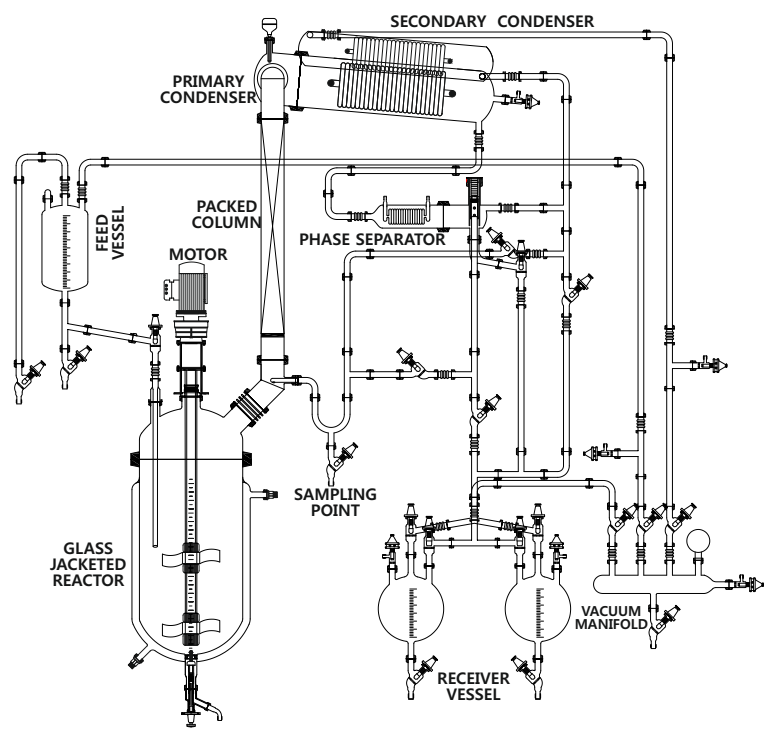


Ablaze offers customized Distillation Systems with Jacketed Glass Reactor. It includes vapour column, condensers, reflux provision, phase separator, addition and receiver vessels, along with valves at suitable places, and supporting metal structure. The units are supplemented with TCU (Thermal Control Unit) for circulation in Jacket of reactor.

Salient Features

- Full View Glass Reactor to Improve and Control Chemical Reaction
- Triple Wall Reactor for Cryogenic (-90°C) Chemistry
- Internal Baffles for Improved Mixing
- Complete Documentation (IQ/ OQ/ DQ)
- GMP Design / ATEX Compliant
- Glass / PTFE Pressure Relief Valve and Rupture Disc for Safety
- Integration of Automation with Data Acquisition
- Easily integrated with our Nutsche Filter and Scrubber Systems
- Modular and Compact Steel Frame available to minimize floor Footprint and Height of Pilot Plant
- Control and Sampling Valves at accessible locations



DESCRIPTION		AGR 20	AGR 50	AGR 100	AGR 200
Reactor Nominal Capacity	ltr.	20	50	100	200
Heat Exchanger (Exchange Surface)	m ²	0.5	1.0	1.5	2.5
Jacket Design Pressure	bar(g)	-1 to +0.5	-1 to +0.5	-1 to +0.5	-1 to +0.4
Vessel Design Pressure	bar(g)	-1 to +1	-1 to +0.7	-1 to +0.5	-1 to +0.4
Plant Working Temperature	°C	-50 to +180	-50 to +180	-50 to +180	-50 to +180
Plant Design Temperature	°C	-60 to +200	-60 to +200	-60 to +200	-60 to +200
Plant Working Pressure	bar(g)	+0.8	+0.6	+0.4	+0.3
Feed Vessel	ltr.	10	20	50	100
Receiver Vessel	No. x ltr.	2 x 10	2 x 20	2 x 50	2 x 100
Vapour Line Column	DN	50	80	100	100

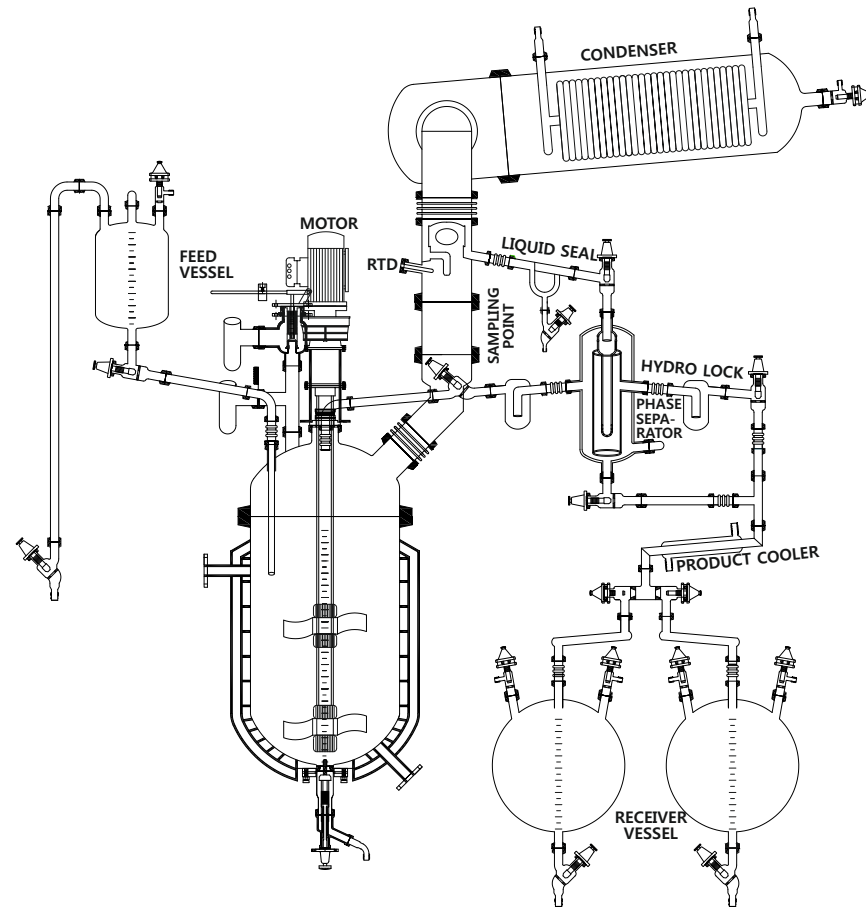
Stirrer Speed	rpm	20 to 250	20 to 250	20 to 250	20 to 250
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Distillation Plant with 100 Liter Reactor System
Made in Borosilicate Glass 3.3

Ablaze also offers standard distillation systems with Glass Lined Reactors, with rest of the assembly same as type AGR. This helps in scale-up to production design, offers excellent heat transfer and replicates process conditions of production very closely.

Salient Features

- Suitable for high value, low volume production from 25 liters to 630 liters
- Transparency for Better Understanding during Process Development
- Glass Lined Reactor for Cryogenic (-90°C) Reaction
- Glass Lined Steel Stirrer for Zero Contamination
- High mechanical stability & heat transfer
- CIP Capable
- Twin Distillate Receivers for continuous operation without breaking vacuum
- Baffle with PT100 temperature sensor provided



DESCRIPTION		AGR/GL 25	AGR/GL 50	AGR/GL 100	AGR/GL 250
Reactor Nominal Capacity	ltr.	25	50	100	250
Heat Exchanger (Exchange Surface)	m ²	0.5	1.0	1.5	3.0
Jacket Design Pressure	bar(g)	-1 to +6	-1 to +6	-1 to +6	-1 to +6
Vessel Design Pressure	bar(g)	-1 to +6	-1 to +6	-1 to +6	-1 to +6
Plant Working Temperature	°C	-20 to +180	-20 to +180	-20 to +180	-20 to +180
Plant Design Temperature	°C	-25 to +200	-25 to +200	-25 to +200	-25 to +200
Plant Working Pressure	bar(g)	+1.0	+0.7	+0.5	+0.5
Feed Vessel	No. x ltr.	2 x 5	1 x 10	1 x 20	1 x 50
Receiver Vessel	No. x ltr.	2 x 5	1 x 10	1 x 20	1 x 50
Vapour Line Column	DN	50	80	100	150

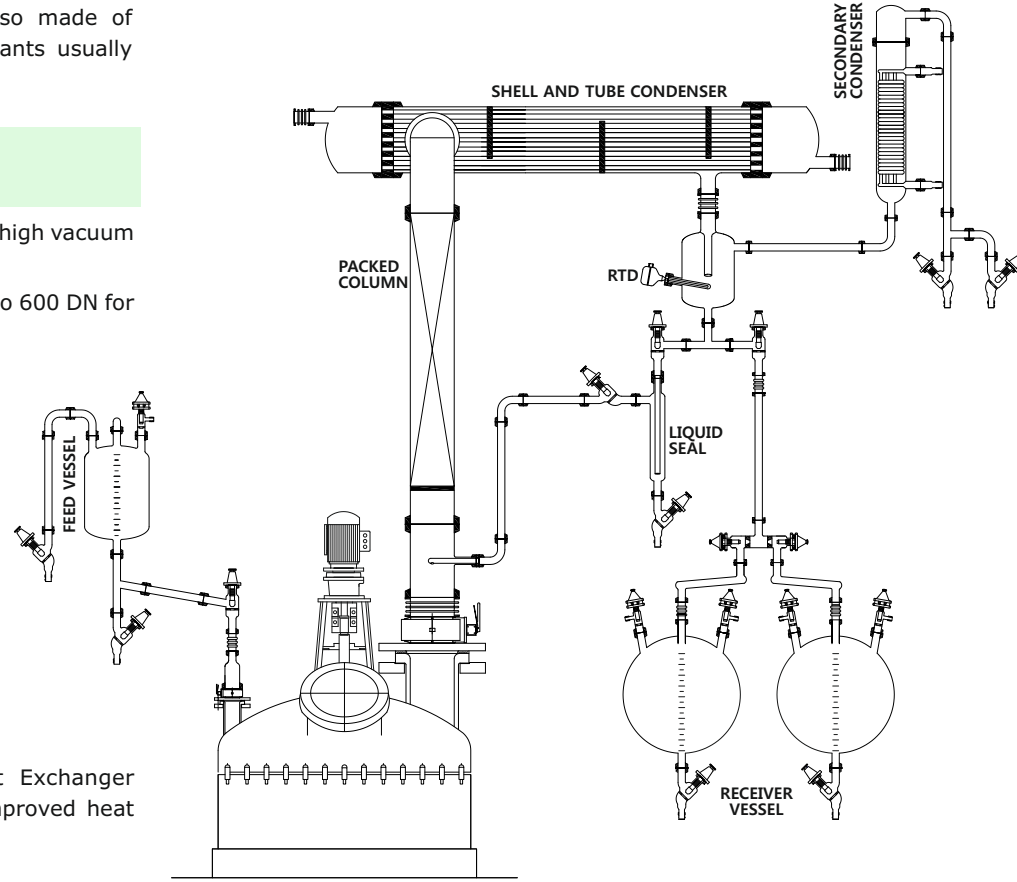
Stirrer Speed	rpm	20 to 250	20 to 250	20 to 250	20 to 250
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Distillation Plant with 30 Liter Glass Lined Reactor System
Made in Borosilicate Glass 3.3

For production scale chemical synthesis , distillation , solvent recovery , rectification processes, Glass Shell & Tube Condensers are used along with Glass Lined Reactors. Complete process piping is also made of borosilicate glass 3.3 These plants usually operate under vacuum.

Salient Features

- Suitable for operation under high vacuum and low pressure
- Setup can be configured up to 600 DN for large size reactors
- Visual monitoring of process, improving safety and reliability of production
- Customized compact design as per available space
- Measure and control devices can be easily equipped
- High corrosion resistant Coupling and Fasteners
- Shell and Tube type Heat Exchanger available up to 40m² for improved heat transfer efficiency



DESCRIPTION		AGR/GL 1000	AGR/GL 1600	AGR/GL 3000	AGR/GL 5000
Reactor Nominal Capacity	ltr.	1000	1600	3000	5000
Heat Exchanger (Exchange Surface)	m ²	8.0	12.5	16.0	26.0
After Cooler (Exchange Surface)	m ²	2.0	2.5	4.0	5.0
Jacket Design Pressure	bar(g)	-1 to +6	-1 to +6	-1 to +6	-1 to +6
Vessel Design Pressure	bar(g)	-1 to +1	-1 to +1	-1 to +1	-1 to +1
Plant Working Temperature	°C	-20 to +180	-20 to +180	-20 to +180	-20 to +180
Plant Design Temperature	°C	-25 to +200	-25 to +200	-25 to +200	-25 to +200
Plant Working Pressure	bar(g)	+0.5	+0.5	+0.5	+0.5
Feed Vessel	No. x ltr.	2 x 100	1 x 200	2 x 200	2 x 200
Receiver Vessel	No. x ltr.	2 x 100	2 x 200	2 x 200	2 x 200
Rupture Disc	bar(g)	0.5	0.5	0.5	0.5

