Termomeccanica Industrial Process

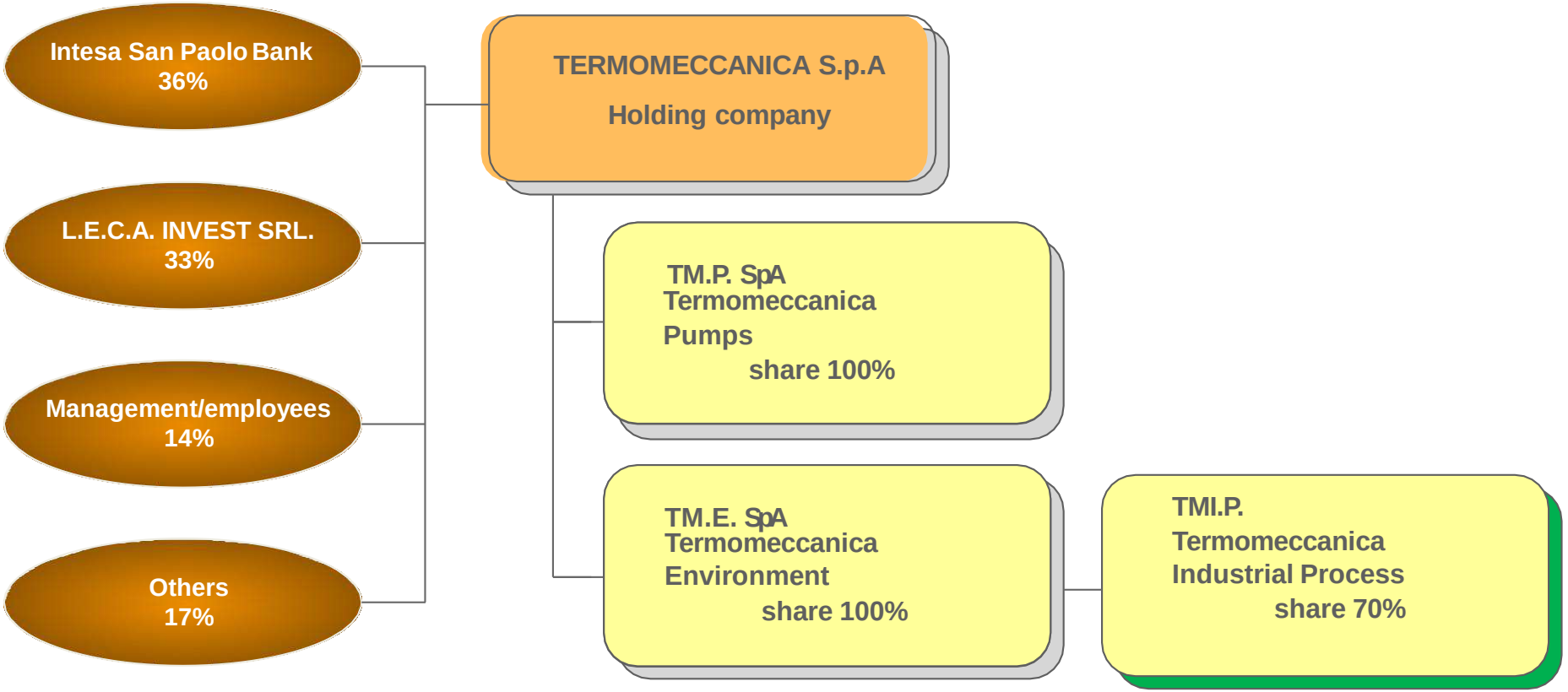
Termomeccanica Group

# TMIP--environmental solutions for Pharmaceutical Industry

January 2021

# TERMOMECCANICA GROUP

## SHAREHOLDERS AND MAIN COMPANY



# TM.I.P. – environmental protection plants

"TM.I.P." was founded towards the end of 2011 to incorporate the know-how, the engineering and constructions technology and of the company "C.M.G." founded in 1977.
The company operates in the environmental protection sector making use of C.M.G. credentials, patents and technical expertise in synergy with the know-how and industrial experience of "Termomeccanica Group".

LLOYD'S REGISTER · LRQA
ISO 9001 - ISO 14001
OHSAS 18001

**TMIP operates in the design and construction of plants (turn key) for the recovery of chemicals (solvents, light and heavy hydrocarbons, etc.) and for treatment of liquids, sludge and gaseous effluents from industrial processes**

**As several of our plants are multiporpose can be used in different dectors :**

1) **Pharmaceutical**
2) **Oil&Gas**
3) **Petrochemical**
4) **Metallurgical**
5) **Resins production**
6) **Coating by PVC or PU**

# TM.I.P. – chemicals recovery plant

The possible solutions (in order to recover) for the chemical compound are the selective recovery system:

- Distillation;
- Adsorption; ( activated carbon )
- Absorption. ( washing or scrubbing )

The recovered product can be used directly in production therefore their installation is high profitable.

Double effect IPA distillation

Gas washing and final adsorbtion bed

**Distillation**

In many processes, solvents are used as solvent mixtures or as water solutions. Solvents can ("must") be recovered. TMIP manufactures both batch and continuous distillation plants suitable for the above mentioned process. Discontinuous (batch) units are normally used for recovering solvents from complex mixtures, usually present in pharmaceutical industry. Continuous distillers are aimed at chemical industries. TMIP distillation plants include units for operating under pressure or vacuum, double or triple effect, with yields above 95% and controlled by some of the most sophisticated control systems available.

**Adsorption**

It's adopted for treating exhaust gas recovering pollutants with the possibility of recycling them in a new process. Adsorbing materials are micro porous substances with a huge surface/height (up to 1700 $m^2$/gr) such as activated carbons, synthetic zeolite, silica gel and activated alumina.

TMIP designs & manufactures adsorption plants with pollutant removal levels of 97% and with a particularly fast investment payback.

