CLOROSUR Technical Seminar & WCC Safety Workshop
Monterrey / Mexico
November 14 – 16, 2018

# NEW HCL SYNTHESIS UNIT (SINTACLOR® ECO&FLEX)

## ENERGY SAVINGS TO OPTIMIZE YOUR OPEX

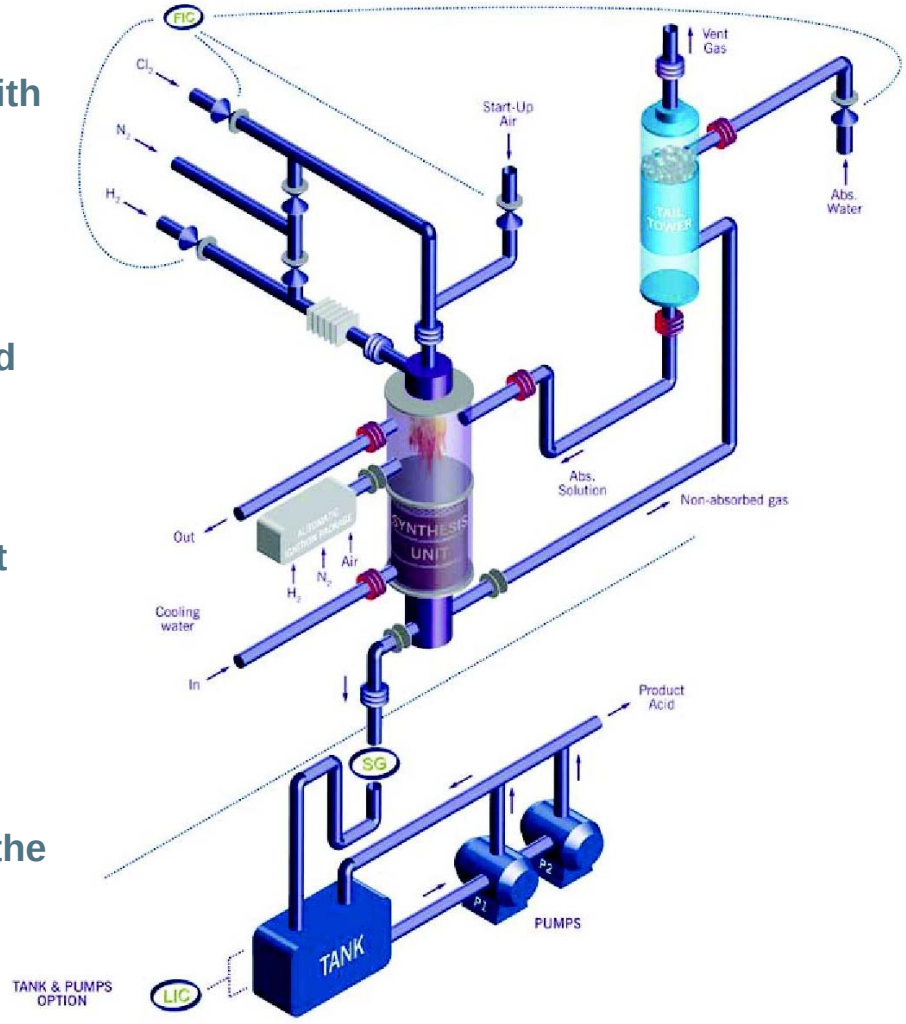
MERSEN, A.C.E. (Anti-Corrosion Equipment)
Wayne Moroz, P.Eng.

# MERSEN'S TOP FIRED SYNTHESIS UNIT DESIGN - SINTACLOR®

- Hydrogen & Chlorine gas enter the top of the unit as well as weak acid from the scrubber
- Hydrogen chloride is formed by burning chlorine with a slight excess of hydrogen.
  - Cl2 (g) + H2 (g) => 2 HCl (g) + 600 kcal/kg
- Hydrogen chloride gas is absorbed in demineralized water to form pure hydrochloric acid in the furnace and absorption section of the integrated unit
- Concentrated HCl acid leaves the bottom of the unit and drains by gravity to an acid tank
- Off-gases with HCl from the absorber section are removed in the counter current scrubber that uses demineralized water; the resulting weak acid at the bottom of the tail tower gravity feed into the top of the synthesis unit

MERSEN HCl SYNTHESIS UNIT DESIGN WITH TOP BURNER

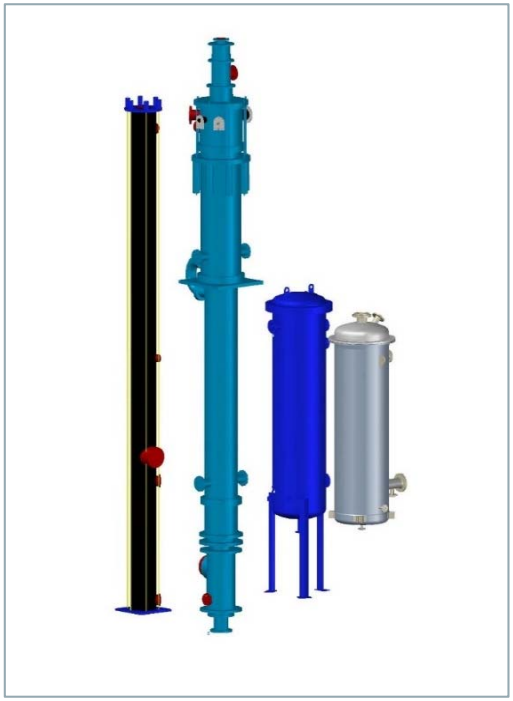
"Best available design for safety and environment"



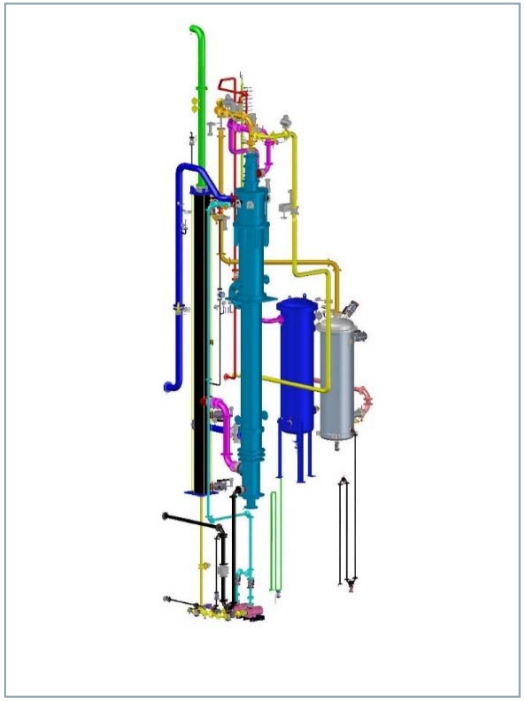
# MERSEN'S TOP FIRED SYNTHESIS UNIT DESIGN - SINTACLOR®

## MERSEN IS A WORLD LEADER FOR THE SUPPLY OF HCL SYNTHESIS UNITS WITH OVER 600 UNITS INSTALLED PROVIDING A TOTAL PACKAGE SOLUTION

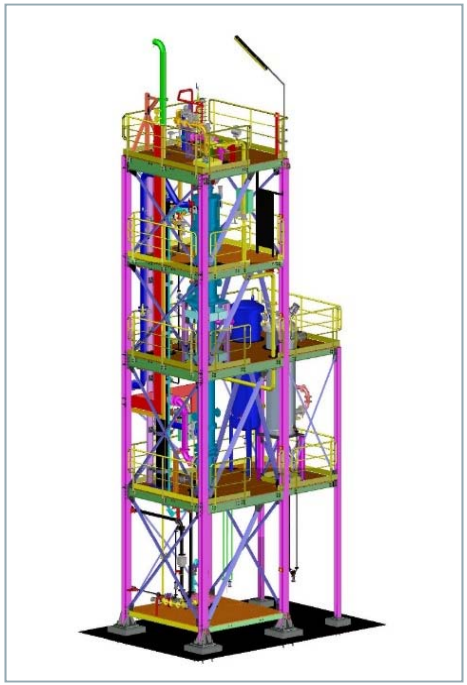
- **ENGINEERING**
  - Conceptual design
  - P&ID
  - Basic/detail engineering
  - Main equipment supply



