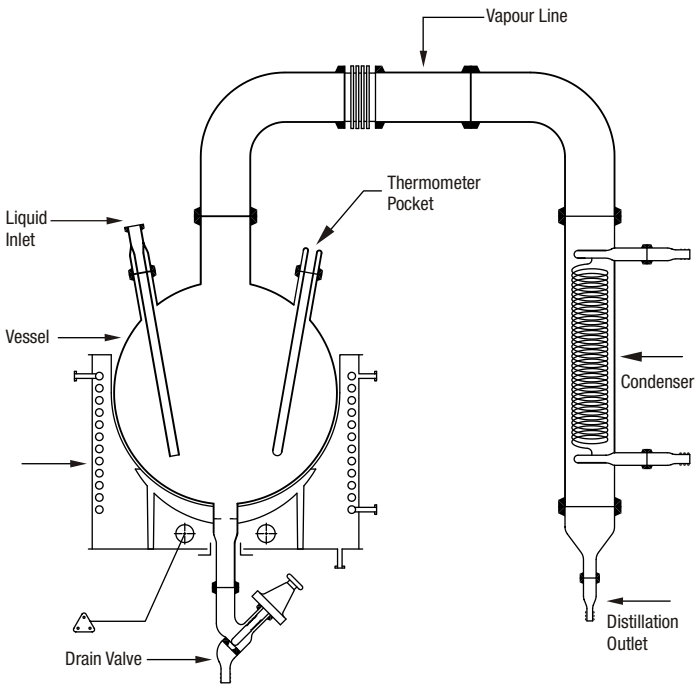


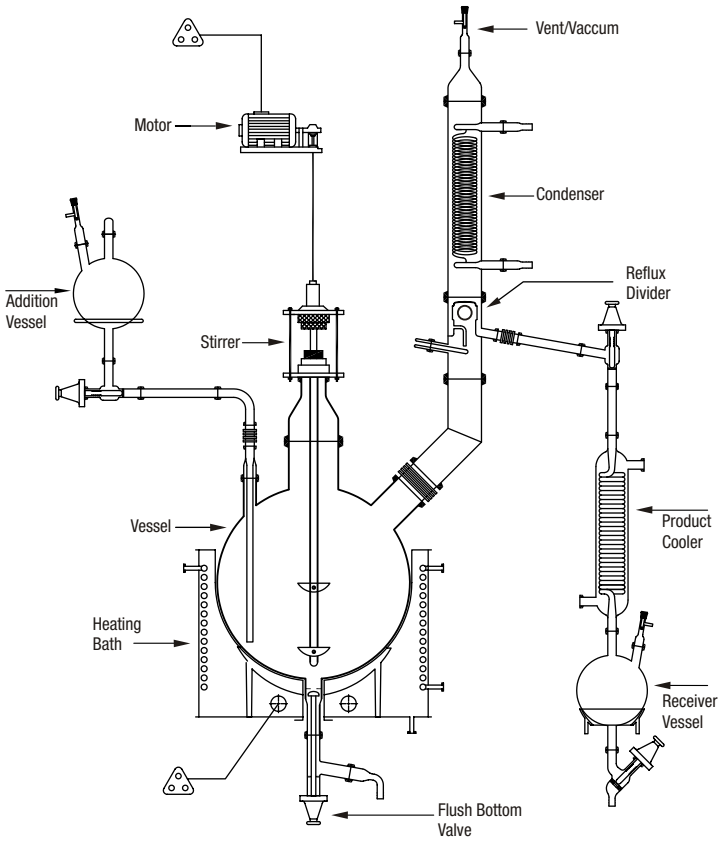
PACKAGE UNITS

Package 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 UNITS

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

Reactor Capacity	Bath KW	Vapour Line	Condenser M²	Cat. Ref.
10 L	2	50 DN	0.2	SSDU 10
20 L	3	80 DN	0.35	SSDU 20
50 L	4.5	100 DN	0.5	SSDU 50
100 L	6	150 DN	1.5	SSDU 100
200 L	9	150 DN	1.5	SSDU 200
300 L	10.5	225 DN	2.5	SSDU 300



REACTION 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 are available in vessel sizes of 20, 50, 100 & 200 & 300Ltr is suitable for operation under atmospheric pressure and full vaccum.

