



## STANDARD - UNITS & TECHNICAL PACKAGES



# Borolab





## STANDARD UNITS & TECHNICAL PACKAGES

Our team of Chemical Engineers having expertise in the field of Process Engineering & its application in the Glass Plants, Glass Equipments & Process Packages.

### STANDARD UNITS

1. Simple Distillation Unit.
2. Reaction Unit.
3. Fractional Distillation Unit.
4. Reaction Distillation Unit.
5. Liquid - Liquid Extraction Unit.
6. Solid - Liquid Extraction Unit.
7. Condensor Assembly Over GLR.
8. Flanged Reactors.
9. Pilot Plant Gas Scrubber.
10. Mobile Mixing Systems.
11. Multi Purpose Unit.



### DESIGN & SUPPLY OF DIFFERENT UNITS

(As per customer's requirements)

1. HCL GAS Absorption System.
2. Falling Film Absorption System.
3. Sulphuric Acid Concentration System.
4. Solvent Recovery System.
5. Anhydrous HCL Gas Generator System by
  - a. Sulphuric Acid Route.
  - b. Boiling Route.
  - c. Calcium Chloride Route.
6. Bromine Recovery System
7. Continuous Distillation System.
8. Rotating disk Extraction System.
9. Precious Metal Refining System.
10. Agitated Glass Nutsche Filter / Peptide Synthesizer.
11. Rotary Evaporators (Laboratory / Industrial)



### PROCESS PACKAGES WITH KNOW-HOW

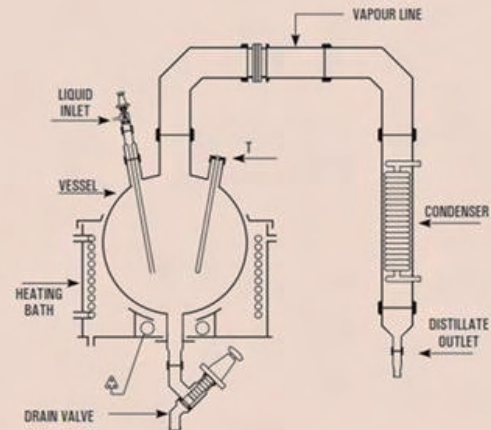
1. Bromine Recovery from Industrial waste / Salt bitern.
2. Nitric Acid Concentration.
3. Sodium Hypochlorite



## SIMPLE DISTILLATION UNIT

It consists of a vessel mounted in a heating bath and fitted with a condenser receiving the condensate. The units are available in vessel sizes of 20, 50, 100, 200 & 300 L and is suitable for operation under atmospheric pressure and full vacuum.

Unit Cat.Ref.	Reactor Capacity	Bath KW	Vapour Line	Condenser M <sup>2</sup>
SDU20	20 L	4.5	80 DN	0.35
SDU50	50 L	6.0	100 DN	0.50
SDU100	100 L	9.0	150 DN	1.50
SDU200	200 L	12.0	150 DN	1.50
SDU300	300 L	16.0	225 DN	2.50

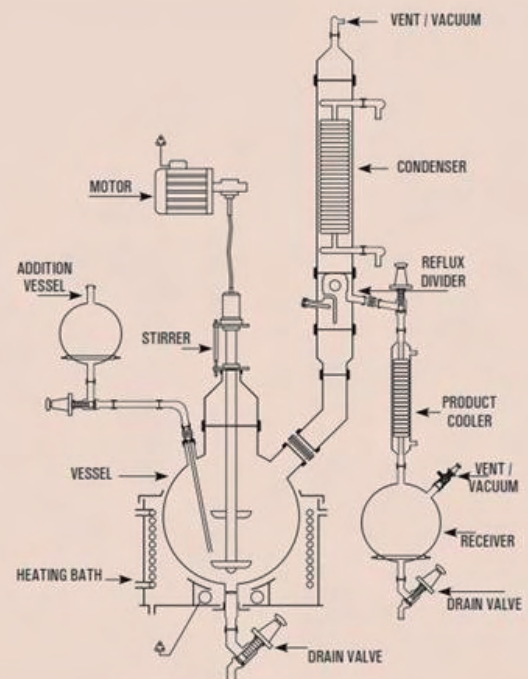


## REACTION UNIT

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 & 200L and is suitable for operation under atmospheric pressure and full vacuum.

Unit Cat.Ref.	Reactor Capacity	Bath KW	Addition Vessel	Vapour Line	Condenser HTA M <sup>2</sup>	Cooler HTA M <sup>2</sup>	Receiver Size
RDU20	20 L	4.5	2 L	80 DN	0.35	0.10	5L
RDU50	50 L	6.0	5 L	100 DN	0.50	0.20	10L
RDU100	100 L	9.0	10 L	150 DN	1.50	0.35	20L
RDU200	200 L	12.0	20 L	150 DN	1.50	0.35	20L
RDU300	300 L	16.0	20 L	225 DN	2.50	0.50	20L



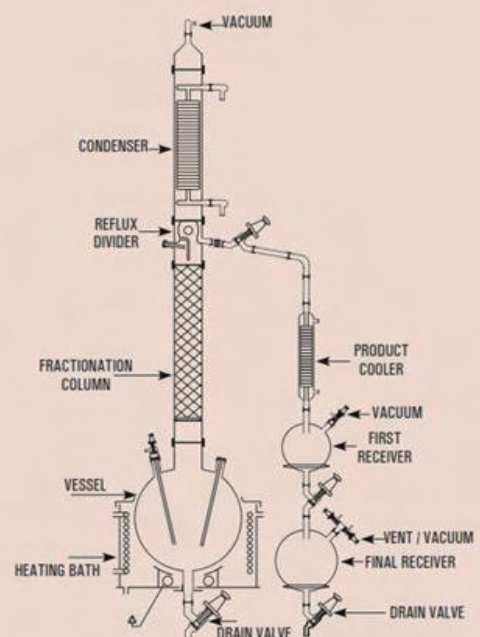
## FRACTIONAL DISTILLATION UNIT

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 is suitable for operation under atmospheric pressure and full vacuum.

Unit Cat.Ref.	Reactor Capacity	Bath KW	Addition Vessel	Vapour Line	Condenser HTA M <sup>2</sup>	Cooler HTA M <sup>2</sup>	Receiver Size
FDU20	20 L	4.5	2 L	80 DN	0.35	0.10	5L
FDU50	50 L	6.0	5 L	100 DN	0.50	0.20	10L
FDU100	100 L	9.0	10 L	150 DN	1.50	0.35	20L
FDU200	200 L	12.0	20 L	150 DN	1.50	0.35	20L
FDU300	300 L	16.0	20 L	225 DN	2.50	0.50	20L



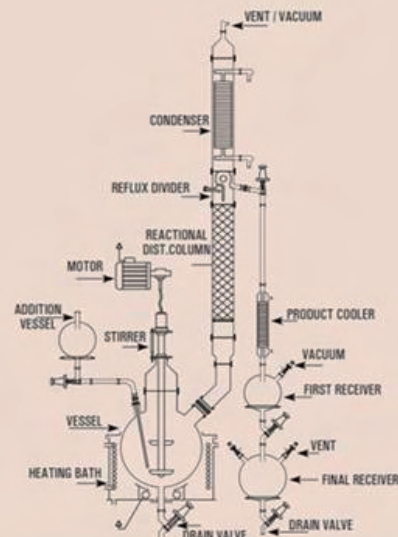


## REACTION DISTILLATION UNIT

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, 200 & 300 L and is suitable for operation under atmospheric pressure and full vacuum.

Unit Cat.Ref	Reactor Capacity	Bath KW	Addition Vessel	Vapour Line	Condenser HTA M <sup>2</sup>	Cooler HTA M <sup>2</sup>	Receiver Size
FRU20	20 L	4.5	2 L	80 DN	0.35	0.10	2L, 5L
FRU50	50 L	6.0	5 L	100 DN	0.50	0.20	5L, 10L
FRU100	100 L	9.0	10 L	150 DN	1.50	0.35	10L, 20L
FRU200	200 L	12.0	20 L	150 DN	1.50	0.35	10L, 20L
FRU300	300 L	16.0	20 L	225 DN	2.50	0.50	20L, 20L



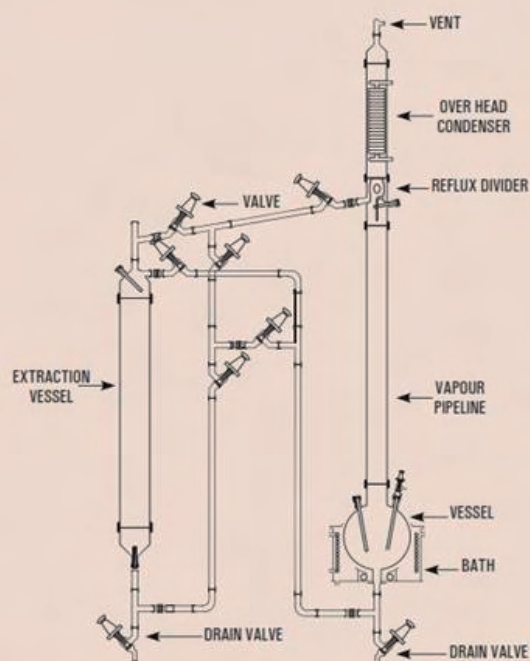
## LIQUID-LIQUID EXTRACTION UNIT

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 from their respective vessels.