- **PROCUREMENT**
  - Instrumentation
  - Piping and valves
  - Automated control cabinet
  - Main equipment supply



- **CONSTRUCTION**
  - Main equipment supply
  - Modular assembly: installation of equipment, piping & valves, instrumentation, cabling, pre-plumbed & pre-wired within a steel skid



→ **Skid-mounted turn-key solution**

## SINTACLOR® - MERSEN'S HCL SYNTHESIS UNIT

# 4 MAIN SAFETY REASONS TO CHOOSE MERSEN'S TECHNOLOGY

**1. Burner + Reactor + Absorber encompassed in one piece of equipment – compact design**

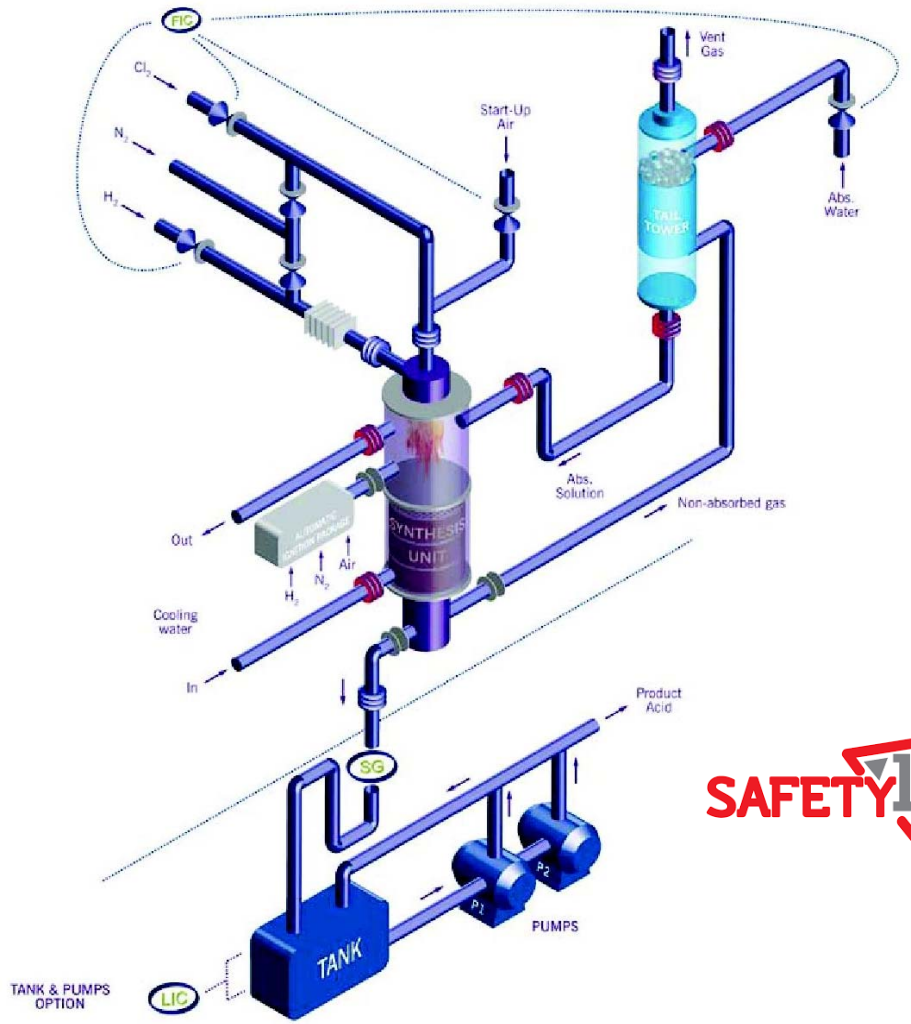
**2. Wetted wall furnace design with optimized flame velocity & immediate liquid mass transfer (absorption) of acid permits reduced volume of gas in the unit**
**→ translates to reduced explosive volume & increased safety (compared to up fired units)**

**3. Hydrogen gas (explosive) is far above the ground (above the pipe rack)**
**→ ATEX area far above the ground.**

**4. Chlorine gas (toxic) is far above the ground (usually > 6 meters elevation [above pipe rack])**
**→ toxic Cl2 gas far above the ground.**

**Top firing technology = Best design for Safety & Environment**

MERSEN HCl SYNTHESIS UNIT DESIGN WITH TOP BURNER
"Best available design for safety and environment"




SAFETY 1st

MERSEN

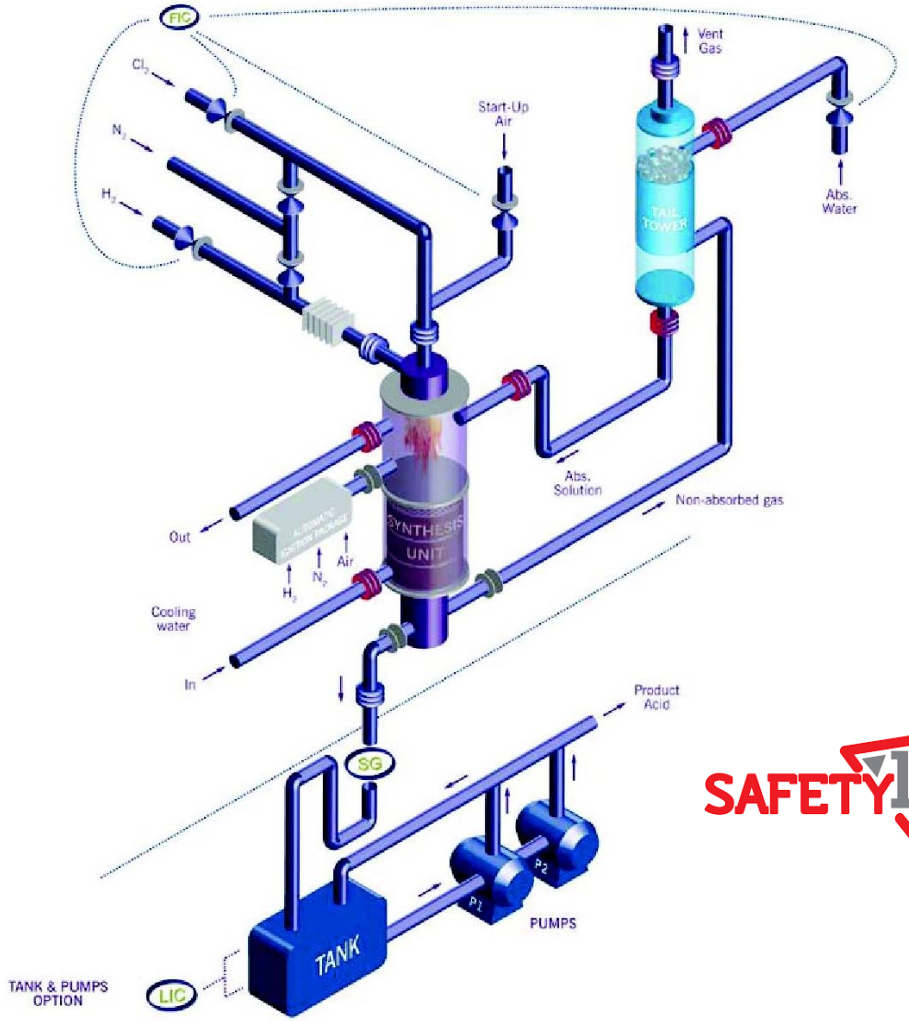
## SINTACLOR® - MERSEN'S HCL SYNTHESIS UNIT

# OTHER SAFETY ENHANCEMENTS & DEVELOPMENTS

- **Other MERSEN safety enhancements**
  - Material selection
  - Safe equipment design
  - Attention to control philosophy and safe practices (HAZOP/LOPA, etc.)
  - Process control & selection of control elements
  - State of the Art BMS- Burner Management System
- **These were presented at CLOROSUR 2016**
- **RECENT DEVELOPMENT: NEW SINTACLOR III ECO&FLEX ENERGY RECOVERY INNOVATION**

MERSEN HCl SYNTHESIS UNIT DESIGN WITH TOP BURNER

"Best available design for safety and environment"