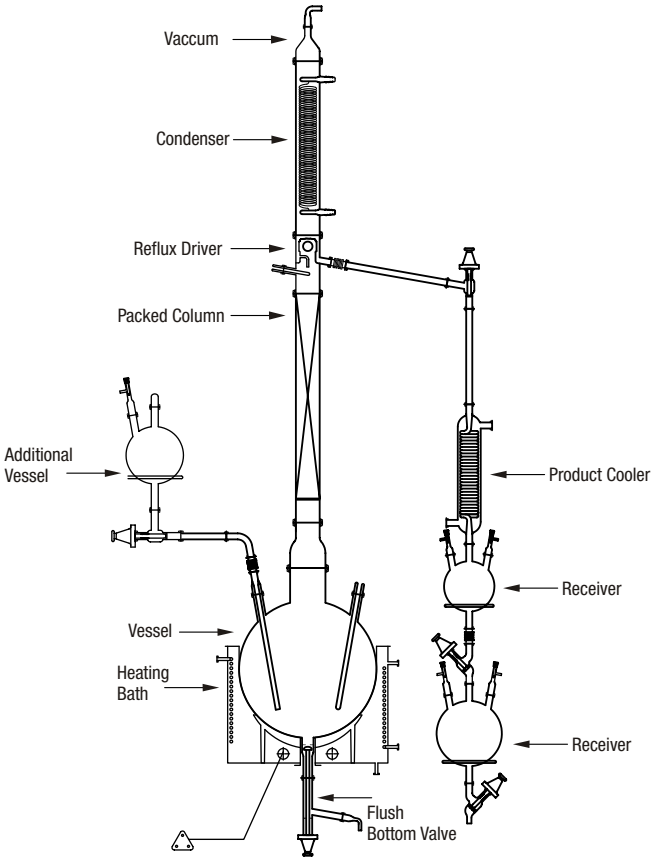
Reactor Capacity	Bath KW	Addition Vessel	Vapour Line	Condenser HTA M²	Cooler HTA M²	Rece-iver Size	Cat. Ref.
10L	2	2	50 DN	0.2	0.1	2L	SRDU 10
20 L	3	2 L	80 DN	0.35	0.1	5L	SRDU 20
50 L	4.5	5 L	100 DN	0.5	0.2	10L	SRDU 50
100 L	6	10 L	150 DN	1.5	0.35	20L	SRDU 100
200 L	9	20 L	150 DN	1.5	0.35	20L	SRDU 200
300 L	10.5	20 L	225 DN	2.5	0.5	20L	SRDU 300

**These units are available in cylindrical vessel also.*

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

Reactor Capacity	Bath KW	Addition Vessel	Vapour Line	Condenser HTA M2	Cooler HTA M2	Receiver Size	Cat. Ref.
10 L	2	2 L	50 DN	0.2	0.1	2L, 2L	SFDU 10
20 L	4	2 L	80 DN	0.35	0.1	2L, 5L	SFDU 20
50 L	4.5	5 L	100 DN	0.5	0.2	5L, 10	SFDU 50
100 L	6	10 L	150 DN	1.5	0.35	10L, 20L	SFDU 100
200 L	9	20 L	150 DN	1.5	0.35	10L,20L	SFDU 200
300 L	10.5	20 L	225 DN	2.5	0.5	20L,20L	SFDU 300

