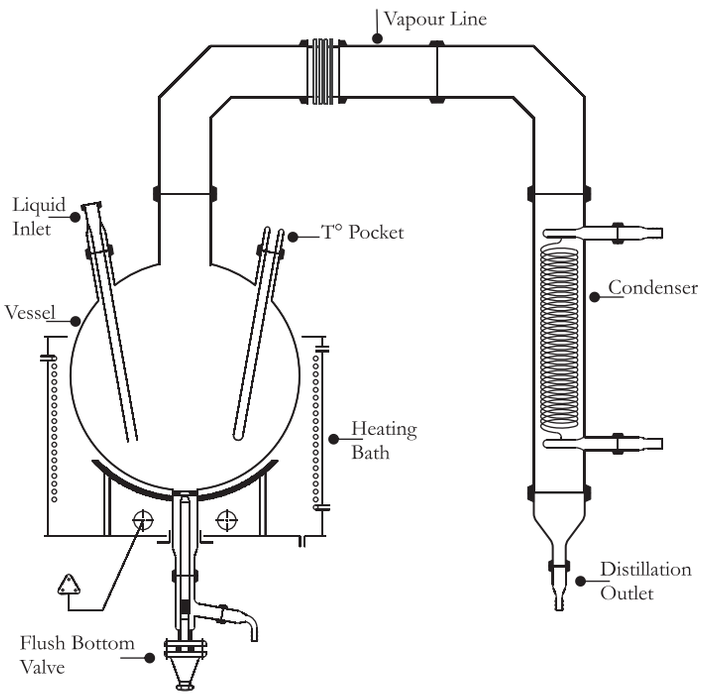
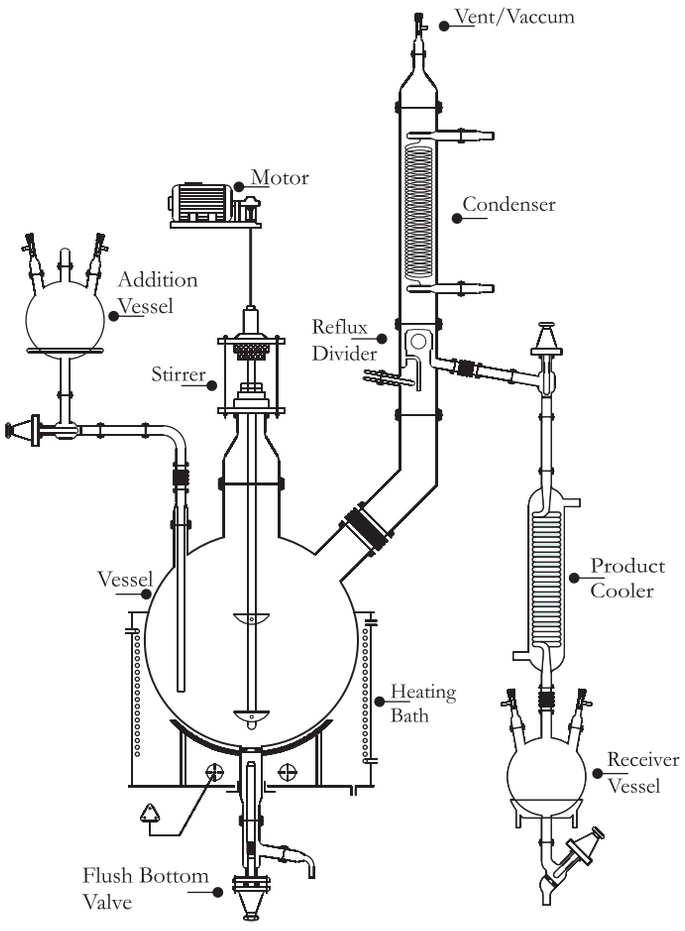
9. STANDARD TYPICAL UNITS

STANDARD TYPICAL UNITS





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 (m^2)	PRO.COOLER HTA (m^2)	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.

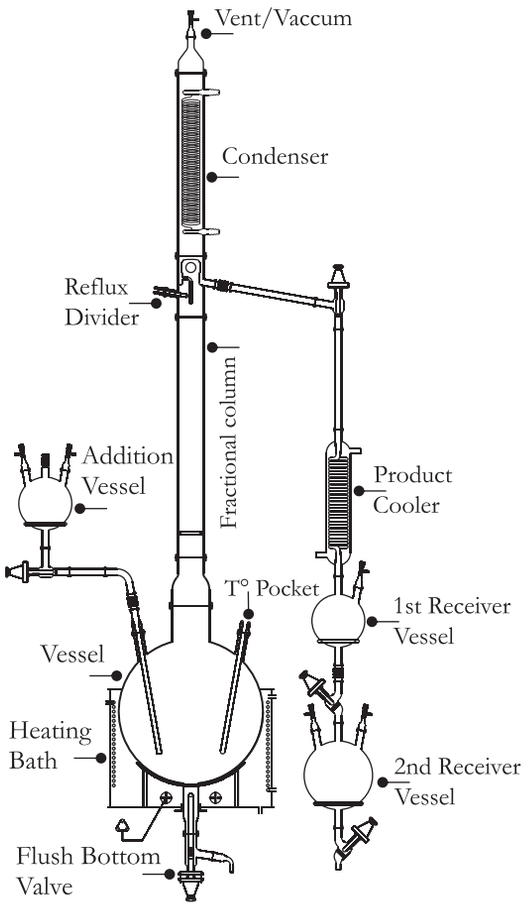
FRACTIONAL DISTILLATION UNIT .