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

Unit Cat.Ref.	Reactor Capacity	Bath KW	Vapour Line	Extraction Vessel	Condenser M <sup>2</sup>
LLU10	10 L	3.00	40mmx1m	10 L	0.35
LLU20	20 L	4.50	50mmx1m	20 L	0.50
LLU50	50 L	6.00	80mmx1m	50 L	1.50



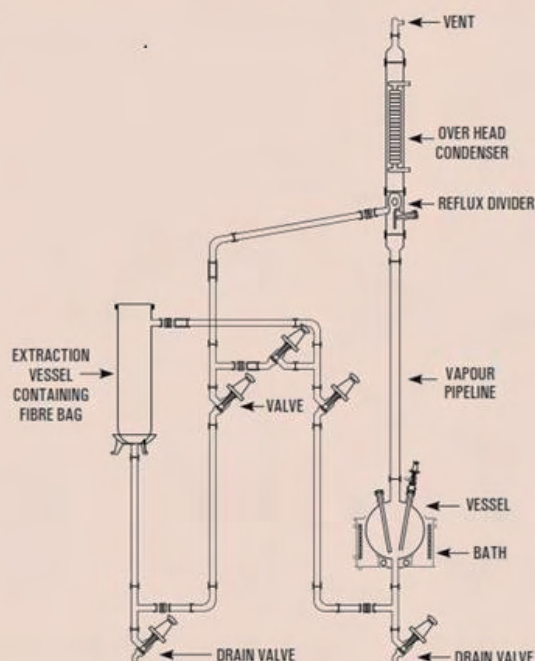
## SOLID-LIQUID EXTRACTION UNIT

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 from their respective vessels.

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

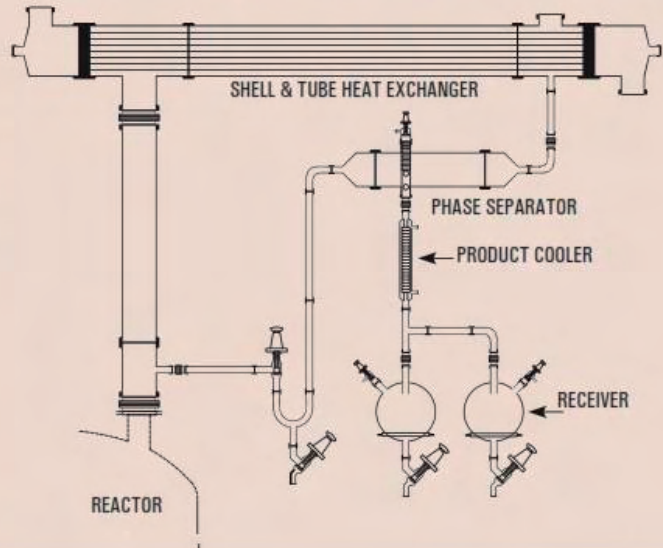
Unit Cat.Ref.	Reactor Capacity	Bath KW	Vapour Line	Extraction Vessel	Condenser M <sup>2</sup>
SLU10	10 L	3.00	40mmx1m	10 L	0.35
SLU20	20 L	4.50	50mmx1m	20 L	0.50
SLU50	50 L	6.00	80mmx1m	50 L	1.50





## 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.



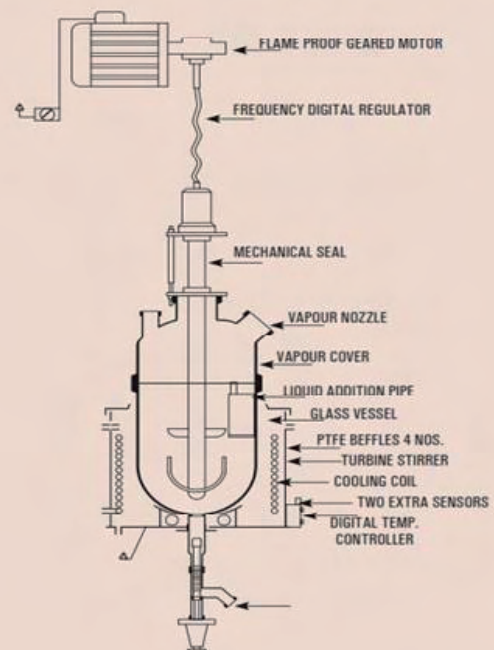
## FLANGED REACTOR

Designed for use in research & development or in pilot plant operations. Our standard Flanged Reactors are provided with cylindrical vessel with wide diameter. Glass Cover with Vapour Nozzle & Feed tube, Flush Bottom Valve, Extra Heating sensors for better heating, PTFE Battery, Flame-proof Electrical Heating Bath/Mantle, Glass Turbine Stirrer, Epoxy coated coupling & PTFE Gaskets.

All wetted parts are made of borosilicate glass or PTFE for optimum compatibility of reactants.

Size :

Cat.Ref.	DN	Actual Capacity
VZR 25/12	300	25 Ltr
VZR 50/16	400	54 Ltr
VZR 100/18	450	101 Ltr
VZR 200/24	600	198 Ltr



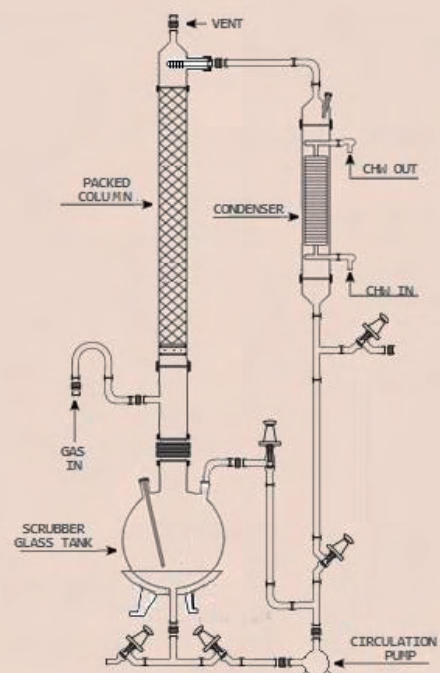
## PILOT PLANT GAS SCRUBBER

Goel offer Pilot Plant Gas Scrubber for various gases likes HCl, Cl<sub>2</sub>, SO<sub>2</sub>, Br<sub>2</sub>, HBr, NO<sub>x</sub> etc or any other corrosive gases. These scrubbers use the media as water / Aq. NaOH / any other suitable solvent which can neutralise the exhaust gases. Our Pilot plant scrubber are ranging from 20L vessel capacity to 500L vessel capacity and scrubber diameter from 80DN to 300DN.

We can also design and offer big size scrubber in Glass up to 800DN (i.e. 400/450/600/800DN). Our scrubber will be having inbuilt Cooler to remove the heat of absorption. We also offer mini Blower of PP/FRP on request along with the Pilot Plant Scrubber.

Pilot Plant Gas scrubber are mainly used in pharmaceutical, chemical, refinery & other industries. Glass scrubber offer process visibility as well as excellent corrosion resistance. Being a Glass Scrubber pressure drop across the scrubber will be minimized.