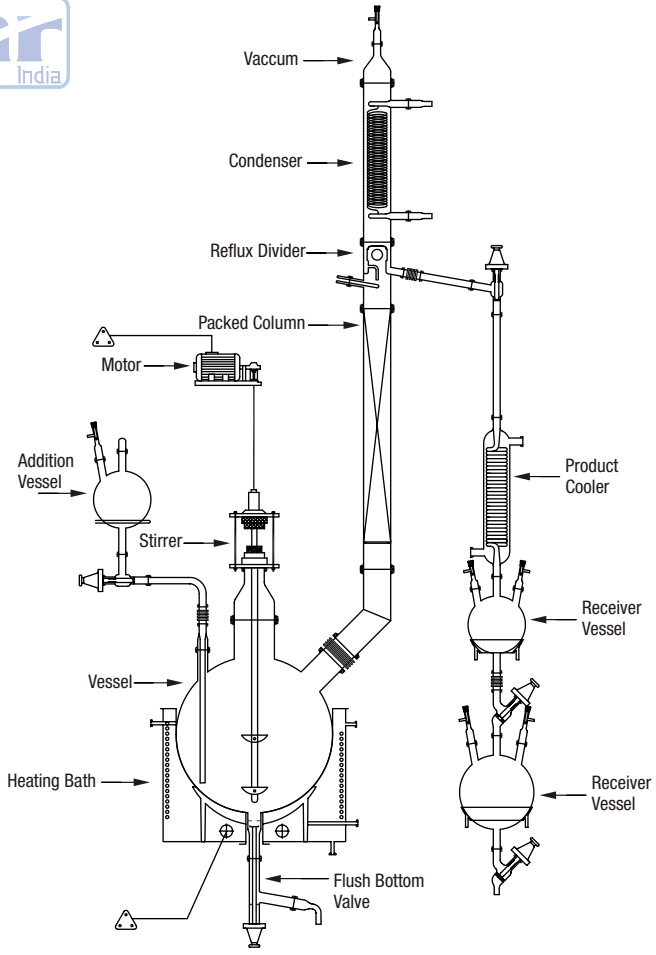


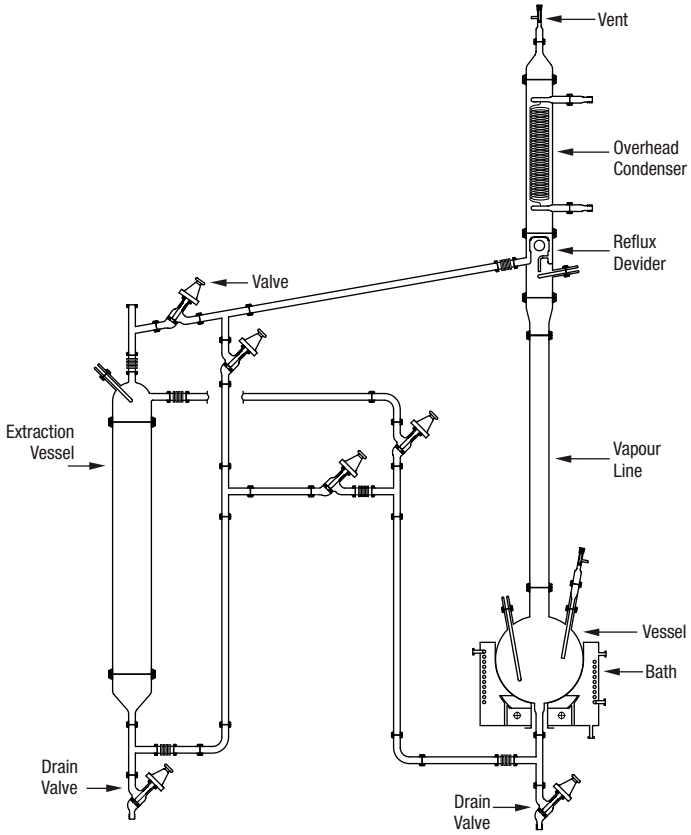
REFLUX REACTION CUM DISTILLATION UNIT

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

Reactor Capacity	Bath KW	Addit-tion Vessel	Vapour Line	Conde-nser HTA M^2	Cooler HTA M^2	Rece-iver Size	Cat. Ref.
10 L	2	2 L	50 DN	0.2	0.1	2 L, 2L	SFRU 10
20 L	3	2 L	80 DN	0.35	0.1	2L,5L	SFRU 20
50 L	4.5	5 L	100 DN	0.5	0.2	5L,10L	SFRU 50
100 L	6	10 L	150 DN	1.5	0.35	10L,20L	SFRU 100
200 L	9	20 L	150 DN	1.5	0.35	10L,20L	SFRU 200
300 L	10.5	20 L	225 DN	2.5	0.5	20L,20L	SFRU 300





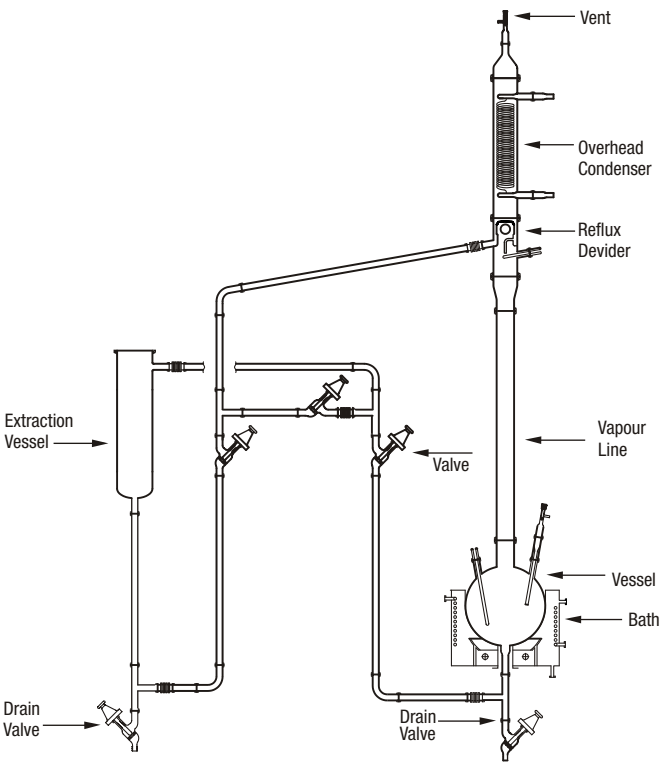
LIQUID-LIQUID EXTRACTION UNIT

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 collecting in a reflux divider and passing 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 enabling the two liquids to be drained form their respective vessels

The units are available in vessel sizes of 10, 20, & 50Ltr. and is suitable for operation under atmoshepric pressure.

Reactor Capacity	Bath KW	Vapour Line	Extraction Vessel	Condenser M^2	Cat. Ref.
10 L	2	40mmx1m	10 L	0.35	S-LLU 10
20 L	3	50mmx1m	20 L	0.5	S-LLU 20
50 L	4.5	80mmx1m	50 L	1.5	S- LLU 50