SAFETY 1st

MERSEN

# SINTACLOR III – ECO&FLEX

## WHAT DOES IT CONSIST OF ?

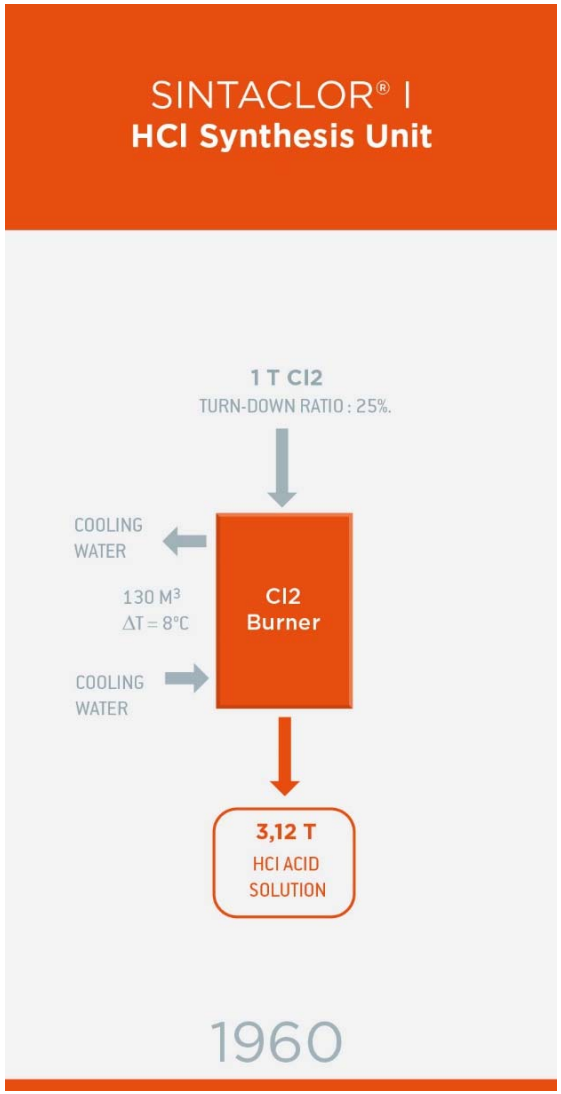
- ADVANCED TECHNOLOGY TO IMPROVE ENERGY EFFICIENCY
- NEW DESIGN FEATURES

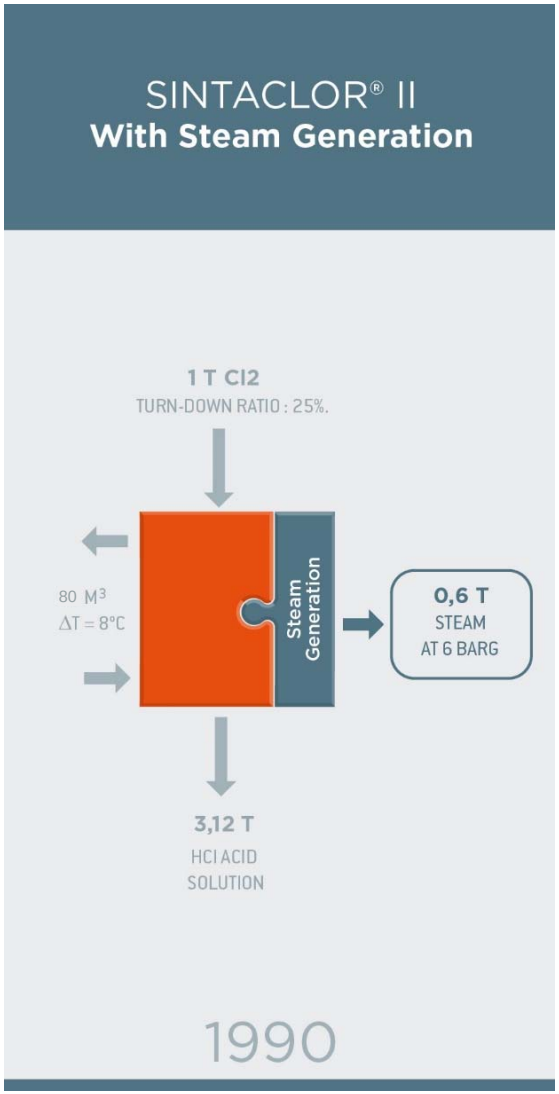
## CUSTOMER BENEFITS ?

- REDUCE OPEX, CAPEX AND CARBON FOOTPRINT
- INCREASED FLEXIBILITY OF OPERATION

## SINTACLOR® II

# ENERGY RECOVERY (STEAM GENERATION) DEVELOPPED IN 1990



## SINTACLOR®

# MERSEN = THE GLOBAL LEADER WITH 60 YEARS EXPERIENCE

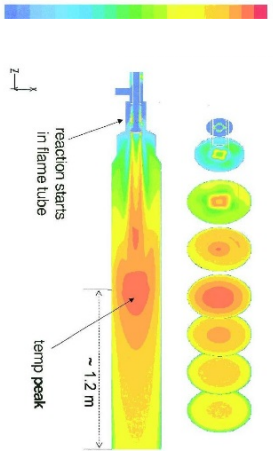
- 1ST UNIT (SINTACLOR® I) MADE IN 1959
- 1ST TURN-KEY PACKAGE MADE IN 1986
- 1ST STEAM GENERATION (SINTACLOR® II) MADE IN 1995

- >600 MERSEN SYNTHESIS UNITS INSTALLED WORLDWIDE
- ~9 MILLION T HCL (100%) / YEAR

ACCUMULATED CONTRACT AWARDS OF HCL BURNERS.

- >450 UNITS OPERATING WORLDWIDE
- 20 UNITS WITH STEAM GENERATION OPERATING
- >60 UNITS OPERATING IN AMERICAS
- 26 SKID PACKAGES DELIVERED IN AMERICAS


63 TPD HCl100%
LEUNA HARZE – Germany
Standardized - Pre-Assembled – Automated




CFD modeling

# LIMITS OF SINTACLOR® I AND II

## 1st LIMIT : MINIMUM CAPACITY ~ 25%

- Customers want to avoid a stop & start of the unit when required capacity is < 25%.

## 2nd LIMIT : ONE END-PRODUCT = HCL ACID

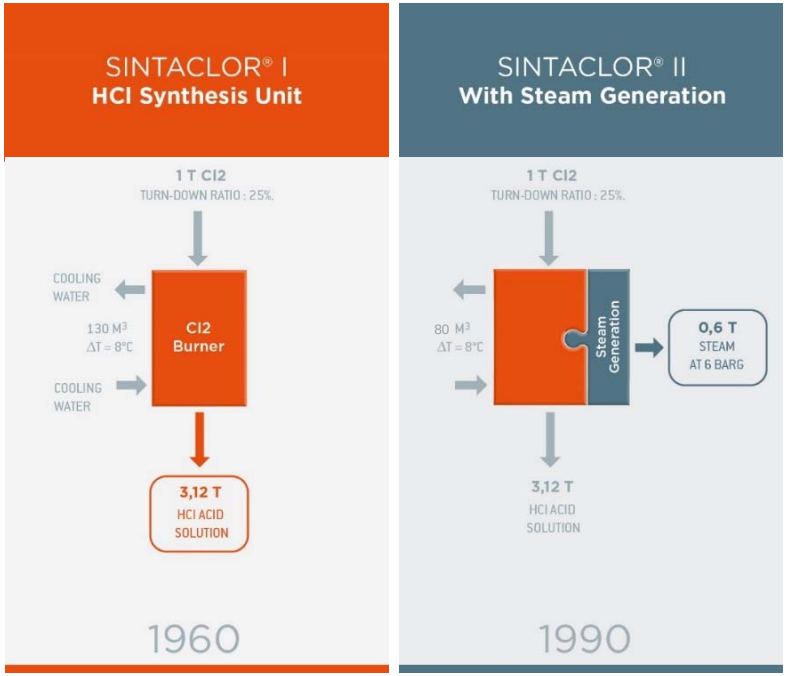
- Customers may want 3 possibilities
  - HCl acid solution, HCl gas, Both at the same time