Cat.Ref	Size	Vessel	Condenser	HTA M <sup>3</sup>
PGS 3	80DN	20 L	0.5	
PGS 4	100DN	50 L	1.5	
PSG 6	150DN	100 L	2.5	
PSG 8	200DN	200 L	5.0	
PSG 12	300DN	300 L	8.0	





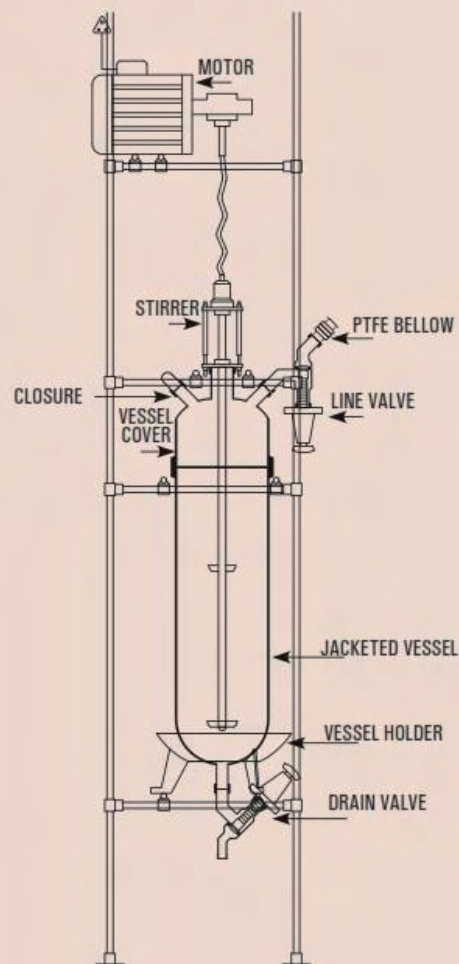
## MOBILE, MIXING SYSTEM

Glass Reactors are ideally 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.

### Cylindrical Mixing Reactor

Cat.Ref.	Vessel Ref.	Nominal Cap.(l)
CGR 20	VSL 20/9	20
CGR 50	VSL 50/12	50
CGR 100	VSL 100/18	100
CGR 150	VSL 100/18	150
CGR 200	VSL 200/18	200
CGR 300	VSL 300/24	300



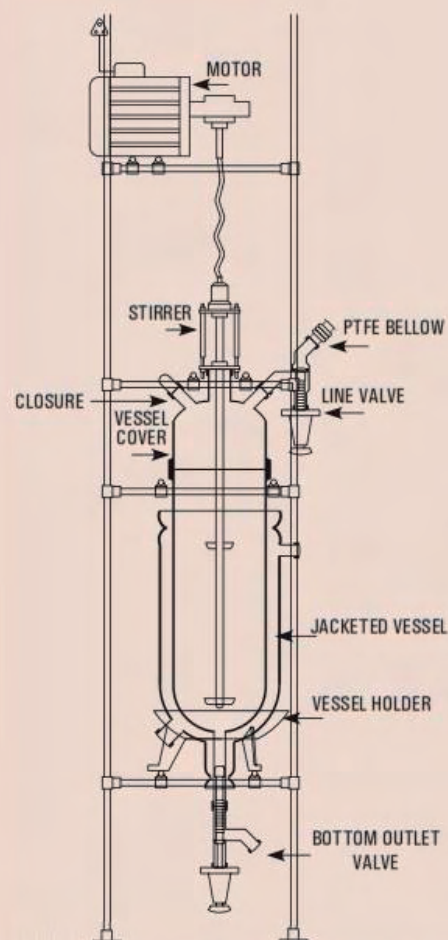
## JACKETED, MOBILE, MIXING SYSTEM

Systems are available with different options, depending upon their size & their utility. Our Technical Department will glad to assist you in finding a suitable solution for your process requirement.

1. Stirrer Drive: Non-Flameproof or Flameproof Motor, 192 RPM with speed regulator.
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: 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 structure are available in Trolley mounted form.
6. Closing Valve: Drain Valve or Flush Bottom Outlet Valve.

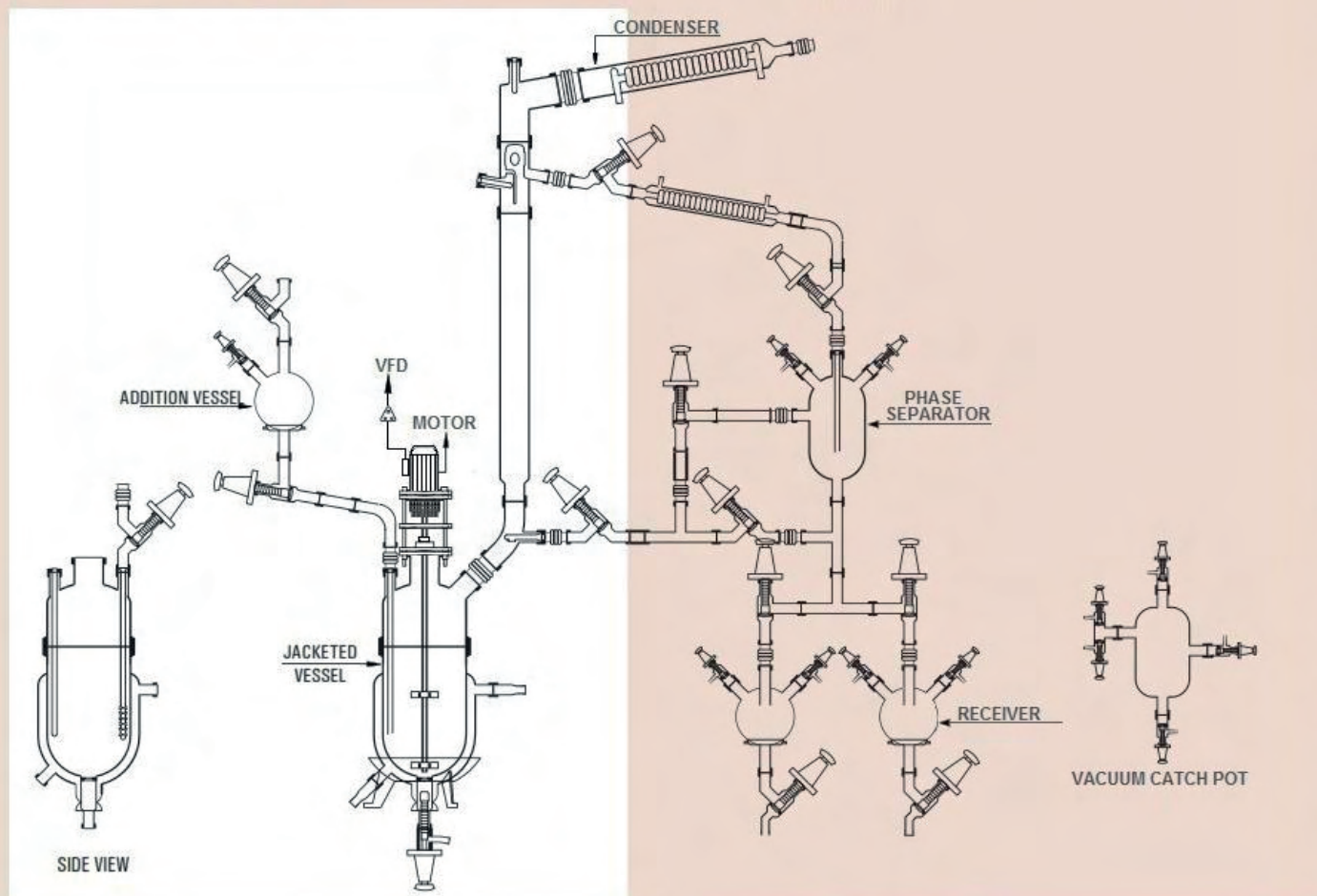
For Graduation on reactor kindly add G to the Cat. Ref.

Cat.Ref.	Vessel Ref.	Nominal Cap.(l)
JGR 5	VZD 5/6	5
JGR 10	VZD 10/9	10
JGR 20	VZD 20/12	20
JGR 30	VZD 30/12	30
JGR 50	VZD 50/12	50





## MULTI PURPOSE UNIT



- \* **Borolab** Multipurpose Pilot Plant for Chemical and Pharmaceutical Industries for Process Development, Scale-up, process Simulation and Kilo-Scale cGMP production in Batch and Semi-batch operation.

The Pilot Plant used for Chemical Processing includes Solid charging, Liquid Charging, Reaction, Heating / Cooling, Rectification, Auto / Manual Reflux arrangement, Layer Separation, Product Cooler, Vacuum Catch Pot, Vacuum Header etc.

- \* The Multipurpose Pilot Plant are designed in such a way that we can modify the same easily as per process requirement.

### Available with

- \* Jacketed full Glass Cylindrical Reactor, Oil Bath with heating & cooling arrangement.
- \* Jacketed full Glass Spherical Reactor, Oil Bath with heating & cooling arrangement.
- \* Multipurpose Glass Distillation overhead.
- \* Flame proof / Non Flame proof / cGMP and Non Gmp models available.
- \* Digital Temperature Controller.
- \* Gas purging, Solid charging / Multi liquid addition.
- \* Vacuum / Exhaust piping.
- \* Additional Feeders / Receivers.
- \* Stainless Steel / MS epoxy coated / MS painted frame supporting.
- \* Excellent corrosion resistant.