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 vaccum.

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 :

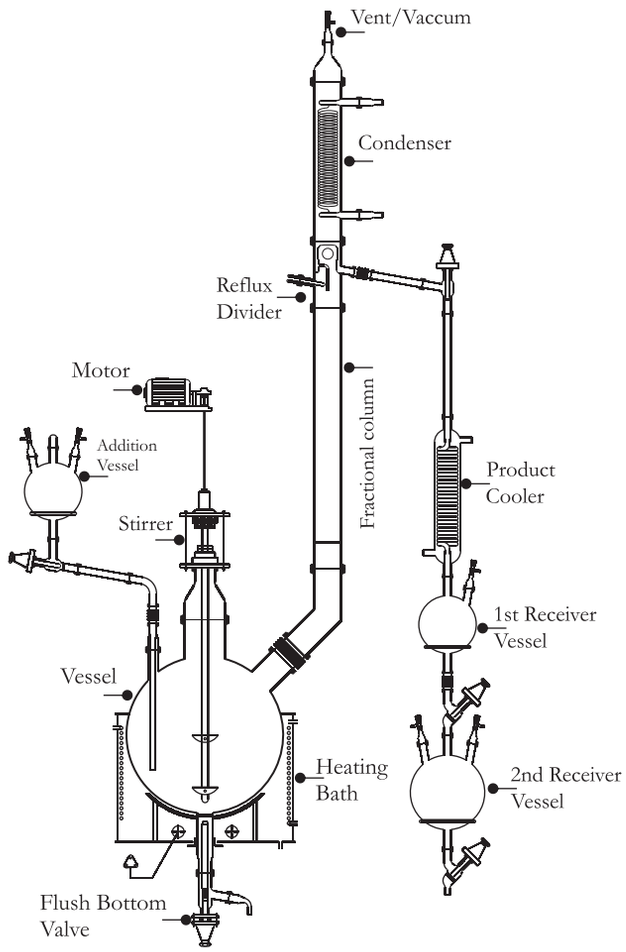
This is a versatile unit and can be used as Reaction Distillation Unit, Fractional Distillation Unit or a combination of both. All features of Reaction Distillation Unit and Fractional Distillation Unit are incorporated.

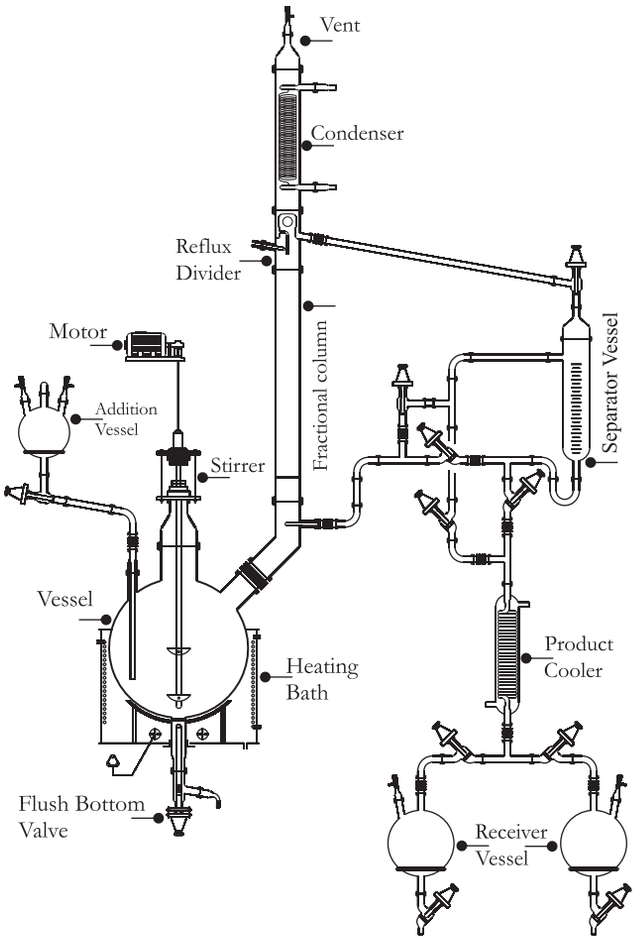
The units is available in vessel sizes of 20, 50, 100 & 200L, 300L and is suitable for operation under atmospheric pressure and full vaccum.

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

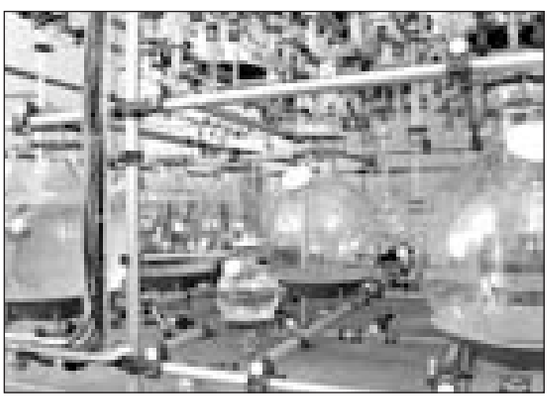
This unit is more versatile and cost effective, capable of working at atmospheric pressure or under full vacuum .