SOLID LIQUID EXTRACTION UNIT

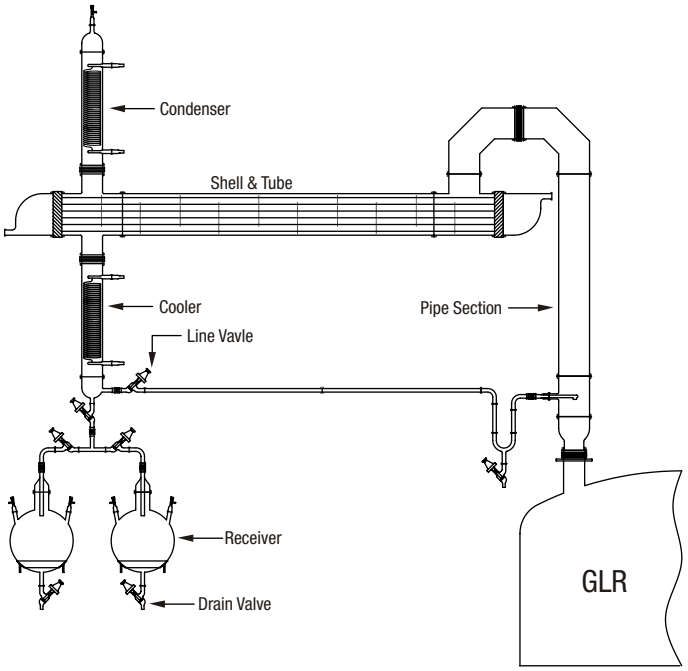
This operation involves preferential solublising of one or more soluble constituents (solutes) of a solid mixture by a liquid solvent. The unit described here is for a semi-batch operation.

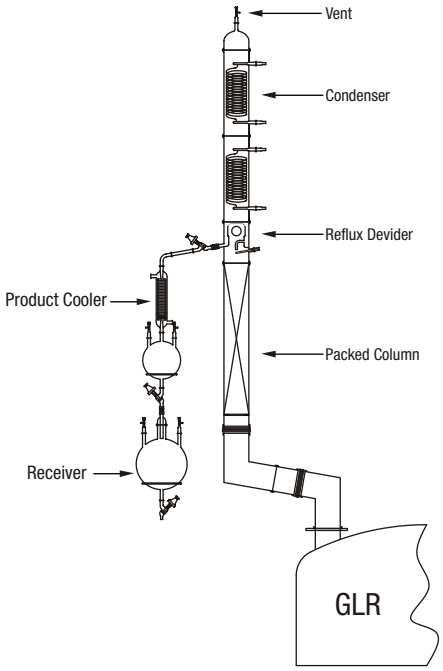
The solid to be extracted is put inside a glass fiber bag and placed in an extraction vessel. Solvent from the reboiler is continuously evaporated,condensed and circulated through a reflux divider by means of piping network and valves. When desired/ steady concentration of solute is achieved in the solution 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 units are available in vessel sizes of 10, 20, & 50Ltr. and is suitable for operation under atmospheric pressure.

Reactor Capacity	Bath KW	Vapour Line	Extraction Vessel	Condenser M2	Cat. Ref.
10 L	2	40mmx1m	10 L	0.35	S- SLU10
20 L	3	50mmx1m	20 L	0.5	S- SLU20
50 L	4.5	80mmx1m	50 L	1.5	S- SLU50

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 adjacent figure.

The Assemblies can be separated into different categories.

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 installation.

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

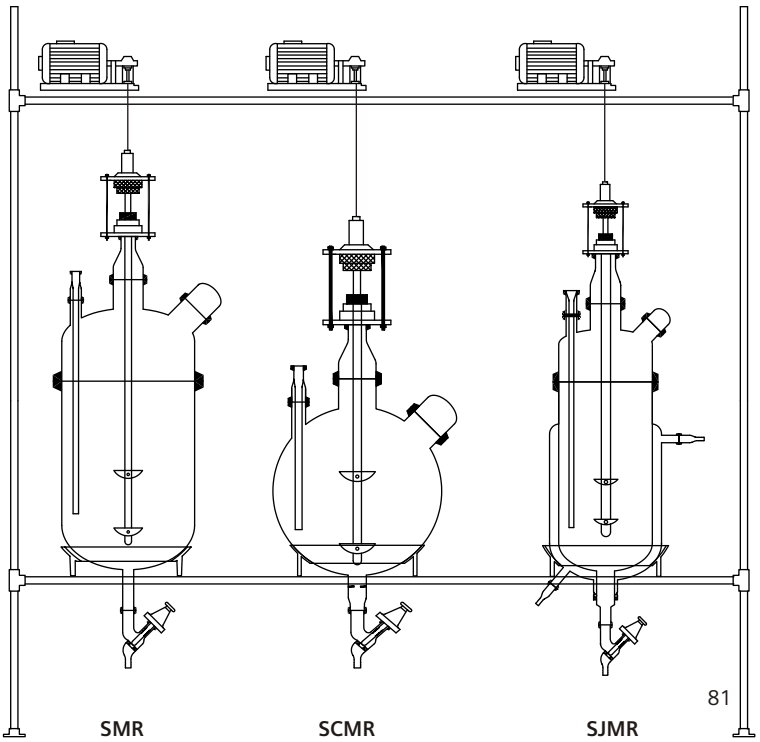
SPHERICAL & CYLINDRICAL MIXING REACTOR

Capacity	Cylindrical Cat .Ref.	Spherical Cat. Ref.
20 L	SMR 20	SCMR 20
50 L	SMR 50	SCMR 50
100 L	SMR 100	SCMR 100
200 L	SMR 200	SCMR 200
300 L	SMR 300	SCMR 300