**Absorption**

TM.I.P. exploits the characteristic of the soluble water solvent that can be recovered by washing the air in counter current air stream with water in a plates tower. Solvent is collected on the bottom of the tower in solution with water. The solution will be distilled to recover pure solvent.

# TM.I.P. – waste liquid and/or gas treatment plants

Where selective recovery systems are not possible due to economically or feasibility reasons, thermal oxidation plants can be installed. In case of thermal oxidation (regenerative, recuperative, catalytic) can be convenient to equip the plant with a heat recovery system (steam, thermal oil or hot water).

The company has complete know-how in waste gas treatment system (wet and dry cleaning system, catalytic system for NOx reduction)

**Incinerators**

Some industrial process produce highly pollutants liquids and gaseous containing solvents or organic compounds, which can not be treated in conventional plants. There are also a huge quantity of distillation residuals and sludge. TM.I.P. build thermal oxidizers working up 1200°C completed with heat recovery system and flue gas cleaning section (dry or wet removal acids).

**Thermal Oxidizer (TO)**

The Thermal Oxidizer (TO - RTO – Catalytic) is a thermal treatment of exhaust process gas for pollutant removal. It utilizes the thermal power of the pollutants contained in the exhaust waste air for the combustion process. The thermal energy, which is produced during combustion, is recovered and used to heat the incoming exhaust air.

The oxidizer utilizes a fuel gas burner for system start-up and for heat integration if the VOCs concentration is too low.

**Flue Gas Treatment**

After combustion process (waste, liquid or sludge), the flue gas with high content of pollutant (SOx, HCl, etc.) need to be treated in order to achieve the law limits and to respect the environment through a dry, semi dry or wet system.


# WASTE GAS and/or LIQUID STREAMS –characteristics

**Waste gas streams:**
All waste gas streams can be polluted by acid gas as HCl or $SO_2$, basic gas as $NH_3$ and ammine or by organic compounds as MeOH, MC, EtOH, IPA, acetone, etc..

**Waste liquid streams:**
Highly polluted water, normally process water containing organic and salts at high concentrations

Low polluted water containing biodegradable organic compounds as MeOH, acetone, etc...

Low polluted water containing no-biodegradable solvent: benzene, toluene, etc..

Complex mixture of solvent

Simple mixture of solvent

Water soluble solvent (IPA, MeOH, EtOH, DMF, NMP, acetone, etc..).

# WASTE GAS STREAMS resume

TM.I.P. is able to design all the caption systems starting from reactors and condensers, different ways can be designed depending on the processes:

- Low flow-rate with nitrogen blanketing
- High flow-rate streams diluted with air in order to control concentration of the remaining solvent out of the explosion limits
- Separation of the streams (chlorinated from not chlorinated)

**Pre-treatment:**

Abatement of stream whit high-high content of acid (HCl) or $SO_2$

**Final treatment:**

- RTO
- THERMAL OXIDATION ( TO )
- Cryogenic condensation for streams having the following characteristics: Low flow-rate (< 4 - 500 Nm3/h) / High concentration of Chlorinated solvent Adsorption with activated carbon

# TM.I.P. and CPTM

Consorzio Polo Tecnologico Magona

**TM.I.P.** is also partners of "**Consorzio Polo Tecnologico Magona**", consortium which the aim is to promote the technological research nd innovation transfer in all the sectors of Chemical Engineering and f Process and Material Industry.

**CPTM** represents a meeting point between companies searching for new solutions and the applied research, result of the synergetic competencies gained by universities, engineering consulting companies, and manufacturers. Applications include chemical and material engineering, environmental protection, industrial safety, energy industry, renewable energy and green chemistry.

Our main reference:

…more than 40 years of expertise in the design and supply of plants for chemical process, energy and environmental protection tailored to Customers requirements.

***TM.I.P: A reliable company for non-conventional processes and solutions…***

# Waste gas stream – case study 1

**SPECIFICATIONS :**

ORIGIN: 40 REACTORS

FLOW-RATE: 5.000 $Nm^3/h$

Solvents:
NOT chlorinated: acetone, ethyl alcohol, toluene etc.