This unit is suitable of 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.

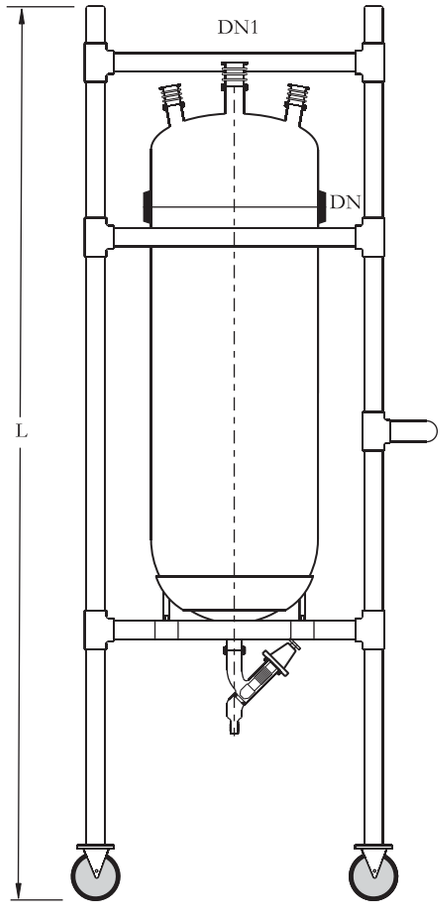


MOBILE VESSEL

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.

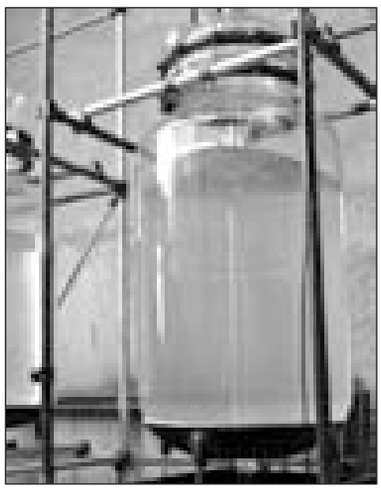
NOMINAL CAPACITY LTR	DN	DN1	L	CAT. REF. WITHOUT PUMP	CAT. REF. WITH PUMP
30	300	40	1500	AMCV30	AMCV30/P
50	300	40	1700	AMCV50	AMCV50/P
100	450	50	1950	AMCV100	AMCV100/P
150	450	50	2250	AMCV150	AMCV150/P
200	450	50	2550	AMCV200	AMCV200/P

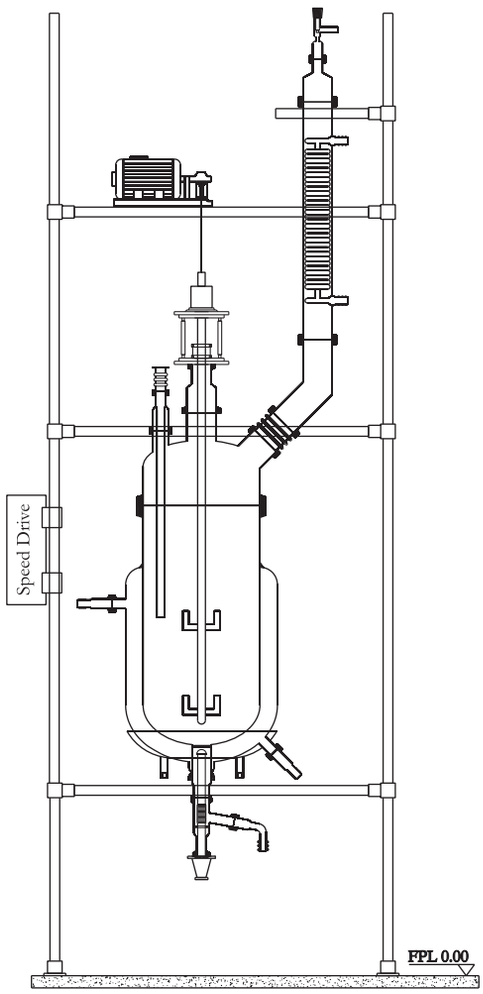
NOTE : "L" is Vary ±50mm or as require size in special case.
Mobile Vessel is also available in Spherical vessel .