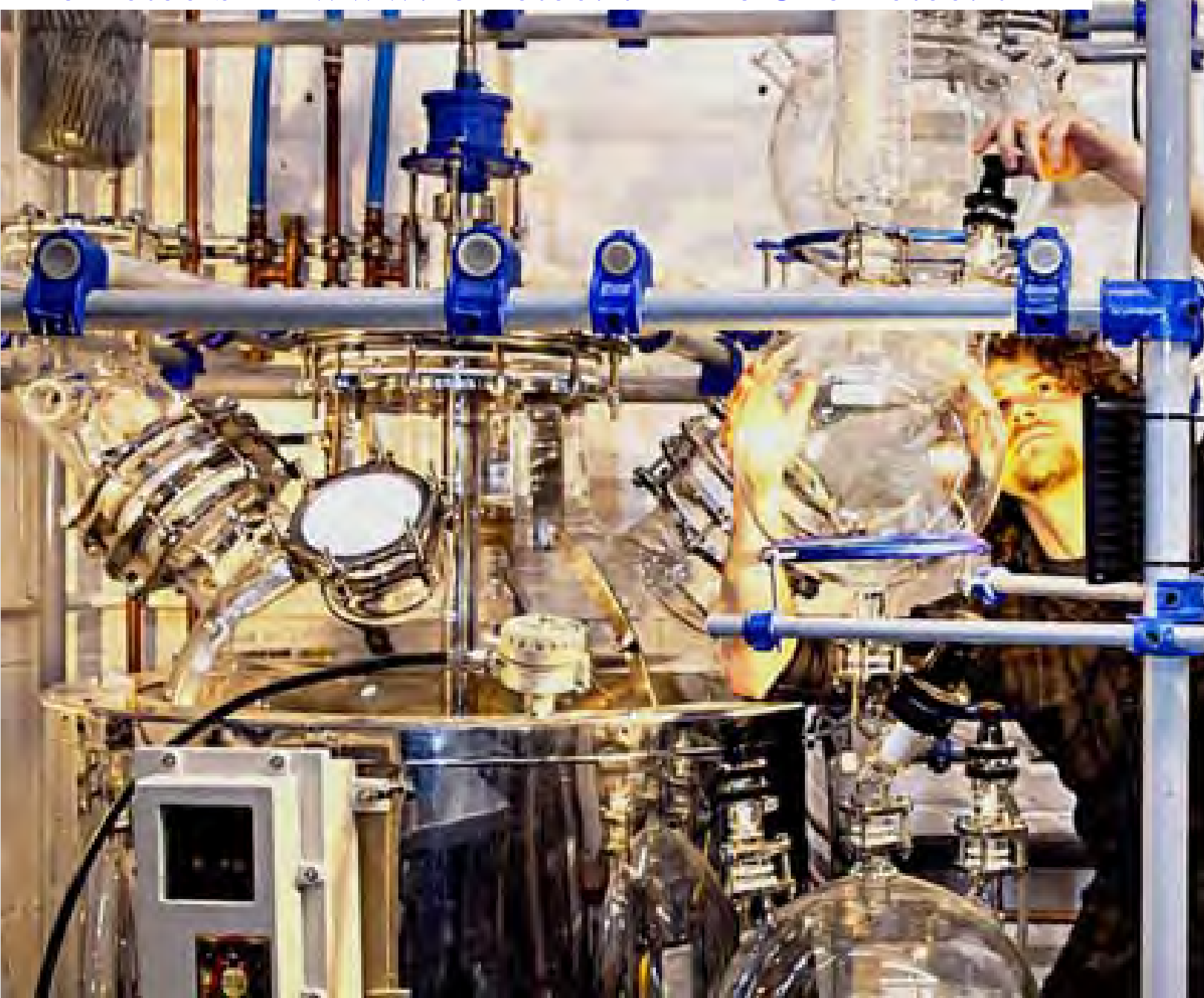
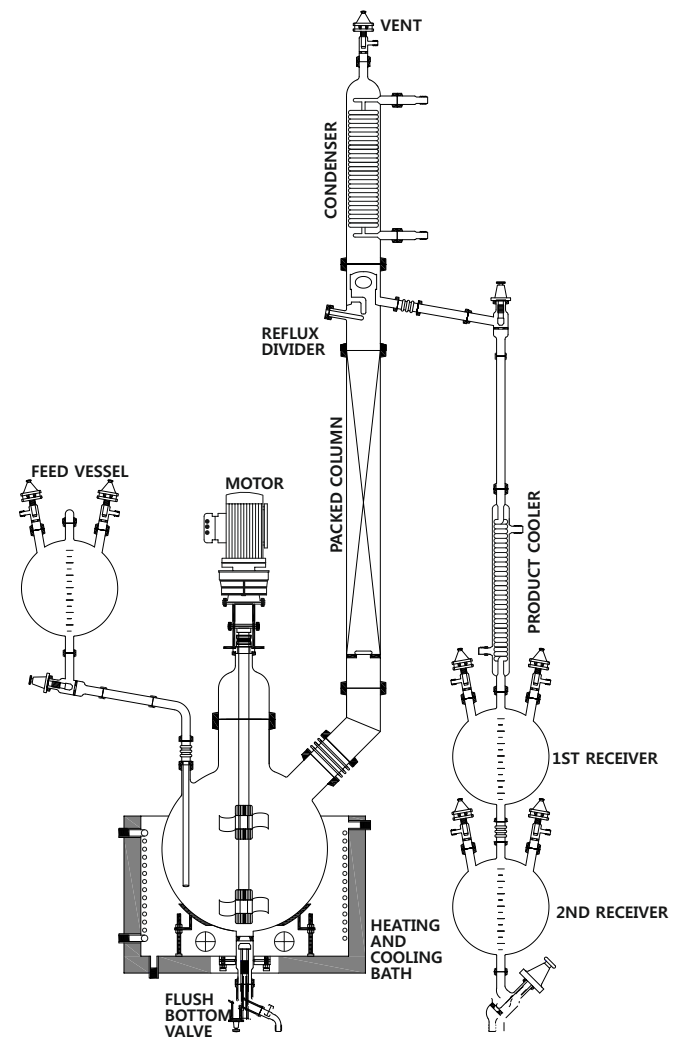


Glass Distillation Plant Overhead with 1000 Liter Glass Lined Reactor
Made in Borosilicate Glass 3.3

Ablaze also offers Reactors with Oil Bath. It a traditional, yet effective design for distillation where in the reactor is put in a metallic bath with coils for heating or cooling. Such units can sustain higher utility pressure and are available in standard and customized designs.

Salient Features

- Reactor up to 500 liter capacity
- "ZERO" Hold Up with Temperature Sensing Valve
- Quick Closer for addition of Solid
- Visual monitoring of process, improving safety and reliability of production
- Dual functional heating & cooling oil/water bath
- Can be designed for batch as well as continuous operations
- All wetted parts are made from Borosilicate Glass, and PTFE, providing universal corrosion resistance
- Low CAPEX, and easy to maintain
- Suitable for installation in fume hoods
- Zero Hold-up in reflux
- Wide range of operation -90°C to +250°C available on request



DESCRIPTION		ARRDU 50	ARRDU 100	ARRDU 200	ARRDU 500
Reactor Nominal Capacity	ltr.	50	100	200	500
Heat Exchanger (Exchange Surface)	m ²	0.5	1.5	2.5	5
Bath Heater Capacity	kW	6	8	12	18
Vessel Design Pressure	bar(g)	-1 to +0.6	-1 to +0.5	-1 to +0.4	-1 to +0.3
Plant Working Temperature	°C	-20 to +180	-20 to +180	-20 to +180	-20 to +180
Plant Design Temperature	°C	-25 to +200	-25 to +200	-25 to +200	-25 to +200
Plant Working Pressure	bar(g)	+0.5	+0.4	+0.3	+0.2
Feed Vessel	No. x ltr.	1 x 5	1 x 10	1 x 20	1 x 50
Receiver Vessel	No. x ltr.	2 x 5	2 x 10	2 x 20	2 x 50
Vapour Line Column	DN	50	100	150	200

Stirrer Speed	rpm	20 to 250	20 to 250	20 to 250	20 to 250
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Reflux Reaction Cum Distillation Unit up to 500 Liter
Made in Borosilicate Glass 3.3

Ablaze's Nutsche Filters are specially designed for effective filtration. It can be conveniently combined with our standard reaction unit to enable Solid Liquid Separation. All contact parts are inert and hence allow the same equipment to be used with a wide range of chemicals and solvents. Appropriate filter is used to separate the solid particles of the slurry, forming a filtered cake.

The filtrate drains to the bottom and can be collected from the bottom outlet valve. The filter cake can be easily removed .

Technical Data

Capacity: 5 to 200 Liter Jacketed & 300 liter Single Wall

Temperature: Up to 200°C

Filter Cloth: Various Mesh Size and MoC available as per requirement

Material of Construction: Borosilicate Glass, PTFE. Customized Configurations available as per requirement

Salient Features

- Lifting System for Easy Cake Removal (Motorized / Manual Lifting)
- Easily Integrated with our Reactors for Solid / Liquid Separation
- GMP Design / ATEX Compliant
- Manual Stirrer or Electrical Stirrer
- Modular & Compact Design
- High Filtration Efficiency
- Easy, Safe & Reliable Operation

Applications

- Heating & Drying
- Solid & Liquid Separation
- Crystallization
- Filtration
- Chromatography
- Solid Phase Peptide Synthesis (SPPS)



Ablaze's Gas scrubbers are used to defuse corrosive exhaust gases, before being released. The stripping liquid is chosen as per the nature of vapour to be scrubbed. A corrosion resistant recirculation pump is taken which ensures constant flow of solvent through the system. The solvent and gas come in contact with each other in the column, which is packed to increase surface area for gas absorption. Scrubbers are available from lab scale up to pilot scale of 500L.

Technical Data

Capacity: 5 to 500 Liters Spherical Vessel

Exhaust Gas Temperature: -60 to +150 °C

Scrubbing Liquid Temperature: 0 to 80 °C

Operating Pressure: -1.0 to +0.5 bar(g)

Material of Construction: Borosilicate Glass 3.3, PTFE. Customized configurations available as per requirement

Circulation Pump: PVDF / PTFE lined Centrifugal Pump

Salient Features

- Highly Corrosion Resistance
- Portable, Mobile and Compact Design
- Optimal Circulation Temperature Maintained
- Ability to handle large gas flow rates
- Flameproof / ATEX / PVDF Pump
- Spiral product cooler maintains temperature of solvent
- Complete Documentation and certificates (IQ / OQ / DQ)
- Easily integrated with our Reaction Systems
- Transparency aids in better understanding of process during R&D
- pH of scrubbing liquid can be monitored

Applications

- Neutralization of exhaust gases
- Scale up Studies
- Gas Liquid Reaction
- Gas Absorption



Ablaze's series of Rotary film Evaporators are designed for Pilot and industrial scale evaporation applications.

Exclusive use of superior quality Borosilicate 3.3 glass and PTFE for all components coming in contact with product ensures complete chemical resistance against almost all mediums.

It is primarily used for distillation of heat sensitive and volatile components, owing to its unique construction. It can operate under full vacuum and is an essential equipment in chemical and pharmaceutical industries.

Technical Data

- Capacity: 10, 20, 30, 50, 100 and 200 Liters
- Models: GMP / non-GMP
- Electricals: ATEX / Flame-proof / Weather-proof

Applications

- Distillation
- Concentration
- Solvent Recycling
- Reflux process reactions
- Component Purification
- Fine Chemical Synthesis
- Crystallization

Salient Features

- Universal heating bath upto 200°C
- High Quality (Reinforced PTFE) seal ensures perfect vacuum & maintenance free operation
- Digital display / control of critical process parameters on control panel
- Uniform heating and reduced residence time
- Mounted on castor wheels for easy movement
- Visibility of entire process

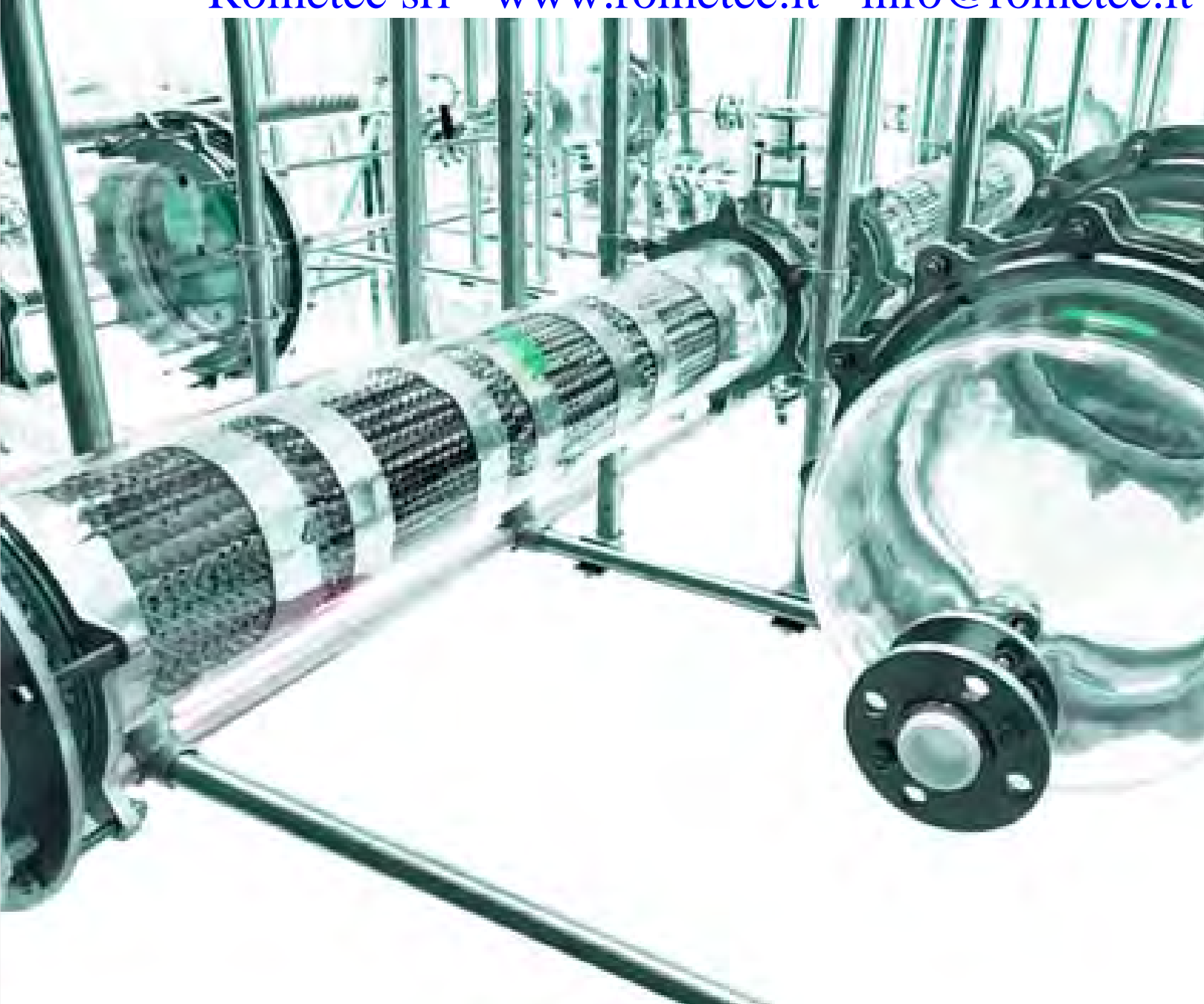
Applicable Industries

- Pharmaceutical
- Chemical
- Herb Extraction
- Petrochemical
- Cosmetics
- Fragrance and Aromatics



	ARE 10	ARE 20	ARE 30	ARE 50	ARE 100	ARE 200
Evaporation Flask Capacity	10L	20L	30L	50L	100L	200L
Heater	4kW	4kW	6kW	10kW	12kW	12kW
Bath Lift	Electrically Controlled					
Rotation Speed	0-90 rpm	0-90 rpm	0-90 rpm	0-90 rpm	0-50 rpm	0-50 rpm
RPM Indicator	Digital Display					
RPM Control	Controlled through Panel (VFD)					
Temperature Range (Heating Bath)	Digital: 20-90°C (water bath) / Digital: 20-180°C (oil bath)					
Temperature Control	PID controlled from main heater					
Overheat Cut-Off Protection	Yes					
Ultimate Vacuum	1 Torr	1 Torr	1 Torr	1 Torr	3 Torr	5 Torr
Receiving Flask Capacity	10 ltr	10 ltr	20 ltr	20 ltr	30 ltr	50 ltr

Power Source	AC 230V / 3Phase / 50 Hz
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Our team of experienced engineers have vast experience of commissioning Turnkey Projects. Ablaze undertakes complete process plants from designing, engineering, scale-up studies, instrument selection and installation to commissioning phase. We aim at providing a solution with technical inputs, for maintenance free operation, with the desired output quality.