CHLORINATED: dichloride methane,

chloroform  CONCENTR: up to 8 g / $Nm^3$

# case study 1– the solution

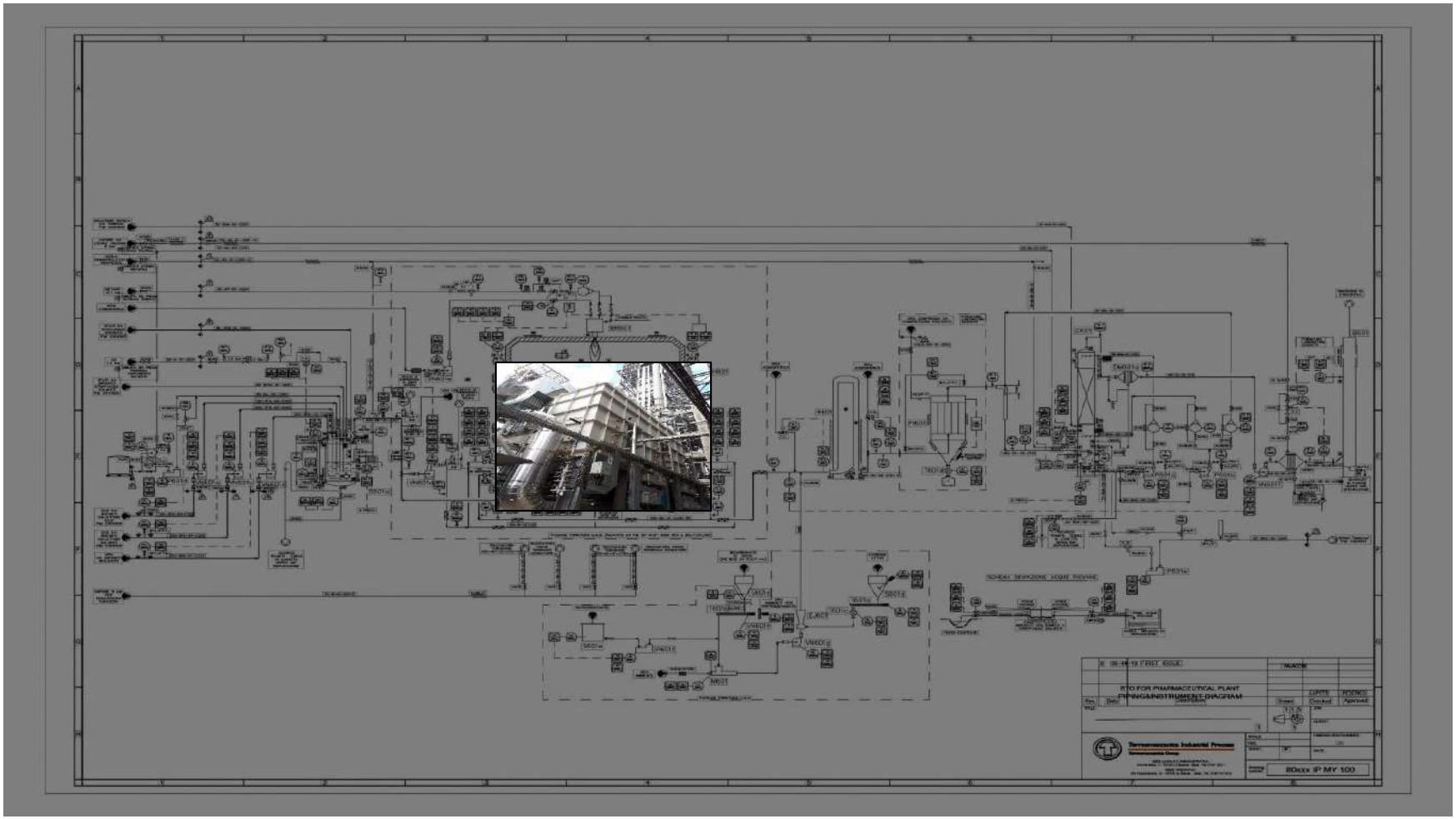
**PROPOSED SOLUTION :**

- PRETREATMENT FOR STREAM WITH HIGH CONTENT OF HCl located near the production units
- Piping collecting system (about 200 m) from production units to final treatment plant

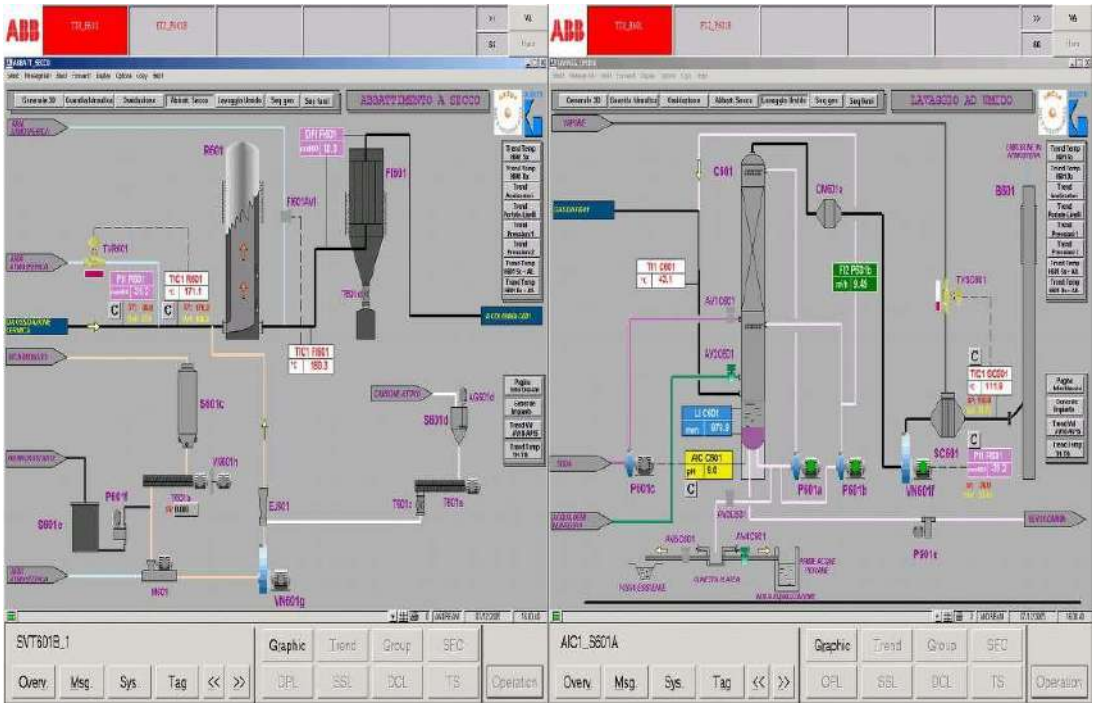
FINAL TREATMENT:

- RTO (REGENERATIVE OXIDATION PLANT)
  OXIDATION TEMPERATURE > 950 °C;
  + dry abatement using Na2CO3 + ACTIVATED CARBON as reactive;
  + wet final abatement;
  + final re-heating before emission into the atmosphere.

# case study 1– P&I



# case study 1—RTO flue gas treatment



# case study 1—technical description

**TECHNICAL / PROCESS**
**solution:**

Chlorinated solvent => formation of hydrochloric acid during the oxidation phase

=> special material needed

=> special care to details during start-up and shut-down of the plant

=> double stage of abatement in order to be able to face a quick increase of solvent concentration.

CONTROL AND SAFETY

- Whole plant controlled by a DCS (Distributed Control System);
- Solvent concentration inlet / outlet measured by COT continuous analyser;
- Hydraulic seals to physically separate production units and oxidation plant;
- Remote control for a 24 hours assistance.