Reactor Capacity	Jaketed Mixing Reactor Cat. Ref.
5 L	SJMR 5
10 L	SJMR 10
20 L	SJMR 20
30 L	SJMR 30
50 L	SJMR 50
100 L	SJMR 100

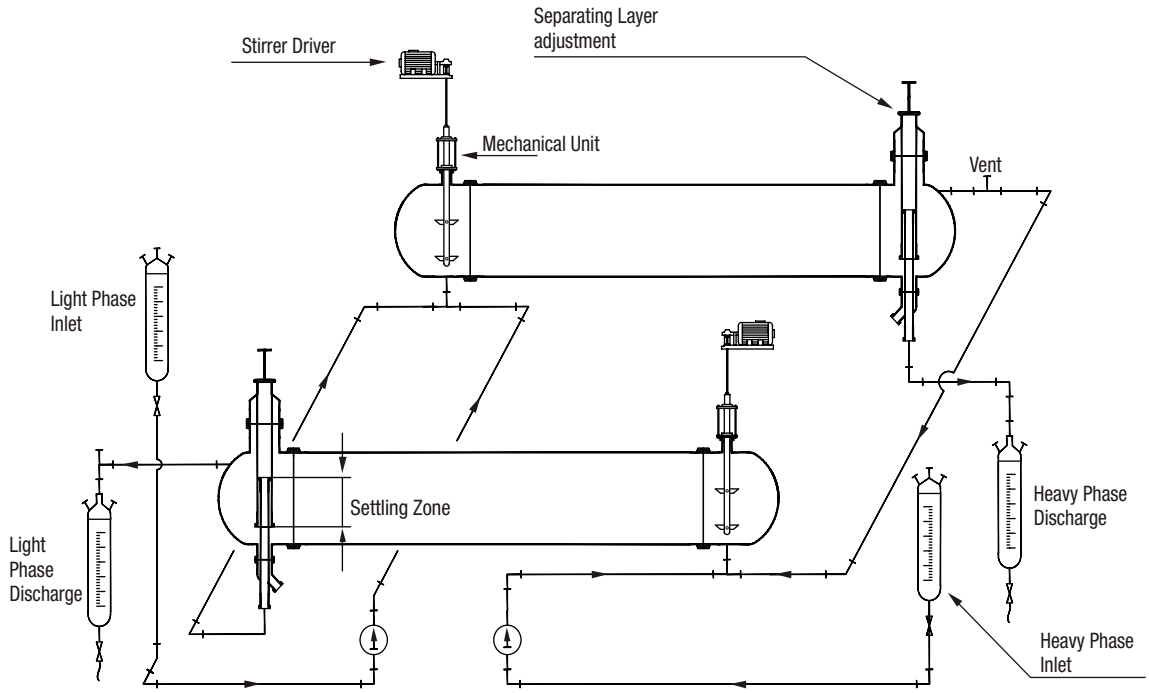
Material of construction

1. Stirrer Drive, non-flameproof or flameproof Motor, 192 RPM.
2. Stirrer material of construction glass or PTFE Lined.
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 carbon steel, epoxy coated carbon steel, stainless steel 304 & stainless steel 316. All structures are available in trolley-mounted form.
6. Closing valve drain valve or flush bottom outlet valve.



SMR SCMR SJMR

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 through 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 chemical process industry , particularly in :

- Azeotropic Distillation
- Extractive Distillation
- Steam Distillation
- Esterification Reaction
- 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.

Construction

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. Firstly, 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 two immiscible liquid phases for a given volume. This enhances the efficiency of the separation process.

Non Corrosive

Being Borosilicate glass, the corrosion and temperature resistance of the material of construction is unmatched by any other alternate which is transparent too.

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.

