AUTOCOL

Solvent Recovery.
Purification.
Fractionation.

Autocol systems from Pope Scientific deliver economical packed column technology for a wide range of batch distillation applications.

FOR CONCENTRATING WASTES FOR SAFER AND MORE ECONOMICAL DISPOSAL OR FOR PURIFYING SOLVENTS FOR REUSE, AUTOCOL SYSTEMS CAN DELIVER THE PURITY YOU NEED, AND CURTAIL — IF NOT ELIMINATE — THE HIGH COST OF OFF-SITE TREATMENT. NOW YOU CAN OBTAIN ***PURE*** SOLVENTS FOR REUSE INSTEAD OF SETTLING FOR CRUDE SOLVENT MIXTURES.

THE FLEXIBLE NEW EASY-TO-USE, MICROPROCESSOR DRIVEN AUTOCOL SYSTEM INCORPORATES ALL THE PROVEN ADVANTAGES OF MULTI-PLATE, PACKED COLUMN DISTILLATION IN ONE COMPLETE, EASY TO USE PACKAGE. AN AUTOCOL SYSTEM IS YOUR BEST CHOICE FOR MANY DEMANDING ENVIRONMENTS, INCLUDING CLINICAL, RESEARCH, AND ANALYTICAL LABORATORIES, AND INDUSTRIAL FACILITIES.

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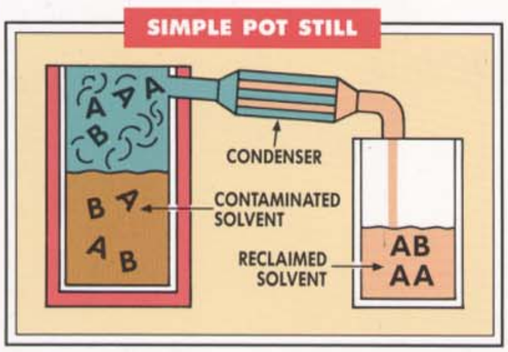
Design Factors Limit Simple Pot Stills...

There are many devices known as "simple pot stills" on the market today, but they cannot effectively separate and purify a mixture unless the boiling points of that mixture's components differ substantially. The reason: as the more volatile components ("A" in illustration below) in any mixture begin to boil, some of the less volatile components ("B") will vaporize and condense, too, contaminating the collected solvent.

While a simple pot still may be adequate for some situations — removing a single solvent from a heavy, nonvolatile oil or sludge, for example — in many real world applications, mixtures contain several solvents, resulting in often unpredictable, impure and only marginally beneficial separations.

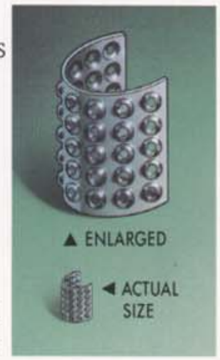
There is no practical way to overcome these thermodynamic limitations with a simple pot still.



But Autocol Provides Real Separation Power

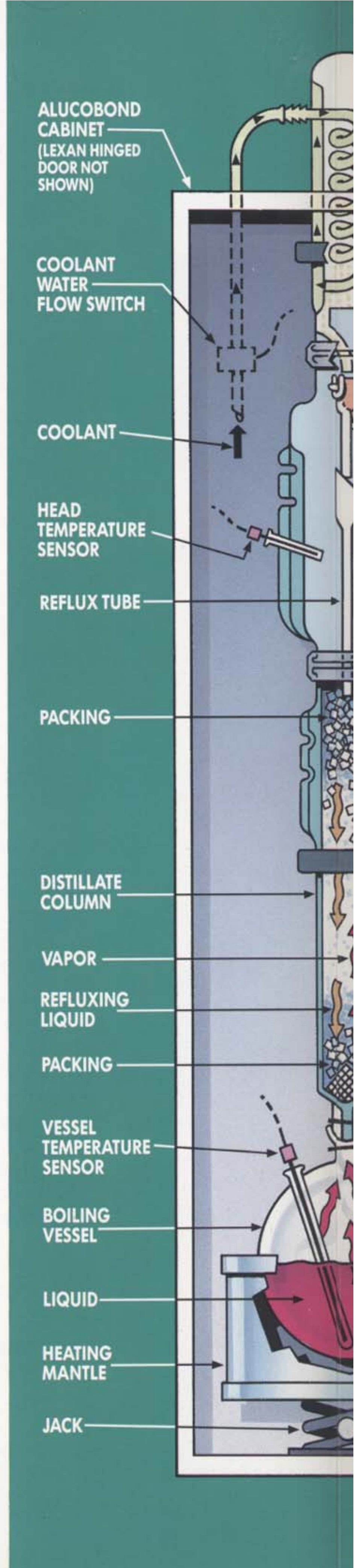
In an Autocol from Pope Scientific, some of the vapor driven off the boiling vessel condenses in a column. As it flows back to the vessel it tends to attract molecules like itself out of the vapor. Increased liquid / vapor contact as vapor travels up through the column tends to increase the concentration of the more volatile component in the vapor. This phenomenon, known as fractionation, provides powerful separation of individual components which *cannot* occur in any simple pot still.