ENERGY CONSUMPTION

- Depending on the solvent concentration: no consumption if solvent % > 3- g/$Nm^3$;
- Low natural gas consumption in case of low solvent concentration.

# Waste liquid + gas stream – case study 2

**LIQUID and GAS INCINERATION**

THERMAL OXIDATION WITH ENERGY RECOVERY

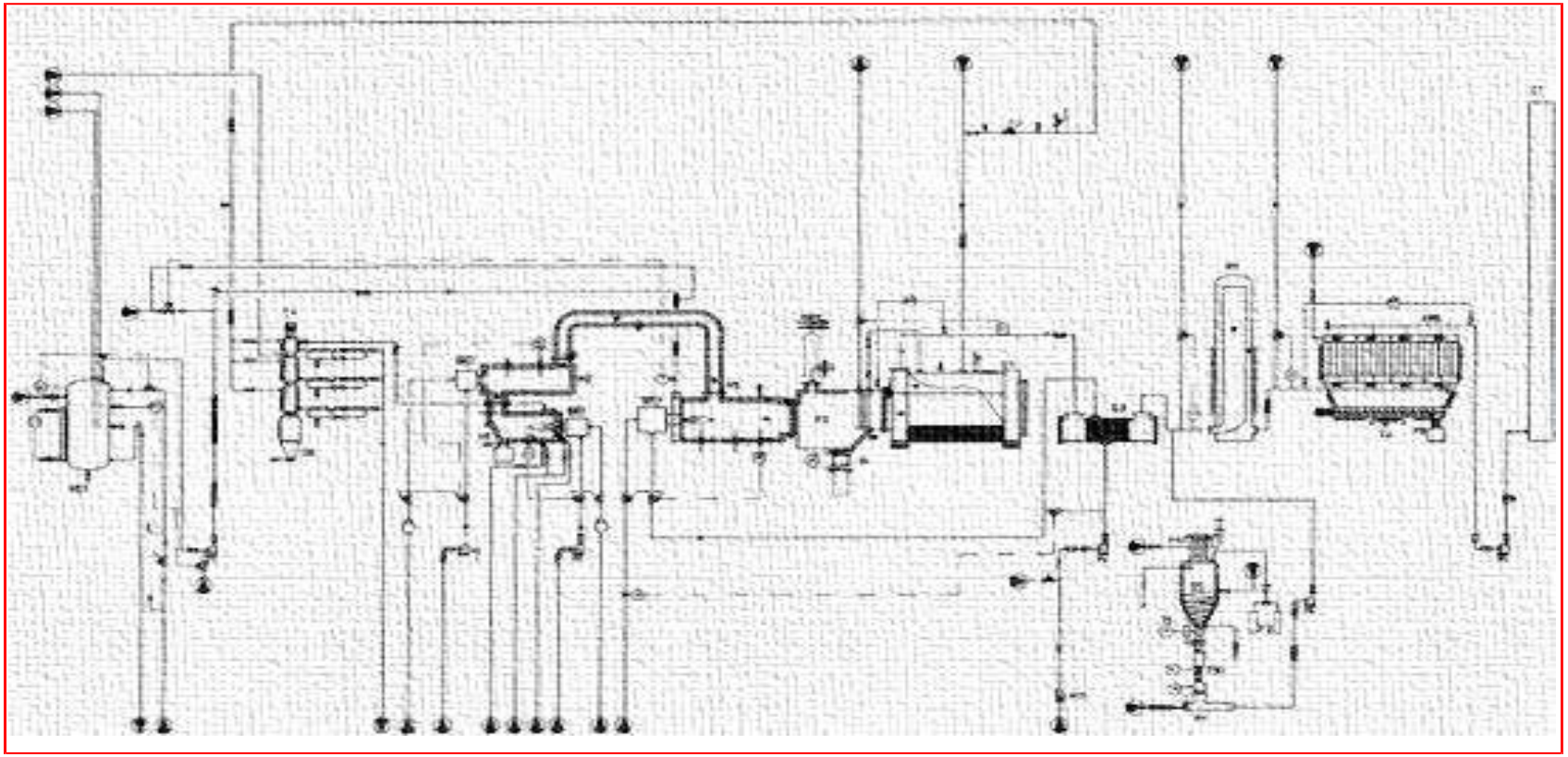
This technology is used when is convenient to recover energy, for example producing steam, or heating thermal oil.

**PROPOSED SOLUTION :**

- Horizontal Static Chamber With injection nozzles for liquid waste and distributor for vents;
- Oxidation Temperature: up to 1100 °C
- Residence time: 2s
- Oxygen Concentration in the flue gas: 6% vol.
- Plant sections: steam boiler + flue gas
- treatment ; Dry + Wet abatement