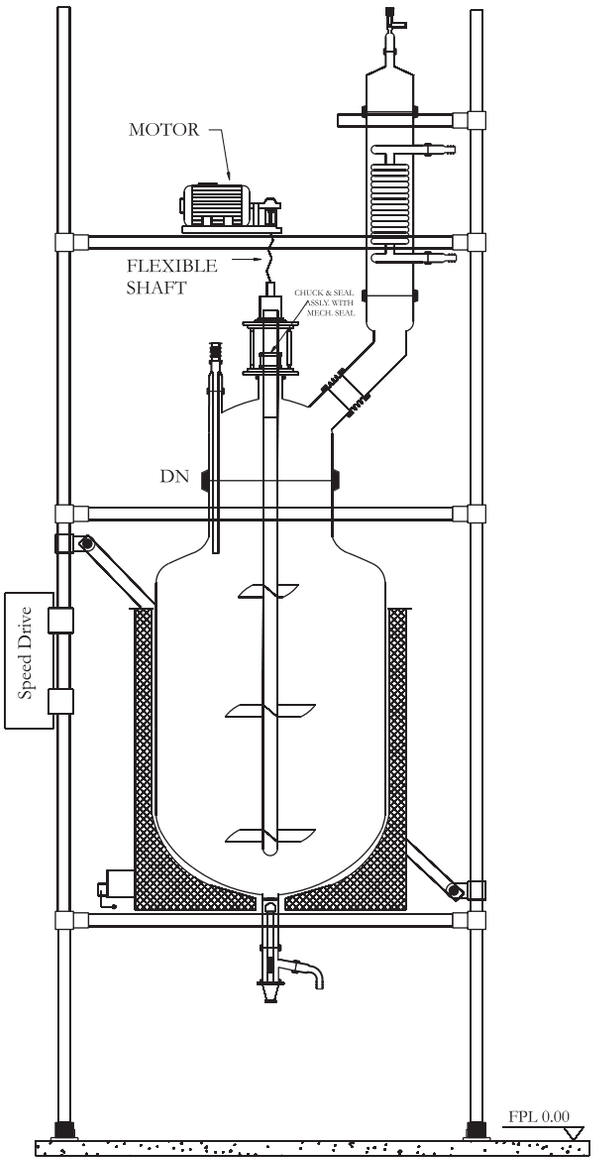


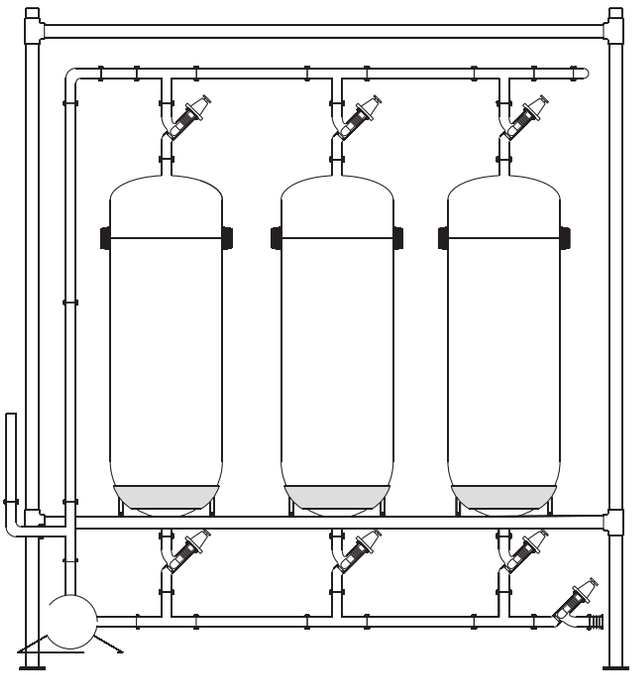
JACKETED CYLINDRICAL MIXING REACTOR

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 capacity200-500, 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.

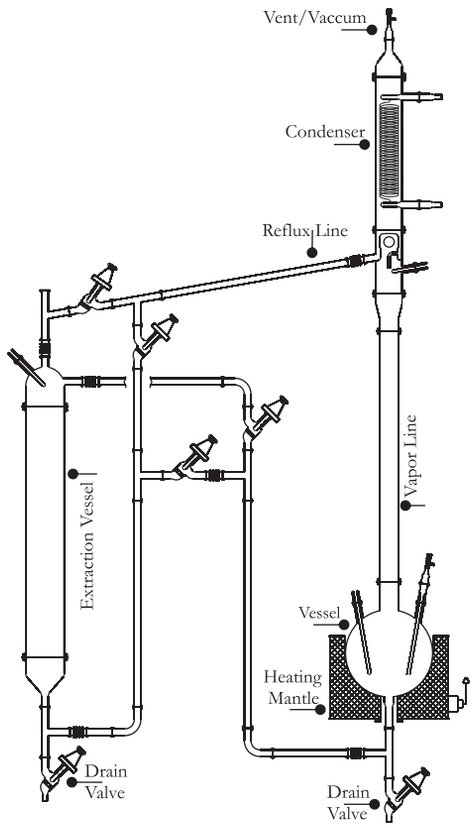
LIQUID-LIQUID EXTRACTION UNIT

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 of 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 form their respective vessels.