Commercial Hydrochloric acid in the market is available as 30% aqueous solution and is widely used in industry in large quantities. However for certain application, such as hydrogenation reaction and in bulk drug /pharmaceutical industry, HCl is required in gaseous and anhydrous form.

Different processes for HCl gas generation from commercial grade HCl Acid are offered based on customer requirement. These processes are as follows.

- ▶ **Concentrated Sulfuric Acid Route**
- ▶ **Distillation or Boiling Route**
- ▶ **Calcium Chloride Route**

HCl Gas Generation Plants are normally available from 5Kg/Hr up to 250 Kg/Hr capacity. Large capacity plants can also be provided on request .

Ablaze has a long and successful record of design and supply of several engineered systems for HCl gas generation. Being manufacturer of Borosilicate glass equipment, PTFE Components and PTFE lined components, Ablaze is well qualified to handle such systems, as these are the major material of construction used in such systems, Ablaze also has in-house capabilities for instrumentation and automation , which is necessary for reliable and safe operation.

Applicable Industries

- **Chemicals:** For production of Methyl Chloride, Vinyl Chloride, Synthetic Rubbers, etc
- **Petrochemical Industry:** To promote and regenerate catalysts and to add viscosity to oils
- **Electronics:** For selective etching, as cleaning agent for electroplating
- **Textile:** For separation of cotton from wool, in delinting of cotton
- **Steel and Metal:** In production of hard metals
- **Pharmaceutical and Biotechnology:** In Pharmaceutical synthesis



The plant produces dry HCl gas by the process of distillation of 30% hydrochloric acid with concentrated sulphuric acid as entrainer.

Feed Sulphuric acid is fed from top to the packed column and feed 30% hydrochloric acid is also fed to the column. Both the acid flow cocurrently.

HCl gas is generated by mixing of the two liquid acid feeds. The top portion of the packed column acts as drying zone for the product HCl gas.

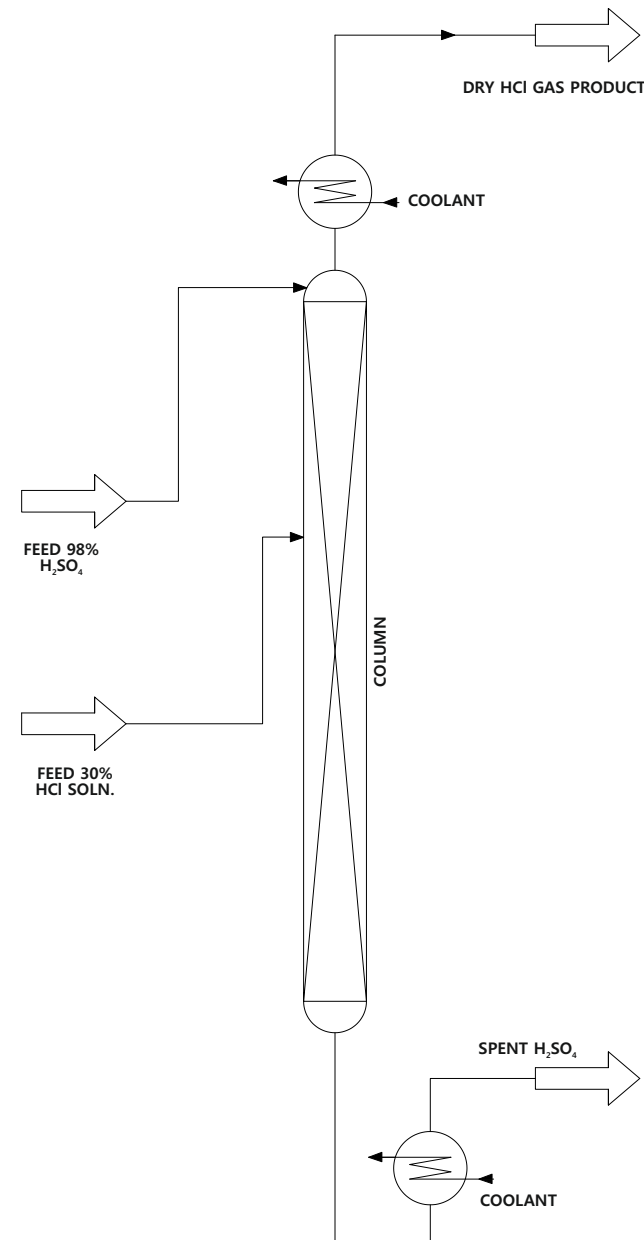
Condenser / Cooler are provided on top of column to cool the outgoing HCl gas. Suitable drying section removes final traces of moisture from outgoing HCl gas.

The bottom product from the plant is spent Sulphuric acid with 70% strength (with 1-1.5% HCl content). It is cooled in heat exchanger prior to discharge.

All the wetted parts of the system are fabricated from corrosion resistant materials (Glass and PTFE).

Salient Features

- Low capital cost
- Simple process
- Very compact design
- Spent Sulphuric acid (approx 70% w/w) with 1% HCl content as by product
- Medium operating cost



The plant produces dry HCl gas by the process of distillation of 30% hydrochloric acid solution as a continuous process.

The feed 30% HCl acid is pre heated by the outgoing hot bottom product in the heat exchanger and fed to the azeotropic distillation column by the pump in controlled rate.

The heat energy is supplied by steam to the thermosiphon reboiler at bottom of the column.

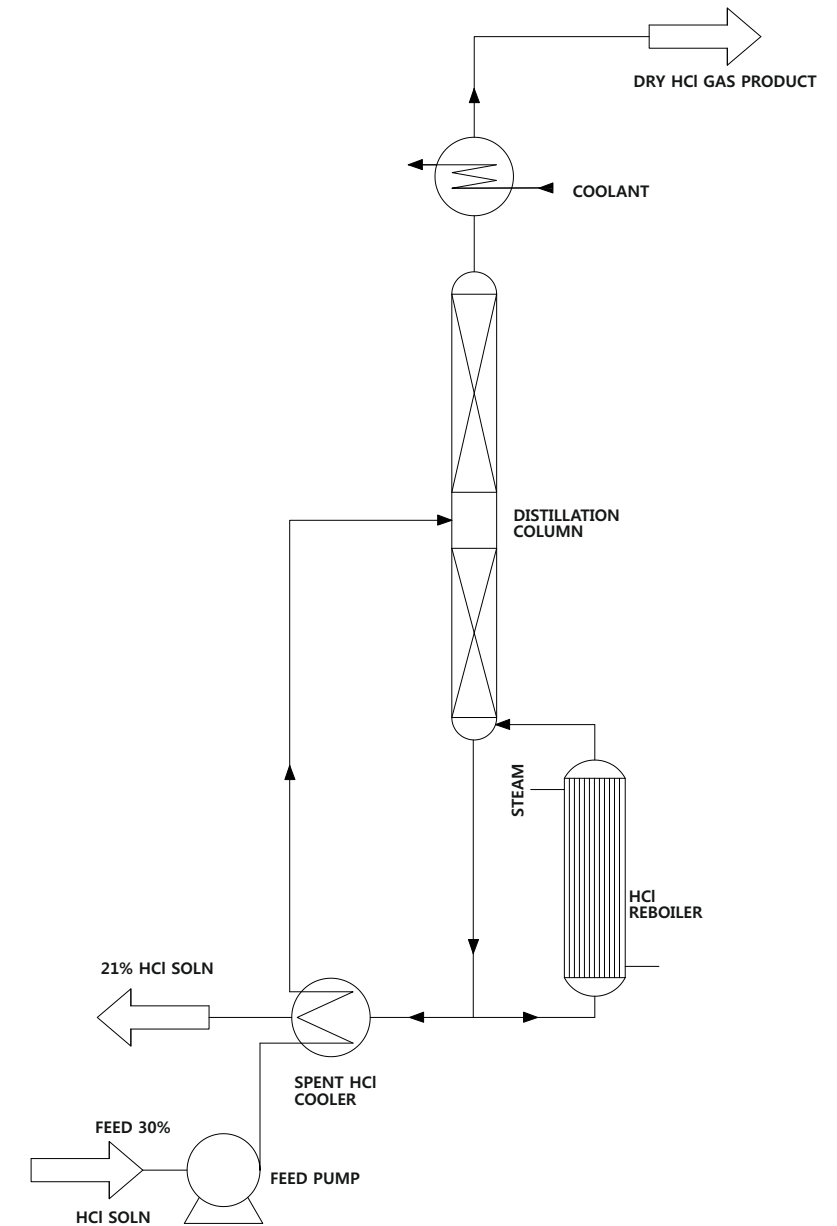
The bottom product from the plant is constant boiling approx 21% acid solution which is cooled by the cold 30% acid feed solution prior to discharge.

The top product HCl gas is dried in the Drying Unit using Sulfuric acid / suitable dehydrating agent. The product HCl gas is anhydrous.

All the wetted parts of the system are fabricated from corrosion resistant materials (Glass and Graphite).

Salient Features

- Medium capital cost
- Simple process
- Compact design
- Pure 21% HCl as bottom product
- Low operating cost.



The plant produces dry HCl gas by distillation of 30% hydrochloric acid with Calcium Chloride solution as entrainer.

Preheated 30% HCl acid is fed to the azeotropic distillation column. Co-current feed of concentrated Calcium Chloride solution is also fed to the distillation column. HCl gas is generated by mixing of both liquids and rises in the column. The top product HCl gas is dried in the Drying Unit using sulfuric acid / suitable dehydrating agent.

Thermosiphon reboiler provides the heat energy for the distillation process using steam. The bottom product from the

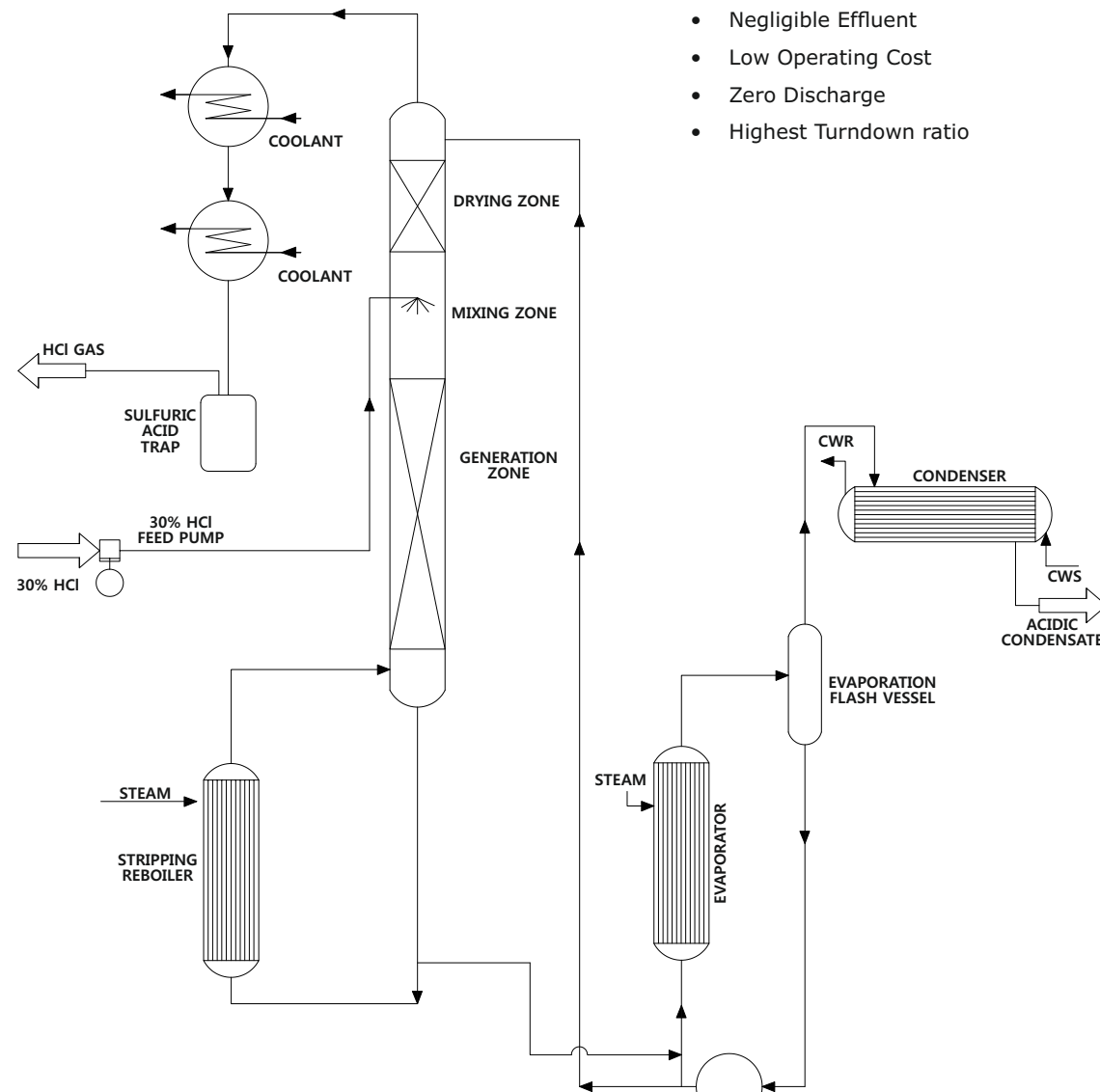
column is dilute Calcium Chloride solution with dissolved HCl content.

The dilute CaCl₂ solution is concentrated in the evaporator by steam and the re-concentrated CaCl₂ solution is recycled to the distillation column by pump. The vapour from the evaporation process is condensed and consists of water and approx 1% HCl.

All the wetted parts of the system are fabricated from corrosion resistant materials (Glass and Graphite etc.)

Salient Features

- Negligible Effluent
- Low Operating Cost
- Zero Discharge
- Highest Turndown ratio



Bromine finds its application directly and indirectly in manufacture of pesticides, agrochemicals, pharmaceuticals, fire-retardants, photography chemicals and many others.