# case study 2--photo

# Case study 2 –P&I



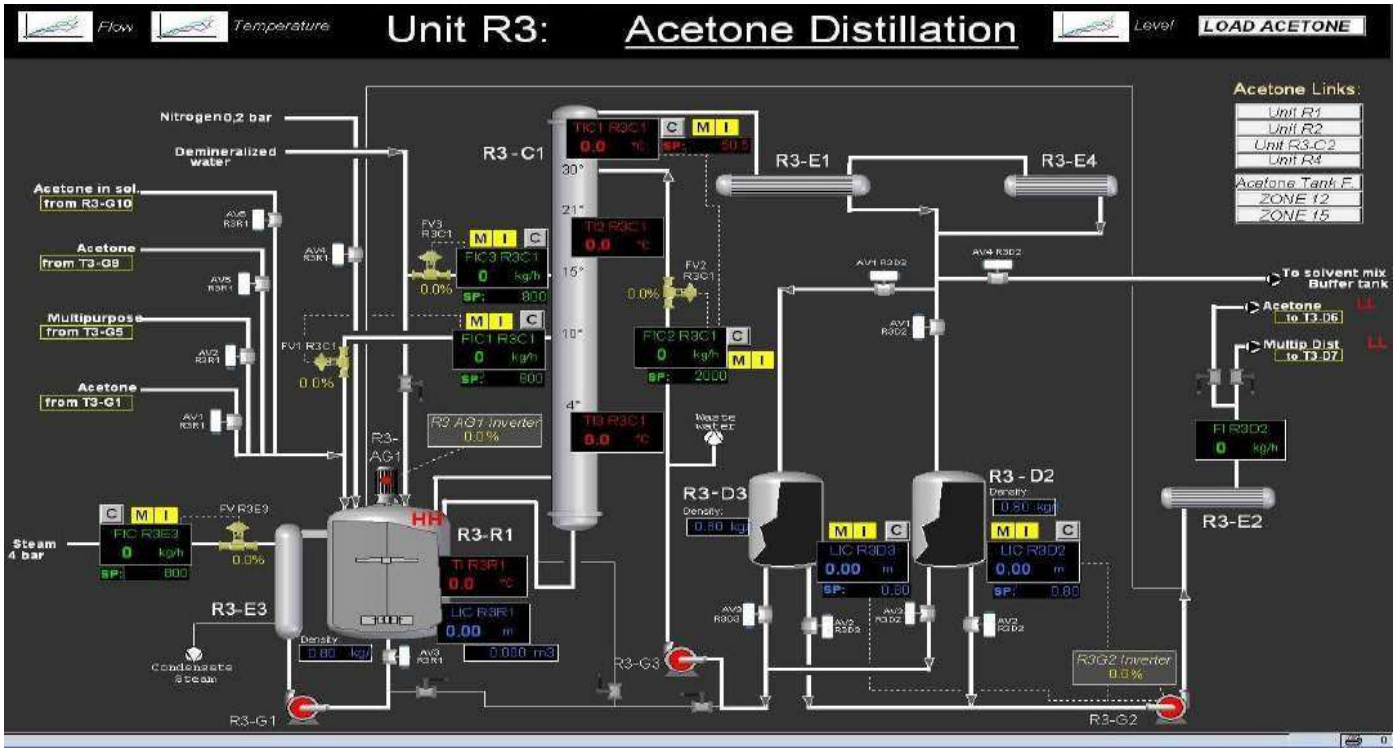
# Liquid stream-solvent recovery – case study 3

Waste liquid streams: simple aqueous + solvent solutions  Recovery by Distillation

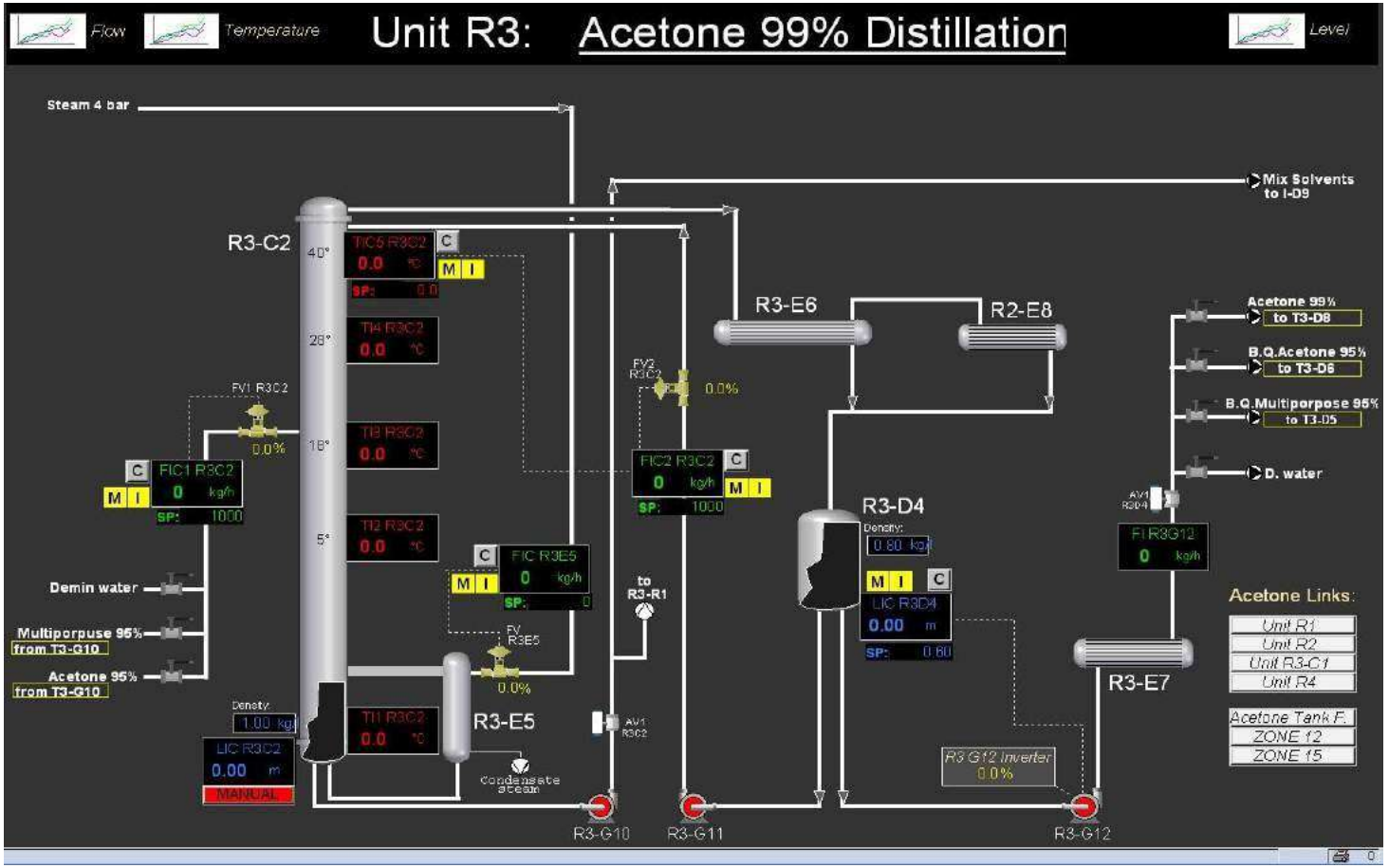
BATCH DISTILLATION PLANT: quantity < 14 $m^3$/day