Unit Cat. Ref.	Reaction Capacity	Bath KW	Addition Vessel	Vapour Line	Condenser HTA m2	Cooler HTA m2	Receiver Size
MPU 20	20 L	4.5	2 L	80 DN	0.35	0.10	2L, 5L
MPU 50	50 L	6.0	5 L	100 DN	0.50	0.20	5L, 10L
MPU 100	100 L	9.0	10 L	150 DN	1.50	0.35	10L, 20L
MPU 200	200 L	12.0	20 L	150 DN	1.50	0.35	10L, 20L
MPU 300	300 L	16.0	20 L	225 DN	2.50	0.50	20L, 20L

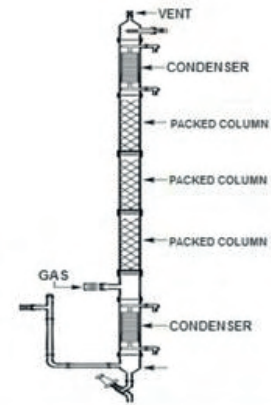


## HCL GAS ABSORPTION SYSTEM

### Introduction

Vast quantities of Chlorine are used in the Organic chlorine process. The process produces an equivalent weight of Hydrogen chloride gas containing solvent vapours, excess chlorine and other inert gases. Effective absorption and disposal of the HCL gas is required by law. Usually economic considerations demand the recovery of good quality of Hydro-chloric Acid as a by product.

HCL gas absorption system (Packed Type) provides the solution to this problem. This unit operates on the principle of adiabatic absorption, using vapourisation of water from the solution in the Column to remove heat liberated during the absorption of hydrogen chloride to water. Unit is available in different capacities up to 600DN.



## FALLING FILM ABSORPTION SYSTEM

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 flow concurrently 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 of flow than could be obtained if the tube flowed full.

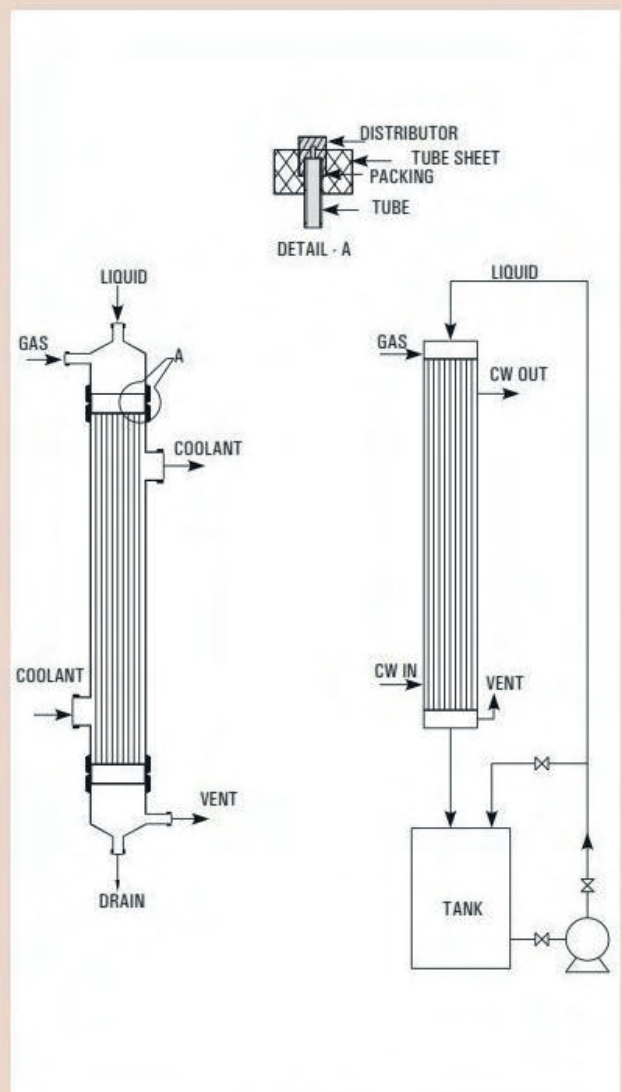
The equipment works as a number of water cooled wetted-wall columns in parallel and each tube is provided with distribution system on top to effect uniform distribution of both liquid and gas and also formation of a thin liquid film on the inner surface of the tube.

### SALIENT FEATURES

1. The heat of absorption is continuously removed. This ensures better absorption and product concentration as compared with conventional packed tower.
2. Low residence time and operating temperature ideally suited to heat sensitive materials.
3. Borosilicate glass and PTFE contact parts ensure corrosion/contamination free operation.
4. Both standard and custom built units are available.
5. Capable of operating from zero to maximum gas flow rate.
6. Ease of installation due to light weight.
7. Trouble free and consistent performance with minimal attention.
8. Wide application e.g. HCl, HBr, NH<sub>3</sub>, SO<sub>2</sub>, H<sub>2</sub>S, Br<sub>2</sub> etc.
9. Less cost.
10. Negligible pressure drop compared to conventional columns.
11. Compact design Sleek and slender.
12. Both heat and mass transfer operations are incorporated in a single equipment.
13. Very high heat transfer coefficient as the liquid falls instead of flowing.
14. Scaling of process fluid is minimal due to high velocity and ease of cleaning by simple acid circulation.
15. Hot conditions are eliminated at all stages namely pipe, tanks and pumps.

### LIMITATIONS

1. Not recommended for gases containing high proportion of inert (insoluble).
2. Not applicable if the gases are not highly soluble.



## SPECIFICATIONS

Sr. No.	Nominal Size (mm)	Absorber Area (m <sup>2</sup> )	No. of Tubes/ Tube OD (mm)	Max. Gas Absorption Rate (Pure HCl) * (kg/hr)	Max. Acid Prod. Rate (As 30% HCl) (kg/hr) *	Height (m)
1.	80	1.00	4/ 20	30	100	4400
2.	100	1.76	7/ 20	60	200	4500
3.	150	4.80	19/ 20	150	500	4600
4.	225	7.80	31/ 20	250	833	4920
5.	300	15.30	61/ 20	500	1667	5050
6.	400	36.00	143/ 20	1175	3917	5300
7.	450	47.00	187/ 20	1500	5000	5700



## SULPHURIC ACID CONCENTRATION SYSTEM

Commercial sulfuric acid is a cheap commodity and in its dilute and impure form does not have good market potential.

Disposal by neutralization with lime is associated with, problems of solid (calcium sulfate) handling and also adds to the cost.

To overcome these problems BOROLAB offers know-how, design engineering services of sulfuric acid concentration system in which the dilute sulfuric acid generated is reconcentrated to desired level for reuse. That is to say a twofold benefit of eliminating the disposal problem and minimizing fresh commercial acid requirement.

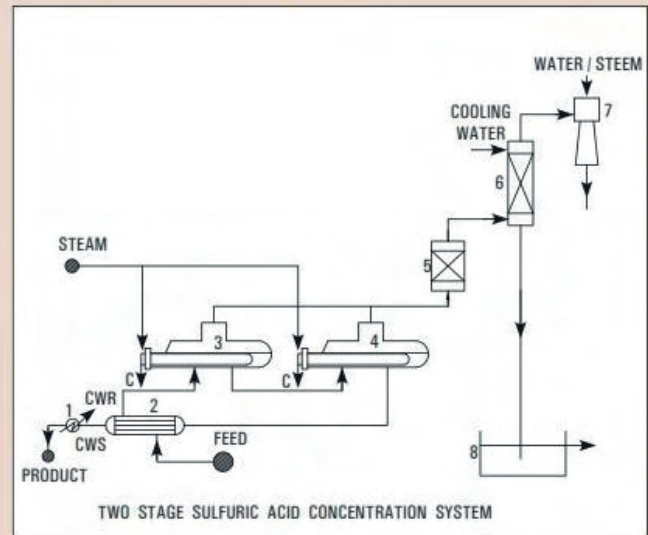
### PROCESS DESCRIPTION

The process is extremely simple & involves concentration of dilute sulfuric acid by evaporation using steam/thermic fluid as heating media under vacuum. The dilute feed is preheated & fed to a series of evaporators in stages to achieve the concentration level. The vapors from the evaporators are condensed and drained out through barometric legs and non-condensables are removed by an ejector. The final product is cooled and drawn in the storage tank.