Bromine occurs in nature as Bromide salt present in sea-water and in-land brine which is used for grassroots production of Bromine. It is also recovered from industrial effluents/byproducts where it occurs as different Bromide salts.

Ablaze has a long and successful record of design and supply of several Bromine recovery systems – both grass-root and from industrial effluents. Being manufacturer of Borosilicate Glass equipment, PTFE components and PTFE lined components, Ablaze is well qualified to handle such recovery systems as these are the major Material of Construction used in such systems.

Custom made designs are offered for various Bromine recovery systems, depending on the source of Bromide and the end use of final product Bromine.

Typical Product quality for Bromine recovered from such recovery plants is as follows

- **Bromine** 99.5% w/w min
- **Chlorine** 0.3% w/w max
- **Moisture** 0.1% w/w max

However, system can be designed to give desired product quality as per the customer requirement. For eg. system can be designed to give dry Bromine if so required.

There are two established processes for recovery of Bromine from aqueous Bromide solutions

- Hot Process
- Cold Process

For grass root bromine recovery, either Hot Blowing Process or Cold Blowing Process is selected depending on the Bromine content in the bittren. Also, Cold Process is preferred for very large production capacities.

As the industrial effluents are more concentrated in Bromine/ Bromide content, Hot Process is employed for Bromine recovery from industrial effluents.

However, since the industrial effluents invariably contain some impurities carried over from the source process, such recovery system is preceded by a suitable pre-treatment system.

Salient Features

- Energy efficiency
- Lower specific consumption figures
- Instrumentation
- Safety
- Alternative/ options of MoC



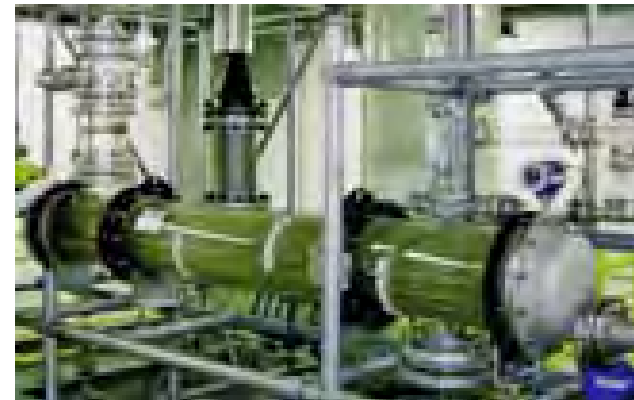
Sulfuric acid finds its application directly and indirectly in manufacture of fertilizers, dyes, intermediates and many others. Commercial Sulfuric acid is typically available as 98% w/w concentration.

Several applications of Sulfuric acid involve the use of medium or high concentration acid, which ends up as relatively dilute acid by picking up water from the reaction. This dilute acid may be concentrated to bring it to the desired concentration level and recycled in the process. This takes care of effluent problem and also, reduces requirement of fresh make-up acid.

Sulfuric acid is highly toxic and corrosive and reacts readily with metals, depending on its strength and operating parameters. Thus, very few Material of Construction are compatible to handle, process and store Sulfuric acid. Thus, special design and special knowledge is required to set up and operate plants handling Sulfuric acid.

Ablaze has a long and successful record of design and supply of several Engineered systems for mineral acids. Being manufacturer of Borosilicate Glass equipment, PTFE components and PTFE lined components, Ablaze is well qualified to handle such systems as these are the major Material of Construction used in such systems. Ablaze also has in-house capabilities for Instrumentation and Automation, which is necessary for reliable and safe operation.

Custom made designs are offered for Sulfuric concentration systems, depending on the initial and final concentrations of acid, heating medium and cooling medium available, etc.



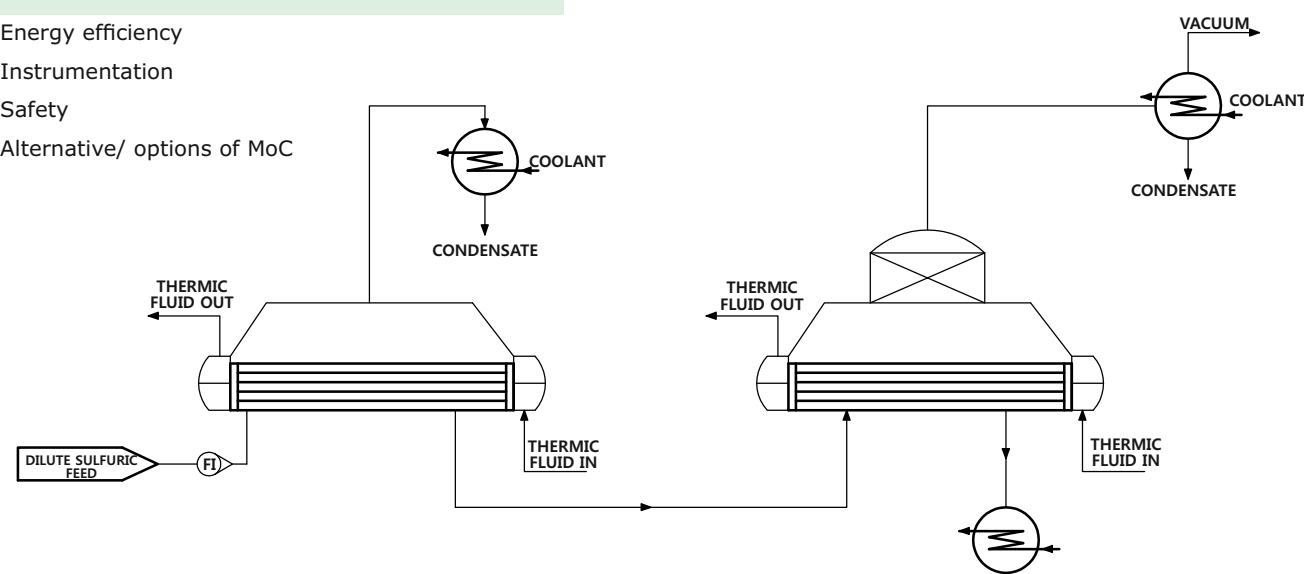
The process basically involves boiling of Sulfuric acid to preferentially evaporate water. The process scheme and operating parameters are selected based on several factors like plant capacity, feed composition/ impurities, initial and final concentration, utilities available etc.

A typical and generic flow scheme is shown for concentration of Sulfuric acid. The actual process scheme is decided based on the above factors.

Feed Dilute Acid is fed to the Evaporator/ Boiler at suitable operating pressure. The preferentially evaporated water is condensed in a condenser and the condensate collected. Multiple stages and Vacuum operation may be considered depending on final strength, utilities available and the plant capacity. At higher concentrations of acid, proper demister needs to be provided to avoid carryover of Acid mist.

Salient Features

- Energy efficiency
- Instrumentation
- Safety
- Alternative/ options of MoC



Sulfuric acid finds its application directly and indirectly in manufacture of fertilizers, dyes, intermediates and many others. Commercial Sulfuric acid is typically available as 98% w/w concentration.

Several applications of Sulfuric acid involve the need of diluting high concentration acid to medium or low concentration to be used in reactions. Dilution of Sulfuric acid evolves high amounts of heat, posing engineering challenges.

Sulfuric acid is highly toxic and corrosive and reacts readily with metals, depending on its strength and operating parameters. Thus, very few Material of Construction are compatible to handle, process and store Sulfuric acid. Thus, special design and special knowledge is required to set up and operate plants handling Sulfuric acid.

Ablaze has a long and successful record of design and supply of several Engineered systems for mineral acids. Being manufacturer of Borosilicate Glass equipment, PTFE components and PTFE lined components, Ablaze is well qualified to handle such systems as these are the major Material of Construction used in such systems. Ablaze also has in-house capabilities for Instrumentation and Automation, which is necessary for reliable and safe operation.

Custom made designs are offered for Sulfuric dilution systems, depending on the initial and final concentrations of acid, cooling medium available, etc.

There are two Established Methods For Sulfuric Dilution

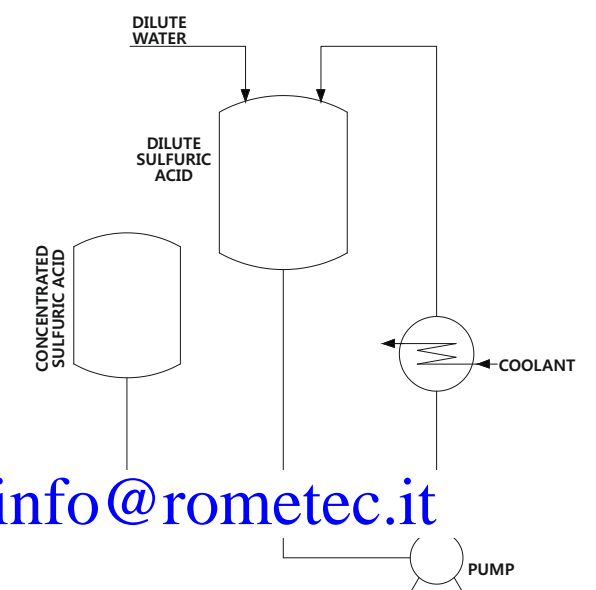
- **Batch / Re-circulatory process** – typically used for small to medium capacity units
- **Continuous/ Once through process** – typically used for medium to high capacity units

Batch / Recirculatory Process

The Dilute acid Tank is filled with required amount of Dilution water. This water is circulated through pump and a cooler back to the tank.

Metered quantity of concentrated Sulfuric acid is added online to the circulating stream. The heat generated is controlled and removed through the cooler while addition is being carried out.

At the end of the process, addition of concentrated Sulfuric acid is stopped and the tank is ready with the required dilute Sulfuric acid.



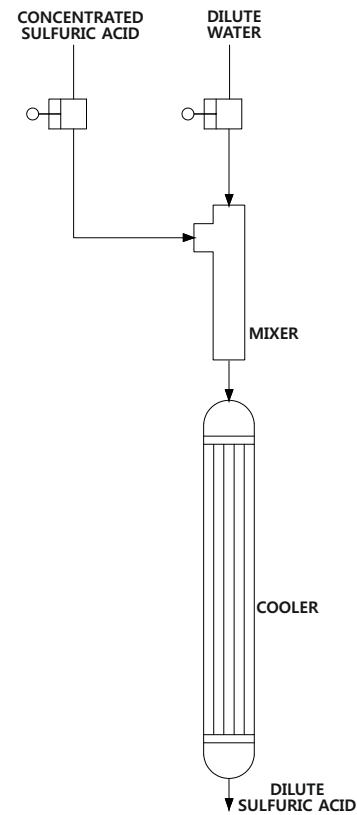
Continuous / Once Through Process

This process may be carried out in single or multiple stages, depending on initial and final concentrations. For high range of dilutions, multiple stages are required to limit the temperature rise arising from dilution.

The concentrated Sulfuric acid is pumped from Feed tank to the Mixer, where Dilution water is added in metered quantity. This section allows intimate mixing of concentrated Sulfuric acid with water to yield intermediate / required strength of Sulfuric acid. The resultant acid is now passed through shell and tube type cooler where it is cooled down by circulating cooling water.

For multiple stages, this process is repeated. The intermediate concentration is carefully calculated and selected to optimize the system.

The final Dilute Sulfuric acid is taken to the storage facility for further use.



Other Technical Packages

- Sulfuric acid Purification
- Nitric acid Purification
- Nitric acid Concentration
- Solvent Recovery plants
- Purification of Spent acids
- Purification of natural extracts such as essential oils
- Waste water treatment plants
- De- Nitration plants
- NOx absorption
- Precious metal recovery and refining
- Integrated NAC / SAC
- Exhaust Gas Purification
- HNO₃ Purification
- Sodium Hypochlorite



America Region

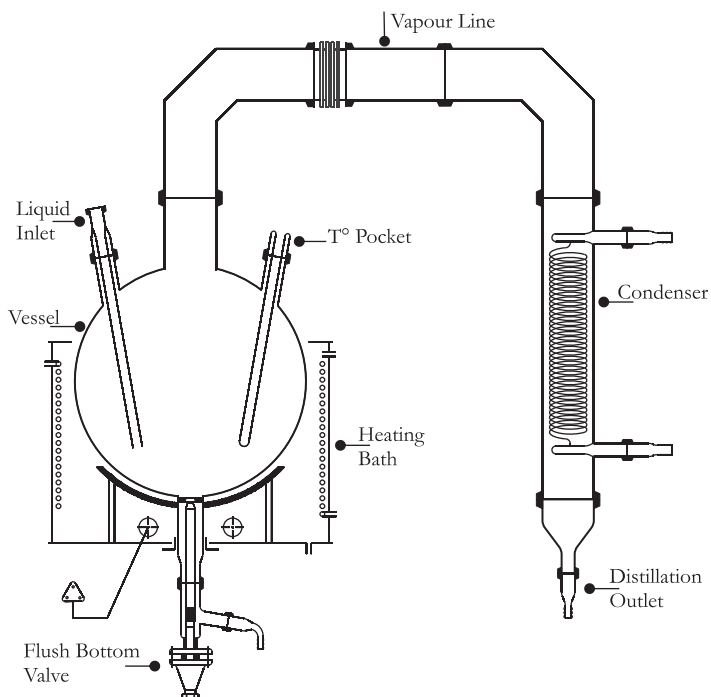
- ▶ Canada
- ▶ Guatemala
- ▶ Uruguay
- ▶ USA

Europe Region

- ▶ Czech-Republic
- ▶ France
- ▶ Georgia
- ▶ Italy
- ▶ Netherlands
- ▶ Russia
- ▶ Turkey
- ▶ United Kingdom

Asia Pacific Region

- ▶ Australia
- ▶ Japan
- ▶ Iran
- ▶ India
- ▶ Israel
- ▶ Sri Lanka
- ▶ South Korea
- ▶ Taiwan



INTRODUCTION

Typical Units/ Assemblies are multi-purpose units having flexibility of utility. These units have been standardised by incorporating all basic & essential features such as heating, stirring, condensation, fractionation, cooling etc. for multipurpose use. Therefore, though termed " Package Units" from constructional viewpoint they actually serve as "Flexi Units" from utility point of view.

These units find use in educational institutions, R&D centers and industries. They can be conveniently and quickly modified according to specific process needs due to modular construction, Borosilicate glass offers additional benefits of universal corrosion resistance, visibility and cleanliness.

SIMPLE DISTILLATION UNIT

It consists of a vessel mounted in a heating bath and fitted with a condenser for condensing the fumes. Receiver with drain valve can be added for receiving the condensate. The unit is available in vessel sizes of 20, 50, 100, 200 & 300 L and is suitable for operation under atmospheric pressure and full vacuum.