CONTINUOUS DITILLATION PLANT : quantity > 14 $m^3$/day

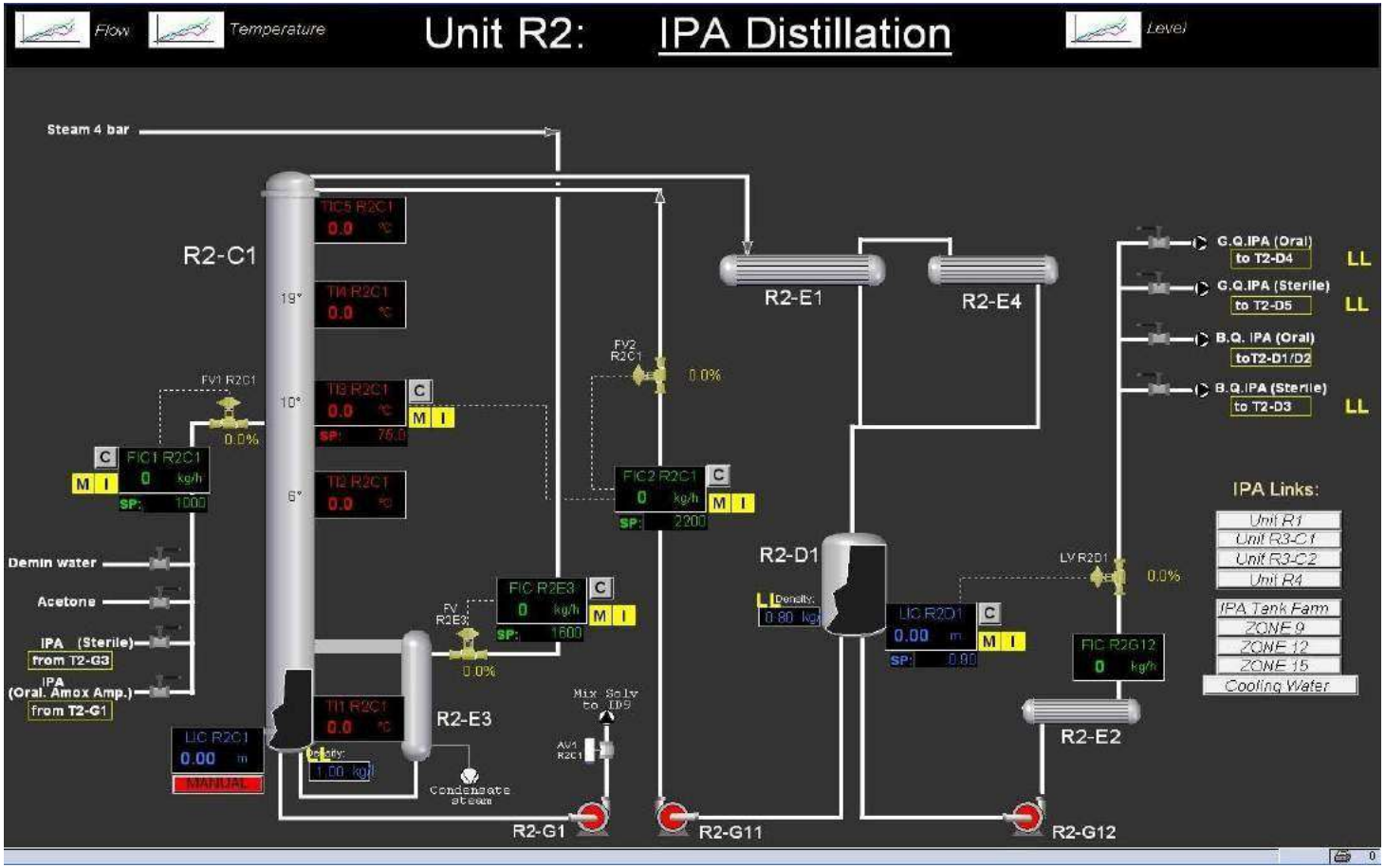
Solvent: Ethanol – Acetone – DMF - NMP – IPA