## 3rd LIMIT : STEAM GENERATION AT 6 BARG

- Customers may want higher steam pressure

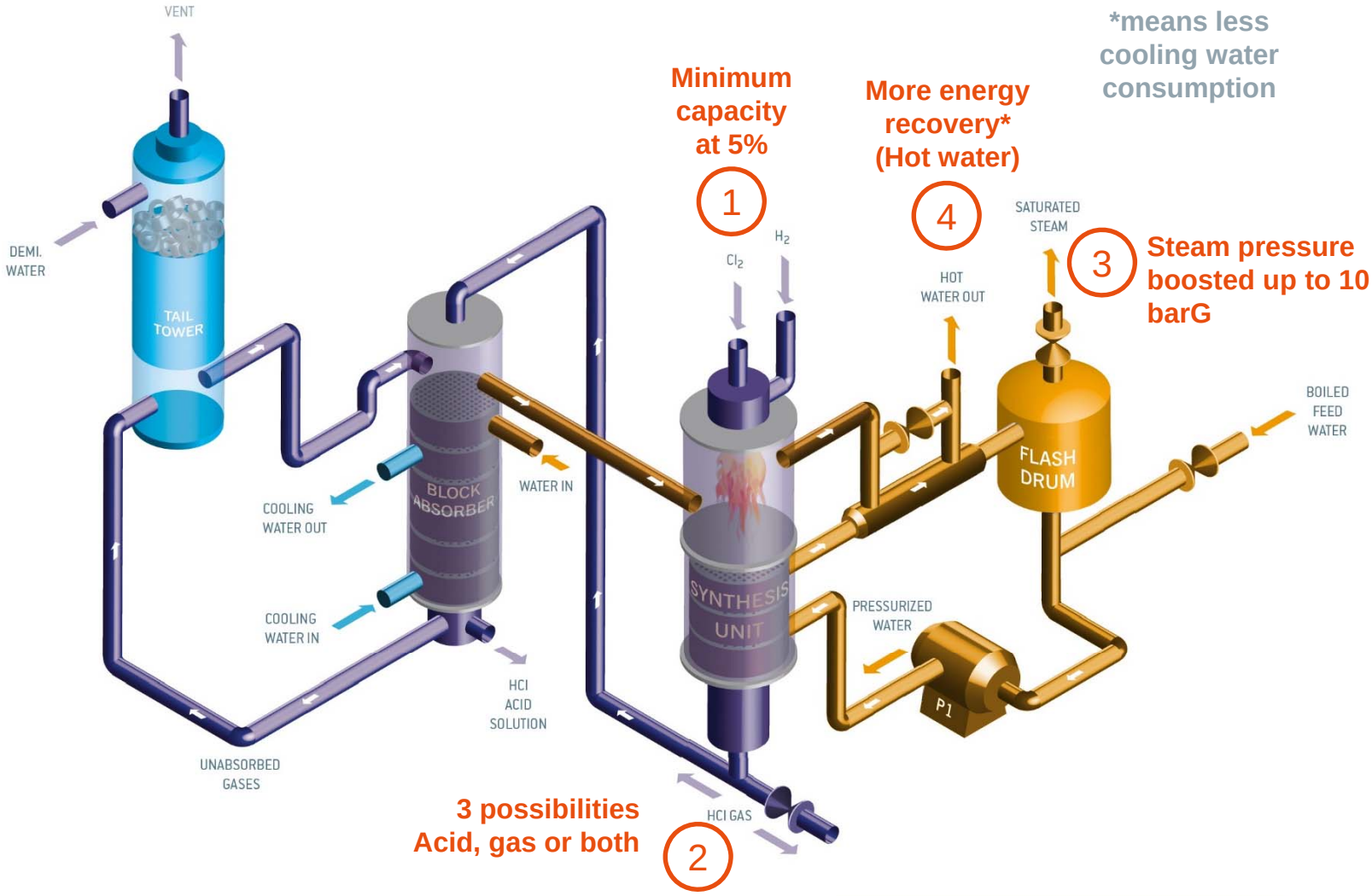
## 4th LIMIT : COOLING WATER CONSUMPTION