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



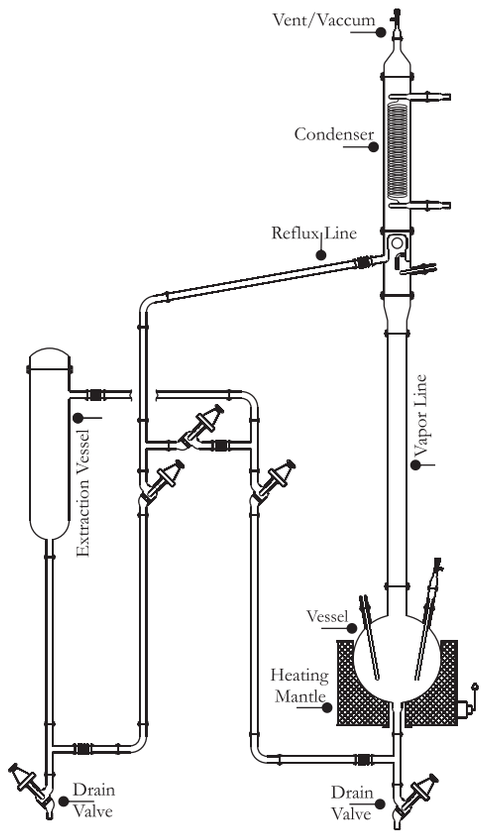
SOLID LIQUID EXTRACTION UNIT

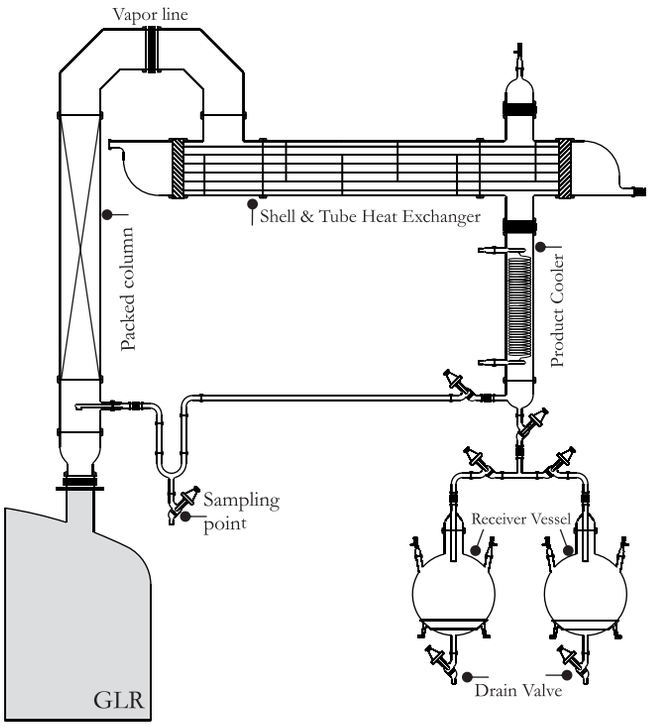
This operation involves preferential solublising of one or more soluble constituents (solutes) of a solid mixture by a liquid solvent. The unit described here is for a semi-batch operation.

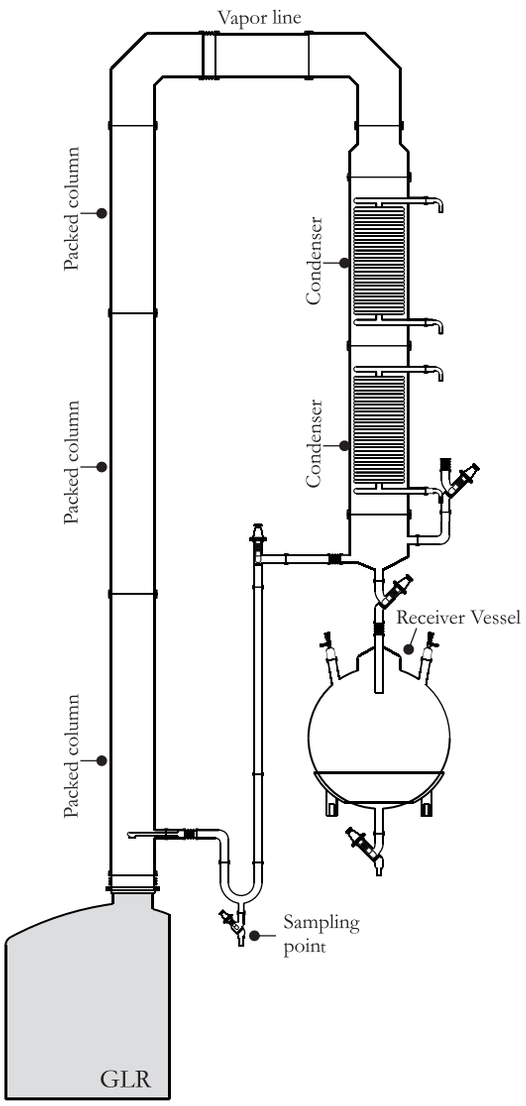
The solid to be extracted is put inside a glass fiber bag and placed in an extraction vessel. Solvent from the reboiler is continuously evaporated,condensed and circulated through a reflux divider by means of piping network and valves. When desired/ steady concentration of solute is achieved in the solution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

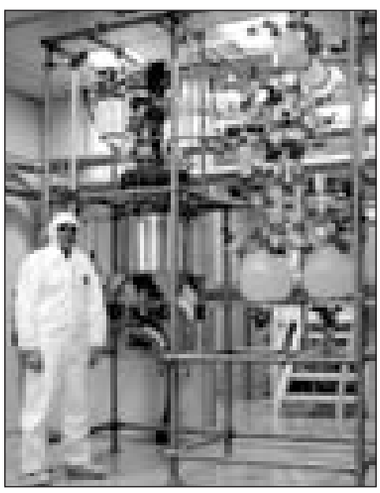






ASSEMBLIES OVER GIASS LINED REACTOR

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 assemby 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.

