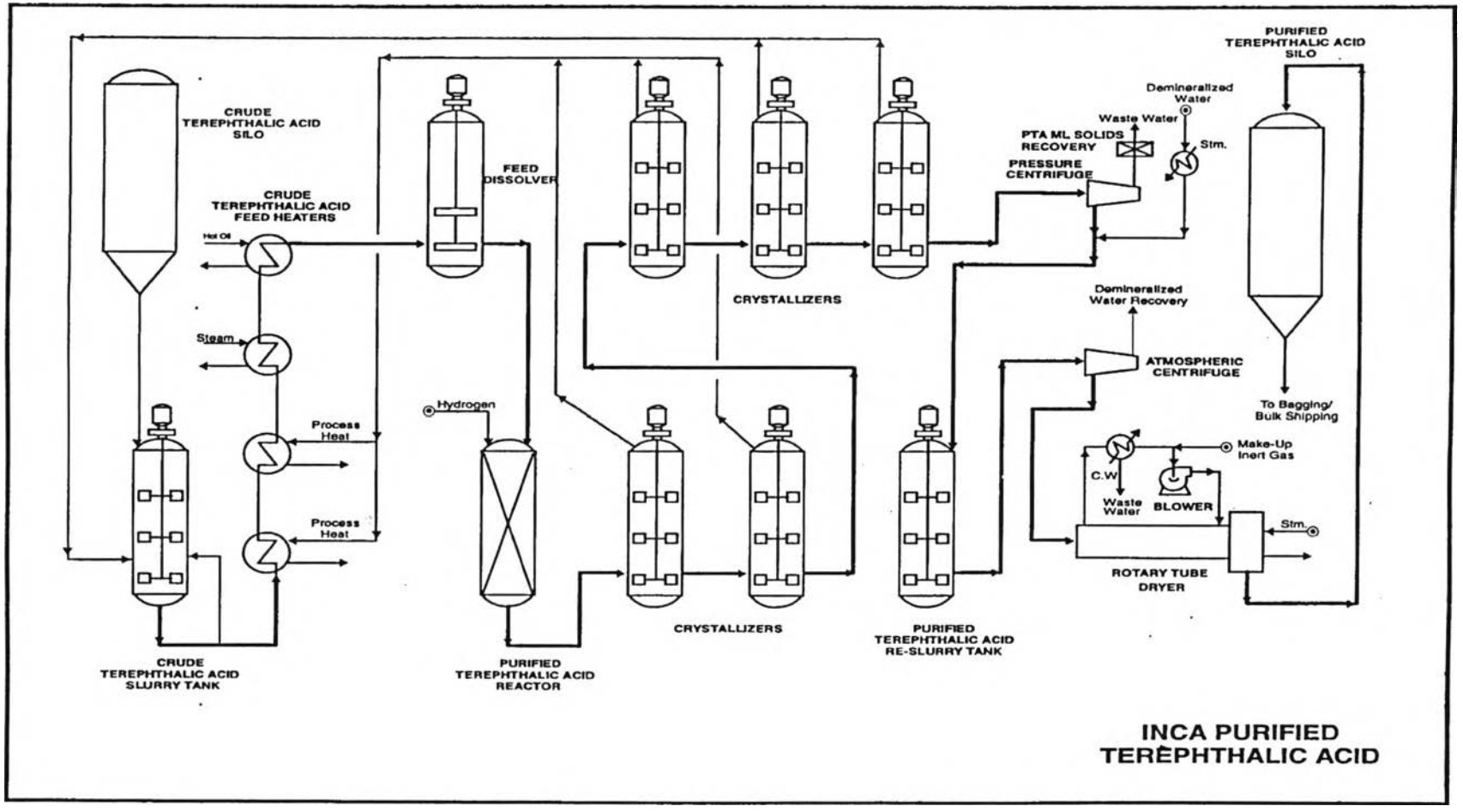
As shown in Figure 4.2, CTA from intermediate storage is mixed with water in the slurry drum to the desired concentration for the hydrogenation step (e.g., 20 percent to 30 percent) and dissolved in a series of dissolver preheaters. The solution is passed over a fixed bed of Pd/C catalyst in the presence of pure hydrogen which primarily converts 4CBA into para-toluic acid. The principal side reaction on the Pd/C catalyst is decarboxylation of terephthalic acid producing small quantities of benzoic acid which is removed during the recrystallization. The differences in solubilities of para-toluic acid, benzoic acid and terephthalic acid in water provide the basis for purification of the terephthalic acid by recrystallization.

(b) Crystallization and Product Recovery

The rate of crystallization of terephthalic acid in the PTA process is carefully controlled by depressurizing the hydrogenation reactor effluent across a sequence of crystallizers in series (e.g., five), principally to control the PTA particle size distribution. This is important for controlling the ethylene glycol-to-PTA ratio and ethylene glycol utilization/costs in the polycondensation along with the finished polymer characteristics. Product from the final crystallizer is typically recovered by pressure centrifugation, dried in a rotary steam tube dryer and stored in product silos prior to bagging (one ton "super sacks") or bulk shipment.

Mother liquor from the pressure centrifuges is recycled controlling on the para-toluic acid concentration in the PTA product. A portion of the mother liquor may be sent to a "mother liquor solids recovery" section which recovers the small amount of PTA dissolved in the mother liquor by flash separation and filtration, and intermediates such as para-toluic acid and 4-CBA may be recovered and recycled back to the CTA process.

FIGURE 4.2
INCA PURIFIED TEREPHTHALIC ACID



Source : INCA Process Technology for Produce PTA from para-Xylene and Acetic Acid

From the details of PTA process as mentioned above, we would like to illustrate the picture of PTA plant from the bird eye views as shown in the figure 4.3 and 4.4 below.

FIGURE 4.3 CTA PROCESS PLANT

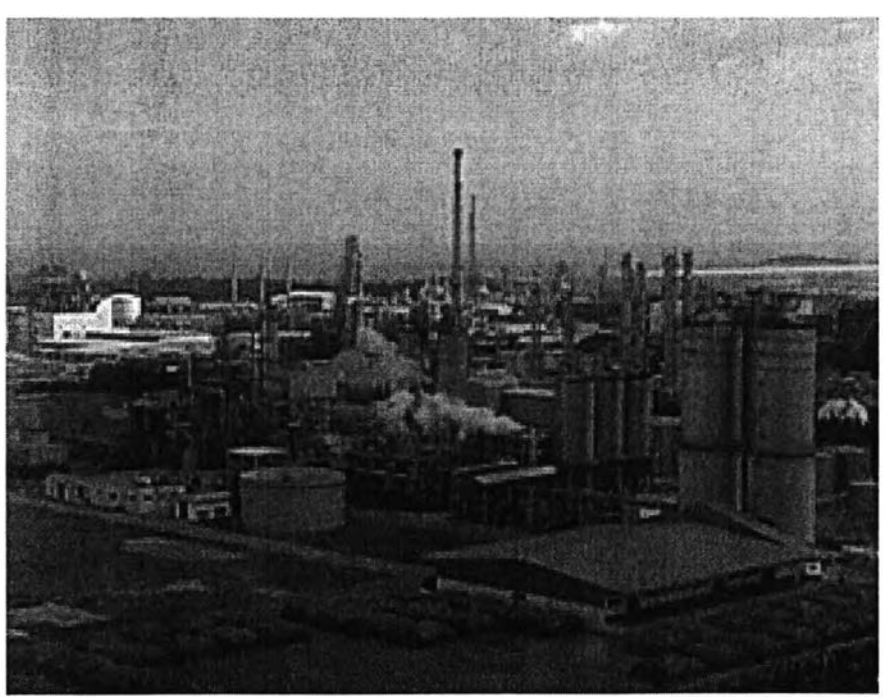


FIGURE 4.4 PTA PROCESS PLANT

4.2 OTHER FACILITIES

The PTA project plant will be designed as a stand-alone facility, and utilities will be made available from the Map Ta Phut industrial complex.