### REQUIREMENT OF UTILITIES

The requirement of utilities viz. steam/thermic fluid, cooling water and power vary widely depending on feed rate, feed concentration and product concentration. For example for a plant having 50TPD feed containing 50% H<sub>2</sub>SO<sub>4</sub> the consumption of utilities for achieving 70% concentration are given below.

1. Steam@ 6 bar(g) pressure	800 Kg/hr
2. Cooling water @ 30 °C	70 Cu M/hr
3. Power	15 KW



### Featured Components / Equipments

1 - PRODUCT COOLER	5 - MIST ELIMINATOR
2 - FEED PREHEATER	6 - DIRECT COOLER
3 - 1ST, STAGE EVAPORATOR	7 - EJECTION
4 - 2ND, STAGE EVAPORATOR	8 - SEAL POT
C - STEAM CONDENSATE	
CWS - COOLING WATER SUPPLY	CWR - COOLING WATER RETURN

## SOLVENT RECOVERY PLANT

Solvents are universally used in wide variety of industries, their use by no means being limited to the chemical industry. The choice of solvents such as xylene, acetone, butyl acetate, methanol etc. depends on the type of application and economical considerations.

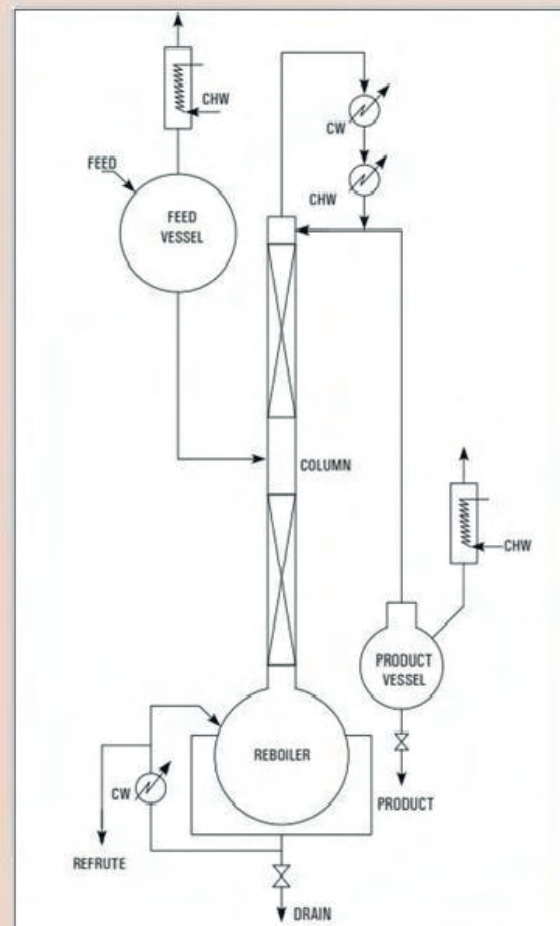
In many cases, the solvent - after use - is contaminated and not in a reusable condition. Purchase of fresh solvent and disposal costs of the contaminated solvent can prove expensive operations. Therefore, it makes sound economic sense to investigate the recovery of contaminated solvents for re-use.

BOROLAB design and supply solvent recovery plants which are capable of recovering solvents from a few kg/day to many tons/day.

### Applications :

1. BOROLAB Solvent Recovery Units are carefully designed to cater the specific requirement for each duty for wide range of solvents.
2. Continuous Distillation Units have distinct advantages, such as
  - 2.1. Ease of Operation due to steady state working.
  - 2.2. Economical design as each equipment viz. column, condenser reboiler is designed for uniform and steady-load.
  - 2.3. Uniform product quality,
  - 2.4. Uniform & low consumption of utilities.
  - 2.5. Higher productivity as down time for start-up, emptying etc. is eliminated.

The outline flow-sheet of the plan is shown in Figure. Regulated quantity of feed is fed to a distillation column from an overhead vessel. The overhead vessel is provided with a vent condenser with chilled water circulation to arrest loss of acetone vapor. The reboiler at the bottom of column in this case was a steam heated oil-bath. The vapors from top of the column pass through primary and secondary condensers with cooling water and chilled water circulation. The condensate is partially refluxed and balance continuously drawn out and collected in receiver provided with a vent condenser. The residue from the reboiler is continuously drained out.





## ANHYDROUS HCL GAS GENERATION SYSTEM SULPHURIC ACID ROUT / BOILING ROUT

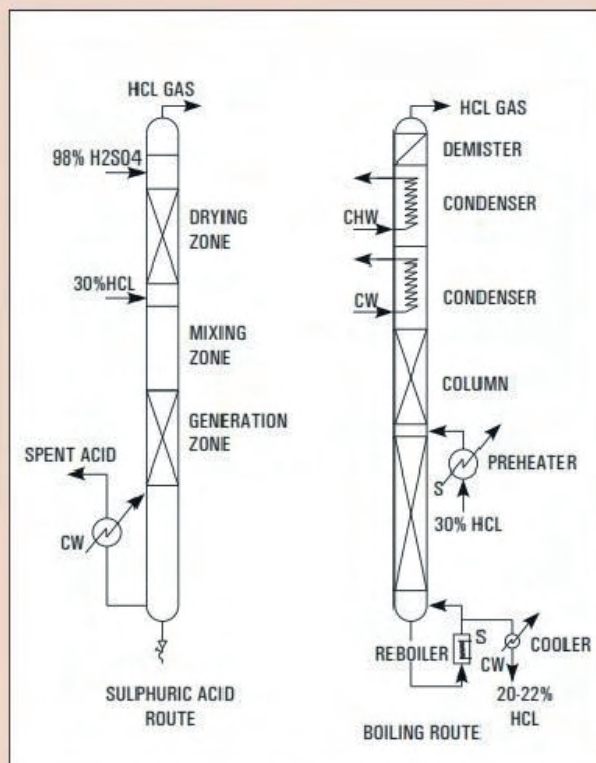
### INTRODUCTION

Commercial Hydrochloric Acid is available in the market as 30% aqueous solution. But for certain applications e.g. bulk drug and pharmaceuticals, HCl 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.

### METHOD

Several methods have been adopted by industries. But generation by Sulphuric Acid Route and Boiling Route are commonly practiced.

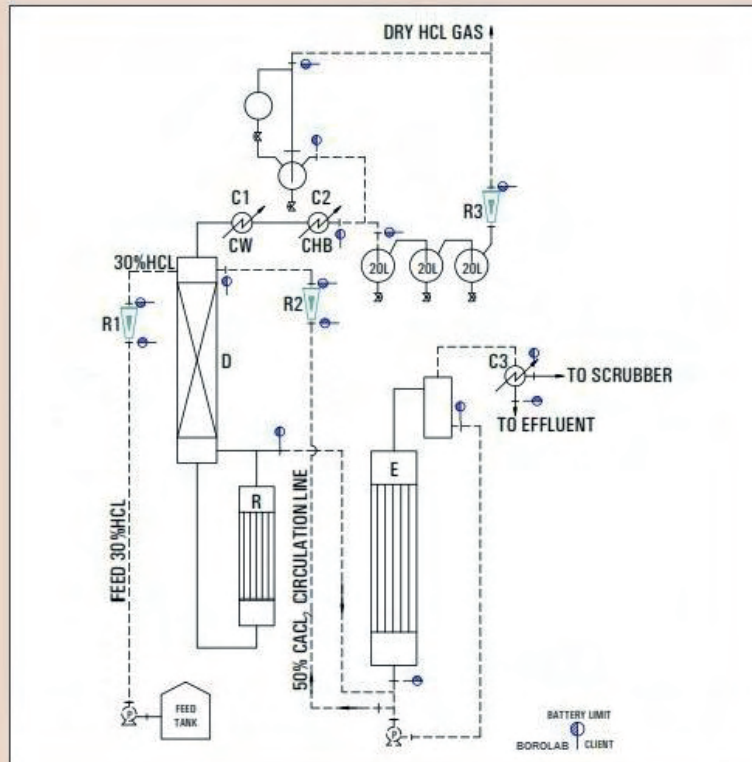
We offer Calcium Chloride Route also.