Reactor Capacity	Bath KW	Vapour Line	CONDENSER HTA (m2)	Unit Cat. Ref.
10 L	2	50 DN	0.2	ASDU 10
20 L	3.6	80 DN	0.35	ASDU 20
50 L	4.5	100 DN	0.5	ASDU 50
100 L	6	150 DN	1.5	ASDU 100
200 L	8	150 DN	1.5	ASDU 200
300 L	12	225 DN	2.5	ASDU 300

* This units is also available in cylindrical vessel .

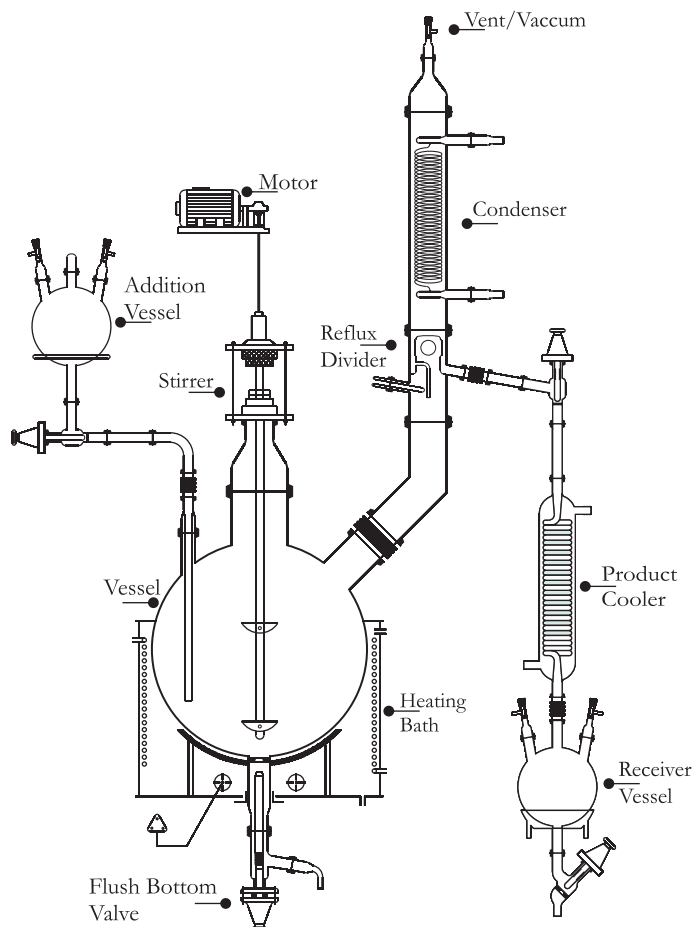
* Heating Mantel is also available in the same unit, please specify before the order.

REACTION DISTILLATION UNIT

This unit is used for carrying out reactions under stirred condition and with provision for simple reflux distillation.

The reaction vessel is mounted in a heating bath and fitted with addition vessel, motor-driven stirrer and provision for condensation with refluxing. The product is sub-cooled and collected in a receiver.

The units is available in vessel sizes of 20, 50, 100 & 200L, 300L and is suitable for operation under atmospheric pressure and full vaccum.



Reactor Capacity	Bath KW	Addition Vessel Size	Vapour Line	CONDENSER HTA (m²)	PRO.COOLER HTA (m²)	RECEIVER VESSEL SIZE	Unit Cat. Ref.
10 L	2	2 L	50 DN	0.2	0.1	2L	ARDU 10
20 L	3.6	5 L	80 DN	0.35	0.1	5L	ARDU 20
50 L	4.5	5 L	100 DN	0.5	0.2	10L	ARDU 50
100 L	6	10 L	150 DN	1.5	0.35	20L	ARDU 100
200 L	8	20 L	150 DN	1.5	0.35	20L	ARDU 200
300 L	12	20 L	225 DN	2.5	0.5	20L	ARDU 300

* This unit is also available in cylindrical vessel .

* Heating Mantel is also available in the same unit , please specify before the order

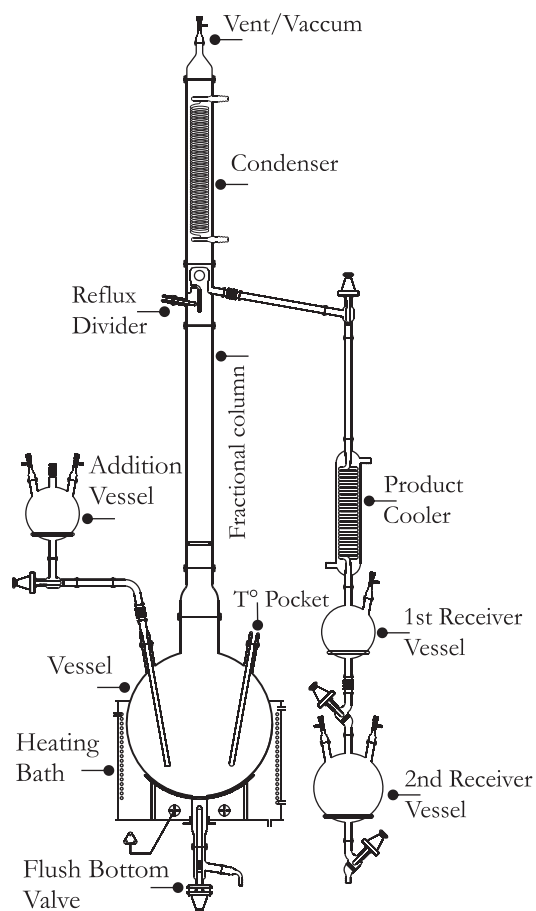
FRACTIONAL DISTILLATION UNIT .

This is essentially a compact batch-type fractional distillation unit in which the reboiler consists of a vessel mounted in a heating bath and with a packed column above. The vapours from top are condensed and can be refluxed as per requirement.

The top product is sub-cooled and collected in receivers. The bottom product is finally drained from the reboiler through a drain valve.

The unit is available in vessel sizes of 20,50,100 & 200L,300L and is suitable for operation under atmospheric pressure and full vacuum.

Reactor Capacity	Bath KW	Addition Vessel Size	Vapour Line	CONDENSER HTA (m ²)	PRO.COOLER HTA (m ²)	RECEIVER VESSEL SIZE	Unit Cat. Ref.
10 L	2	2 L	50 DN	0.2	0.1	2 L, 2L	AFDU 10
20 L	3.6	5 L	80 DN	0.35	0.1	2L,5L	AFDU 20
50 L	4.5	5 L	100 DN	0.5	0.2	5L,10L	AFDU 50
100 L	6	10 L	150 DN	1.5	0.35	10L,20L	AFDU 100
200 L	8	20 L	150 DN	1.5	0.35	10L,20L	AFDU 200
300 L	12	20 L	225 DN	2.5	0.5	20L,20L	AFDU 300

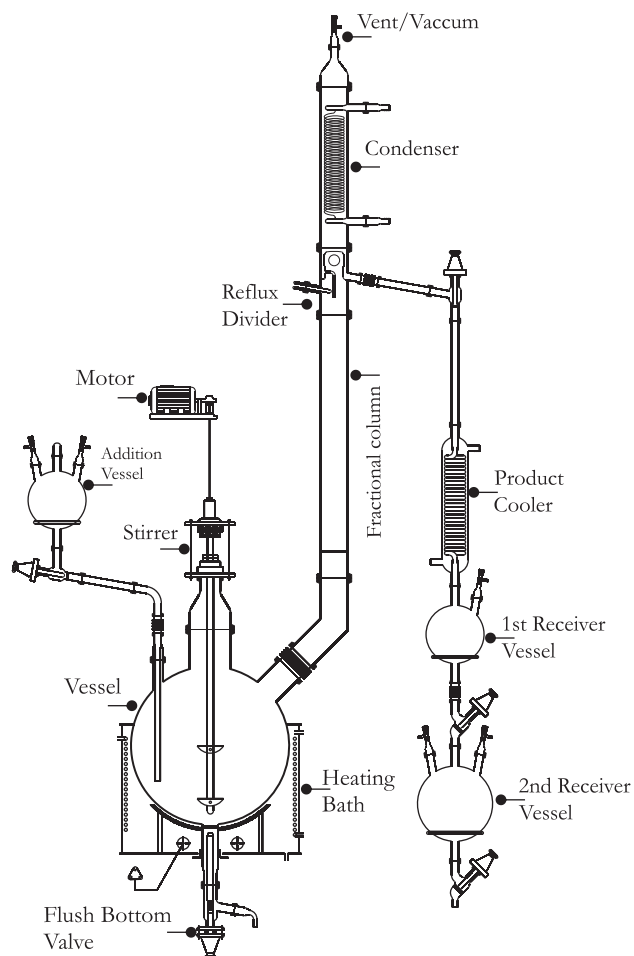


REFLUX REACTION CUM DISTILLATION UNIT :

This is a versatile unit and can be used as Reaction Distillation Unit, Fractional Distillation Unit or a combination of both. All features of Reaction Distillation Unit and Fractional Distillation Unit are incorporated.

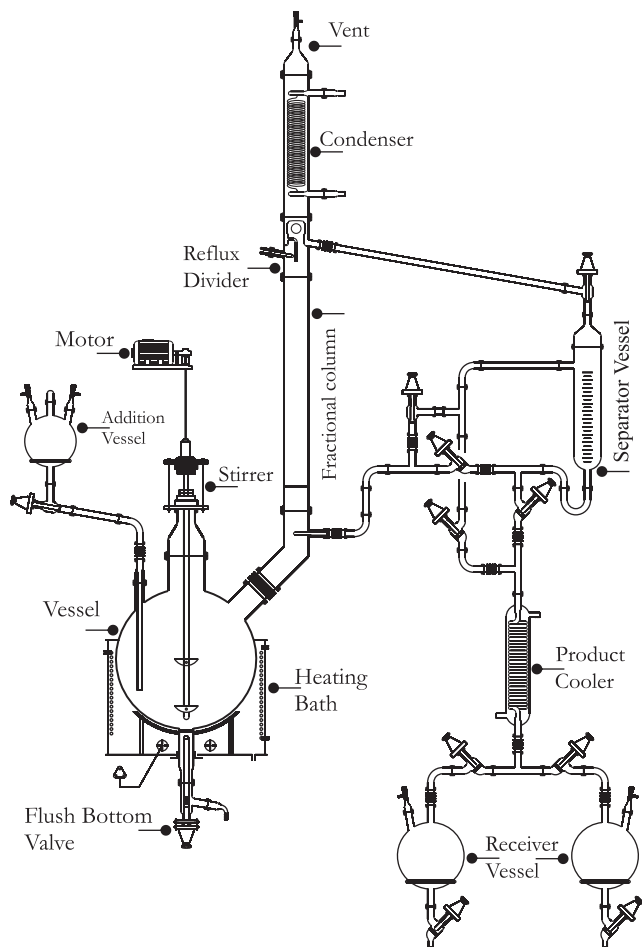
The units is available in vessel sizes of 20, 50, 100 & 200L, 300L and is suitable for operation under atmospheric pressure and full vacuum.

Reactor Capacity	Bath KW	Addition Vessel Size	Vapour Line	CONDENSER HTA (m ²)	PRO.COOLER HTA (m ²)	RECEIVER VESSEL SIZE	Unit Cat. Ref.
10 L	2	2 L	50 DN	0.2	0.1	2 L, 2L	ARRDU 10
20 L	3.6	5 L	80 DN	0.35	0.1	2L,5L	ARRDU20
50 L	4.5	5 L	100 DN	0.5	0.2	5L,10L	ARRDU50
100 L	6	10 L	150 DN	1.5	0.35	10L,20L	ARRDU100
200 L	8	20 L	150 DN	1.5	0.35	10L,20L	ARRDU200
300 L	12	20 L	225 DN	2.5	0.5	20L,20L	ARRDU300



* These unit is also available in cylindrical vessel.

* Heating Mantel is also available in the same unit , please specify before the order.



MULTI - PURPOSE R&D UNIT

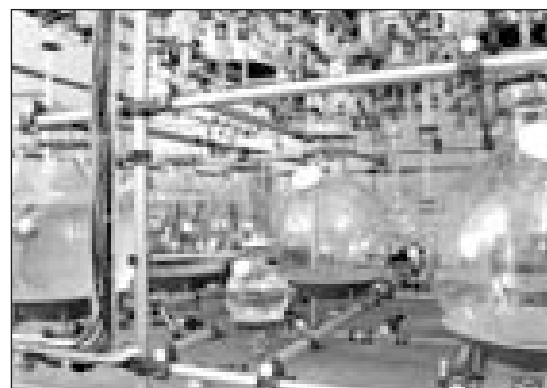
This unit is more versatile and cost effective, capable of working at atmospheric pressure or under full vacuum.

This unit is suitable for performing the boiling under reflux, stripping and continuous distillation, batch distillation, Interface separation, without chemical reaction. The unit can be modified as per the specification and requirement of the customer.

Reactor Capacity	Bath KW	Addition Vessel Size	Vapour Line	CONDENSER HTA (m ²)	PRO.COOLER HTA (m ²)	RECEIVER VESSEL SIZE	Unit Cat. Ref.
10 L	2	2 L	50 DN	0.2	0.1	2 L, 2L	AMRD10
20 L	3.6	5 L	80 DN	0.35	0.1	5L, 5L	AMRD20
50 L	4.5	10 L	100 DN	0.5	0.2	10L, 10L	AMRD50
100 L	6	10 L	150 DN	1.5	0.35	10L, 10L	AMRD100

* The unit is also available in cylindrical vessel.

* Heating Mantel is also available in the same unit, please specify before the order.

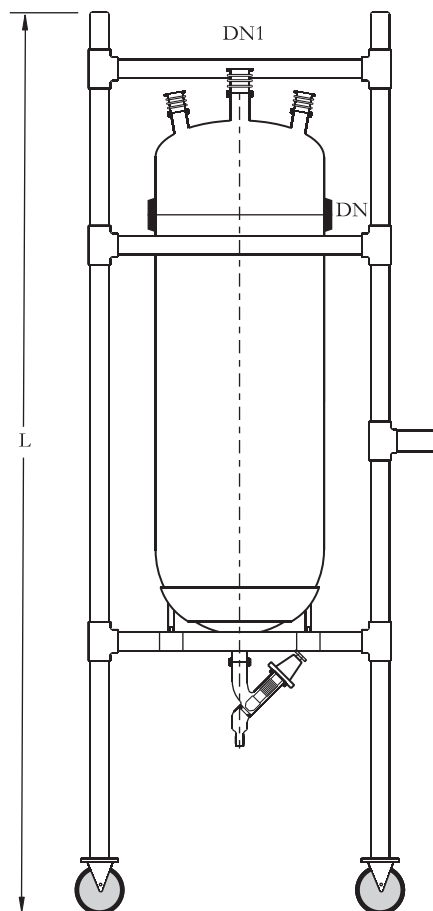


MOBILE VESSEL

Mobile vessel is perfect for pilot plant and production use to transport and store products. Cylindrical mobile vessel can be supplied from 30 to 200 liter and spherical vessels from 50 to 200 liter. If required, it can also be graduated.