4.3 PLOT PLAN

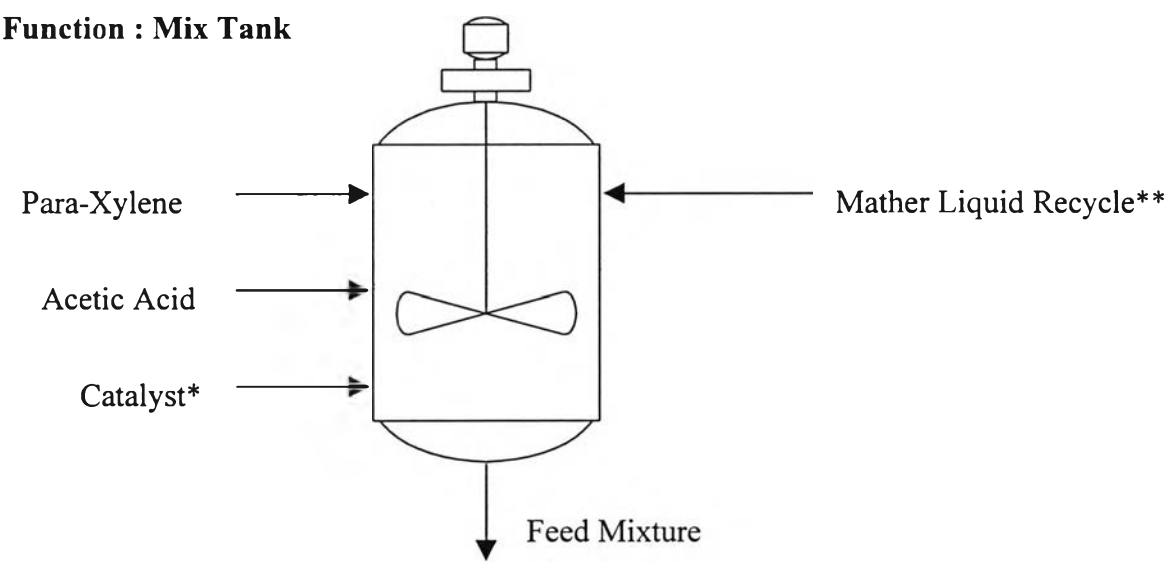
The area required for the facilities by INCA process technology as noted previously is approximately 125,000 square meters (500 X 250).

4.4 MAJOR PROCESS EQUIPMENT AND DUTY

The major of process equipment as shown in the figure 4.1 (CTA process) and 4.2 (PTA process) can be explained in their function and duty of each equipment as details following.

4.4.1 CTA Process

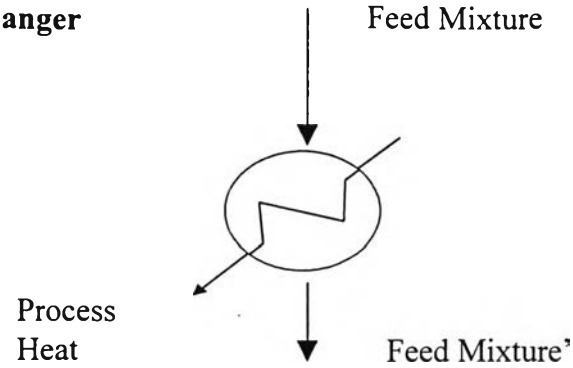
Function : Mix Tank



Unit	Mix Tank
Input	1. para-Xylene 2. Acetic Acid 3. Catalyst 4. Mather Liquid Recycle
Output	Feed Mixture
Duty	Mixing all raw materials that are liquid and solid by stirring

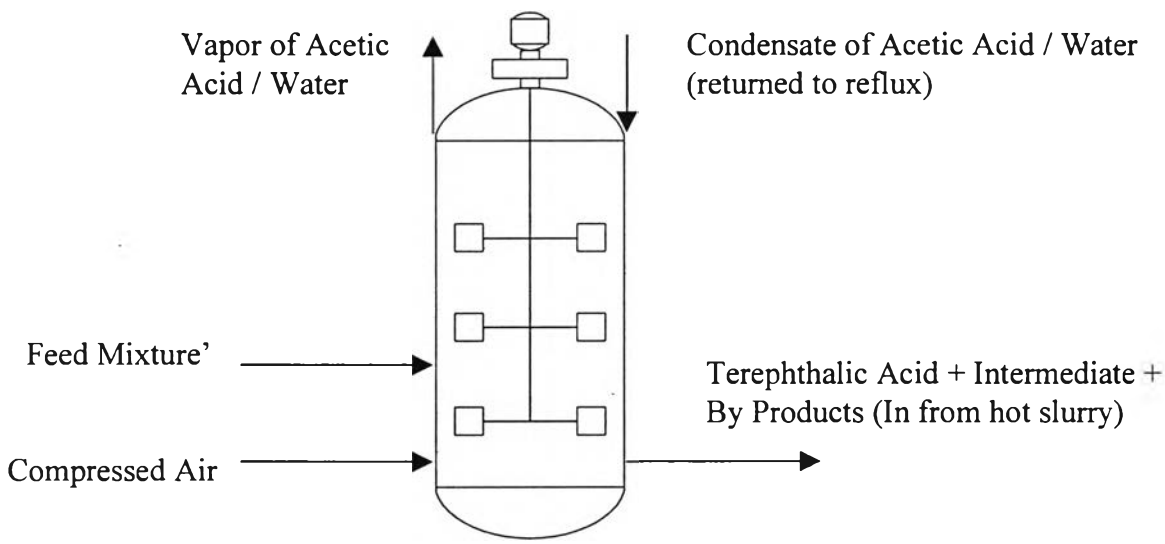
Note : * Cobolt and Manganese Ligand Salt and Bromine Promoter
** Acetic Acid + Water + Intermediate + Catalyst .

Function : Heat Exchanger



Unit	Heat Exchanger (1)
Input	Feed Mixture
Output	Feed Especially high temperature mixture'
Duty	Increase more temperature to feed mixture before feeding to reactor

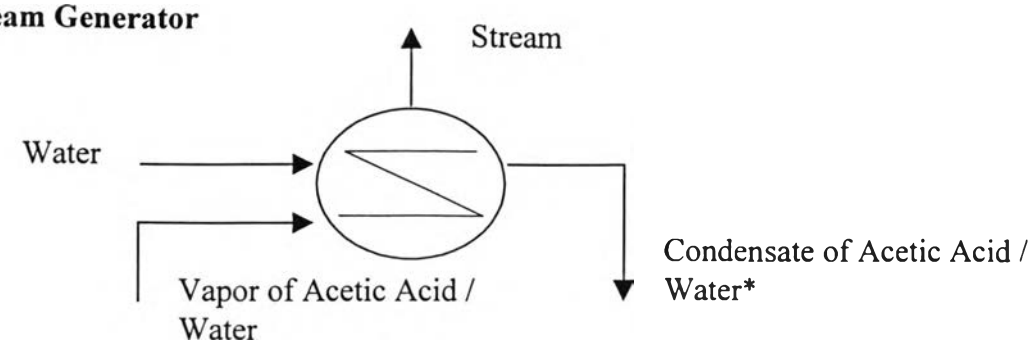
Function : Reactor



Unit	Crude Terephthalic Acid Reactor
Input	1. Feed Mixture' 2. Compressed Air (O_2 conductor to reactor)
Output	Terephthalic Acid + Intermediate + By Products (In from hot slurry)
Duty	Chemical reaction tank of Oxidation reaction which cause highly temp. to control tank temperature, the pressure and temperature in tank should be released by being taken with stream of Acetic Acid and water* to the over head condenser.

Note : * Water is a by product from the converging para-Xylene to be Terephthalic Acid.

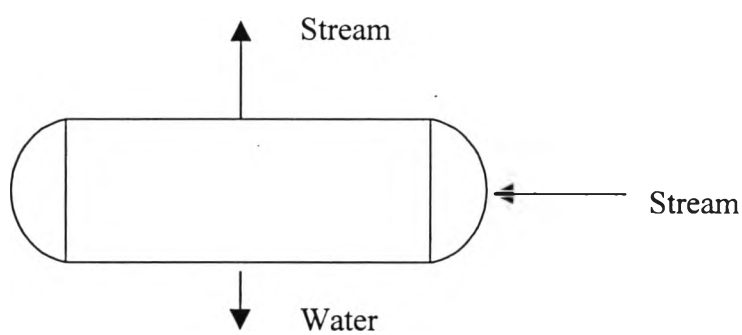
Function : Steam Generator



Unit	Stream Generator or Overhead Condensor
Input	1. Vapor of Acetic Acid / Water 2. Water (from stream drum)
Output	1. Condensate of Acetic Acid / Water 2. Stream
Duty	This is a heat exchanger that transfer the heat from Acetic Acid / Water and Water-Stream. The duties are 1. Pull out heater from the vapor of Acetic Acid / Water and condense to liquid phase. 2. Increase temperature to water (that come from stream drum) until the range of vapor pressure to be 2-6 Bar.