# case study 3—P&I--acetone

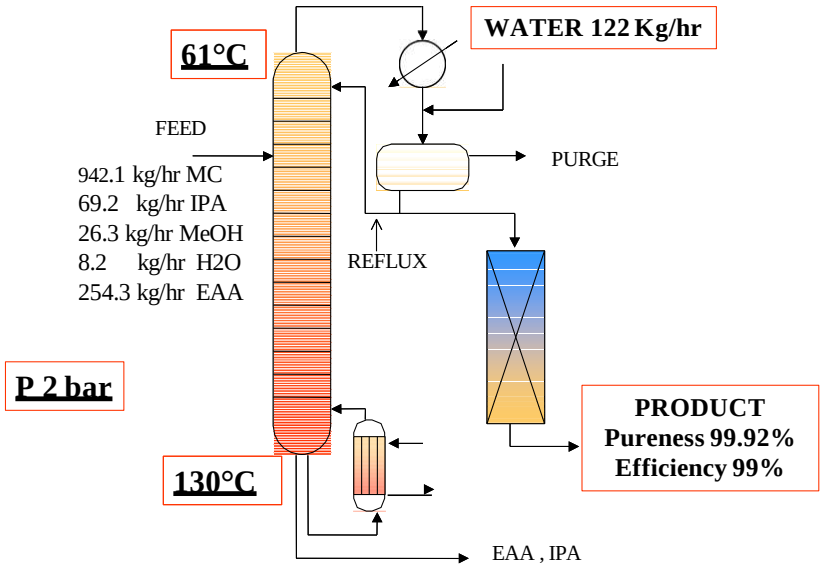


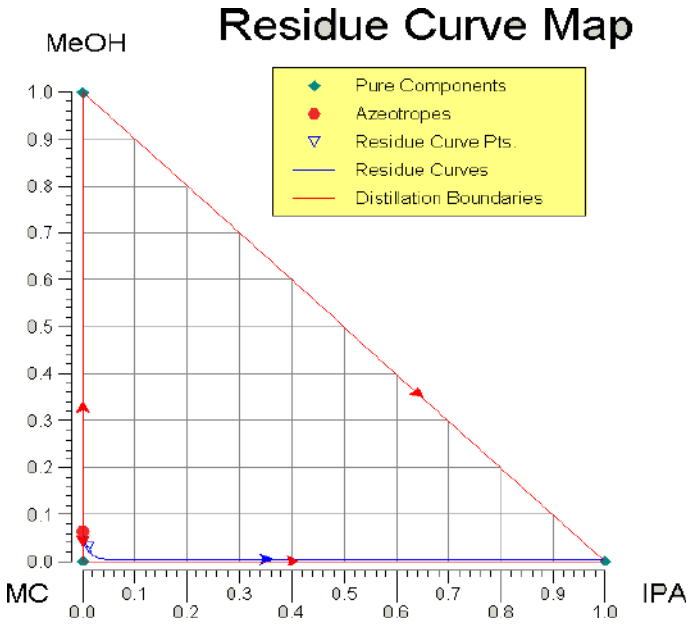
# case study 3—P&I—IPA



# case study 3—solvent mixture

Waste liquid streams: COMPLEX ACQUEOUS SOLVENT SOLUTIONS
Recovery by Distillation + PURIFICATION (MOLECULAR SIEVES)
BATCH DISTILLATION PLANT: quantity < 14 $m^3$/day  CONTINUOUS DITILLATION PLANT : quantity > 14 $m^3$/day
MeOH – IPA - Methylene chloride – ETHYL ACETATE



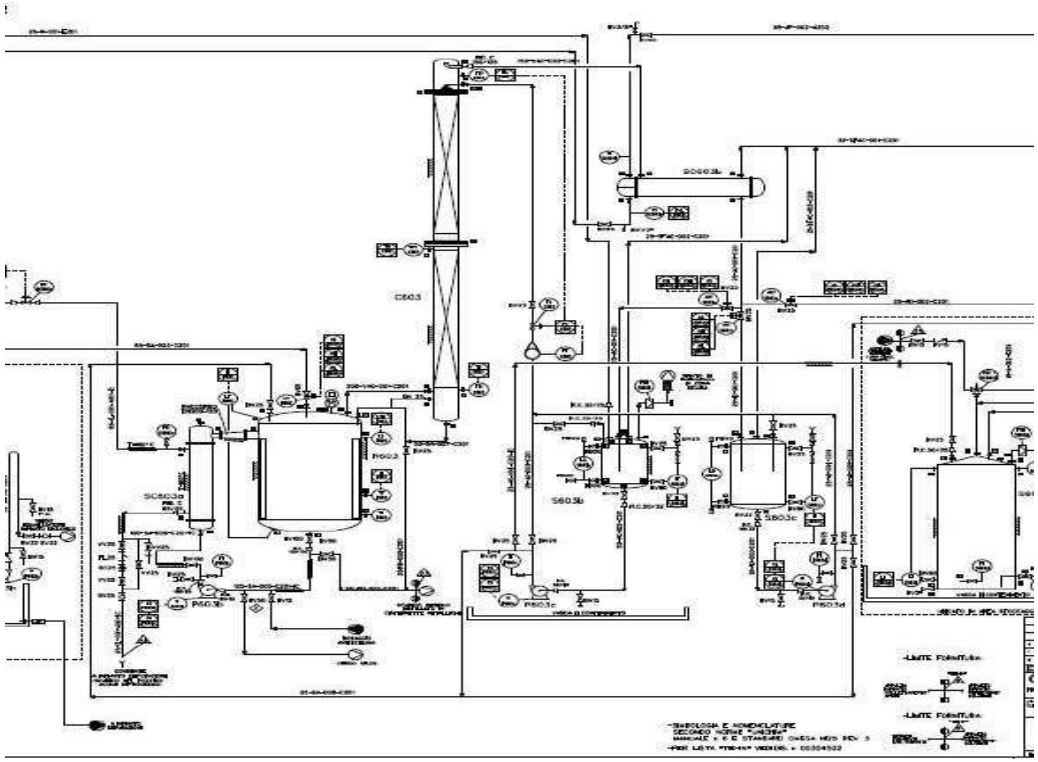
# case study 3—final purification

Waste liquid streams: COMPLEX ACQUEOUS SOLVENT SOLUTIONS  PURIFICATION (MOLECULAR SIEVES)

Methylene chloride

# Waste liquid stream – case study 4

Waste liquid streams: LOW CONCENTRATION HIGH BOILING SOLVENT (TOLUENE, XILOLO )
**Technology: stripping** / Recycle: water to final biological waste treatment plant