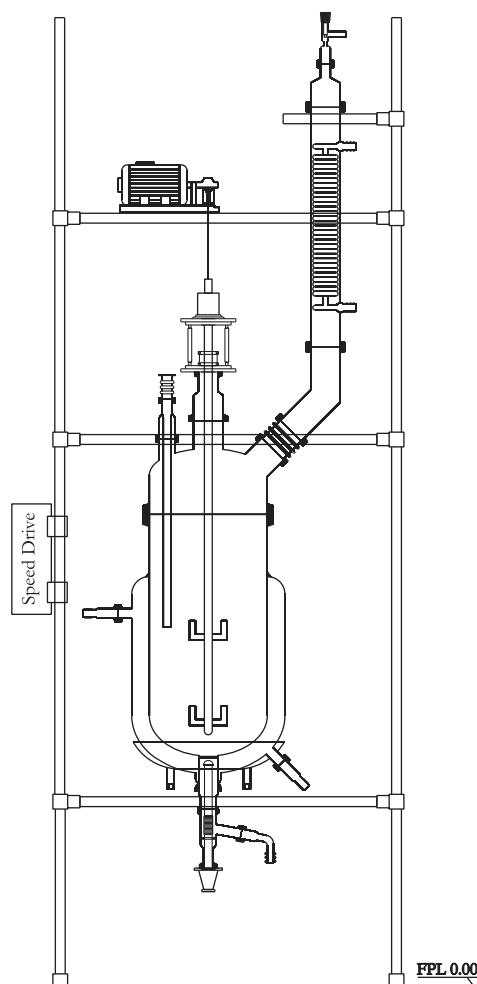
NOMINAL CAPACITY LTR	DN	DN1	L	CAT. REF. WITHOUT PUMP	CAT. REF. WITH PUMP
30	300	40	1500	AMCV30	AMCV30/P
50	300	40	1700	AMCV50	AMCV50/P
100	450	50	1950	AMCV100	AMCV100/P
150	450	50	2250	AMCV150	AMCV150/P
200	450	50	2550	AMCV200	AMCV200/P

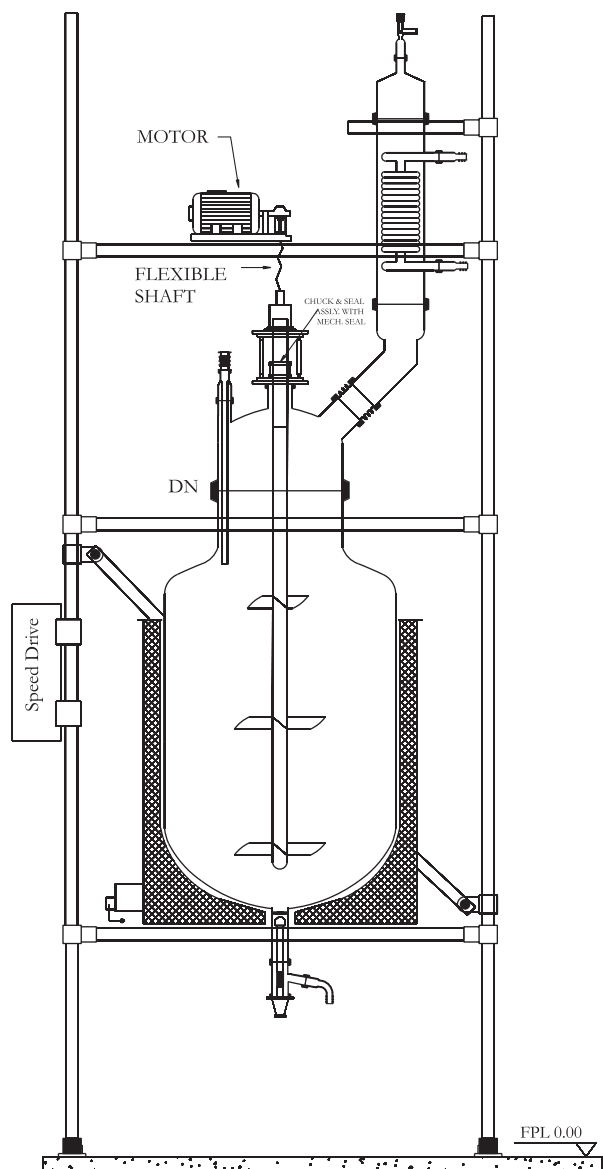
NOTE: "L" is Vary ± 50 mm or as require size in special case.
Mobile Vessel is also available in Spherical vessel .



JACKETED CYLINDRICAL MIXING REACTOR

Reactor Capacity	JACKETED MIXING REACTOR CAT. REF.
5 L	AJMR 5
10 L	AJMR 10
20 L	AJMR 20
30 L	AJMR 30
50 L	AJMR 50
100 L	AJMR 100





MIXING REACTOR

Mixing reactor systems represent a long-term evaluation of equipment and customer requirements. The mixing reactors are preferably used for wide applications in laboratory, pilot plant & for small-scale production. They reduce the need for investment in permanent installations & also reduce the pressure & temperature losses resulting from pipeline installations.

These reactors are available with spherical shape & cylindrical shape. These reactors are also available in cylindrical jacketed form.

Construction of assembly:

1. Stirrer Drive, non-flameproof or flameproof Motor, 192 RPM.
2. Available with suitable condenser (HTA m2).
3. Stirrer shape glass impeller stirrer with PTFE blades, vortex stirrer, propeller stirrer & anchor stirrer.
4. Stirring assembly with bellow seal or with mechanical seal
5. Supporting structure in carbon steel, epoxy coated carbon steel, stainless steel 304 & stainless steel 316. All structures are available in trolley-mounted form.
6. Closing valves are available as a drain valve or flush bottom outlet valve.

SPHERICAL & CYLINDRICAL MIXING REACTOR

REACTOR CAPACITY	SPHERICAL CAT. REF.	CYLINDRICAL CAT. REF.
20 L	ASMR 20	ACMR 20
50 L	ASMR 50	ACMR 50
100 L	ASMR 100	ACMR 100
200 L	ASMR 200	ACMR 200
300 L	ASMR 300	ACMR 300

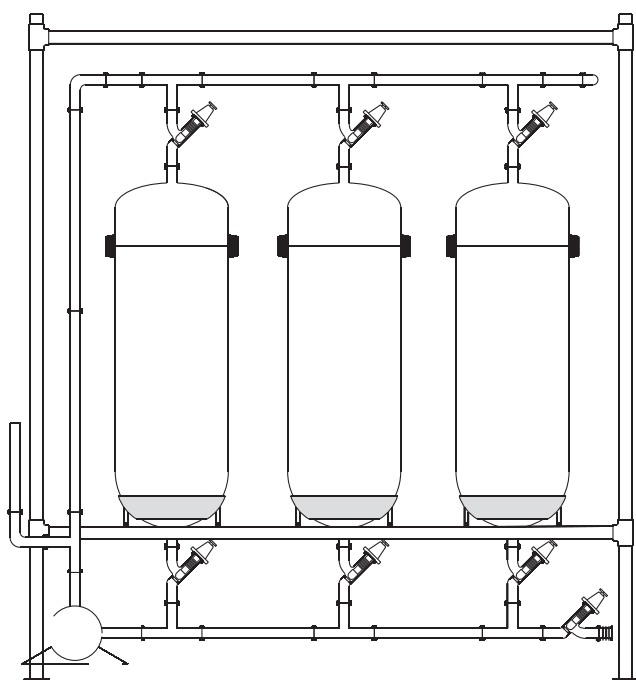
STORAGE TANK OF VOLUME 100–500

They are composed of glass cylindrical kettles or flasks of capacity 200-500, discharges of vessels are consistent by glass piping DN 50/40.

CYLINDRICAL VESSEL

NOMINAL CAPACITY LTR	D MM	L MM	CAT. REF.
100L	470	1020	ASCY100
150L	470	1315	ASCY150
200L	600	1190	ASCY200
300L	600	1590	ASCY300
400L	600	1715	ASCY400
500L	760	1550	ASCY500

Storage Vessel also available in Spherical vessel up to 300Ltr.



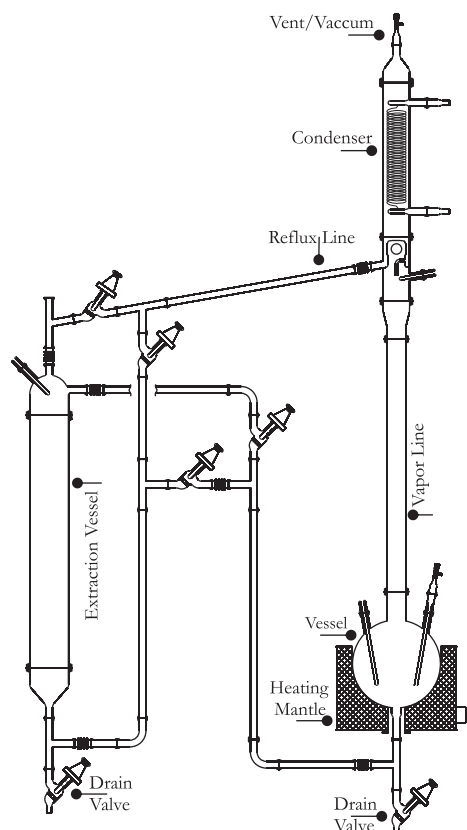
LIQUID-LIQUID EXTRACTION UNIT

Liquid extraction, sometimes called solvent extraction, is the separation of constituents of a liquid solution by contact with another insoluble liquid. The unit described here is for a semi-batch operation.

The liquid to be extracted is poured into an extraction vessel. Solvent is boiled in a reboiler vessel and condensed in an overhead condenser, the condensed liquid collected in a reflux divider and passed through pipework to the extraction vessel. The pipework incorporates valves in order that the solvent can enter the extraction vessel at either the base or the top, depending on the relative densities of the solvent and liquid to be extracted. The solvent and the extracted liquid pass back to the reboiler and the process is repeated until the extraction is complete. The extraction vessel is then drained and the solvent evaporated from the reboiler vessel and collected in the extraction vessel enables the two liquids to be drained from their respective vessels.

The unit is available in vessel sizes of 10, 20, & 50L and is suitable for operation under atmospheric pressure.

REACTOR CAPACITY	BATH KW	VAPOUR LINE	EXTRACTION VESSEL	CONDENSER M2	UNIT CAT. REF.
10 L	3	40mmx1m	10 L	0.35	ALLU 10
20 L	4.5	50mmx1m	20 L	0.5	ALLU 20
50 L	6	80mmx1m	50 L	1.5	ALLU 50



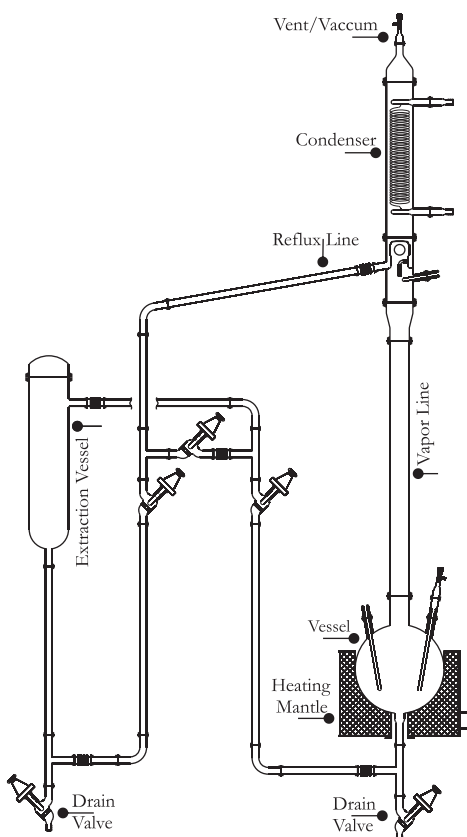
SOLID LIQUID EXTRACTION UNIT

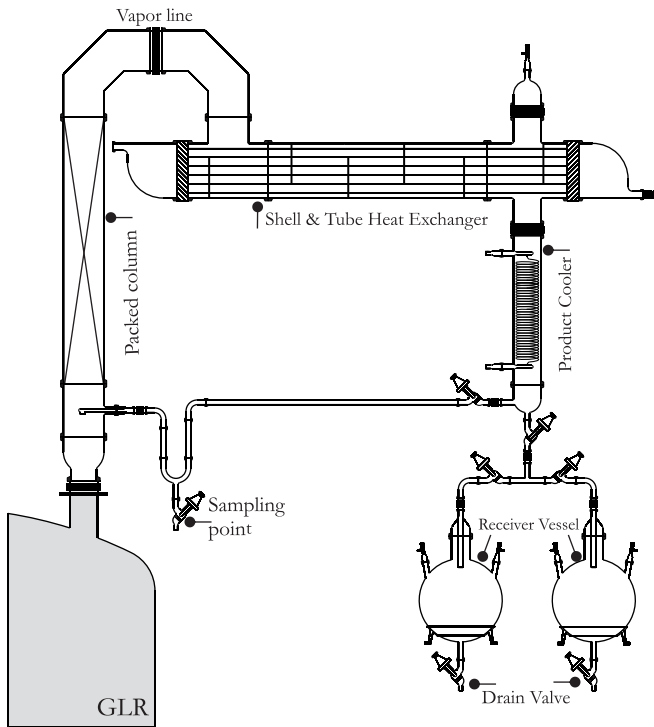
This operation involves preferential solubilising of one or more soluble constituents (solutes) of a solid mixture by a liquid solvent. The unit described here is for a semi-batch operation.

The solid to be extracted is put inside a glass fiber bag and placed in an extraction vessel. Solvent from the reboiler is continuously evaporated, condensed and circulated through a reflux divider by means of piping network and valves. When desired/ steady concentration of solute is achieved in the solution the operation is discontinued. The solution is drained off and collected for further use.

After charging fresh solid in fiber bag and solvent in reboiler, the cycle can be restarted again. The unit is available in vessel sizes of 10, 20, & 50L and is suitable for operation under atmospheric pressure.