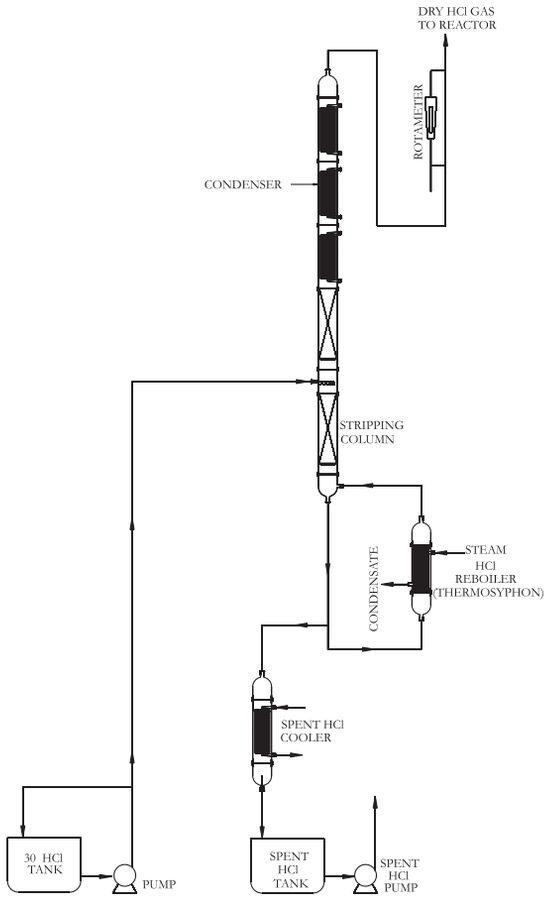
Salient features :

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



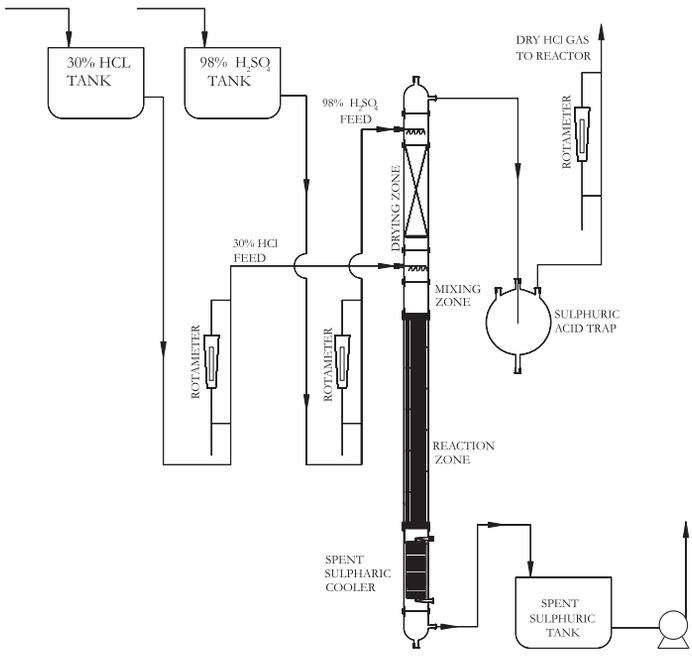
HCI GAS GENERATOR

(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 :

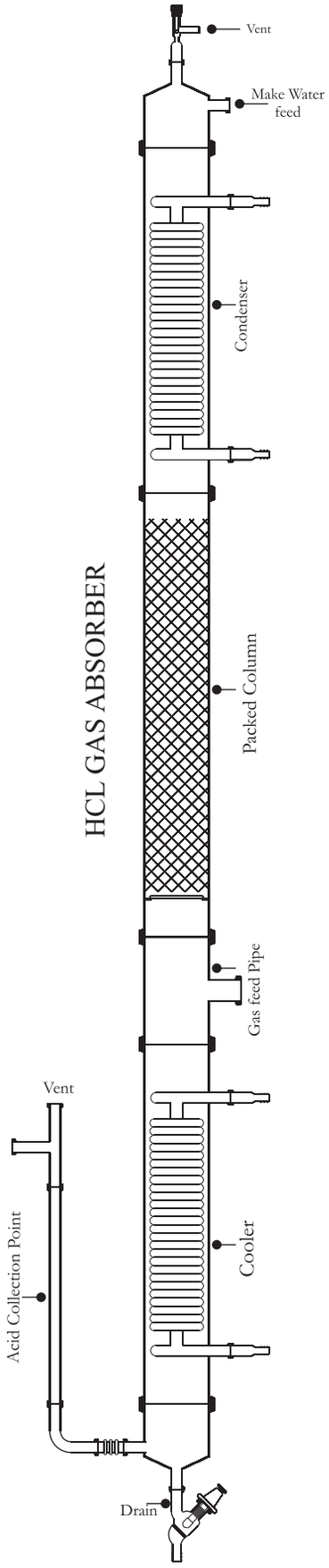
1. Operational reliability – the unit can be started/stopped in seconds.
2. Compact and continuous unit – all operations viz. drying, mixing, gas generation and cooling achieved in same unit.
3. Available in wide range capacities – from 5kg to 200kg/hr of dry HCl.
4. Except cooling water no other utility 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 it's 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 abssorbing 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