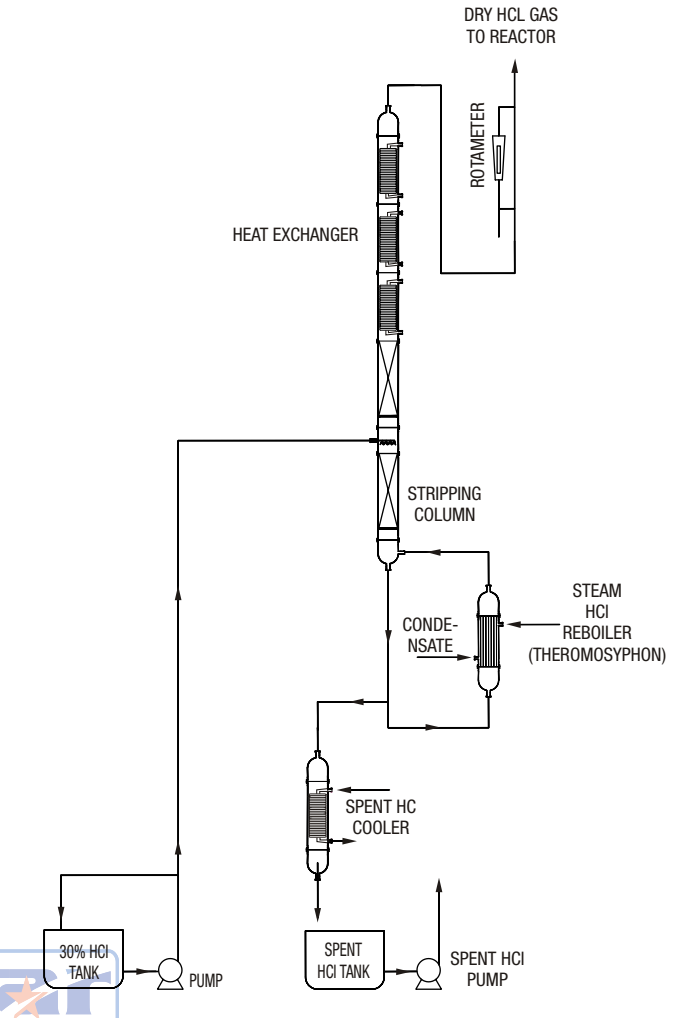
Salient features

1. Operational reliability
2. Available in wide range capacities - from 10kg to 200kg/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 (M^3/hr)	:	3.5
3.	Chilled brine at -10° C (M^3/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.

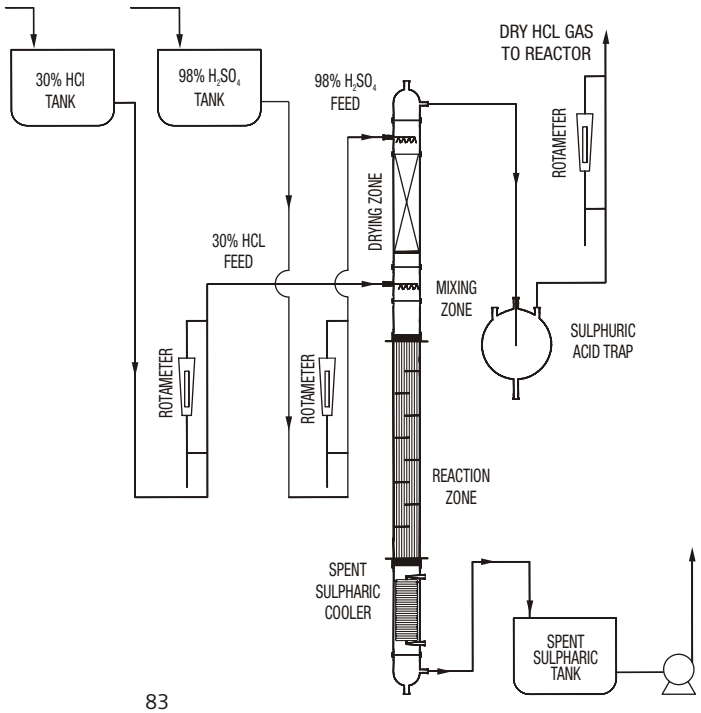
Salient Features

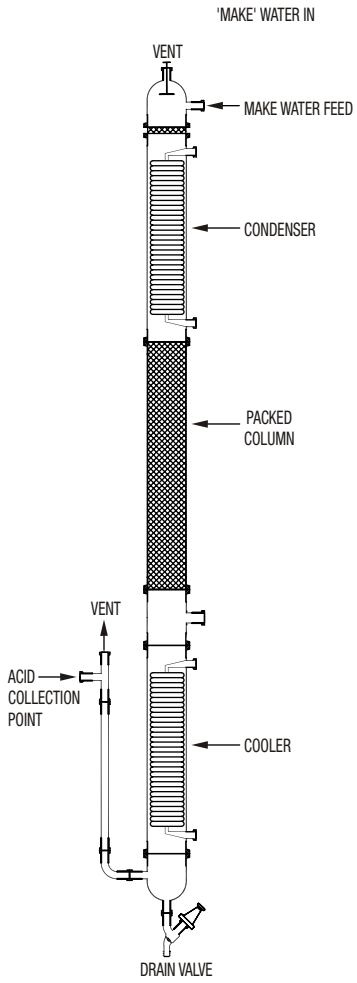
1. Operational reliability – the unit can be started/stopped in seconds.
2. Compact and continuous unit – all operations viz. drying, mixing, gas generation and cooling achieved in same unit.
3. Available in wide range capacities – from ±5kg to 200kg/hr of dry HCl.
4. Except cooling water no other utility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





HCL GAS ABSORBER (ADIABATIC TYPE)

Process Description

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.

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. Make 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).