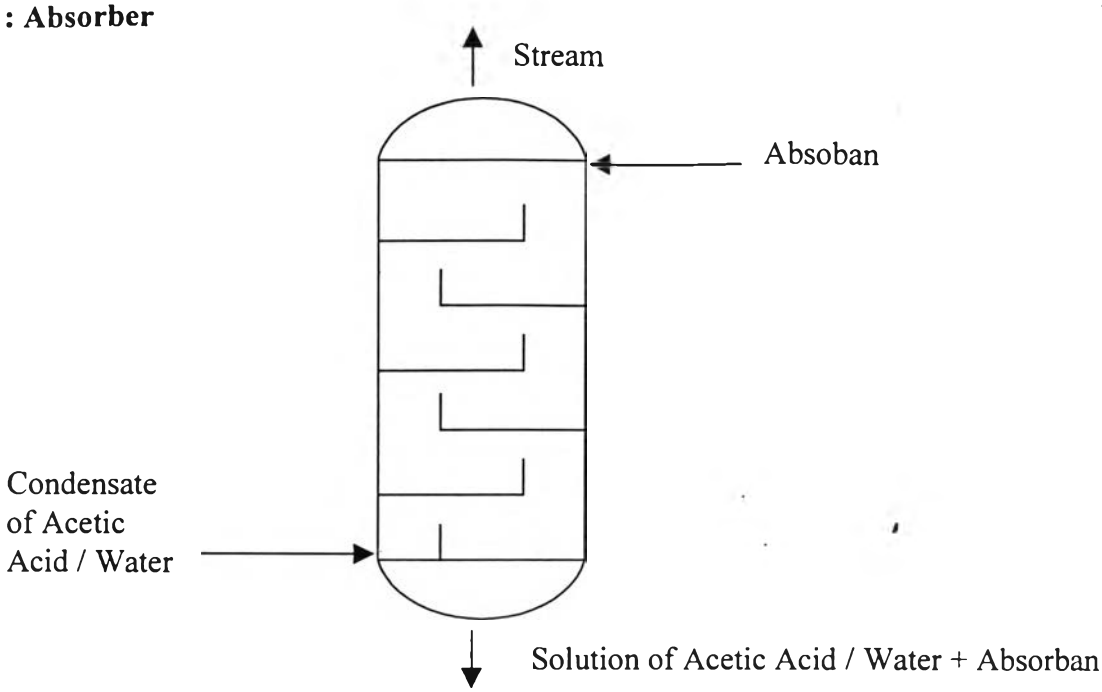
Note : * Most of condensate of Acetic Acid / Water will be fed to solvent recovery section and the remaining will be returned to CTA reactor for reflux.

Function : Steam Drum



Unit	Stream Drum
Input	Water
Output	Stream (2-6 Bar)
Duty	Tank for stream from stream generator in order to separate liquid and stream and control vapor pressure before feeding its to tennerge recovery turbines.

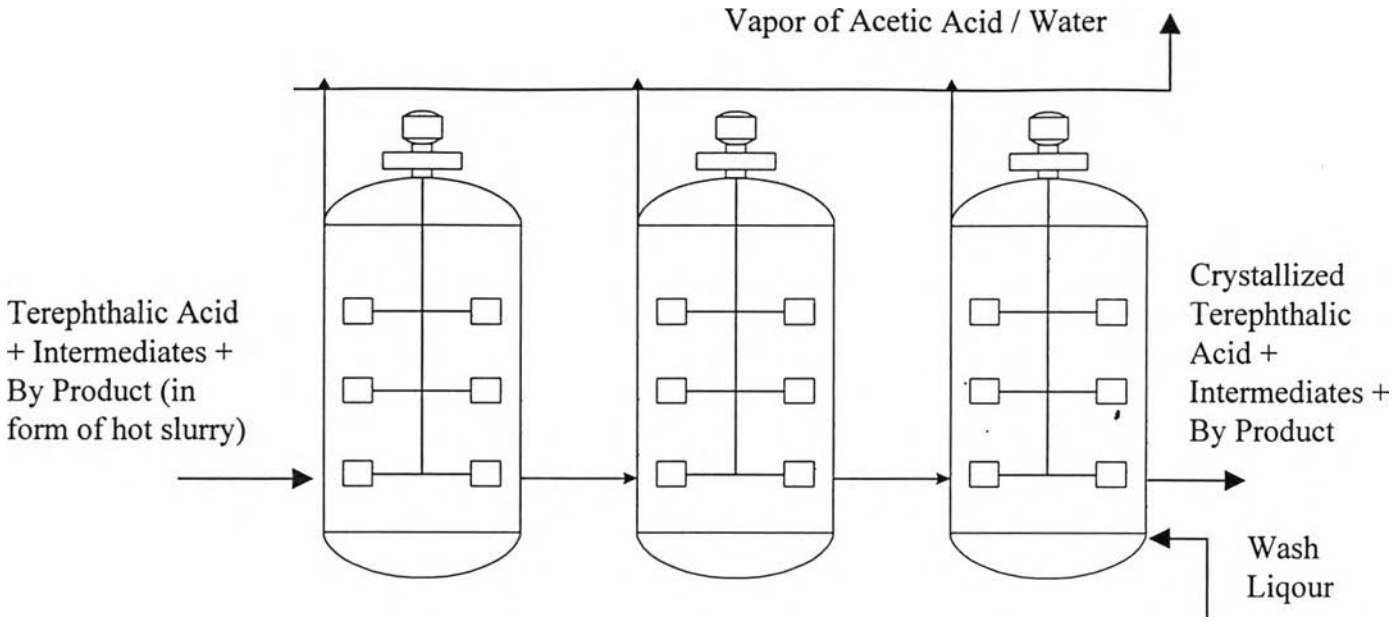
Function : Absorber



Unit	Absorber Tower
Input	1. Condensate of Acetic Acid / Water (Vapor) 2. Absorban
Output*	1. Vapor of Acetic Acid / Water 2. Absorban' (pull out Acetic Acid from vapor of condensate) 3. Stream (2-6 Bar)**
Duty	Exchanger collumn to pull out Acetic Acid from vapor of condensate.

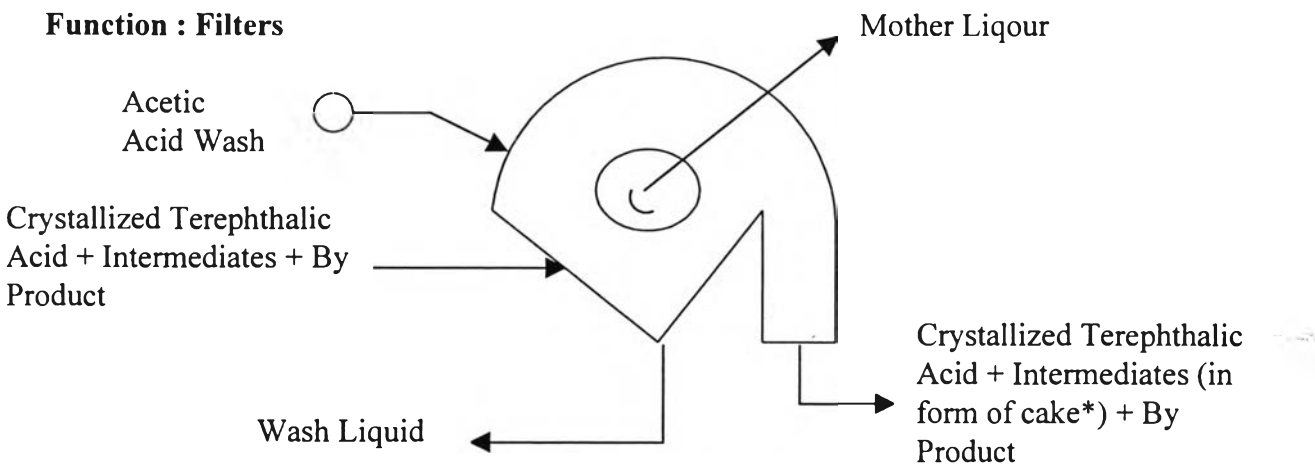
Note : * The solution of Acetic Acid / Water & Absorban will be separated & Acetic Acid will be feeding to the recovery section in order to recovery Acetic Acid back for re-used.
** Stream will be feeding to generate energy recovery turbines.