- Customers want to reduce cooling water consumption and boost heat recovery



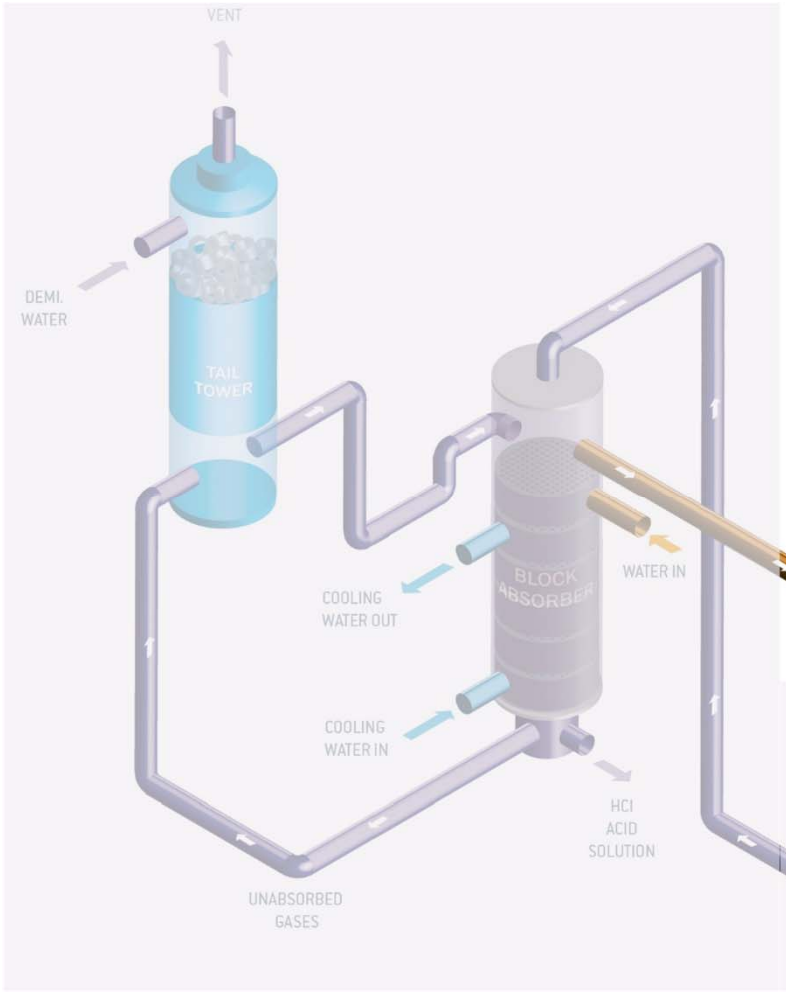
## SINTACLOR® ECO & FLEX

# BREAK THE LIMITS



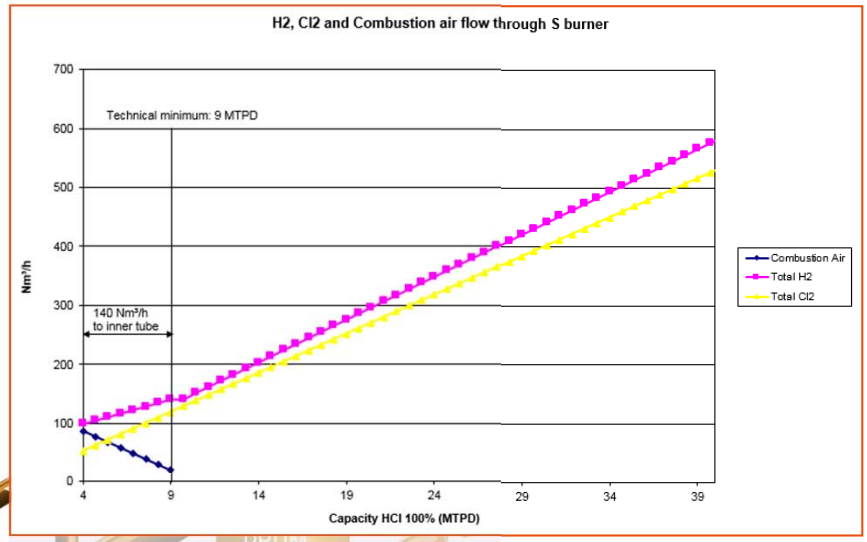
## SINTACLOR® ECO & FLEX

# = INJECTION OF AIR TO ALLOW GREATER TURN-DOWN




**Minimum capacity at 5%**

1

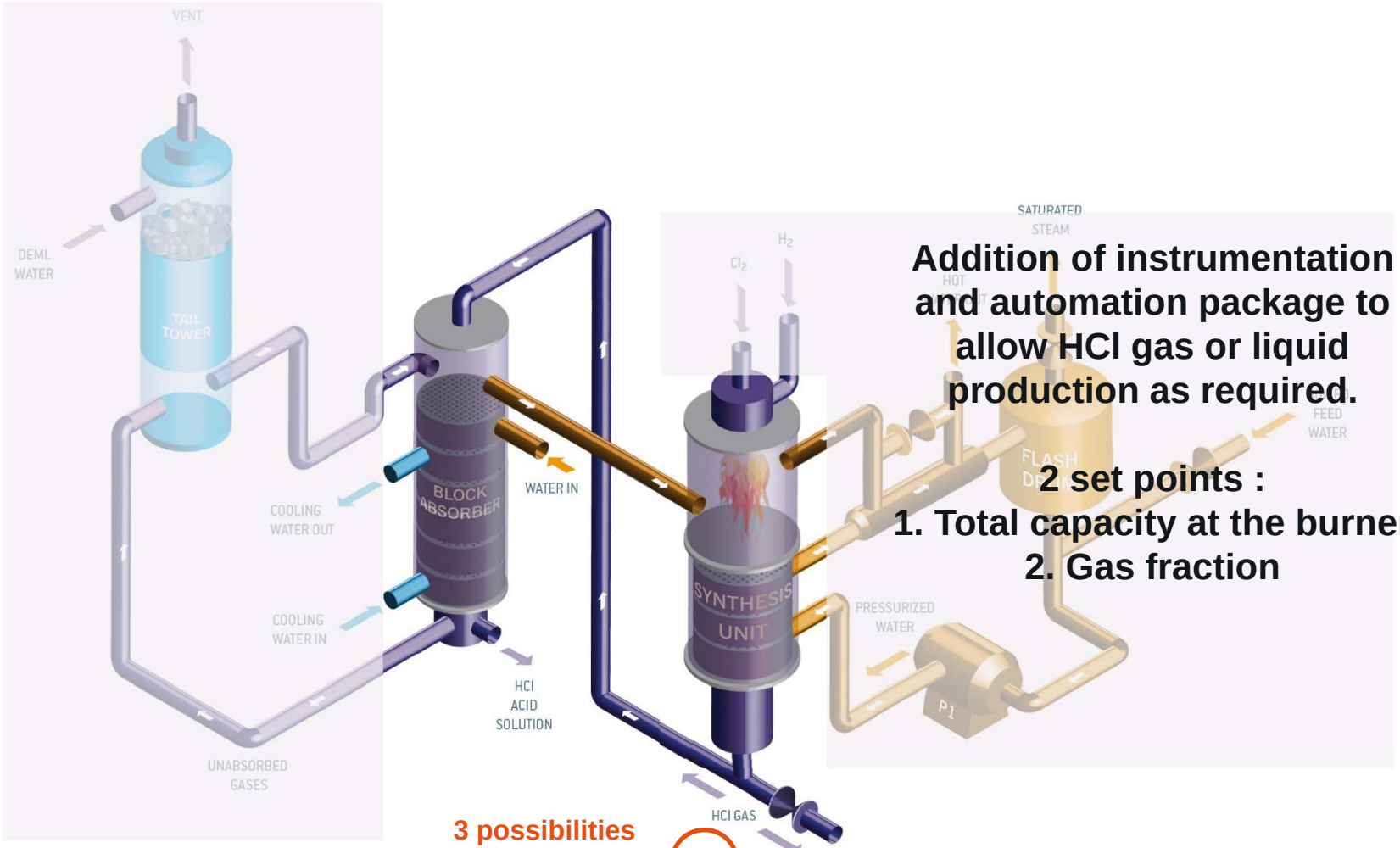



**Maintain gas velocity in burner to ensure stable flame & enable combustion at lower HCl flow rate – addition of combustion air**

ABSORPTION | BURNER | HEAT RECOVERY

## SINTACLOR® ECO & FLEX

# = 3 POSSIBILITIES (HCL GAS, HCL LIQUID, BOTH AT THE SAME TIME)




**Addition of instrumentation and automation package to allow HCl gas or liquid production as required.**

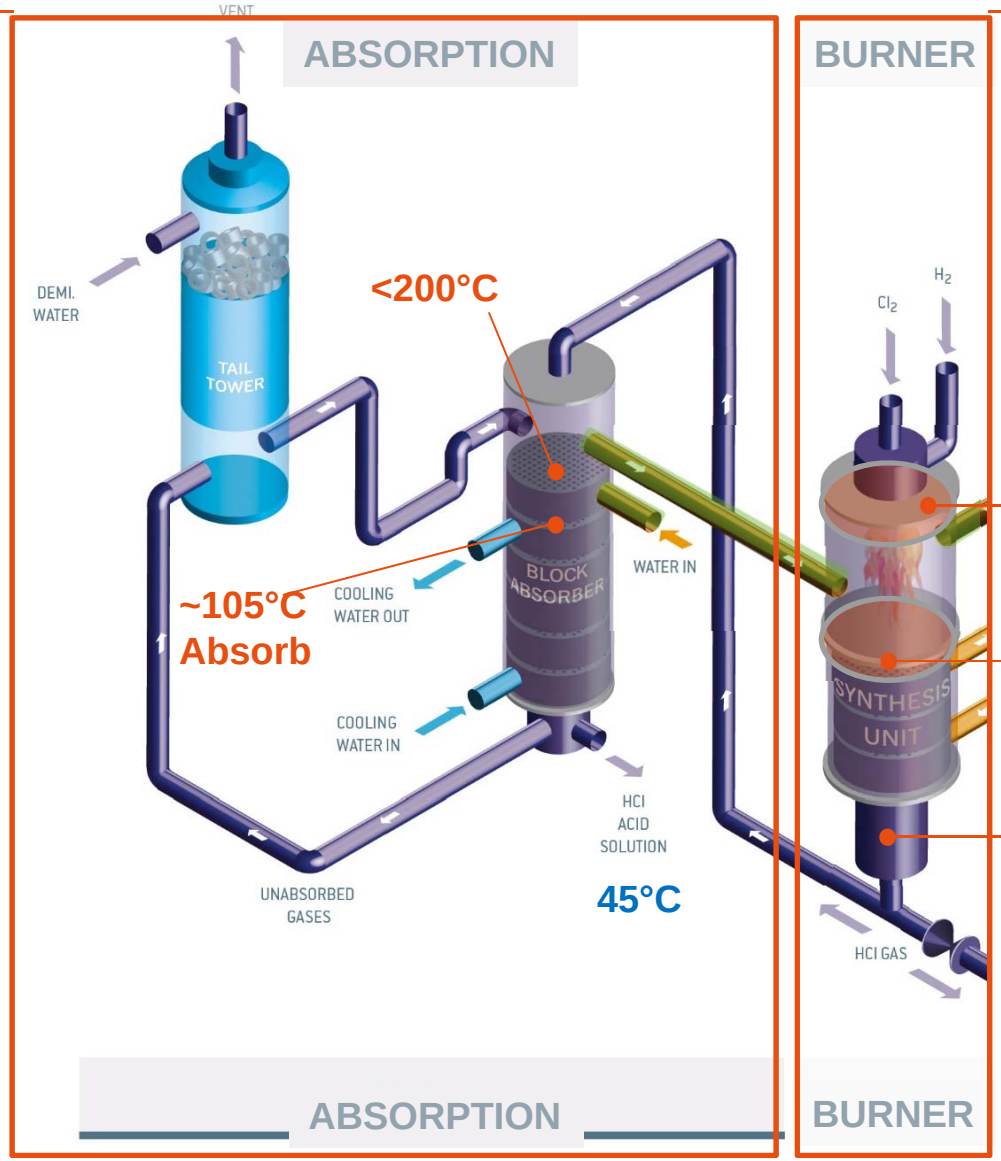
**2 set points :**
**1. Total capacity at the burner**
**2. Gas fraction**