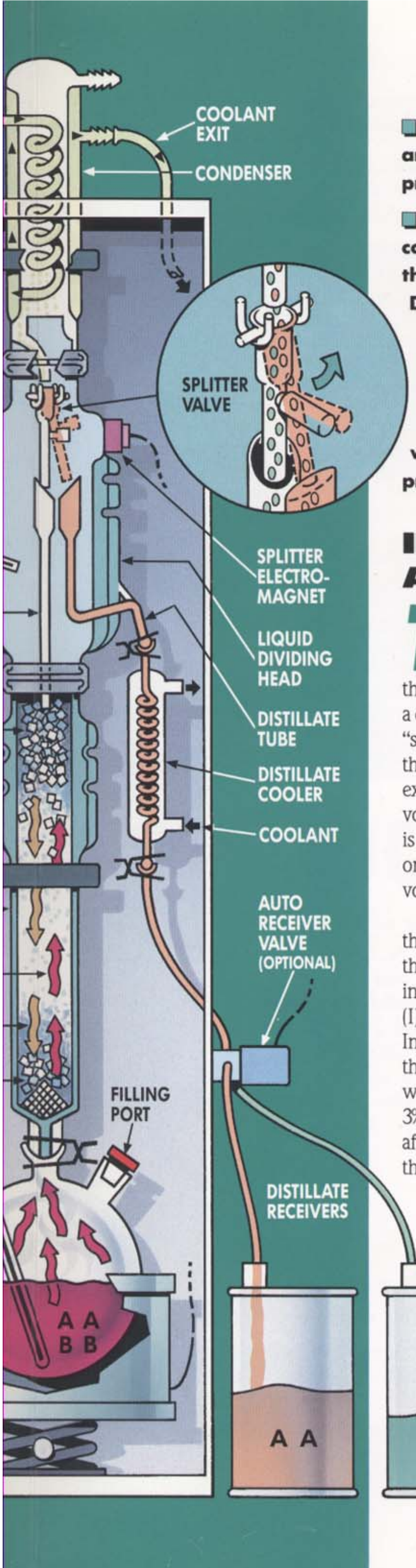
When the returning condensate (or *reflux*) and the rising vapor reach equilibrium, a "theoretical plate" exists. A still's separating ability depends on the number of theoretical plates *and* the proportion of liquid returned to the boiling vessel (the *reflux ratio*). A simple pot still has one theoretical plate, offers no control over the reflux ratio, and provides almost no fractionation. The result is an impure distillate.