Function : Crystallizers



Unit	Crystallizer (in series)
Input	Terephthalic Acid + Intermediates + By Product (in form of hot slurry)
Output	1. Crystallized Terephthalic Acid + Intermediates + By Product (in from of hot slurry) 2. Vapor of Acetic Acid / Water
Duty	Atmospheric cause CTA completely to be crystallized by reducing temperature & pressure gradually until this condition reaching to the normal atmosphere.

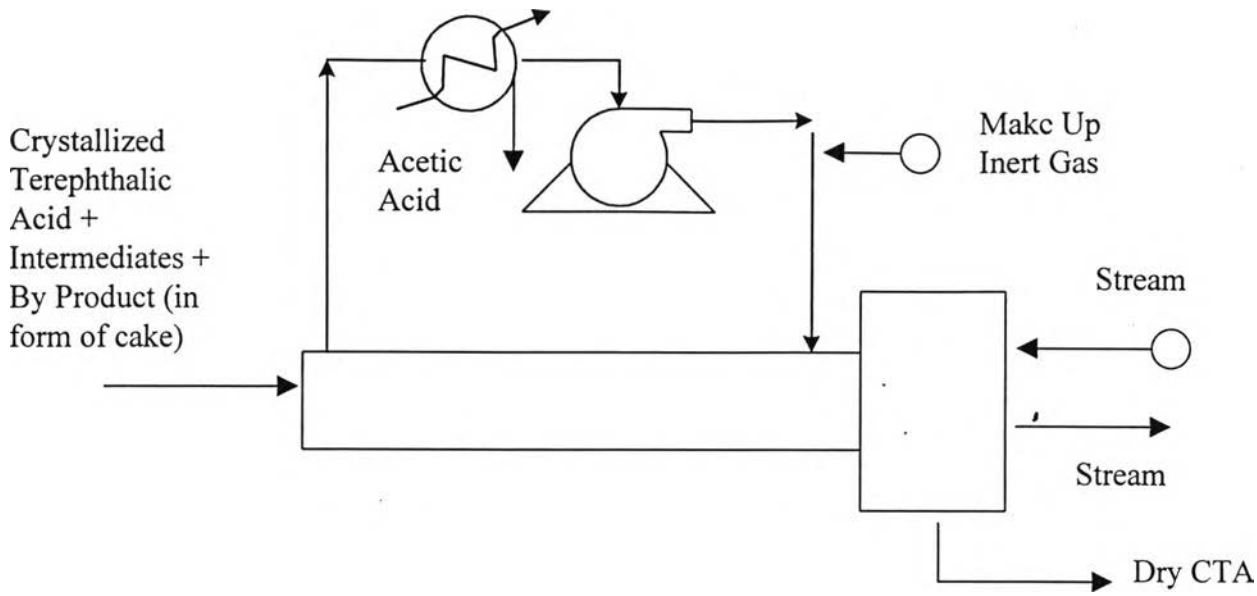
Function : Filters



Unit	Solid – Liquid Separators (Rotary Vacuum Filter)
Input	Terephthalic Acid + Intermediates + By Product
Output	Crystallized Terephthalic Acid + Intermediates (in form of cake)
Duty	Separate and clean liquid of intermediate and also by products from crystallized terephthalic acid.

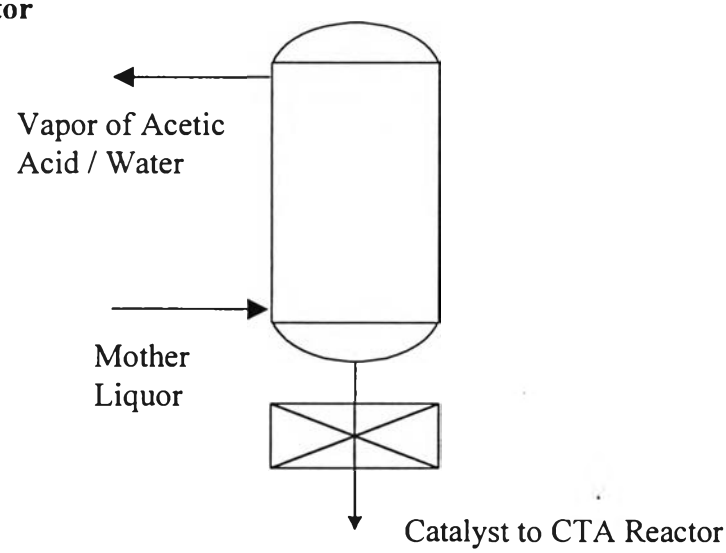
Note : * Moisture in cake is about 30-50%

Function : Dryer



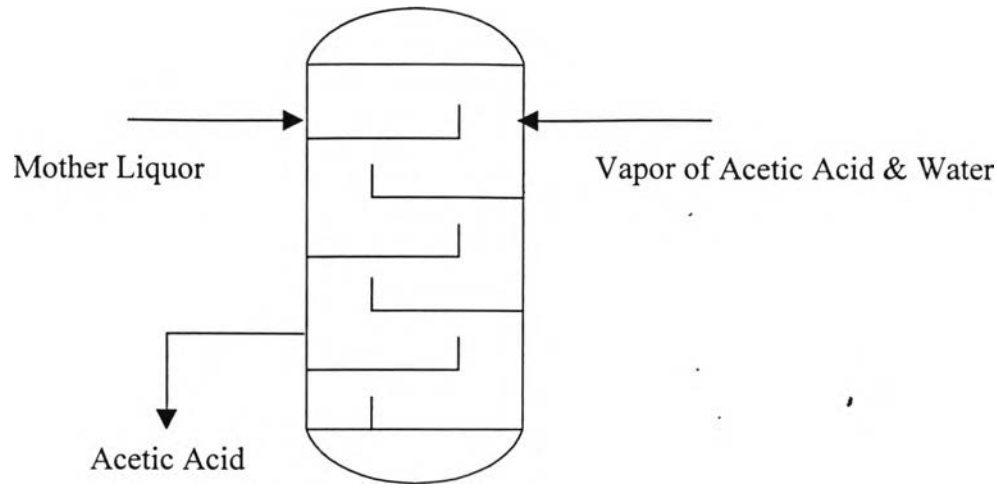
Unit	Rotary Stream Tube Dryer (dryer)
Input	Crystallized Terephthalic Acid + Intermediates + By Product (in form of cake)
Output	1. Dry CTA 2. Acetic Acid
Duty	Remove the moisture from cake of Crystallized Terephthalic Acid. Then, the dried of CTA will come out and sent to store in silo.

Function : Seperator



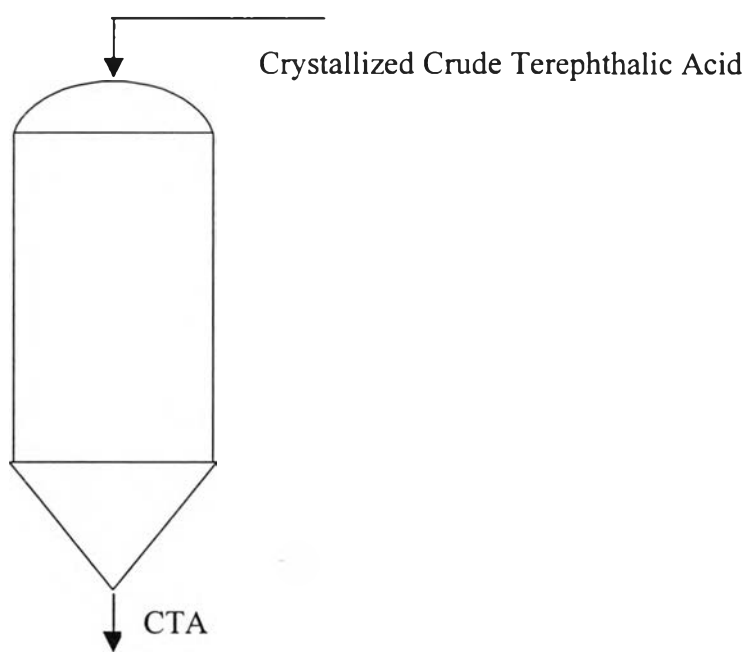
Unit	Solvent / Catalyst Seperator (flash drum)
Input	Mother Liquor
Output	1. Flush Residue at the bottom of tank (it's compose of catalyst and will sent back to catalyst recovery unit) 2. Vapor of Acetic Acid / Water
Duty	Separate catalyst from Acetic Acid / Water by rapidly reducing pressure until cause Acetic Acid & Water which have low boiling point become to vapor.