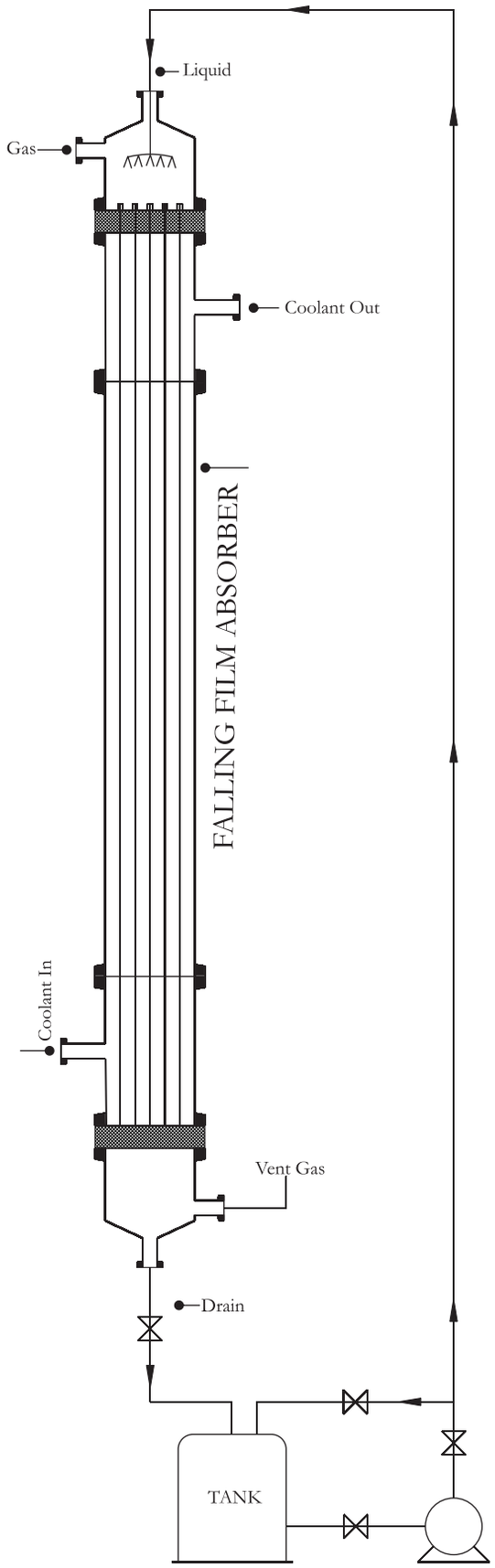
Hydrogen Chloride Gas / Chlorine Gas Absorption

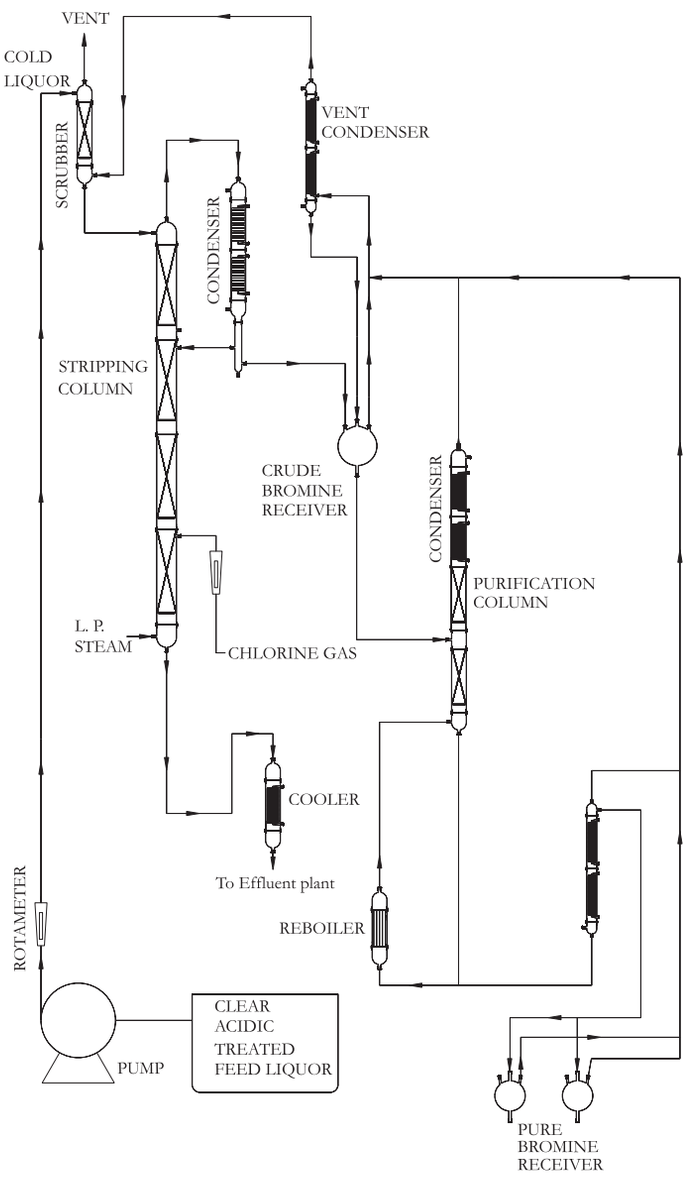
Hydrogen Chloride Gas / Chlorine Gas / / Sulphur Dioxide Absorption