A Pope column contains a specially engineered perforated 316 protruded stainless packing to increase vapor to liquid contact, and achieve a rating of more than 15 theoretical plates with a column height of only 24 inches. The result is a still that is more than 15 times more efficient than any simple pot still. Here is an example of what happens during an Autocol distillation:

- **The operator turns on the Autocol programmable microprocessor and follows the prompts to select (or create) a distillation program. The Microprocessor checks to confirm the cooling water flow, heater operation, temperatures, and other variables.**
- **The Heating Mantle begins to boil the mixture in the Boiling Vessel, and vapor rises through the Column. Condensation forms in the Column, flows downward as reflux, and further purifies the vapor.**
- **The Condenser condenses the purified vapor, which flows into the Liquid Dividing Head.**
- **A Splitter Valve (driven by an Electromagnet) divides the liquid stream according to pre-programmed reflux ratio.**
- **Collected distillate flows through a Distillate Cooler and into a Distillate Receiver.**





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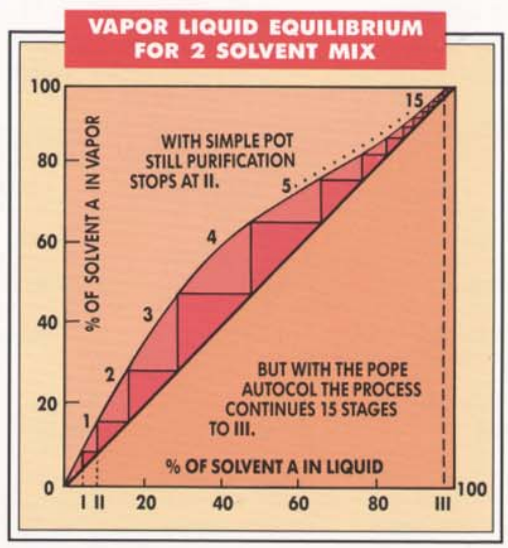
- **Temperature Sensors monitor vapor and liquid temperatures, allowing microprocessor control over the entire run.**
- **An optional Microprocessor-controlled Auto Receiver Valve directs the distillate to selection of two Distillate Receivers. This is especially useful where a "midcut" product is required, and is impossible with a simple pot still.**
- **The unit shuts down automatically when the run is complete, based on programmed temperature limits.**

Illustration of The Autocol Advantage

The plot at right shows the composition equilibrium relationship (McCabe-Thiele Diagram) between a vapor and the liquid from which it is evaporated during a distillation. Here, each "step" up represents one theoretical plate. In this example the more volatile component *(A)* is more easily evaporated than the less volatile component *(B)*.

In a simple pot still the concentration of the distillate could increase from about 3% (I) and stop at 5% (II). In an Autocol system the concentration would increase from 3% (I) to about 98% (II) after going through 15 theoretical plates.



Note that the shape of a vapor composition equilibrium diagram will vary widely with the particular chemicals in the mixture. Also, in many mixtures an *azeotrope* forms at a certain concentration level. No distillation process can purify an azeotrope beyond that fixed point. Other parameters such as reflux ratio and column throughput rate will have a bearing on system separating capability. Keep in mind, however, that the Pope Autocol with multiple theoretical plates will invariably deliver a condensate with greater purity than will a simple pot still.

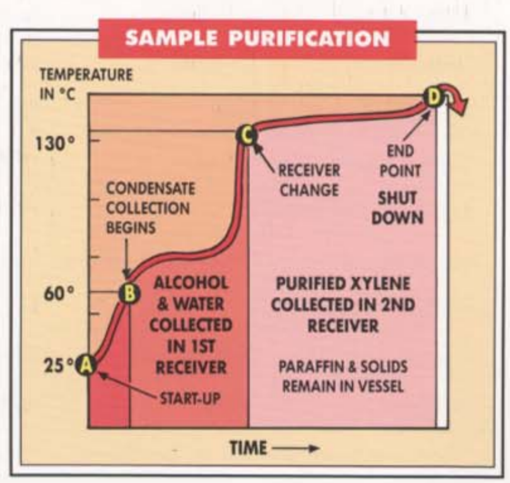
Operation Example – Recovery of Xylene

The second plot is a graphic illustration of a "midcut" distillation of a solution of 80 wt % xylene contaminated with ethanol, water, and paraffin.

The solution is heated for 30 minutes (from A to B), at which point the vapor temperature reaches the first setpoint temperature of 60 °C, and the system begins to collect a first cut. This first condensate consists of ethanol and water, and continues to be collected between points *B* and *C* as the vapor temperature increases gradually.