Route	Sulphuric Acid Route	Boiling Route
Working Principle	Hydrochloric acid is highly soluble in water but the solubility diminishes in presence of H <sub>2</sub> SO <sub>4</sub> and at 70 to 75% H <sub>2</sub> SO <sub>4</sub> concentration its solubility is negligible. Thus by adding (98%) commercial Sulphuric acid to commercial hydrochloric acid (30%) in proper ratio the entire HCl can be liberated in gaseous form leaving 75% H <sub>2</sub> SO <sub>4</sub> as spent acid.	Aqueous hydrochloric acid forms a maximum boiling point azeotrope at 110°C containing 20.24% HCl at atmospheric pressure. Thus by distilling commercial hydrochloric acid (30%) pure HCl gas can be generated and spent acid will contain over 20.24% HCl.
Process Outline	Metered quantities of commercial sulphuric acid hydrochloric acids are fed to the unit where they mix in the Mixing Zone. The gas generated forms a froth and enters the Generation Zone where while traveling through a bed gas is released which travels upwards through the Drying Zone. Here the gas comes in intimate contact with downward flow of 98% H <sub>2</sub> SO <sub>4</sub> . The dry gas leaving the unit passes through a rotameter. The spent liquor containing 70-75% H <sub>2</sub> SO <sub>4</sub> passes through the Cooling Zone before being discharged.	Metered quantity of commercial hydrochloric acid is preheated in a preheater by steam and fed to a fractionating column with steam as heating media in the reboiler. The vapours leaving the column are condensed with coolant as cooling water and chilled brine in stages. The relatively dry gas passes through a mist eliminator and then through a rotameter. The spent acid containing 22% HCl is cooled through a cooler and then discharged.
Salient Features	<ul style="list-style-type: none"> <li>- Operational reliability the unit can be started/ stopped in seconds.</li> <li>- Available in wide range of capacities from 5 to 200 kg/hr of dry HCl.</li> <li>- Except cooling water no other utility e.g. steam chilled water etc. required.</li> <li>- Anhydrous gas.</li> <li>- Capable of operating from 25 to 120%.</li> <li>- Ease of installation.</li> <li>- Negligible pressure drop.</li> <li>- High efficiency 99%.</li> </ul>	<ul style="list-style-type: none"> <li>- Operational reliability.</li> <li>- Available in wide range capacities from 5 kg/hr to 200 kg/hr of dry HCl.</li> <li>- Except commercial hydrochloric acid, no other raw-material is required.</li> <li>- Anhydrous gas.</li> <li>- Capable of operating from 25-100%.</li> <li>- Ease of installation.</li> <li>- Negligible pressure drop.</li> </ul>
Indicative Raw-material & Utilities for 20 kg/hr HCl	30% HCl - 70 kg/hr 98% H <sub>2</sub> SO <sub>4</sub> - 170 kg/hr Cooling Water - 2 m <sup>3</sup> /hr	30% HCl - 200 Kg/hr Saturated Steam - 50 kg/hr Cooling Water - 3.5 m <sup>3</sup> /hr Chilled Brine - 4 m <sup>3</sup> /hr



## ANHYDROUS HCL GAS GENERATION SYSTEM CALCIUM CHLORIDE ROUT



### Working Principle:

Hydrochloric acid and water form a maximum boiling point azeotrope at  $110^{\circ}$  corresponding to a concentration of 20.24% (W / W) HCL. By adding concentrated  $\text{CaCl}_2$  solution to commercial hydrochloric acid the azeotrope point is eliminated and the entire HCL becomes available for liberation by distillation. Anhydrous HCL gas generation through Calcium Chloride Route is the most environmental friendly technique.

### Process Description:

The above principle is achieved in practice by feeding metered quantities of commercial HCL and 50%  $\text{CaCl}_2$  solution to a stripping column with a steam heated re-boiler at bottom. The effluent from bottom of the column is a diluted acidic calcium chloride solution which is concentrated to 50% in an evaporator and re-used. The vapor leaving is condensed, stage-wise with cooling water and chilled brine as coolant. The relatively dry gas passes through a mist eliminator and then through a rotameter to the point of consumption.

### Raw material utility requirement

The indicative requirements for 20 Kg / hr HCL Gas Generation System are given below:

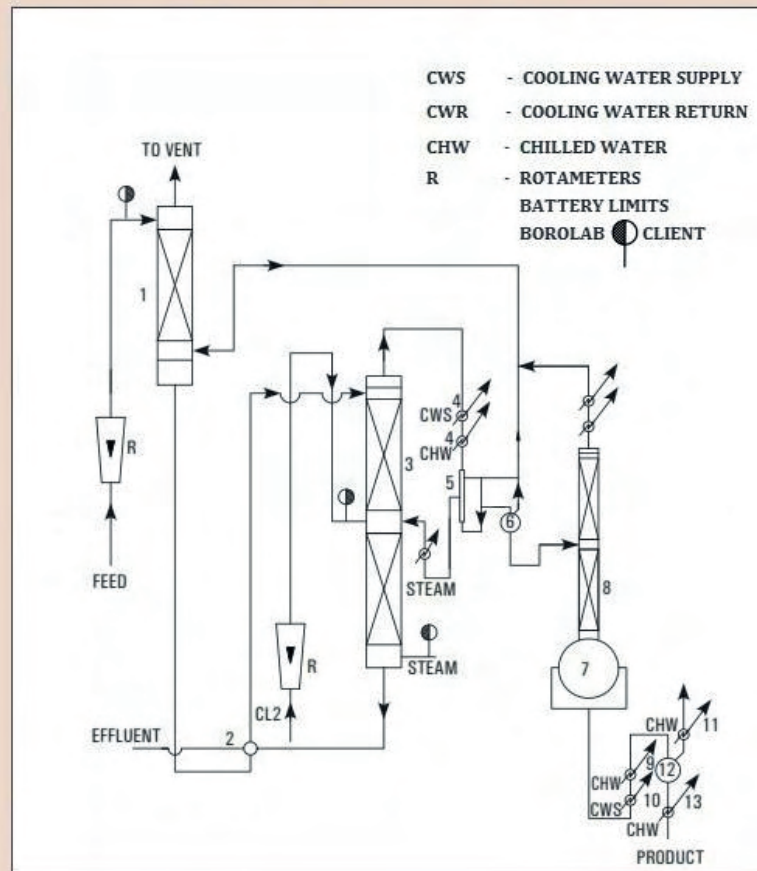
a.	30-32% HCL, (Kg / hr)	:	66
b.	Cooling Water at $30^{\circ}\text{C}$ ( $\text{M}^3$ / hr)	:	4
c.	Chilled Brine at $10^{\circ}\text{C}$ ( $\text{M}^3$ / hr)	:	3
d.	Steam at 6 Kg / cm (g)	:	150

### KEY:

R - REBOILER	C2 - SECONDARY CONDENSER	CW - COOLING WATER
D - COLUMN	R1 - FEED HCL ROTAMETER	CHB - CHILLED BRINE
E - EVAPORATOR	R2 - FEED $\text{CaCl}_2$ ROTAMETER	C3 - CONDENSER
C1- PRIMARY CONDENSER	R3 - DRY HCL GAS ROTAMETER	P - PUMP



## BROMINE RECOVERY SYSTEM



Hydrochloric acid and water form a maximum boiling point azeotrope at 110° corresponding to a concentration of 20.24%; Bromine is available in the sea bittern, as well as Industrial waste e.g. Aq. HBr / Aq. NaBr / Aq. K Br. The Bromine concentration in the feed stock varies from 2 gpl to 300 gpl from Industry to Industry.

BOROLAB Offer suitable Bromine Recovery System for the various feedstock based on long time expertise in this field. The package considered is schematically shown in drawing enclosed herewith.

The process consists of simultaneous chlorination and steam blowing. The feedstock, acidic in nature, is preheated near to its boiling in feed pre heater and then fed to the main column where steam and chlorine are blown simultaneously. The bromine as set free by chlorine are steam distilled. The liberated bromine together with steam and some excess chlorine is condensed in the condenser. The condensate is taken to a gravity separator where bromine and bromine water are separated. While bromine is taken in the purification column the Aq. layer is recycled in to the main column. Crude Bromine is purified under reflux and pure bromine is collected in the receiver. All uncondensed vapours pass through the tall scrubber to recover the last traces of bromine.