Function : Distillation Tower



Unit	Solvent Distillation Tower
Input	1. Mother Liquor 2. Vapor of Acetic Acid & Water Liquor
Output	1. Acetic Acid 2. Waste Water
Duty	Distillate Water from Acetic Acid in order to recover Acetic Acid.

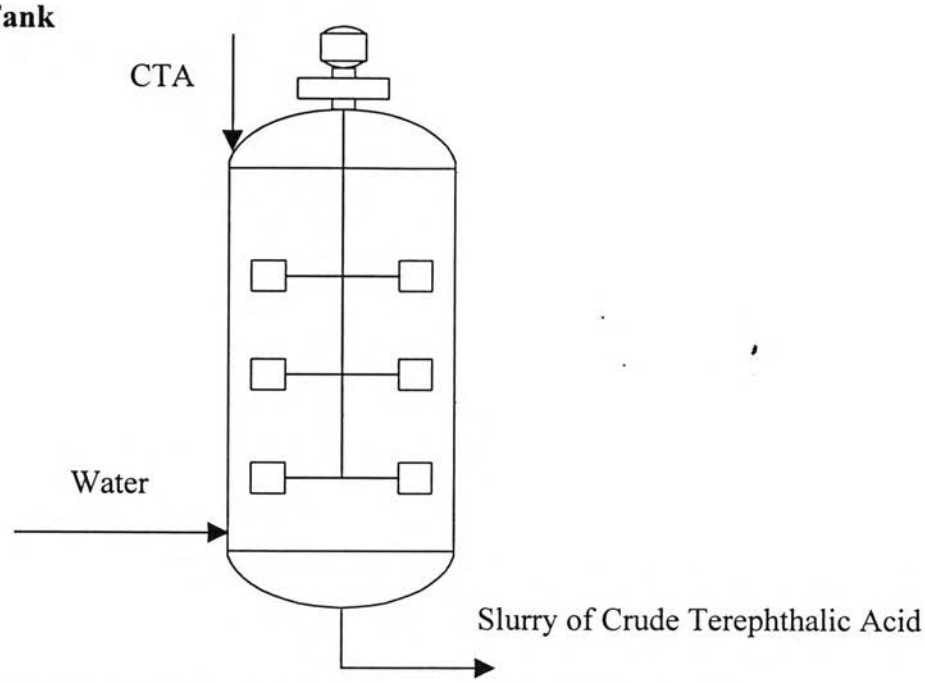
Function : Silo



Unit	Crude Terephthalic Acid Silo
Input	CTA
Output	CTA
Duty	Keep CTA before sending to PTA process

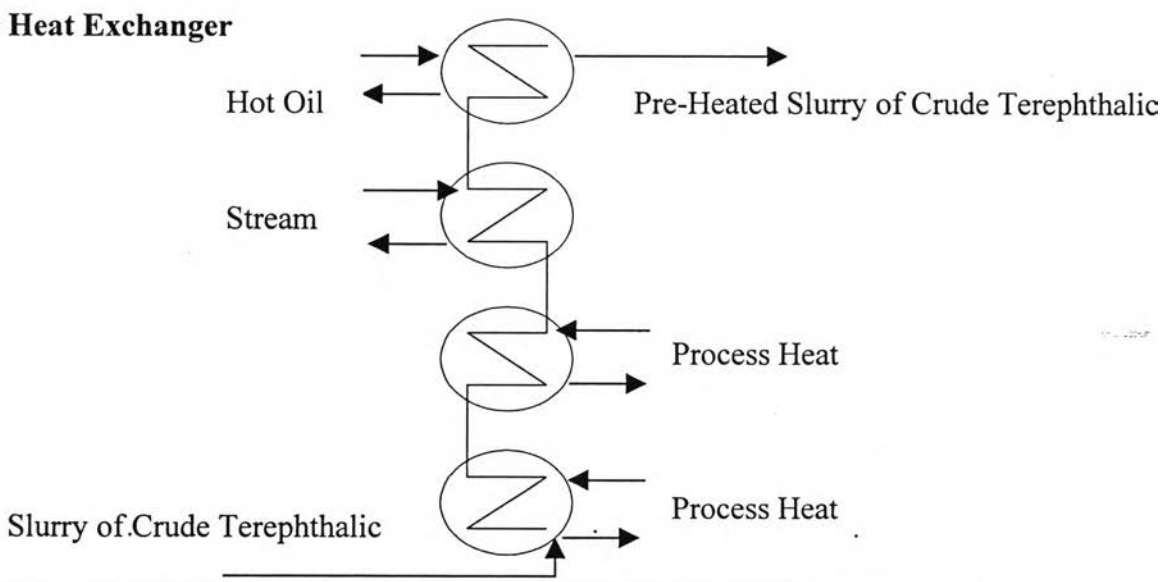
4.4.2 PTA Process

Function : Mixing Tank



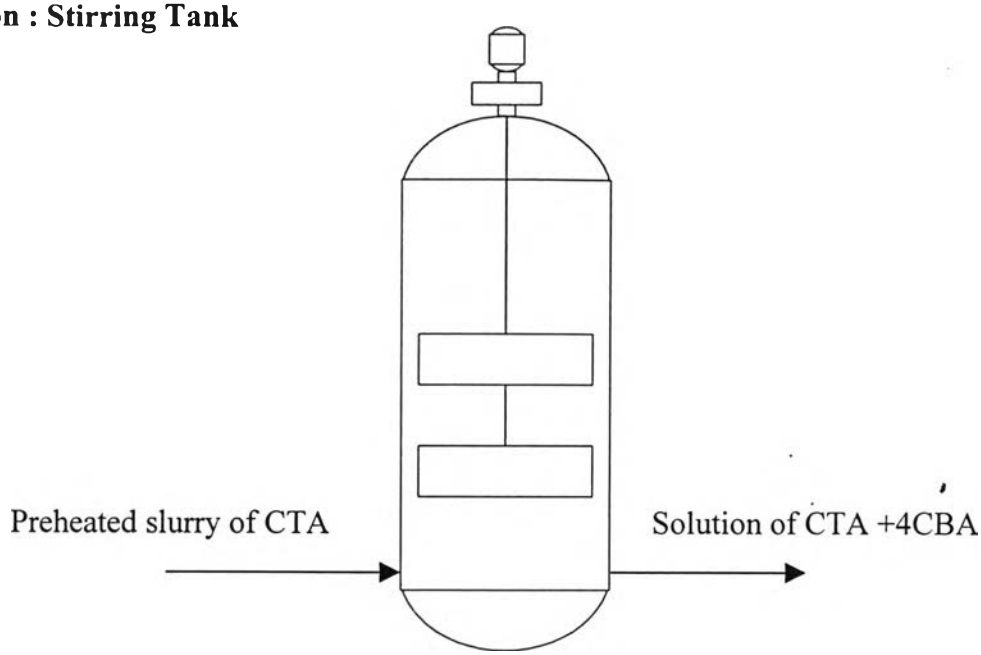
Unit	Crude Terephthalic Acid Slurry Tank
Input	1. CTA 2. Water
Output	CTA in form of slurry
Duty	Mix CTA and Water in the suitable concentration in order to increase hydrogenation reaction

Function : Heat Exchanger



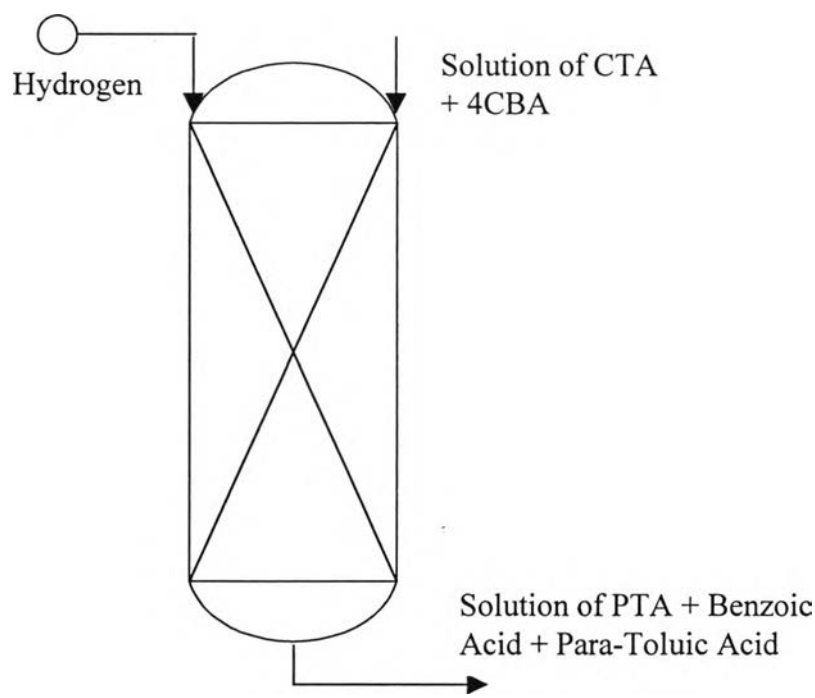
Unit	Heat Exchanger
Input	1. Slurry of Crude Terephthalic Acid 2. Heat from process heat , stream and hot oil.
Output	High temperature of slurry of Crude Terephthalic Acid
Duty	Pre-heater for increasing temperature of slurry in order to feeding back to feed dissolver.