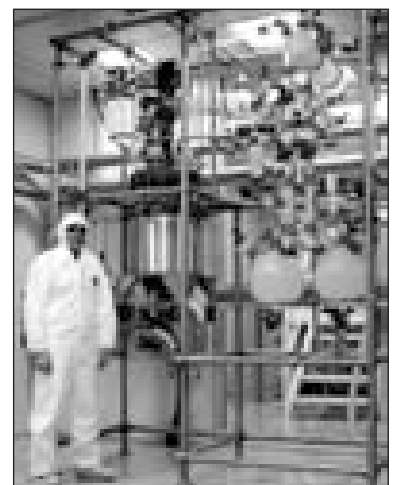
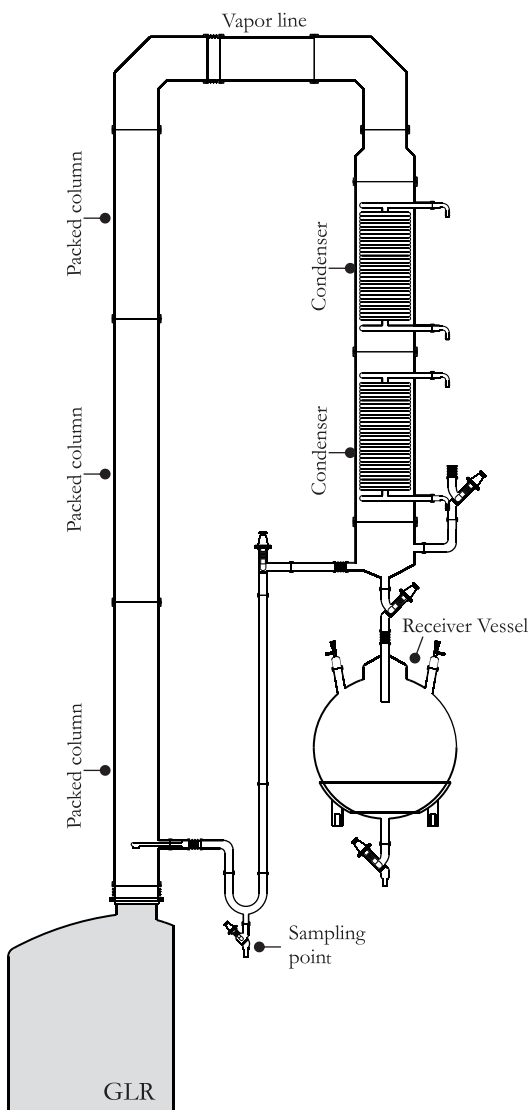
REACTOR CAPACITY	BATH KW	VAPOUR LINE	EXTRACTION VESSEL	CONDENSER M2	UNIT CAT. REF.
10L	3	40mmx1m	10 L	0.35	ASLU10
20L	4.5	50mmx1m	20 L	0.5	ASLU20
50L	6	80mmx1m	50 L	1.5	ASLU50





ASSEMBLIES OVER GLASS LINED REACTOR

Glass Lined Reactors are used instead of glass reactors specially when scale of operation is large and relatively high pressure steam is to be used as heating media. Quite often assemblies like Simple Distillation Unit, Reaction Distillation Unit, Fractional Distillation Unit etc. are installed above glass lined reactors. The basic features of these assemblies remain the same but glass shell and tube heat exchanger is preferred due to large scale of operation. A typical fractional distillation unit type assembly over GLR is shown in nearby figure. The assembly can be separated into different categories.



HCl GAS GENERATION - Azeotropic Boiling Route

Commercial hydrochloric acid is available in the market as 30% aqueous solution and is widely used in industry in large quantities. But for certain applications e.g. in bulk drug/pharmaceutical industry HCl gas is required in gaseous form. Such users generate anhydrous HCl from commercial grade for their captive consumption. Several methods have been adopted and generation through BOILING ROUTE is also a reliable technique.

Salient features :

1. Operational reliability
2. Available in wide range capacities - from 5kg to 300kg/hr of dry HCl.
3. Except commercial hydrochloric acid, no other raw-material is required.
4. The spent acid about 21% HCl usually finds use for captive consumption.
5. Capable of operating from 25-100%.
6. Ease of installation.
7. Negligible pressure drop.

RAW MATERIAL & UTILITY REQUIREMENTS. :

The indicative requirements for 20kg/hr HCl gas generator are given below:

- | | |
|--|-------|
| 1. 30-32% HCl, (kg/hr) | : 250 |
| 2. Cooling water at 30° C (M3/hr) | : 3.5 |
| 3. Chilled brine at -10° C (M3/hr) | : 4 |
| 4. Saturated Steam at 2.5 Kgs/cm ² - g (Kgs.) | : 50 |

HCl GAS GENERATOR

(Sulphuric Acid Route).

Commercial hydrochloric acid is available in the market as 30% aqueous solution and is widely used in industry in large quantities. But for certain applications e.g. in bulk drug/pharmaceutical industry HCl gas is required in anhydrous state for critical reactions where moisture cannot be tolerated. Such users generate anhydrous HCl from commercial grade for their captive consumption. Several methods have been adopted but generation through SULPHURIC ACID ROUTE is the most reliable and handy technique.

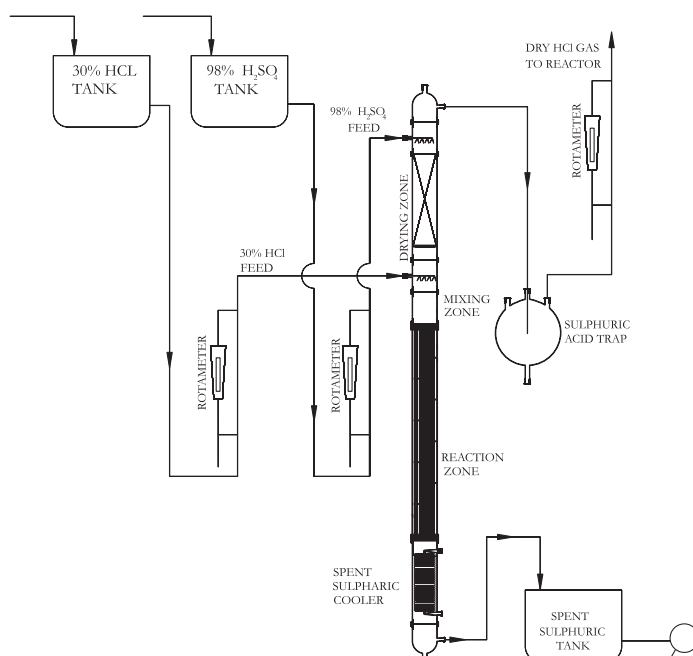
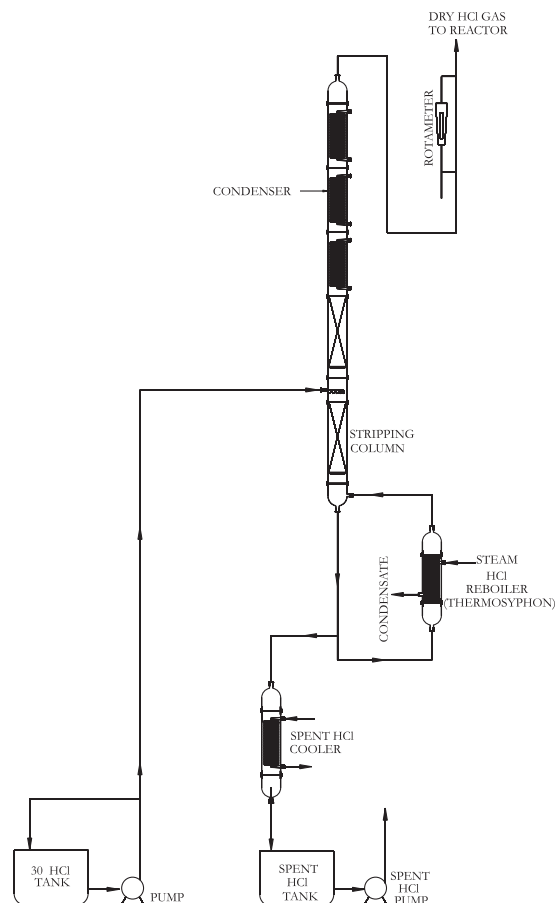
Salient Features :

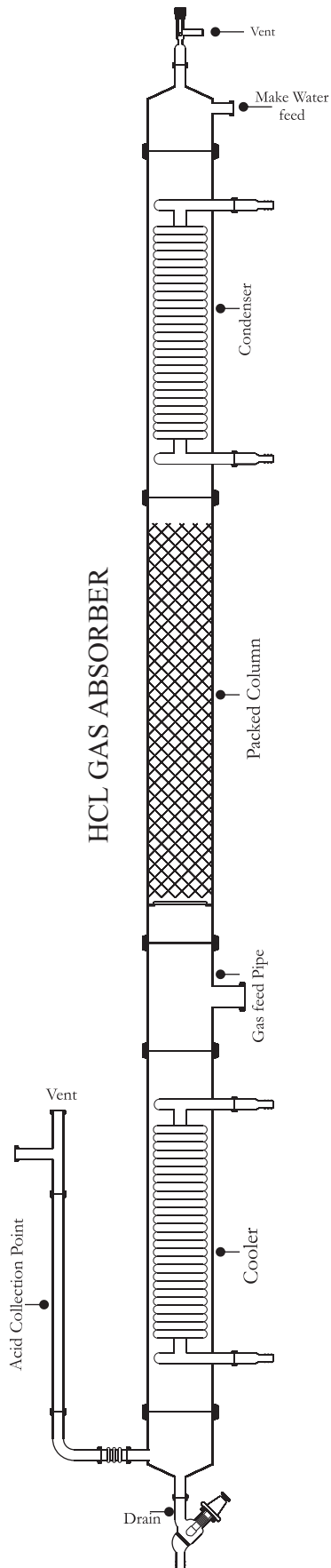
1. Operational reliability – the unit can be started/stopped in seconds.
2. Compact and continuous unit – all operations viz. drying, mixing, gas generation and cooling achieved in same unit.
3. Available in wide range capacities – from 5kg to 200kg/hr of dry HCl.
4. Except cooling water no other utility e.g. steam, chilled water etc. are required.
5. Anhydrous gas.
6. Ease of installation.
7. Capable of operating from 25-120%.
8. Negligible pressure drop
9. High efficiency – 99%.

Raw Material Requirement :

The indicative requirements for 20 kg/hr HCl gas generator are given below:

- | | |
|-----------------|--------------------|
| 1. 30% HCL - 70 | 2. 98% H2SO4 - 170 |
|-----------------|--------------------|





HCl GAS ABSORBER - ADIABATIC TYPE

HCL absorption columns are used for absorption of Hydrochloric gas which statutorily are not permitted to vent into the atmosphere, and to produce the HCl acid. Hydrogen Chloride is very soluble in water but its absorption is complicated by the high heat of solution and the high partial pressure over warm concentrated solutions. In practice, the basic problem in making concentrated solutions is one of efficient heat removal. In this type of absorber, the heat of absorption is removed by evaporation of water and acid in the column. The vapour being condensed is diluted with 'makeup' therefore, mostly removed via condenser. Concentration and cooling of the liquid phase is assisted by evaporation of water to maintain the vapour/liquid equilibrium in the lower part of the packed section.

The column is constructed with a series of packed sections, a gas introduction point below that, a condenser on the top, and a cooler at the bottom and water is sprayed from the top and acid is collected from the bottom. Hcl absorption columns are available in 80DN to 300DN diameter (for the gas rate 10 Kgs/hr to 300 Kgs/hr approx.)

PACKED COLUMN	CONDENSER HTA (m2)	GAS RATE (Approx.)	CAT. REF.
80mmx3m	0.35m2x2	10Kg/hr	AHCL3
100mmx4m	0.5m2x2	20Kg/hr	AHCL4
150mmx4m	1.5m2x2	60Kg/hr	AHCL6
225mmx4.5m	2.5m2x2	150Kg/hr	AHCL9
300mmx4.5m	2.5m2x2	300Kg/hr	AHCL12

GAS ABSORBER - FALLING FILM TYPE

Process Description

Efficient gas absorption depends on the following:

1. Intimate contact
2. Efficient Heat Transfer

This is achieved in a Falling Film Absorber which is essentially a shell & tube heat exchanger in which both, gas to be absorbed and absorbing liquid, flows co-currently downward with extraction of heat by circulation of coolant in the shell. The absorbing liquid is circulated through a tank till desired concentration is achieved. The liquid flows at such a rate that the tubes do not flow full of the liquid but instead, descends by gravity along the inner walls of the tubes as a thin film. Obviously, this produces a much greater linear velocity for a given rate flow than could be obtained if the tube flowed full.

The equipment works as a number of water cooled-wall columns in parallel and each tube is provided with distribution system on top to effect uniform distribution of both liquid and gas and also formation of a thin liquid film on the inner surface of the tube.

SALIENT FEATURES

1. High absorption efficiency.
2. High acid concentration achievable.
3. Low outlet temperature.
4. Easy operation and maintenance.
5. Safe Operation due to low isothermal temperature.
6. Handle a wide range of gas loading with minimum liquid flow rates to maintain full tube wetting.
7. All the wetted parts of the falling film absorber are corrosion resistant to all the aggressive gases even at elevated temperatures.
8. Variation in Hydrogen Chloride Gas flow rates or Composition causes no operation problem.