**3 possibilities**
**Acid, gas or both**

2

## SINTACLOR® WITH ENERGY RECOVERY

# = OPERATIONAL TEMPERATURE SNAP SHOT

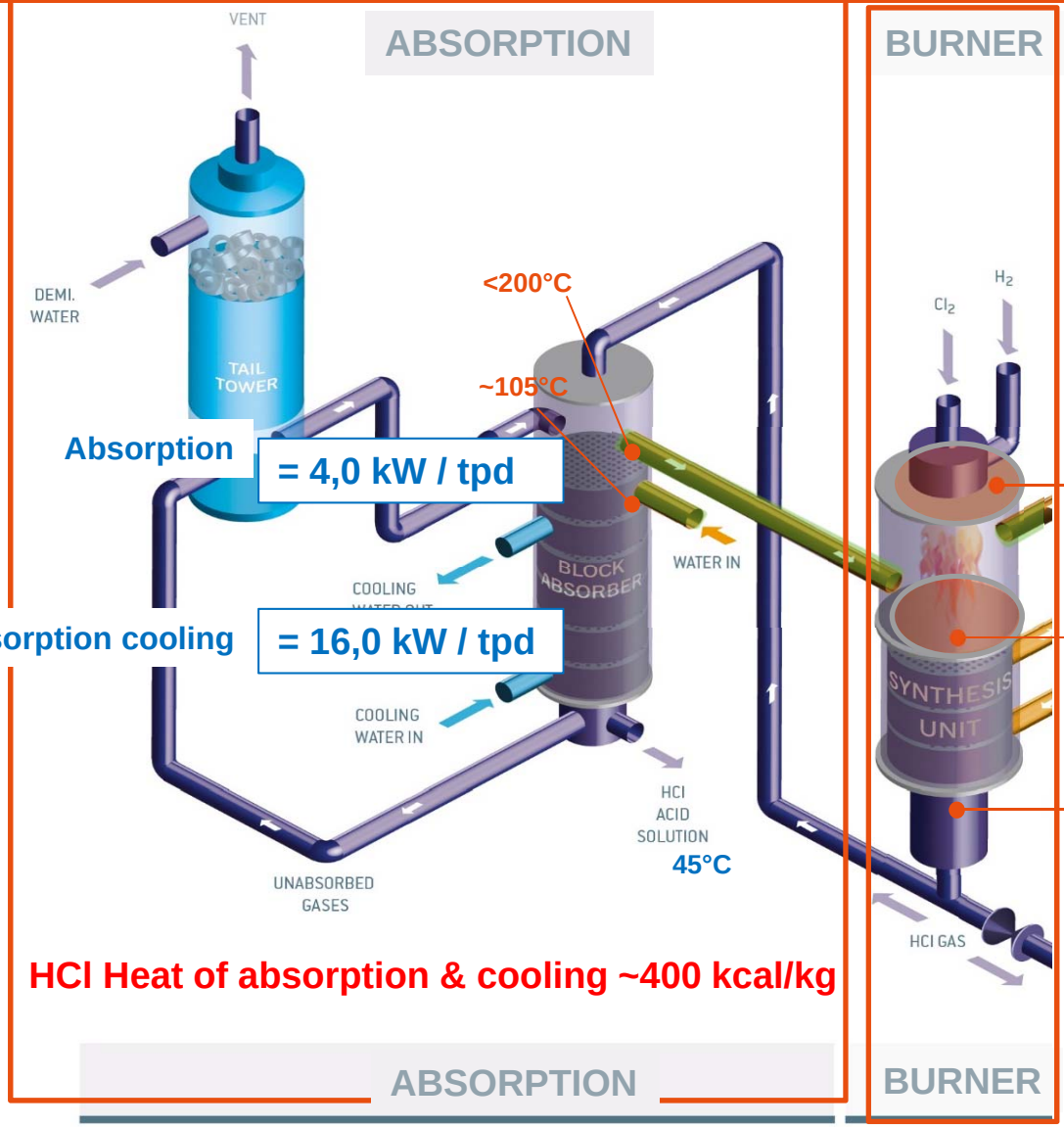



>2300°C flame temperature

<1800°C HCl furnace outlet

<200°C HCl gas outlet

# SINTACLOR® II
# = 48,9 KW / TPD HCL EXCHANGED.




HCl Heat of absorption & cooling ~400 kcal/kg

HCl Heat of combustion & cooling ~ 600 kcal/kg

% Total Duty

~8%

Absorption = 4,0 kW / tpd

~33%

Absorption cooling = 16,0 kW / tpd

% Total Duty

Combustion = 10,4 kW / tpd

~21%

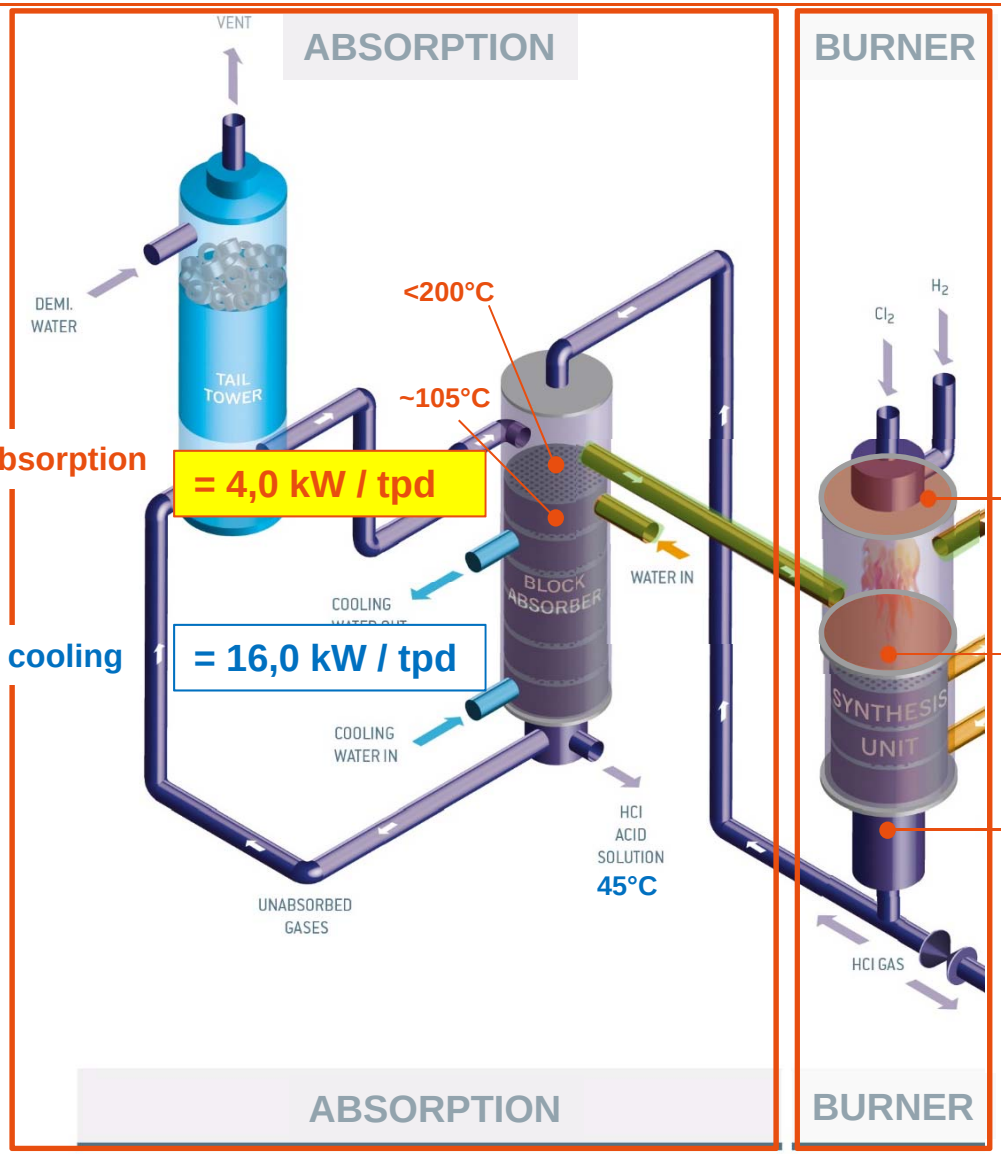
Gas Cooling = 18,5 kW / tpd

~38%