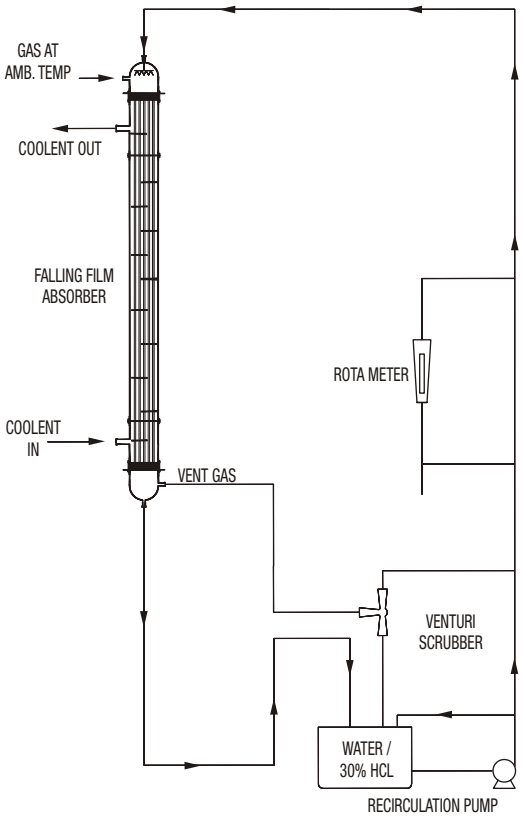
PACKED COLUMN	CONDENSER HTA	GAS RATE (APPROX.)	CAT. REF.
80mmx3m	0.35m 2x2	10Kg/hr	HCL 3
100mmx4m	0.5m 2x2	20Kg/hr	HCL 4
150mmx4m	1.5m 2x2	60Kg/hr	HCL 6
225mmx4.5m	2.5m 2x2	150Kg/hr	HCL 9
300mmx4.5m	2.5m 2x2	300Kg/hr	HCL12

HCL GAS ABSORBER (Falling Film Type)

Process Description

Hydrogen Chloride gas is produced from the variety of process industries & mainly from chlorination operation. This must be scrubbed before venting to the atmosphere. Hydrogen chloride has great affinity of water and easily absorbed in water. The absorption of Hydrogen Chloride gas in to water cause large amount of heat, which has to be removed by means of suitable device.

The falling film absorber is the simplest form of HCl absorber, which can be operated continuously. Falling Film Absorber is a vertically mounted shell and tube heat exchanger. The standard configuration of the falling film absorber consists of a suitable shell and tube heat exchanger with the necessary drain outlet for the acid. The Hydrogen Chloride Gas enters at the top of the absorber and flows concurrently with water/Dilute HCl. Cooling Water is circulated through shell side of the Falling Film absorber to absorb the heat generated by the dilution of Hydrochloric acid gas with water. Due to its unique design and construction, the heat of absorption is efficiently removed at the zone of absorption, thereby making the absorber extra efficient. Thus the higher concentration of acid is produced due to low absorbing temperature.



Capacity Range : 10Kg /hr to 900 KG/hr.

Available up to 600mm dia.

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.

BROMINE RECOVERY PLANT

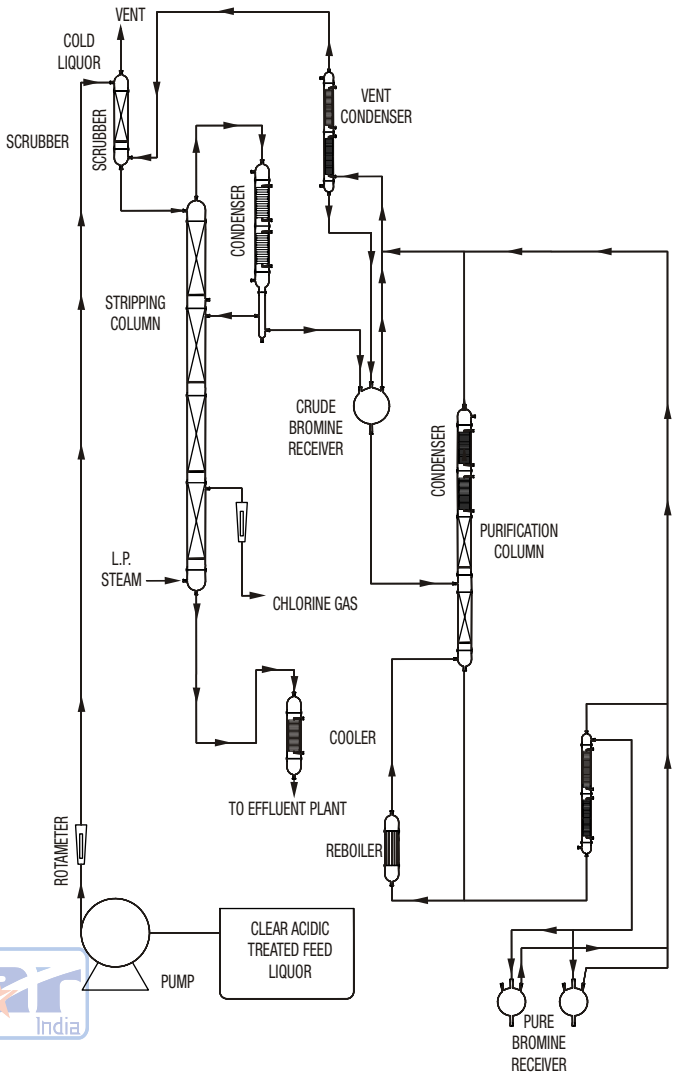
Process Description

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 and goes to Product receivers. 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

Stripping /Reaction Column - Glass
Cooling/Chilling Heat Exchangers
Phase Separator - Glass
Bromine Purification Column
Pure Bromine Condenser -Glass
Vent / Guard Condenser - Glass
Bromine Reboiler - Glass Bromine
Product Cooler - Glass
Crude / Pure Bromine Collecting Receiver - Glass