Other Area Of Application:

Hydrogen Chloride Gas / Sulphur Dioxide Gas Absorption

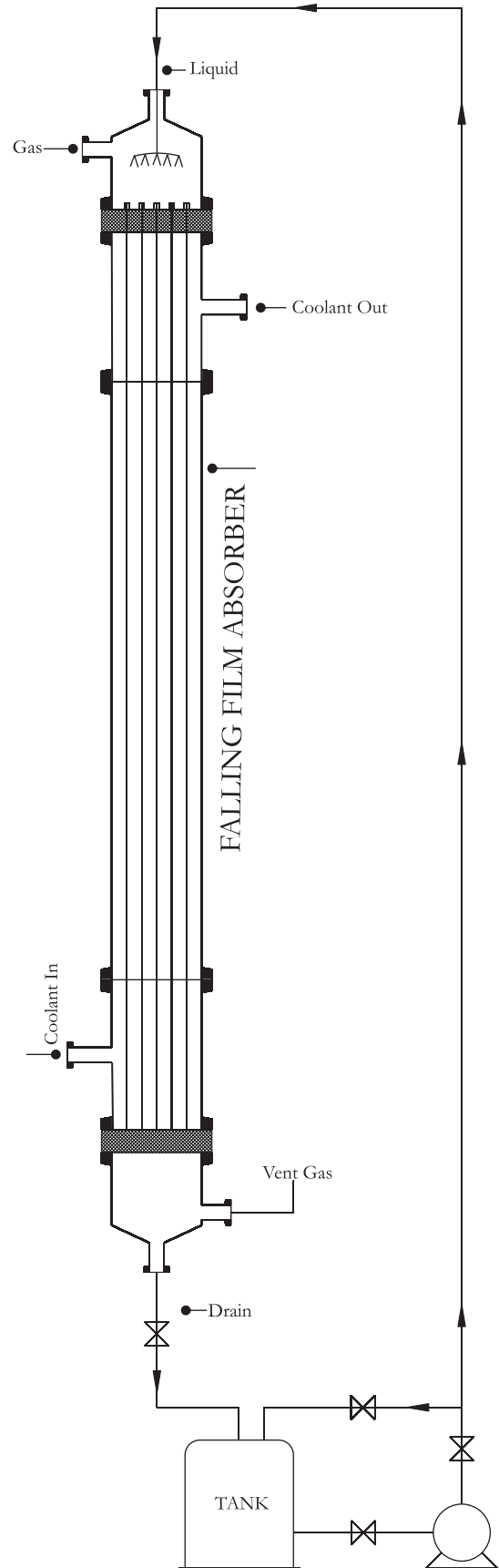
Hydrogen Chloride Gas / Chlorine Gas Absorption

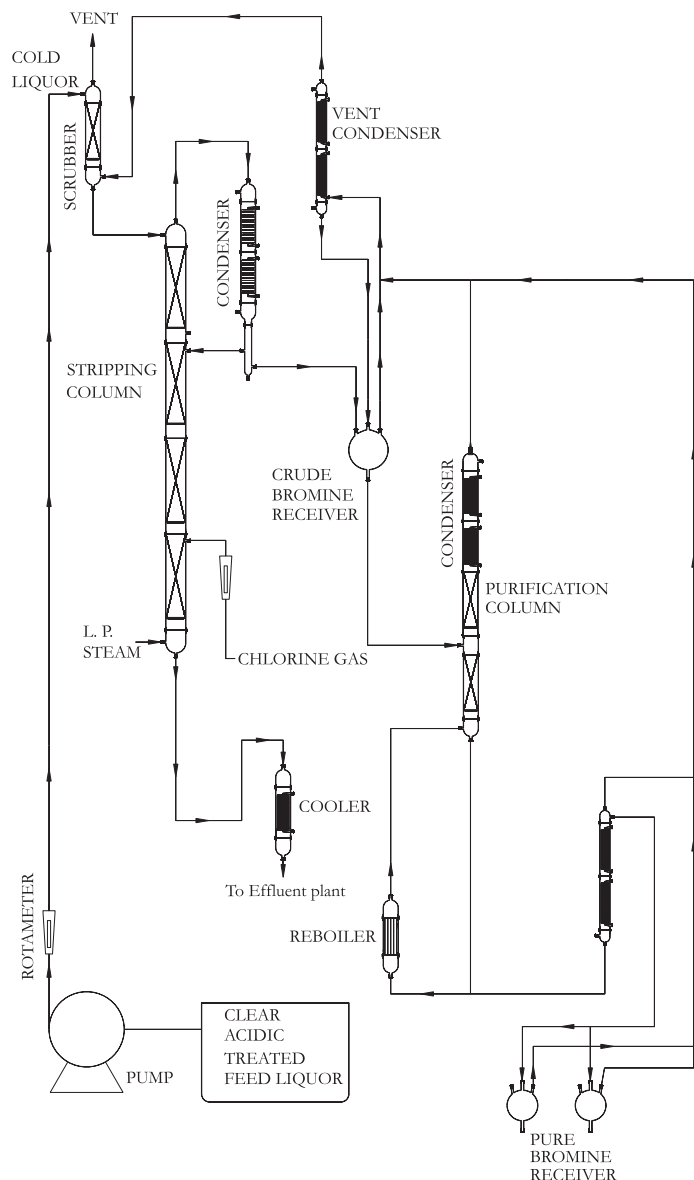
Hydrogen Chloride Gas / Chlorine Gas // Sulphur Dioxide Absorption

Hydrogen Bromide Gas absorption

SPECIFICATIONS:

NOMINAL SIZE (mm)	ABSORBER AREA (m ²)	NO. OF TUBE TUBE OD (mm)	MAX. GAS ABSORPTION RATE (Pure HCL) (kg/Hr)	MAX. ACID PROD. RATE (As 30% HCL) (kg/Hr)	CAT. REF.
80	1.00	4/20	30	100	AFFA3
100	1.76	7/20	60	200	AFFA4
150	4.80	19/20	150	500	AFFA6
225	7.80	31/20	250	833	AFFA9
300	15.30	61/20	500	1667	AFFA12
400	36.00	143/20	1175	3917	AFFA16
450	47.00	187/20	1500	5000	AFFA18
600	84.00	333/20	2700	9000	AFFA24





BROMINE RECOVERY PLANT

Process Description

The feed is acidified with 30% HCl acid and acidified feed is fed to the scrubber by pump to scrub uncondensed chlorine from vent condenser and return back to the reaction column. In some cases the part feed is preheated using effluent from the reaction column prior to the entry of reaction column and part feed is fed to the scrubber to conserve energy. Chlorine and Steam are also fed to the reaction column.

In the reaction column the feed is reacted with chlorine gas & bromine is liberated instantly. This liberated bromine is stripped out of the solution by live steam. The bromine and water vapor stream leaves the top of the column and enters the condenser. Condensate falls into the Phase Separator where it forms two phases, the light aqueous phase (water) being returned to the column, while the heavy phase (Bromine) being feed the purification column. Cooling Water & Chilled Water is used as cooling media in heat exchanger provided at the top of the column to condense water vapor & Bromine.

Purification of the Bromine is achieved by distillation. Heat being introduced into the column through the reboiler. Bromine and Chlorine vapor leave the top of the column and enter the condenser. The Bromine gets condensed in the condenser and falls back into the column while uncondensed Chlorine vapor along with traces of Bromine escapes from the condenser and enter into the vent condenser, where remaining Bromine gets condensed and back to the crude Bromine receiver.

Pure Bromine is cooled in a product cooler to and goes to product receiver. Guard condenser is also provided at the top of the receiver to prevent escape of Bromine. Bromine is then collected in glass bottles.

From Industrial Effluents (NaBr/KBr/HBr) From Sea-Bittern. Available up to 600 mm Dia.

Over view of the system

The system consists of :

1. Stripping /Reaction Column - Glass
2. Cooling/Chilling Heat Exchangers
3. Phase Separator - Glass
4. Bromine Purification Column
5. Pure Bromine Condenser -Glass
6. Vent / Guard Condenser - Glass
7. Bromine Reboiler - Glass
8. Bromine Product Cooler - Glass
9. Crude / Pure Bromine Collecting Receiver - Glass

Raw Material Requirement :

1. Sea- Bittern (Brine)/ NaBr /KBr
2. Chlorine Gas
3. 30% HCl

Products Specifications :

Bromine Liquid : 99.7% (w/w, min)

Chlorine : 0.3 % (w/w, max)

Non -volatile matter : Balance

SULPHURIC ACID DILUTION PLANT

Process Description

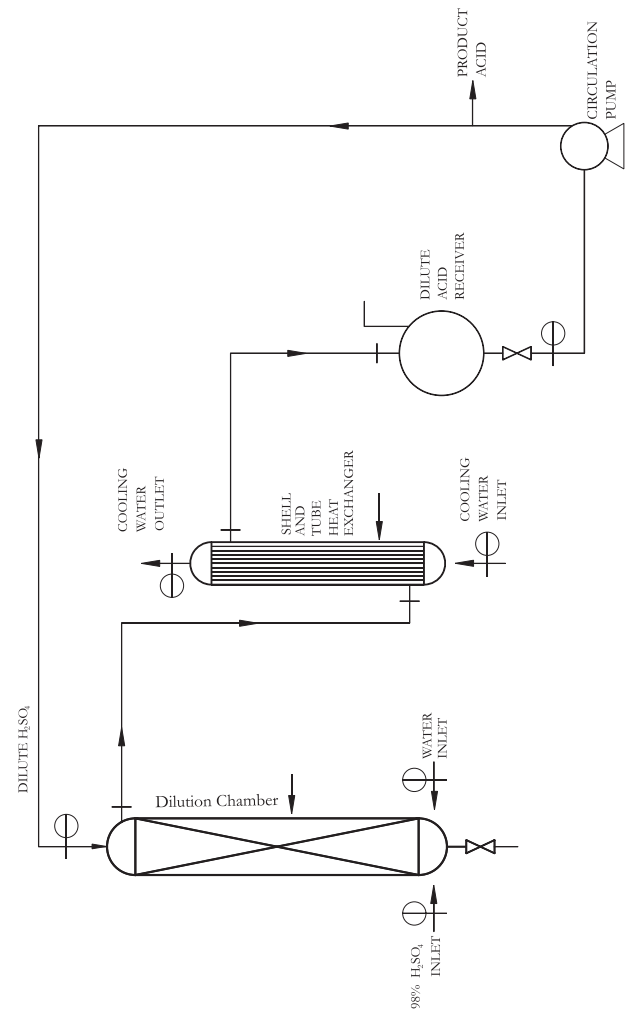
The unit consists of a Dilution Chamber, followed by a Heat Exchanger. Dilution Chamber is used for diluting concentrated Sulphuric acid to the desired concentration and the Heat Exchanger is used for bringing down the temperature of dilute acid to desired temperature, (when the concentrated acid mixes with water, large amounts of heat are released). The Heat Exchanger is of Shell and Tube type to dilute the acid. The acid should be added slowly to cold water to limit the buildup of heat. If water is added to the concentrated acid, enough heat can be released at once to boil the water and separate the acid. Sulfuric acid reacts with water to form hydrates with distinct properties.

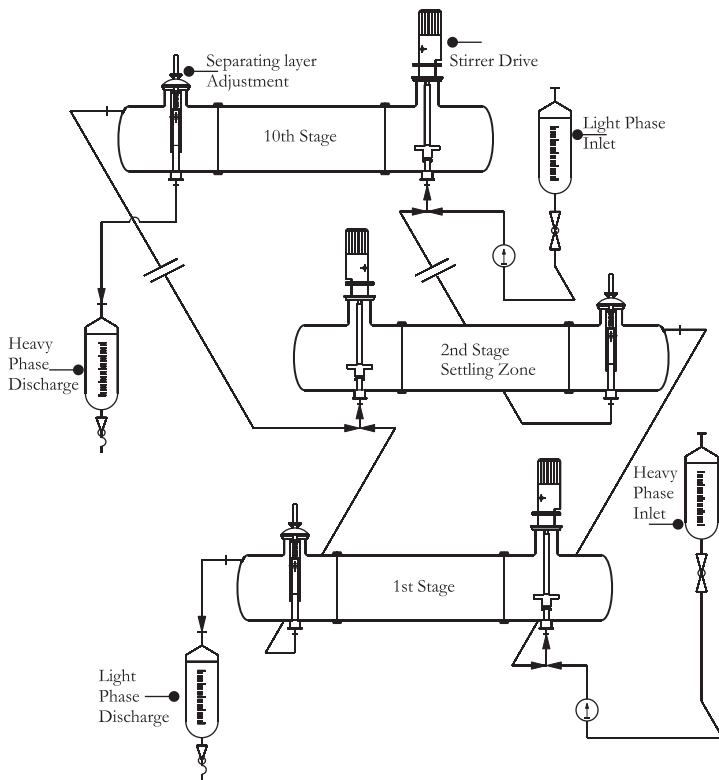
The system consists of:

1. Dilution Chamber with accessories -Glass.
2. Heat Exchanger - Glass.
3. Glass Buffer as Receiver & Circulation of dilute acid (Optional).
4. Dilute Sulphuric acid Circulation Pump (Optional).
5. Glass Pipelines, Valves, & Fittings and Thermo well.
6. Non - Return Valve for Acid & Water Inlet.
7. Expansion Bellows In PTFE for all Nozzles of Glass Components.

Outstanding Features

1. Continuous method of producing the broad range of Sulphuric acid grades (Dilute Sulfuric acid from 98% to 10% ~ 15%)
2. The all Glass & PTFE construction of plant eliminates the material corrosion and allows this profitable operation to take place safely.
3. The unit can be offered vertical or horizontal as per site layout.
4. Compact design. The equipment is simple and easy to operate.
5. Control outlet acid temperature
6. Design temperature: 160 Deg C





MIXER SETTLER

The MIXER -SETTLER is a revolutionary new device, which makes phase separation automatic and simple, irrespective of the concentration of two phases (interface height). The mixer settler is the name given to a type of EXTRACTOR made up of a number of mixing and settling chambers connected alternately in series. In the mixing chambers optimum mass transfer is achieved by mixing of two phases with the aid of pumps and stirrers. In the simplest case, the MIXER -SETTLER consist of adjustable overflow valve, stirrer drive assembly and settling zone.

The MIXER SETTLER has a wide application in the process industry , particularly in .

- * Azeotropic Distillation
- * Steam Distillation
- * And other process, calling for separation and recycle of two Immiscible liquid phase.
- * Extractive Distillation
- * Esterification Distillation

Over View Of The System

The system consists of the following adjustable overflow valve, stirrer drive assembly and settling zone.

Stirrer Drive Assembly

The mixing chamber consists of a cylindrical glass cover in which a variable speed stirrer drive is fitted. Glass impeller Stirrer creates a negative pressure at the inlet, which can be used to draw liquid from a previous stage in the process. In the mixing zone a turbine stirrer with variable speed unit mixes the two phases and the mass transfer takes place during dispersion.

Separation Zone

Separation of phases takes place in two phases. The turbulent flow in the mixing zone must be brought under control and converted in to axial flow. Then the mixer passes into the separation zone where the two phases separate, due to their specific gravity difference.

Auto Continuous Separation

The adjustable overflow valve assembly at one end of the vessel can be set for any interface height. The position of the overflow weir is adjusted to suit the relative densities of the two phases. This valve can be operated externally such that the interface height can be set or reset depending on the operating process conditions. The separating head incorporates an internal overflow weir, which is manually adjusted using a hand wheel.

The internals are arranged in such a way that the heavy phase flows up through the annular space between the dip pipe and the over flow weir and then overflows through holes in the overflow pipe and out through the outlet pipe.

Visual Monitoring

The transparency of Borosilicate glass facilitates the adjustment of the overflow valve by visual monitoring where by any change in the process conditions resulting into a change in layer (interface) height can be immediately adjusted by resetting the overflow valve.

The resetting of the separation height is very simply achieved by rotating the hand wheel of the overflow valve assembly in the clock or anti clock direction.

Large Interface Plane Area

The horizontal glass vessel of the MIXER -SETTLER provides a large interface area of separation in two immiscible liquid phases for a given volume. This enhances the efficiency of the separation process.