### KEY:

1.	TAIL SCRUBBER	7.	REBOILER
2.	FEED PREHEATER	8.	PURIFICATION COLUMN
3.	Br STRIPPING COLUMN	9.&10.	PRODUCT COOLER
4.	Br CONDENSERS	11.	VENT CONDENSER
5.	PHASE SEPERATOR	12.	PRODUCT RECEIVER VESSEL
6.	CRUDE Br RECEIVING VESSEL	13.	PRODUCT RECEIVER VESSEL

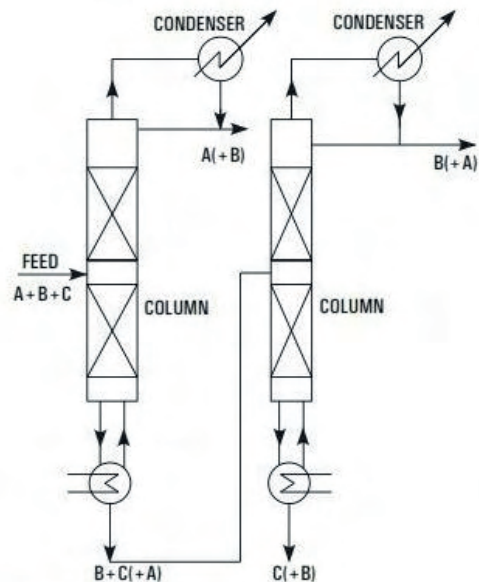
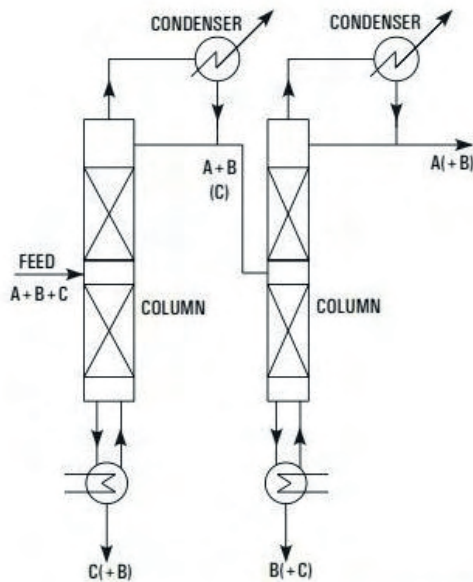
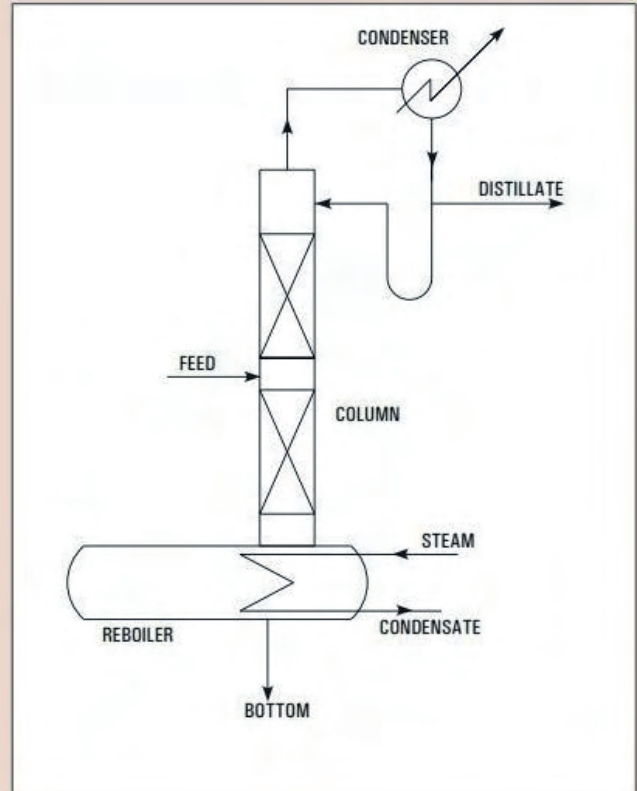


## CONTINUOUS DISTILLATION SYSTEM

The limitations of batch distillations are naturally circumvented in continuous distillation as shown in fig.2 which is a typical fractionating unit comprising of ratification & stripping sections. Here feed is continuously fed to the column with withdrawal of top & bottom products. The process takes care on its own by simply maintaining the flow rates of feed & Utilities.

However when more than two products are desired as in case of multicomponent systems additional columns are required as each column is capable of giving two products only. That is to say, for multicomponent system only one product is obtain in relatively pure form from each column. The other product containing the remaining components is fed to a subsequent column where again one product is obtained in relatively pure form. The addition of columns continue till the system becomes binary & both components are separated in the final column.

An important principle to be emphasized is that a total  $n-1$  fractionators are required for complete separation of system of  $n$  components. Which of the two products in a column is to be obtained in relatively pure form depends on relative volatility of each component in the feed stock. For example consider a ternary solution consisting of a components A, B & C whose relative volatilities are in that order (A most volatile). In order to obtain three substances in substantially pure form either of the schemes shown in fig-3 may be used. Which of the two schemes would be used depends on the relative difficulties of separation in each method and the choice calls for finer considerations of principles of distillation. However scheme (b) is usually preferred since it requires one vaporization of substance A.



Component given in bracket are in small quantities.



## ROTATING DISK EXTRACTION COLUMN

### Introduction

Separation will be carried out normally with the help of distillation but when it is not feasible by distillation or ineffective liquid-liquid extraction is one of the process to consider. There few mixtures are having close boiling points components or heat sensitive components which can not withstand the temperature of distillation, even under vacuum may often be separated from impurities by extraction which utilize the chemical properties like specific gravity, solubility etc. instead of vapour pressure differences.

Separations by liquid-liquid extraction can be defined as the selective removal of one or more components either from a homogenous liquid mixture or from a solution, using a second liquid or solvent, which is partially or wholly immiscible with the first.

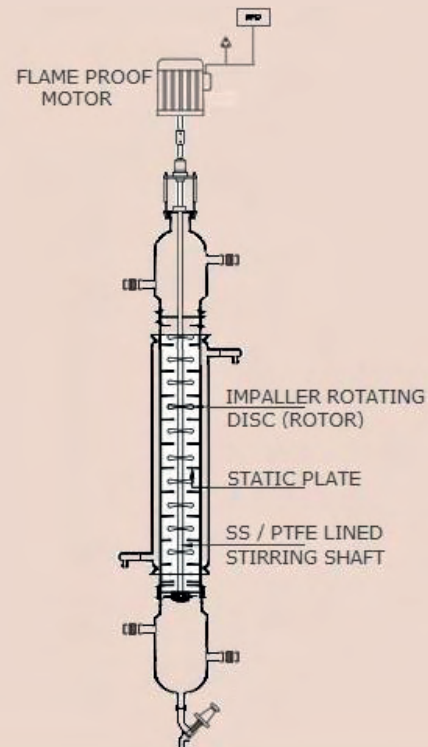
### Construction

The core of the unit is a rotating disc with varied no of stages between 1 m to 2 m height. The RDC blade can be made of PTFE or SS 304 or SS 316 depending on the customer requirement.

The system can be supplied with or without dosing pump and two feed vessels as well as two receivers. The drive used for the rotation of the disc is a standard geared-motor with an AC speed regulator. The agitator shaft is sealed by means of a mechanical seal.

The outer column can be constructed as a jacketed pipe or without jacket as per the customer requirement. The unit is designated by the diameter of the extraction column and no. of stages as per the customer specification depends on the flowrates and properties of the chemical used.

Model	Size	DN (mm)Hight
RDC3	80	2.0
RDC4	100	2.0
RDC6	150	2.0
RDC9	225	2.0
RDC12	300	2.0
RDC16	400	2.0



## PRECIOUS METAL REFINING SYSTEM

### Introduction

Borosilicate glass is inert to almost all materials. Due to which it is now widely used in Precious Metal Refining Industry. Borosilicate Glass is the only material which doesn't absorb Precious metals. Its transparency allows ease of visualization & smooth surface allows ease of cleaning.

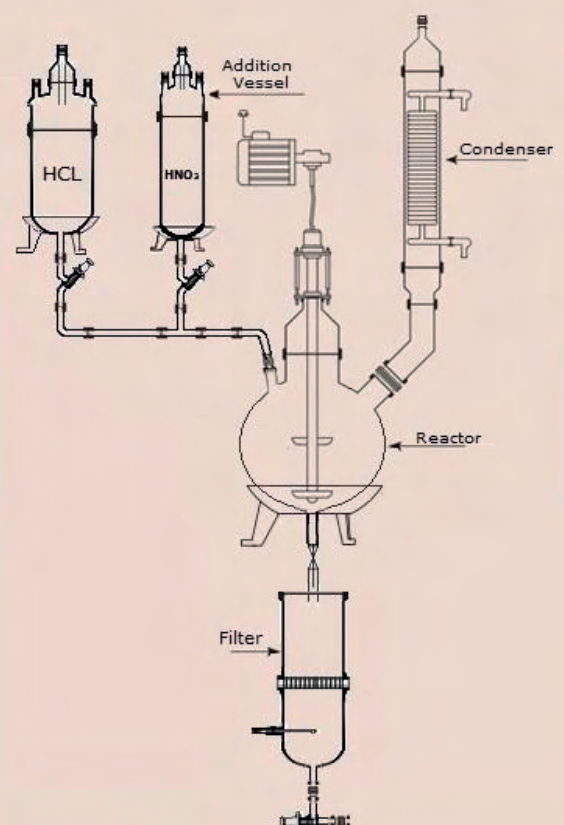
We have supplied various capacity glass assemblies in precious metal refinery for Aqua Regia solution. Our Glass Container/Vessel are also used as dissolution, precipitator and separator for Gold /silver/ platinum recovery with Aqua Regia / Hydrazine solution.