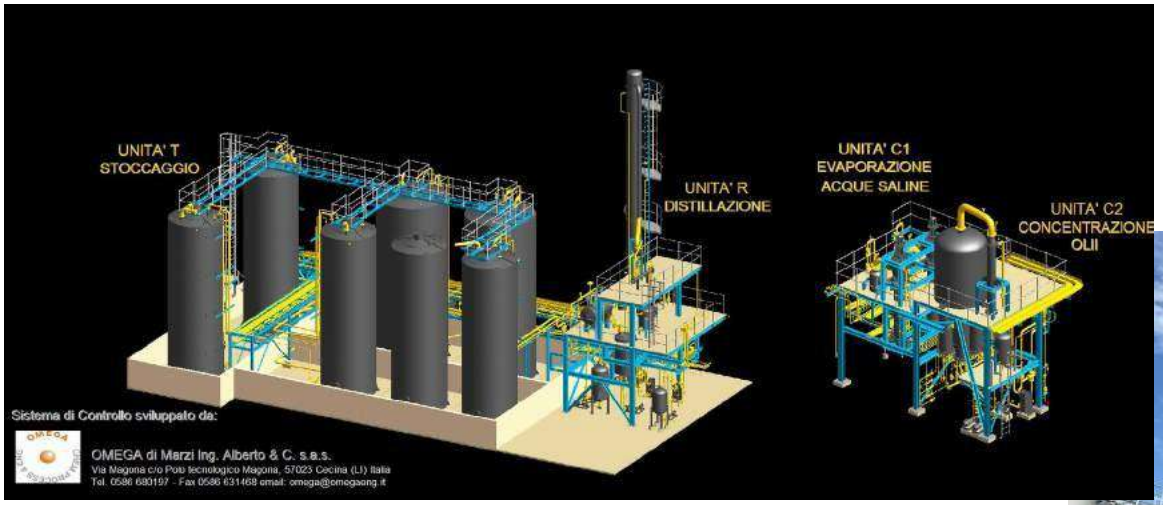


# Waste liquid stream – case study 5

**Technology ; by DISTILLATION**

Waste liquid streams: LOW CONCENTRATION (UP TO 30%) / LOW BOILING SOLVENT (TIPICALLY ACETONE, ETOH )

Technology: CONTINUOUS DISTILLATION



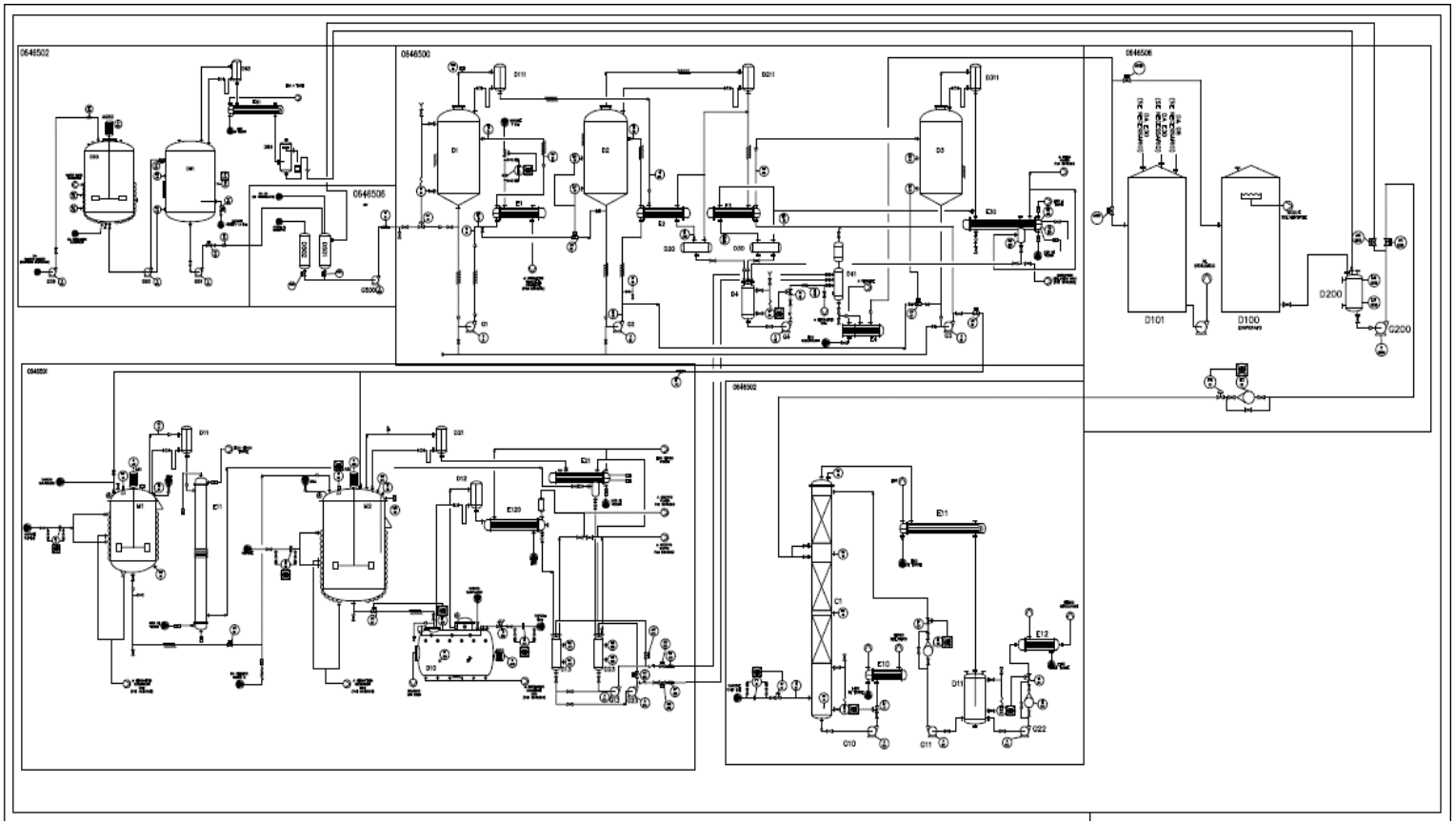

# Waste liquid stream – case study 5

**Technology: THIN FILM EVAPORATOR**

FINAL PRODUCT => DRY SALT + PURE WATER

# *Highly polluted water tratment*

# *Highly polluted water treatment--technology*



# *Thank you*

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