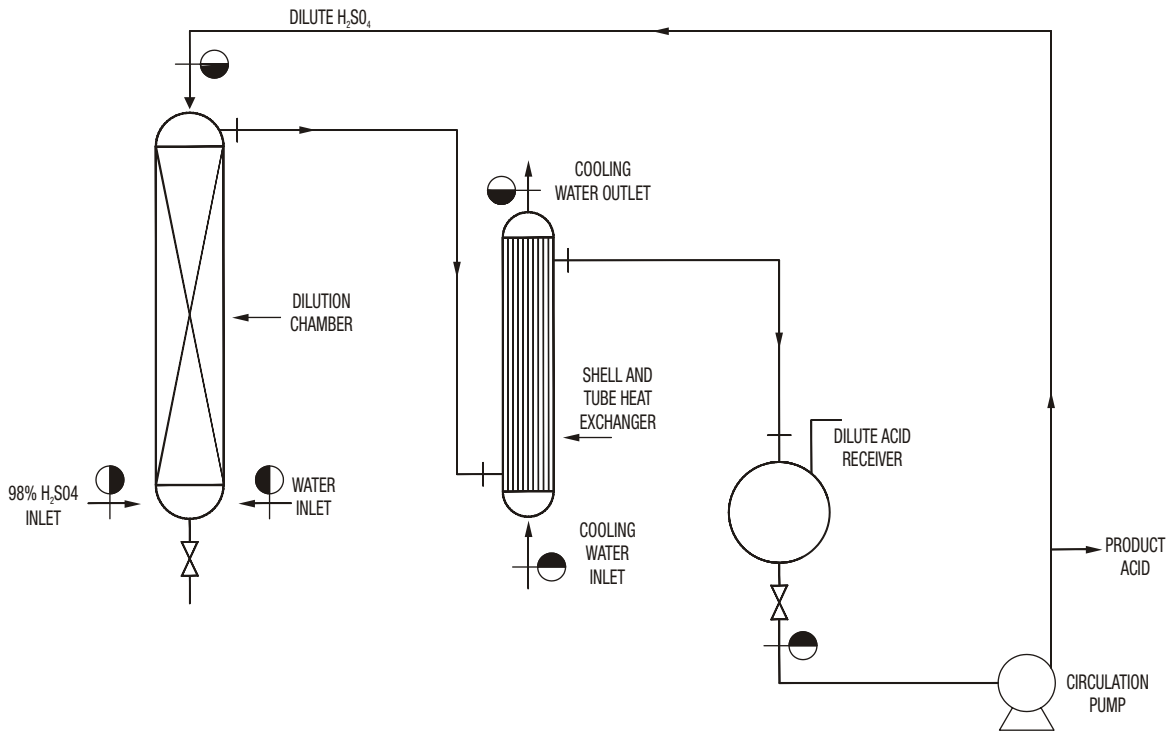
Raw Material Requirement

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)

SULPHURIC ACID DILUTION PLANT



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 spatter 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

ROTARY FILM EVAPORATOR

We offer a wide range of solutions based on evaporation in different application fields.

Application

Batch or Continuous Operations under vacuum or atmospheric pressure.

"Evaporation of solvents containing heat sensitive materials or solids under reduced pressure.

Vacuum drying of wet solids. Especially designed for high boiling solvents. Degassing of liquids.

Principal of Rotary Evaporator

1. Thin Film Evaporation.
2. Large Surface Area
3. Uniform transfer of heat through its glass wall to the thin film.

A wide range of evaporation flask volumes from 1 liter up to 50 liter allows finding an appropriate size of distillation performance from the Lab up to the Production Plant.

Its broad temperature range from +20°C to 180°C opens up a wide range of application and it's modular design makes it possible to fully adapt the evaporator to your individual needs .

Outstanding Features

1. High performance sealing system.
2. Dual over- temperature cutout devices
3. Manually adjustable maximum temperature control
4. Protection hood for the oil/water bath & rotating flask
5. All components are designed to suit high Vacuum
6. High efficiency with limited space requirements
7. High Distillation rates/Solvent Recover
8. Low Operating Temperature
9. High purity of distillate/Solvent
10. All evaporators can be upgraded for future needs.

Overview of the System

A typical set up of Rotary Evaporator glassware consists of an evaporating flask, a receiving flask & a condenser. The evaporating flask holds the sample to be evaporated. Once a sample is placed in the evaporating flask, it is lowered in to a heated water bath and is rotated in the water bath. The rotation of the evaporation flask creates a thin film of sample on the inside of the glassware. Increase surface are encourages evaporation of the molecules. Heated water encourages the free flow of molecules to move toward the condenser to be collected in the receiving flask. The receiving flask collects the condensate that comes from the condenser for evaluation of the pure solvent or proper waste disposal

The system consists of

1. Evaporating Rotating Flask 1 no.
2. Sparkless Induction Electric gear motor 1 no.
3. Cooling Condenser 1 no.
4. Receiver Flask 2 nos.
5. Instrument panel includes
6. RPM Controller
7. Bath Temperature Controller Stand

Notes