Function : Stirring Tank



Unit	Feed Dissolver
Input	Preheated slurry of CTA
Output	The solution of CTA +4CBA
Duty	Make a CTA solution by dissolving such crystallized CTA.

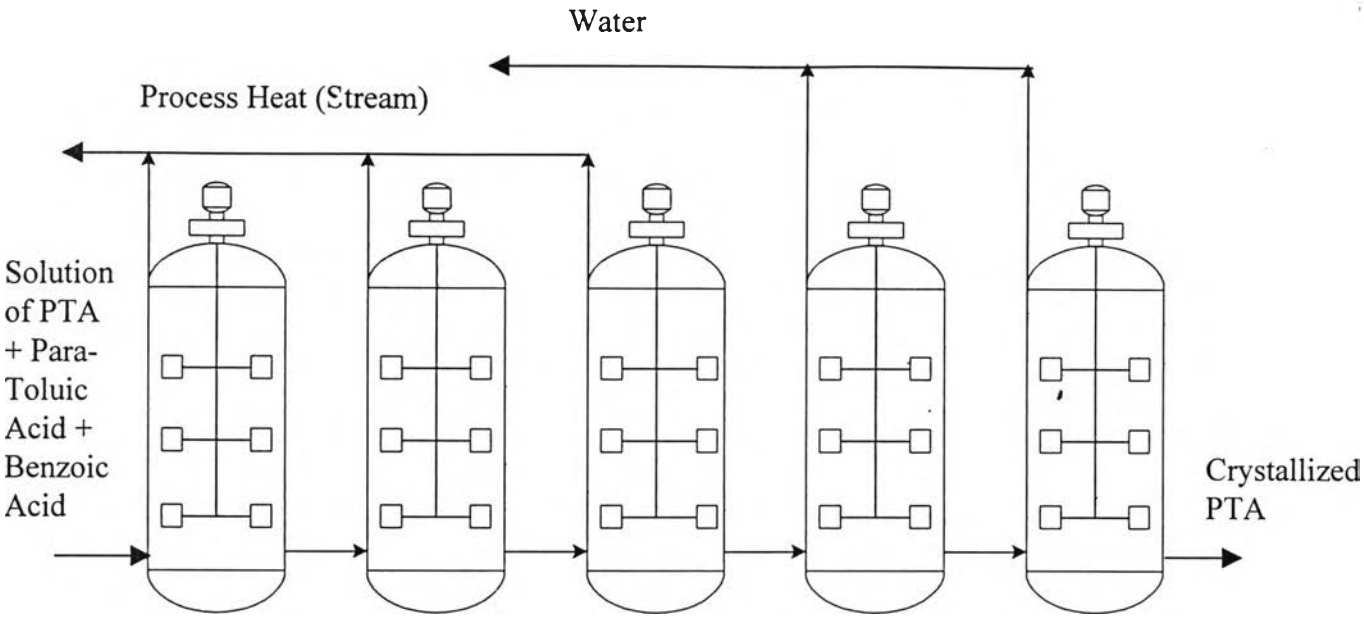
Function : Reactor



Unit	Purified Terephthalic Acid Reactor (fix bed)
Input	1. Solution of CTA + 4CBA 2. Hydrogen
Output	The solution of PTA +Para-Toluic Acid
Duty	Form chemical reaction of $TA+H_2 \longrightarrow$ Benzoic Acid and $4CBA+H_2 \longrightarrow$ Para-Toluic Acid* By using Pd/C as a catalyst

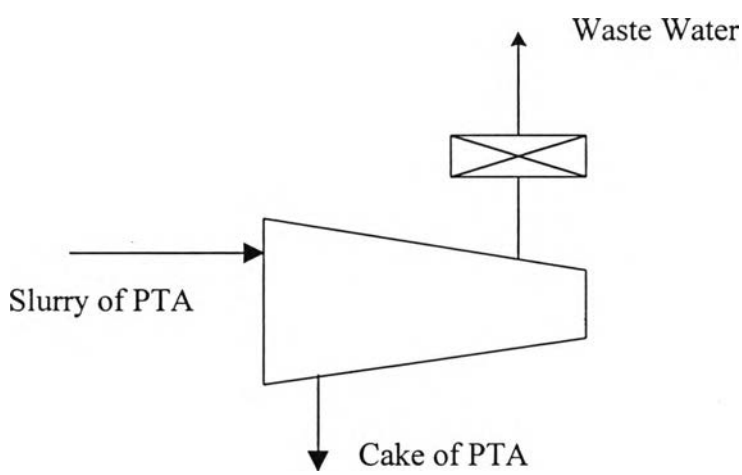
Note : * Para-Toluic Acid has more soluble than 4CBA. So, when the new crystallization is formed again, the new Terephathalic Acid will have high purification.

Function : Crystallizers



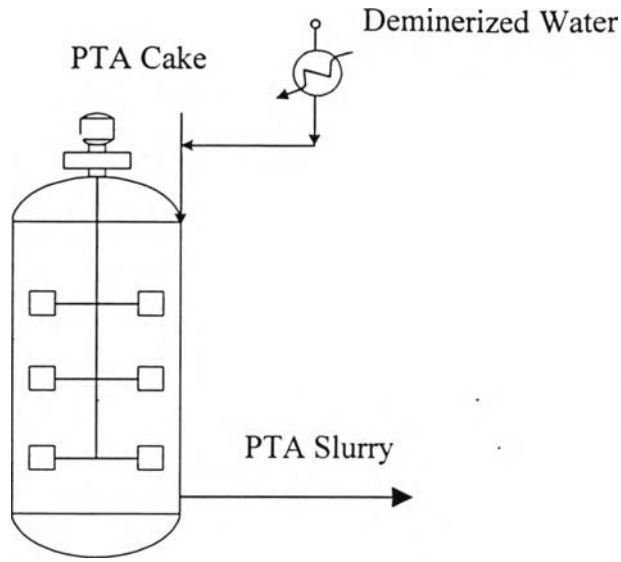
Unit	Crystallizers
Input	The solution of PTA + Para-Toluic Acid + Benzoic Acid
Output	1. Crystallized PTA 2. Stream 3. Water
Duty	Make PTA to crystallized by reducing pressure of PTA solution which is being fed from reactor.

Function : Liquid Solid Seperator



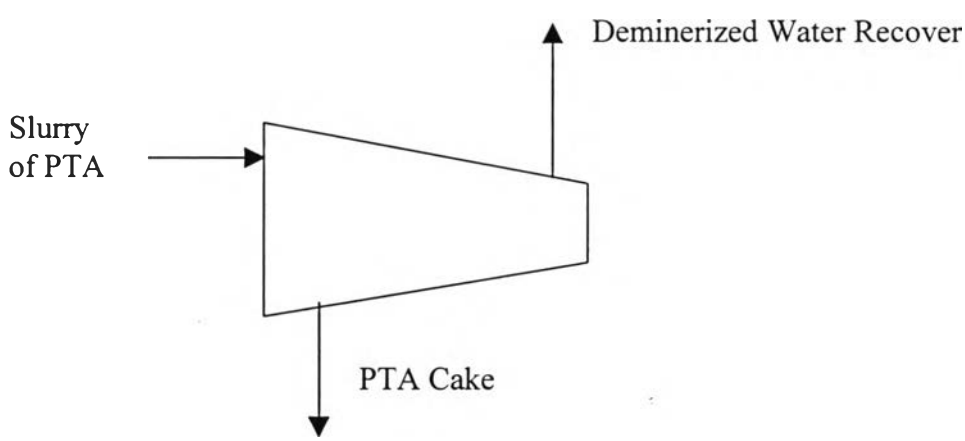
Unit	Pressure Centrifuge
Input	Slurry of PTA
Output	PTA Cake
Duty	Separate such water solution which include of Para- Toluic Acid & Benzoic Acid and crystallized PTA by stirring under a relatively high pressure than the atmospheric condition.