When the waste ethanol and water are removed totally, the vapor temperature rapidly jumps to 132 °C, and the system automatically switches receivers. A second cut consisting of 99+% pure xylene continues between points C and D until the temperature reaches a programmed cutoff of 145 °C, and the system automatically shuts down (point E).

The paraffin remains in the vessel and is discarded.



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AUTOCOL SYSTEM PERFORMANCE WITH TYPICAL SOLUTIONS

High Purity Methanol

99.9% was produced from contaminated 90% methanol by taking off a first cut of distillate at 60° to 63.5° C and recovering the high purity methanol at a 5:1 reflux ratio at 63.8° to 63.9° C. Heat input was 1,300 watts with a distillation rate of approx. 1 L/Hr, excluding warm up, with a 1-1/2" dia. column. 93% of the methanol was recovered.

Fractionation Of A Polymeric Ether

A polymeric ether was fractionated in a 1" column by starting with total reflux during the heat up period. The refluxed fraction has a boiling point 25° C lower than product specifications indicating the presence of monomers or other contamination. With the microprocessor it was possible to "cut" the low boiler out and proceed with the distillation over the specification range of 25° C. Distillation rate averaged 5.97 L/Hr with 700 watts input. The microprocessor allows a "cut" of the distillate into three fractions over the boiling range. Purity would be controlled by imposing the required reflux on each range.

High Purity Acetone Recovery

A 30 wt % solution of acetone in water was distilled in a 1-1/2" diameter packed column to 99.9 +% purity using a 3:1 reflux ratio. Three incremental heat inputs were automatically applied, ranging from 800 watts to 950 watts. The maximum distillation rate was 1.3 L/Hr with an average of 1.16 L/Hr. 92.7% of the acetone was recovered.

Purification Of Acetonitrile

50 wt % was distilled to the azeotrope at 85+ wt %. The recovered azeotrope of 85 + % acetonitrile, 14 + wt % water contained 88% of the available acetonitrile in the original 5.3 liters with an initial reflux of 2:1, the average distillation rate was about 1 L/Hr in a 1-1/2" dia. column. Heat input was 650 watts.

The Microprocessor

The Pope Autocol Microprocessor stores up to eight programs with three cuts each. Selectable parameters include equilibration time, reflux ratios, and heating power for each cut; beginning, middle, and endpoint temperatures; alarm modes; autoreceiver modes; monitor and alarm functions for condenser coolant flow, temperature sensor and heater operation, and deviation from program conditions.

Safety features include initialization prompting, alarm modes as above (with display of the problem detected), overtemperature cutoff, and available optional automatic fire extinguisher.

SYSTEM SPECIFICATIONS

	1" Diameter	1.5" Diameter	2" Diameter
Flask Size	5 liters	12 liters	22 liters
Nom. Filling Capacity	3.7 liters	9 liters	17 liters
Throughput/Boilup***	2.5 liters/hour	6 liters/hour	9 liters/hour
No. Theoretical Plates	15	15	15
Holdup	20 ml	30 ml	50 ml
Column Height	24 inches	24 inches	24 inches
Packing Material	Perf. 316 Stainless*	Perf. 316 Stainless*	Perf. 316 Stainless*
Wetted Material	Pyrex, Teflon	Pyrex, Teflon	Pyrex, Teflon
Cooling Water	0.3 gal/min	0.6 gal/min	0.9 gal/min
Max Wattage	600 W	1300 W	1540 W
Electrical Requirements	120V-6A	120V-12A	120V-15A
Max. Distillation Temp.	300°C	300°C	300°C
Cabinet Material**	Alucobond w/Lexan door	Alucobond w/Lexan door	Alucobond w/Lexan door
Back Clearance Req'd.	6"	6"	6"
Dimensions (W x D x H)	25"x24"x83"	25"x24"x92"	25"x24"x92"
Weight	104 lbs.	122 lbs.	146 lbs.

* Other materials available to meet your specific needs. ** Vent ports available if required.
*** Based on xylene distillation. CSA and UL listed components used throughout.

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ALSO AVAILABLE

- Open frame systems
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