



## SOLVENT RECOVERY

In assessing the economics of a process, the cost of solvent can be a significant factor. This is particularly true when requiring fresh solvent for each batch. The cost is driven up even further due to the costs associated with the waste disposal of used solvents and the associated environmental regulations which must be respected. Recovering solvents therefore presents a good way of making substantial cost reductions with environmental benefits.

Most of the reactions that occur in a synthesis process, within the chemical and pharmaceutical industries, are conducted with one or more solvents. These, except in a minority of special cases, do not participate in the reaction.

At the end of the process, the solvents are typically contaminated and cannot be reused. Therefore it is usually necessary to arrange for their disposal and to buy in fresh solvent. This can all prove to be very costly as the purchase cost for a new solvent is high. The cost of disposal of used solvent is typically around 10% of the solvent purchase price. For these reasons, installing a solvent recovery plant could be economically and environmentally advantageous. The solvents recovered are purified by fractional distillation.



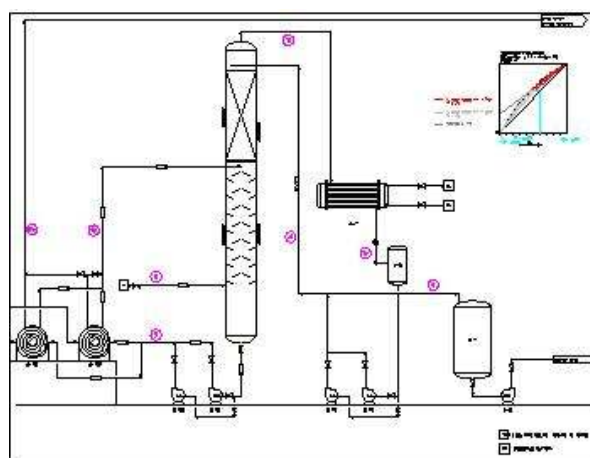
**Solvent recovery plant**

The operating principle is to separate the different components of a mixture by evaporation and condensation by exchange of mass between liquid condensed and vapour generated. Depending on equilibrium, liquid / vapour plants of different complexity are required. It is also important to pay particular attention to the issues of corrosion and fouling.

### HOW CHILWORTH CAN HELP YOU

The extensive experience of our specialists in the design of solvent recovery systems allow us to be authoritative and credible

when proposing specific solutions for processes, whilst respecting the rules of good practice, safety and environment.



In the conduct of our studies, calculations and designs, we use:

- A collection of data containing more than 12500 results of experimental tests on azeotropic (also ternary and quaternary) and non-azeotropic mixtures.
- Software to simulate thermodynamic behaviour of multiphase and multicomponent mixtures. The program to represent the ideal and the non-ideal behaviour of mixture uses the main equations of state, activity coefficients and the properties of transport models. The software is linked to the database DIPPR®, which contains data for almost 2000 different substances.
- Laboratory tests on substances, at UK based laboratories.
- A pilot plant consisting of a structured packing distillation column of 2 litre volume, with a reboiler, a condenser and a vacuum pump.

Specifically, our design activities include:

- **Wastewater stripping plant design**

Stripping plants are a very economical way to clean up wastewater.

This plant is based on a multi-stage continuous distillation process, where the vapour is used to remove VOCs (volatile organic compounds) from wastewaters.

Our engineers can help you in the design of plants for the combustion of VOCs which are unrecoverable.

## • Distillation plant design

We are able to design distillation plants for solvents containing solid substances (dissolved or suspended) without fouling the plant. The distillation can be performed under atmospheric pressure conditions or under vacuum.

We have extensive experience in designing complex systems, which require the use of extractive distillation methods.

From an economic standpoint, waste solvent distillation carried out on-site provides:

- Better control of the quality of the initial and finished products;
- Better energy conservation compared to external treatment or destructive treatment.

## • Distillation vacuum systems design for purification of thermally unstable substances

We have significant experience with high vacuum systems for molecular distillation.

If the information for vapour / liquid equilibrium (VLE) of a substance to be purified by distillation is not available, then it

is not possible to use a process simulation. In such cases we are able to simulate the tests in our pilot plant. In our UK laboratories we are able to perform thermal stability tests on the substances to be distilled.

## • Design of plants for the concentration of saline solutions by vapour recompression

This type of plant is useful for wastewater treatment and for production process operations. The plant is designed according to the customer's needs; it is the most economic system in terms of energy consumption.

As well as providing the complete plant design, our focus on process safety ensures that all designs are safe and comply with all European legislation. Our team of experienced Process Safety Specialists support the activities of the design team and, with back-up, as required, from our Process Safety Laboratories, any identified hazardous scenarios can be studied, fully quantified and corresponding changes made to the design to ensure safety at all times. Our Specialists can also support all aspects of process safety when the plant is installed, in accordance with European legislation. This includes hazard identification studies (eg. HAZOP), ATEX compliance (including Hazardous Area Classification) and Explosion Protection Documents (EPDs).

## Consulting Capability



- Safety Management
- Regulatory Compliance Support

## Technical Specialist Areas

- Hazard Assessment and Risk Analysis
- Explosion Prevention & Protection Modelling
- Chemical Reactions
- Energetic Materials
- Electrostatics
- Fire Prevention & Protection
- Occupational Health & Safety
- Reliability

## Protection & Equipment

- Inert Gas Protection
- Instrumentation and Equipment
- Pressure Vessels

## Project Engineering

### Incidents & Support

- Incident Investigation
- Litigation Support
- Insurance Risk
- Environment
- Testing Capabilities

### Process Safety

- Special Testing
- Laboratory Testing
- Field Tests (Large Scale)

- Explosion (Deflagration)
- Dust
- Gas / Vapour
- Hybrid
- Aerosol
- Thermal Stability / Chemistry
- Chemical Reaction Hazards
- Powder Thermal Stability
- Chemical Process Optimisation
- Explosion (Detonation)
- Propellants / Pyrotechnics
- Explosives / Fire
- Mattress / Furniture
- Custom Tests
- Full Scale Simulation

### Electrostatics

- Process Problems
- Applications
- Safety Test

### Regulatory

- UN / DoT Transportation
- Classification Packaging Labelling (CPL)
- MSDS
- Notification Registration Evaluation
- REACH
- Training Capabilities



### Organisation & Compliance

- Process Safety Management
- Process Safety Culture
- COSHH/OSHA Dust Explosion Prep Training

- ATEX 137 / DSEAR
- Environment / Integrated Management Systems
- Process Hazards Analysis

### Technical Specialist

- Dust Explosion Prevention & Protection
- Control of Static Electricity
- Gas & Vapour Explosions
- Chemical Reaction Hazards / Thermal Stability
- Hazardous Area Classification
- HAZOP

### Protection & Equipment

- IEC 61508/11 SIL Levels
- ATEX 94/9
- Hazardous / Electrical Area Classification
- Vent Design (Explosion, Pressure Relief, Reactor Protection)

### Process Safety Laboratory Equipment (Chilworth Systems)

- Special Equipment
- Large Scale Explosion
- High Pressure / Temperature
- Custom Design
- Explosions
- Dust / Gas / Vapour
- Explosion Testing
- Thermal Stability Chemistry
- Reaction Hazard Screen Tools
- Adiabatic Calorimeter
- Powder Thermal Stability
- Fire I -Cal (Fire Calorimeter)

### Electrostatic Equipment (JCI)

- Laboratory Equipment
- Electric Field Meter / Volt Meter
- Charge Relaxation Time
- Charge Measurement
- Field Test Equipment
- Lightning Warning
- Adverse Conditions Equipment

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