Function : Stirring Tank



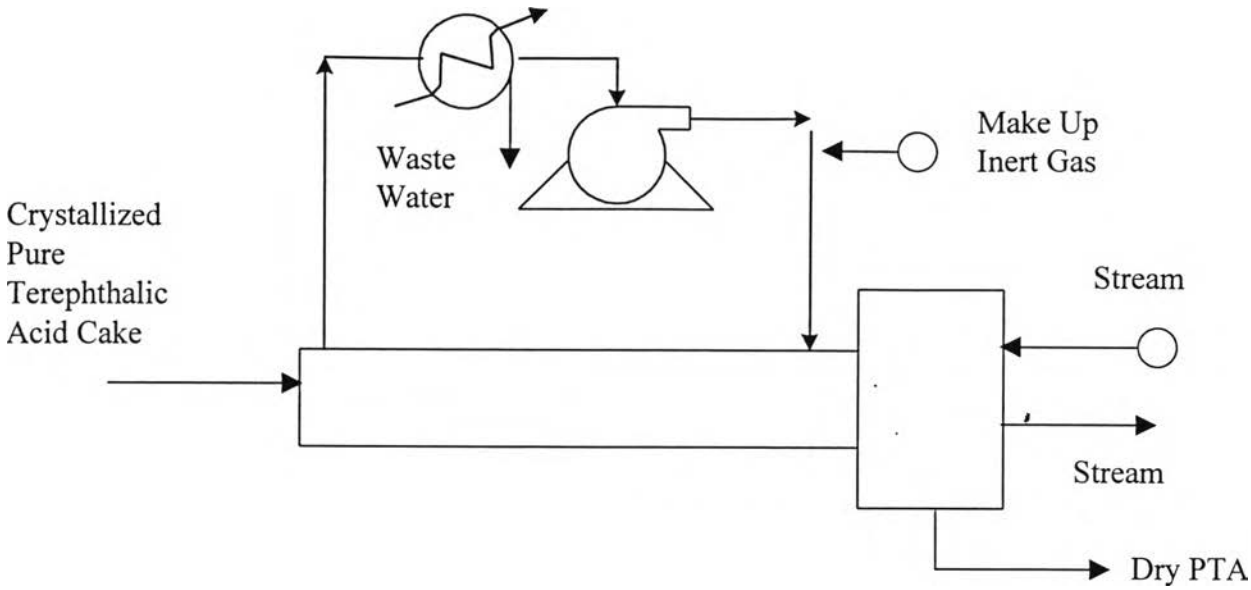
Unit	Purified Terephthalic Acid Re-Slurry Tank
Input	1. PTA Cake 2. Deminerized Water which to be already increase temperature by heat exchanger.
Output	PTA Slurry
Duty	Clean of crystallized PTA

Function : Seperator



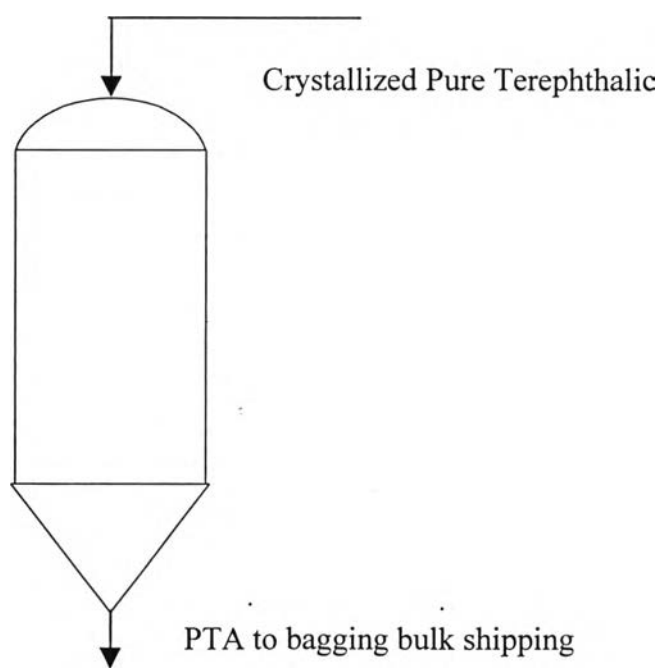
Unit	Liquid Solid Separator (Atmospheric Centrifuge)
Input	Slurry of PTA
Output	PTA Cake
Duty	Separate the water solution of Para-Toluic Acid & Benzoic Acid from crystallized PTA.

Function : Dryer



Unit	Rotary Stream Tube Dryer
Input	Crystallized Purified Terephthalic Acid Cake
Output	1. Dried PTA 2. Waste Water
Duty	De-humidity from cake of crystallized purified terephthalic acid in order to make dried PTA for keeping in silo.

Function : Silo



Unit	Purified Terephthalic Acid Silo
Input	PTA
Output	PTA
Duty	Keep PTA to package.

The process equipment as explained above in 4.4.1 and 4.4.2 are only the major equipment in the process of CTA and PTA but its still lack of minor equipment or facilities such as instrumentation or electrical equipment. Therefore, the full list of all the equipment and its support equipment are listed as details followings.

- Process equipment: vessels and internals, heat exchangers, pumps and compressors, drivers, solid handling, etc.
- Major spare equipment/parts (e.g. spare rotor for turbine or compressor, etc.)
- Process and utility pipes and supports within the major process areas
- Instruments, including computer control systems
- Electrical wires and hardware
- Foundations and pads
- Foundations and pads
- Structures and platforms
- Insulation
- Paint/corrosion protection
- Fire water pipes and monitors
- Utility stations
- Storage for feeds, products, by-products, including tanks/silos, dikes, inerting, process warehouse, and bagging/pelletizing equipment.
- Steam generation units
- Cooling water systems, including cooling towers and circulation pumps
- Process water treating systems and supply pumps
- Boiler feed water treating systems and supply pumps
- Refrigeration systems including chilled water/brine circulating pumps
- Heat transfer medium systems including organic vapor, hot oil, molten salt, etc.
- Electrical supply, transformers, and switchgear
- Loading and unloading arms, pumps, conveyors, and lift trucks, including those to handle barge, tank/hopper car, and tank/hopper/other truck traffic; weigh scales
- Auxiliary building, including all services, furnishing, and equipment:
  - Central control room
  - Maintenance
  - Stores Warehouse
  - Laboratory
  - Garages/fire station
  - Change house/cafeteria
  - Medical/safety
  - Administration
- General utilities, including plant air, instrument air, inert gas, stand-by electrical generator, fire water pumps, etc.
- Site development, including roads and walkways, parking, railroad siding, electrical main substation, lighting, water supply, fuel supply, clearing and grading, drainage, fencing, sanitary and storm sewers, and communications
- Yard pipes, including lines for cooling water, process water, boiler feed water, fire water, fuel plant air, instrument air, inert gas, collection of organic wastes, aqueous wastes, flare/incinerator feeds, and process tie-ins to storage
- Pollution control, organic waste disposal, aqueous waste treating, incinerator, flare.

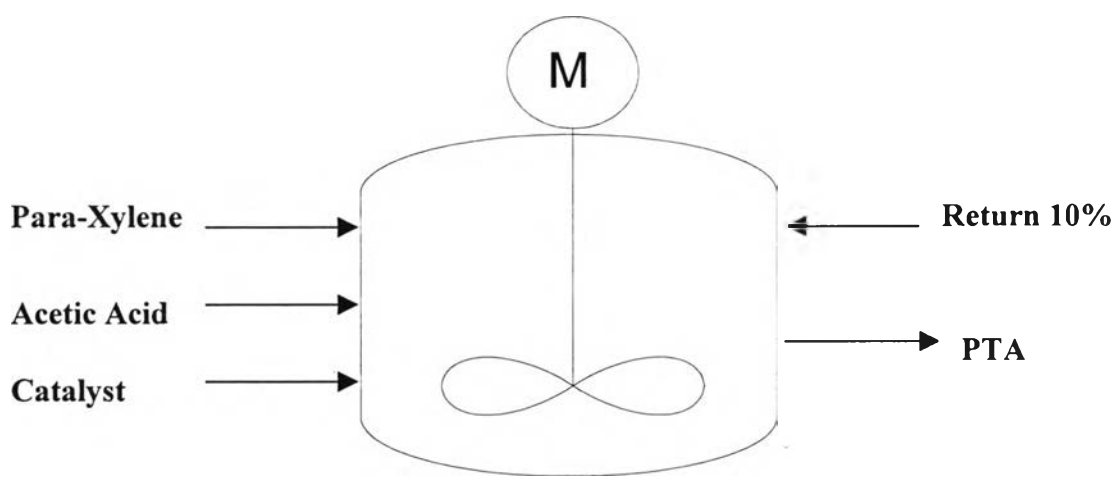
Based on the estimation of INCA process licensor in 1998, the cost of the above process equipment (ISBL) and offtaker (OSBL) would be US$ 280 Million. Such costs are include the installed cost, including construction overhead, fringe benefits, payroll burdens, field supervision, equipment rentals, small tools (expendables), field office expenses, site support services, and temporary facilities.