**Sintaclor® II recovers 18,5 kW from Gas Cooling to produce steam at 6 barG – 38% of total duty.**

## SINTACLOR® ECO & FLEX

# = 32,9 KW/TPD RECOVERED




**Absorption**
**= 4,0 kW / tpd**

**Absorption cooling**
**= 16,0 kW / tpd**

**Combustion**
**= 10,4 kW / tpd**

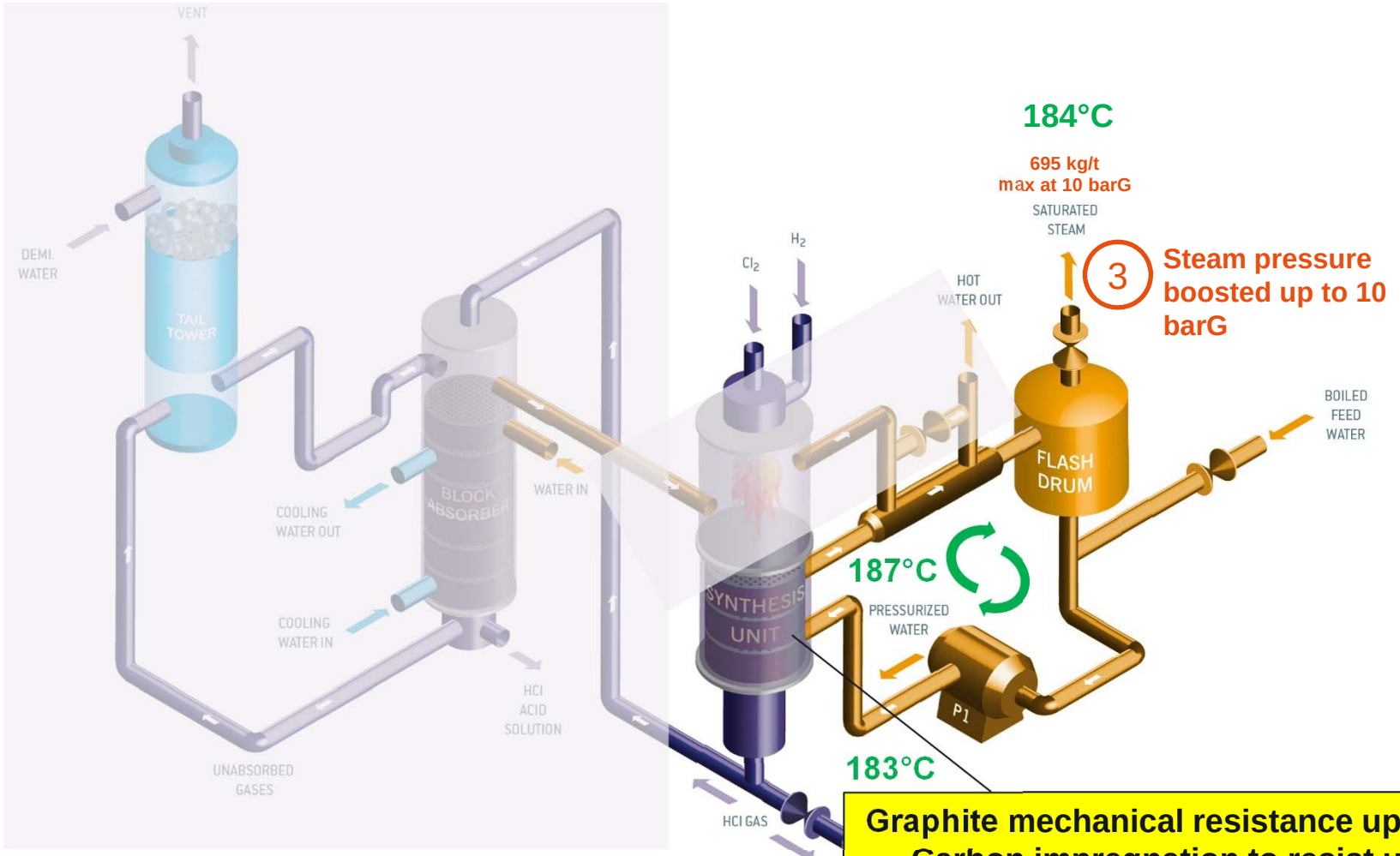
**Gas Cooling**
**= 18,5 kW / tpd**

**Sintaclor® III recovers 32,9 kW or ~67% of total duty**

**Sintaclor® II only recovers 18,5 kW from Gas Cooling to produce steam at 6 barG – 38% of total duty.**

## SINTACLOR® ECO&FLEX
# = PRINCIPLE OF OPERATION

| | | | |
|---|---|---|---|
| Absorption | = 4,0 kW / tpd | Combustion | = 10,4 kW / tpd |
| Absorption cooling | = 16,0 kW / tpd | Gas Cooling | = 18,5 kW / tpd |