**Scrubbing Unit :** The fumes generated by Aqua Regia in a gold refining process are toxic. We design & offer suitable capacity Glass Scrubber Unit for removal of NOX Fumes.

**Filer Unit :** We also offer Glass Filter Unit on wheels for removing of precious metal from the Aqua Regia solution.

**Nitric Acid Boiling Apparatus :** Nitric Acid Boiling Apparatus with condenser for Laboratory testing is also available with us.

**Sampling Tubes :** Vacuum Tubes (VPT 111 ) for removal of samples from the batch are also manufactured by us.





## AGITATED GLASS NUTSCHE FILTER

### Introduction

Agitated Glass Nutsche Filter is a closed vessel designed to separate solid and liquid by filtration under vacuum. The closed system ensures odourless contamination free and non-polluting working conditions maintaining product purity and hygiene. Agitated Nutsche Filters are extensively used in Herbal products, Chemical product development, kilo lab operation, pharmaceutical manufacturing, agro chemical and the food industry.

### GENERAL DESCRIPTION

A typical unit consists of a dish shape vessel with a perforated plate. The entire vessel can be kept at the desired temperature by using a mixer / agitator and jacket. It's completely leak-proof for vacuum or pressure service. The base plate is having arrangement of bolting bar to hold the filter cloth. Suitable nozzles can be provided including Manhole and Side discharge nozzle. PTFE Lined Stirrer are used for Agitator shaft and solid PTFE blades are used to take high torque generation during solid discharge and re-slurring operation. Drive assembly consist of Motor with VFD, Mechanical Seal is provided for vacuum application. Borosilicate Glass Vessel with different nozzles, Manual/Hydraulic system is provided for movement of agitator as well as bottom plate. PTFE Filter Support Plate.

### PROCESS STEPS OF AGITATED NUTSCHE FILTER WITH AGITATOR :

- 1) Filtration.
- 2) Washing of Filter cake.
- 3) Repeat mix or washing of the cake.
- 4) Convection drying of the cake.
- 5) Smoothing with compression of the cake
- 6) Discharge of the wet or dried cake.

### ADVANTAGES OF GLASS NUTSCHE FILTER

- > Vacuum filtration possible.
- > Glass being transparent, offers visibility of processes.
- > Inert gas atmosphere can be maintained.
- > Minimal contamination of the cake.
- > Very high solvent recovery.
- > Solvents are closed systems, so no toxic vapors are let off in the atmosphere.
- > Personal safety is maintained, and heat transfer surfaces can be provided to maintain filtration temperature.



"BOROLAB" Offers Glass Agitated Nutsche Filters from 10L to 200 L cap., for Kilo-Lab operations with or without Jacket, with or without Stirrer.





**ROTARY FILM EVAPORATOR****Introduction**

Rotary Film Evaporators are essentially thin film evaporators. The rotating flask continuously covers a large surface area with a thin film which is ideal for rapid heat transfer. The thin film also ensures uniform heat distribution without local heating. The facility to work the unit under full vacuum further facilitates evaporation at as low temperature as possible. This elaborates that both boiling point and residence time are significantly reduced. These features combined, renders rotary film evaporator to be ideally suited for heat sensitive material. This is equally successful for evaporation of suspension crystallization processes, drying of powder / granules etc.

Rota-evaporators find wide use from small-scale Laboratory set-ups, Kilo-Labs, R&D and Industrial operations.

"Borolab" Rota Film Evaporators are preferred by both research and production facilities & are widely used in Laboratories, Chemical & Pharmaceutical Industries and Food & Biotechnological Industries.



## Rotary Film Evaporators ( 2 Ltrs to 200 Ltrs.)

### SALIENT FEATURES

1. Universal corrosion resistance.
2. Auto controlled digital display of rotational speed and bath temperature.
3. Digital display of process time.
4. Automatic bath lifting.
5. Automatic bath lowering in case of power failure.
6. RS-232 Interface (Optional).
7. Withstands full vacuum.
8. Ideally suited for heat sensitive material.
9. Maintenance free working - Operational reliability.
10. Available in large sizes upto 200 Litre.

### CONSTRUCTION

"Borolab" Rotary Film Evaporators are self contained units consisting mainly of:

- An electrically heated SS heating bath with facility for raising and lowering the height.
- Rotating flask of corrosion resistant borosilicate glass which is connected to drive by a coupling.
- The drive is a hollow glass shaft which also acts as vapour off-take pipe. The drive shaft is sealed on condenser/receiver with teflon seal. Power is transmitted to the shaft by a motor driven gear with provision for varying speed.
- Condenser/receiver arrangements are of standard design depending on the model/size.

### PERFORMANCE DATA

The performance of rota-evaporator depends on various parameters such as temperature differential between bath and contents of flask, RPM, flask capacity and working pressure. An indicative comparison of boil-up of CCl<sub>4</sub> rates for 20L, 50L and 100L is given in adjacent figure.

#### 2, 3 & 5 Ltrs.

##### Salient Features

- \* Attractive Vertical Orientation for Industrial & Robust Use
- \* 2 Ltr Pear Shaped evaporation flask, 1 Ltr receiver
- \* Glass Coil Condenser with 0.10 sq. mtr HTA
- \* Digital RPM indicator & VFD based speed control, 0.25 Hp Motor, 0-80 RPM
- \* Digital Temperature Indicator & controller
- \* Digital vapor temperature indicator
- \* Manual UP & Down of Bath
- \* Jacketed Bath with electrical heaters, 2 KW with Overflow nozzle & drain valves
- \* Durable gearbox, with Motor Encased into the mechanical Assembly
- \* Fully PU Coated
- \* The whole unit is base mounted.
- \* Fully tested & ready to use !!

#### 10, 20, 50, 100 & 200 Ltrs.

##### Salient Features :

- \* Attractive Vertical Orientation
- \* Digital RPM indicator & VFD based speed control
- \* Digital Temperature Indicator & Controller
- \* Digital Process Time Indication
- \* Digital vapor temperature indicator
- \* Motorized VFD based UP & down of bath
- \* S.S. bath with Jacket & electrical heaters with overflow nozzle & drain valves
- \* Durable S.S. gearbox, with motor encased into the Mechanical Assembly
- \* Complete glass assembly as per the specs in the table
- \* Anti splashing hood
- \* PU coated
- \* The whole unit is mounted on lockable wheels.
- \* Dimensions : 1100 x 600 x 1500 approx (with glass assembly)
- \* Fully tested & ready to use !!

##### Optional :

- \* UPS back up for auto lowering bath
- \* Chiller unit
- \* Vacuum pump with setup



MODEL	ROTATING FLASK Cap. (Ltrs.)	ROTATING Speed (RPM)	ELETRIC MOTOR Rating	CONDENSER Cooling Area	RECEIVER FLASK Cap. (Ltrs.)	POWER SUPPLY (Volt/Hz)	ELECTRIC BATH RATING
BRFE 2	2	0-80	40 Watt	0.15	1	230 Volt, 50 Hz	2
BRFE 3	3	0-80	40 Watt	0.15	1	230 Volt, 50 Hz	2
BRFE 5	5	0-80	40 Watt	0.15	2	230 Volt, 50 Hz	2
BRFE 10	10	0-80	0.25 HP	0.20	5	230 Volt, 50 Hz	4
BRFE 20	20	0-80	0.25 HP	0.30	10	230 Volt, 50 Hz	6
BRFE 50	50	0-80	0.5 HP	0.50	20	230 Volt, 50 Hz	8
BRFE 100	100	0-50	2.00 HP	0.30	10	230 Volt, 50 Hz	14
BRFE 200	200	0-50	2.00 HP	0.30	10	230 Volt, 50 Hz	18





**Borolab**



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