Hydrogen Bromide Gas absorption

SPECIFICATIONS:

NOMINAL SIZE (mm)	ABSORBER AREA (m2)	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

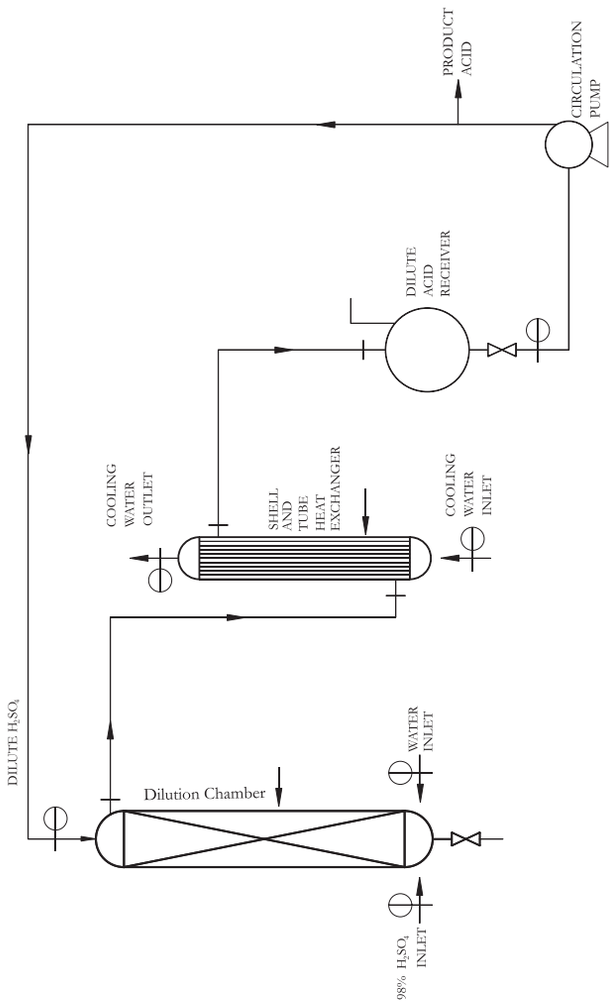
The unit consists of a Dilution Chamber, followed by a Heat Exchanger. Dilution Chamber is used for diluting concentrated Sulphuric acid to the desired concentration and the Heat Exchanger is used for bringing down the temperature of dilute acid to desired temperature, (when the concentrated acid mixes 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.

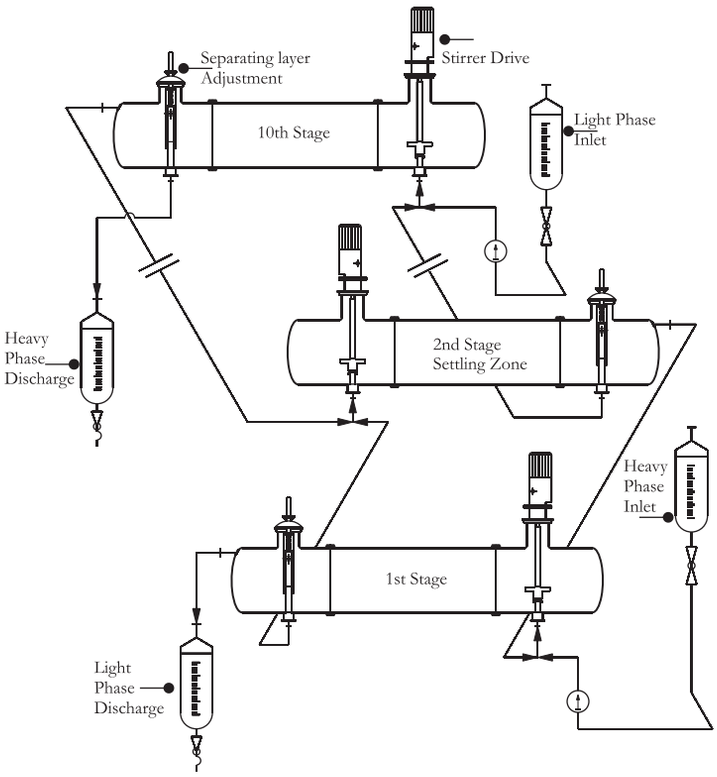
The system consists of:

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

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.