4.5 BASIC DESIGN FOR EQUIPMENT CAPACITY REQUIREMENT

In this research, such sizing and capacity, only one equipment can be calculated. For the other equipment can not be calculated because more data are needed and the licensor will not provide until we buy their license. The example of equipment that can calculate is mixed tank.

Generally, when the designer needs to calculate the capacity for each major equipment in the plant. Such material balance and its retention time are needed to be known in the first step. So, in our research, some data are incomplete due to the patent of each licensor is verified as a top secrete. But, for basic design, it can be roughly estimated for example.

In this case such mixing drum as shown in the figure 4.1 can be calculated by using a basic of design as mentioned above. Therefore, such diagram and data and its assumption are shown below:



Mixing Drum

PTA product requirement	=	**350,000 Tons per Year**
Plant Operating Time	=	**345 Days (20 Days Off for Maintenance)**
Retention Time (Reaction time in the mixing drum)*	=	**1 Hour**
Efficiency of Catalyst to produce PTA in the mixing drum*	=	**90%**
Safety factor of mixing drum (normal condition)*	=	**20%**
PTA density	=	**1.593 Ton per cubic meter**

Note : * Chem Systems recommendation for PTA process

Therefore: The Operating Time = (350,000) / (345*24)
= 42.27 Ton per Hour
Normal Capacity of mixing drum = operating time * retention time
= 42.27*1 = 42.27 Ton
Volume = Mass / Density = 42.27 / 1.593 = 26.53 m^3

Thus: Required Volume of this mixing drum shall be equal to

Safety factor of mixing drum = 20%
Efficiency of catalyst = 90% (return 10% to mixing drum for re-produce)
So; the over volume of mixed tank = 10%+20% = 30%
Required volume = 26.53*1.3 = 34.489 m^3

Sizing of drum = $\pi D^2 h / 4$ (Cylinder Model)*
Assume diameter of drum = 3 meter (Normal Case)*
The height of mixing drum shall be calculated by
Height = 34.489*4 / $\pi 3^2$ = 4.88 meter

Note: * Chem Systems recommendation for PTA process

Finally, the size of this mixing drum shall be roughly estimated to 34.489 m^3 with the diameter and height of 3 and 4.88 meter respectively. So, for other equipment can be roughly estimated by this calculation method. But, for the details design, it need more information to calculate such as temperature, pressure, flow rate, etc. In order to select the material which matching with the PTA process.

4.6 PLANT CAPACITY & PRODUCTION COSTS

Based on the technical research of INCA process technology, capital investment required in a PTA plant depends on its capacity. Table 4.3 and figure 4.5 are show the portion of materials and utility requirements for PTA production and estimated investment costs and expenses at the capacity of 350 thousand metric tons. These assumptions will be used in the part of financial analysis. Also, this feasibility study and the detailed economics discussed in the next section are based on a PTA plant capacity of 350 thousand metric ton per year.

FIGURE 4.5
PTA PRODUCTION COSTS

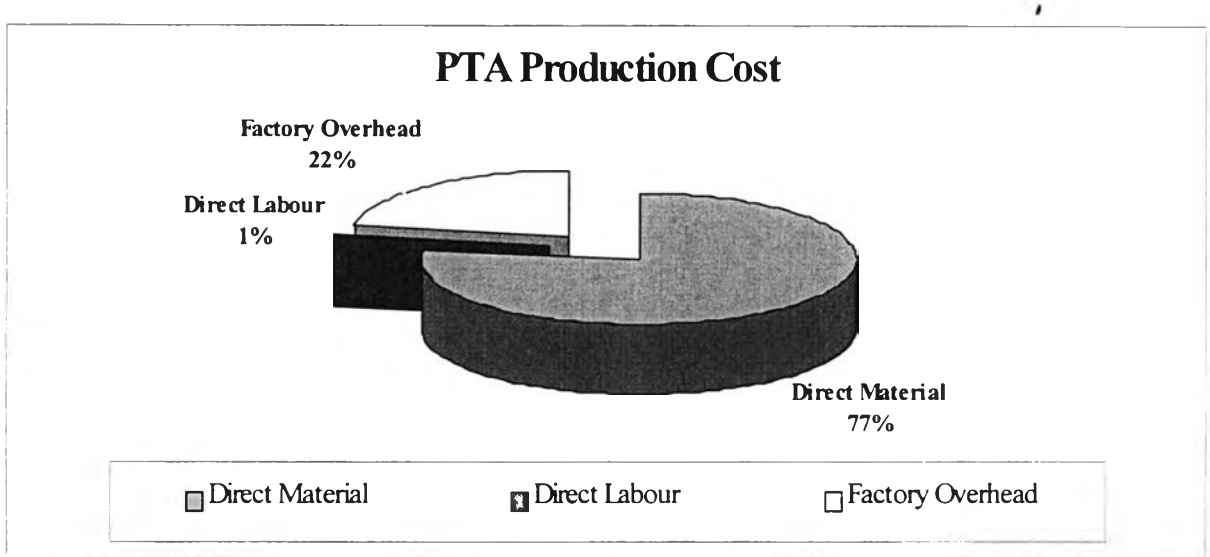


TABLE 4.3 PRODUCTION COST PER UNIT FOR PTA PRODUCTION

Plant capacity, kmta PTA		**350**		
Direct Material				
Feedstocks	per ton PTA	At Capacity	Price (US$)*/MT	Cost (US$)/MT PTA
Paraxylene	0.665	232.75	630	146632.5
Acetic Acid	0.06	21	530	11130
Isobutyl Acetate	0.0012	0.42	1,719.00	721.98
Hydrogen	0.0003	0.11	573	63.03
Sodium Hydroxide	0.0052	1.82	362	658.84
Misc. catalysts	0.001	0.35	1,719.00	601.65
Products : Purified Terephthalic Acid	1			
Total Direct Material Cost per MT PTA (85% plant capacity)				**135,836.80**
Direct Labour				
Labour Cost				
Number of Employee				
AVG. Wage/year				64
Labour Cost				14.349
Total Direct Labour Cost				**918.336**
Factory Overhead				
Utility requirements per ton of PTA production				
Electrical Power	240	84,000.00	0.0702 per KWH	5896.8
Cooling water circulation	190	66,500.00	0.0425 per M3	2826.25
Inert gas	30	10,500.00	0.0366 per M3	384.3
Fuel	0	0	230.36 per ton	0
Demineralized water	2.5	875	1.3248 per M3	1159.2
Heat transfer fluid (hot Oil)	0.39	136.5	30.9838 per Gcal	4229.2887
Total Utilities Cost (85% plant capacity)				**12,321.46**
Administrative management expense				
Number of employee				30
Avg. wages per employee (5% increase/yr)				21.7667
Total administrative management expense				**653.0**
Depreciation				
ISBL (15 years)				13,667
OSBL (15 years)				5,000
Depreciation Expenses				**18,667**
Amortization				
Royalty (10 years)				1,000
Catalyst and Chemical (5 years)				233
Amortization Expenses				**1,233**
Land Lease				**111**
Maintenance Cost				
Maintenance Cost (3% of ISBL)				**6,150**
Total Factory Overhead				**39,135.46**
PTA Production Cost (US$) per MT				**591.23**

Source: INCA Process PTA Capital Investment

*** Price in year 2001**

Cost Percentation	**Percentation (%)**
Direct Material	**77.23**
Direct Labour	**0.52**
Factory Overhead	**22.25**
Total Percentation	**100.00**