# SINTACLOR® ECO&FLEX
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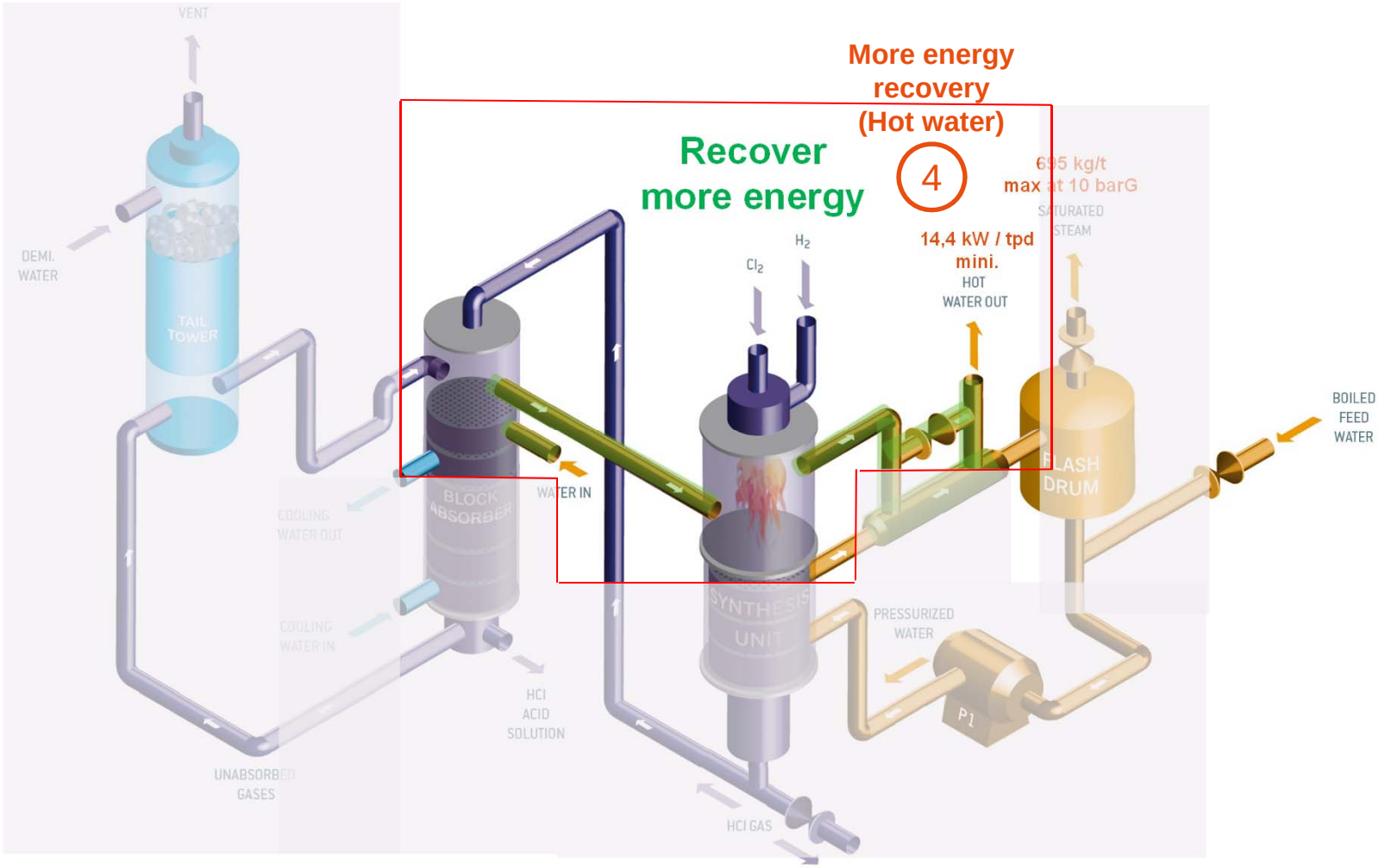
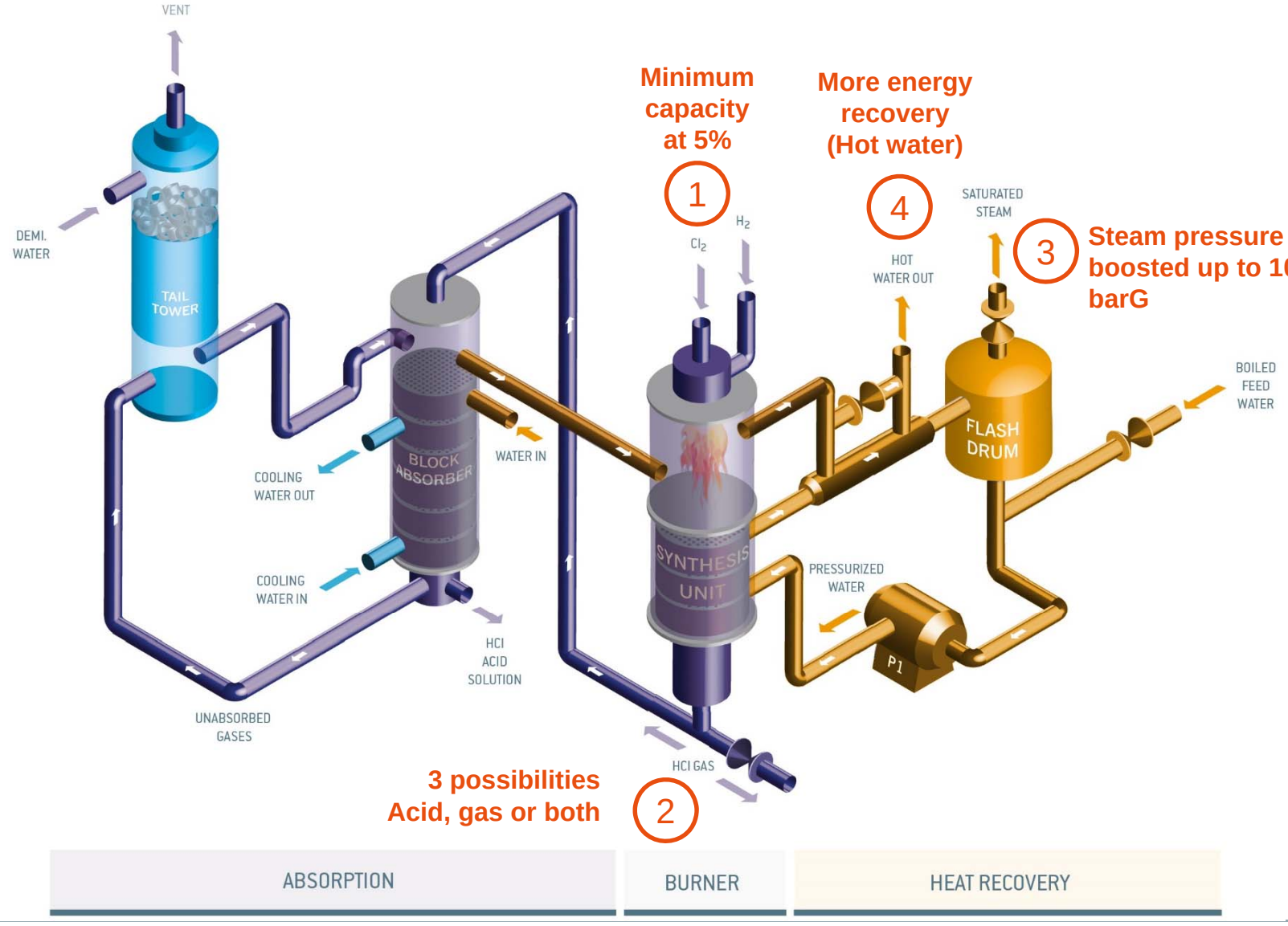
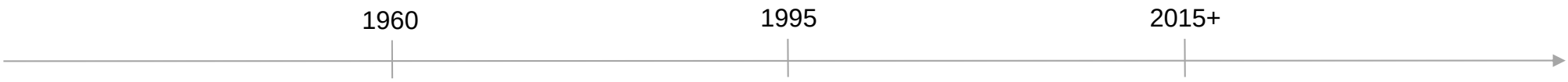


## SINTACLOR® ECO & FLEX

# = BREAK THE LIMITS

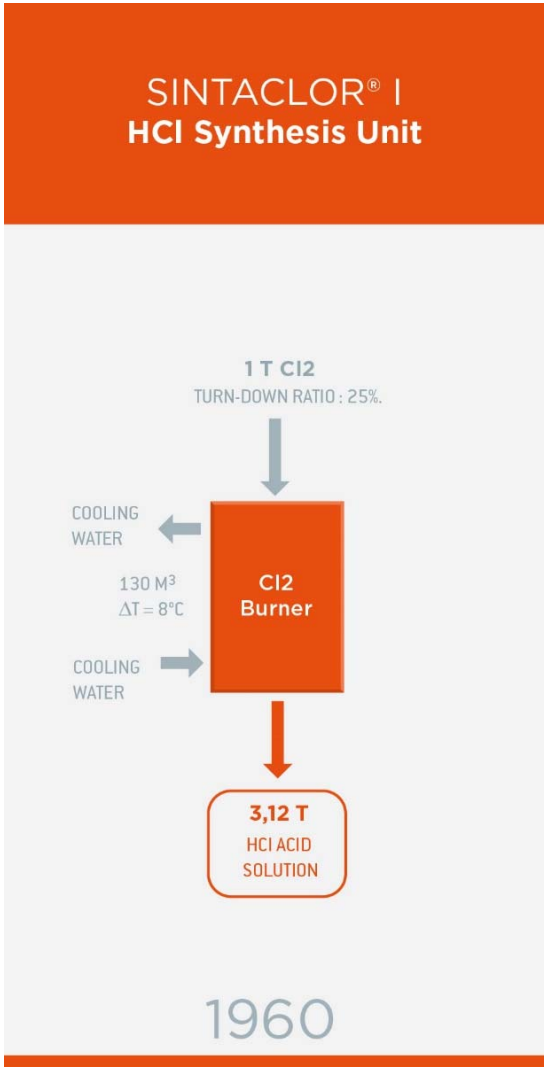


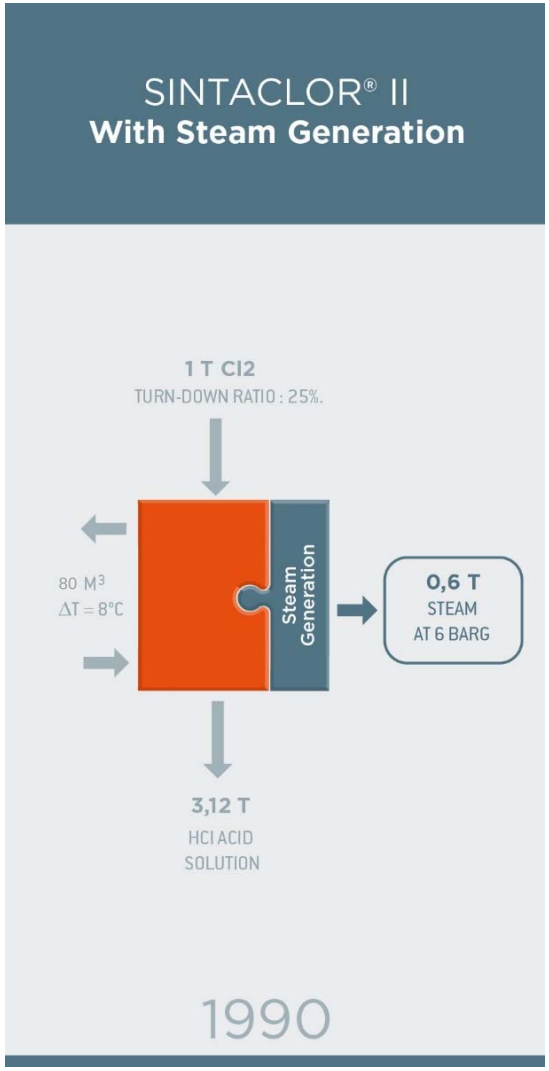
# SINTACLOR® ECO & FLEX PERFORMANCE FOR A 60 MTPD HCL 100%

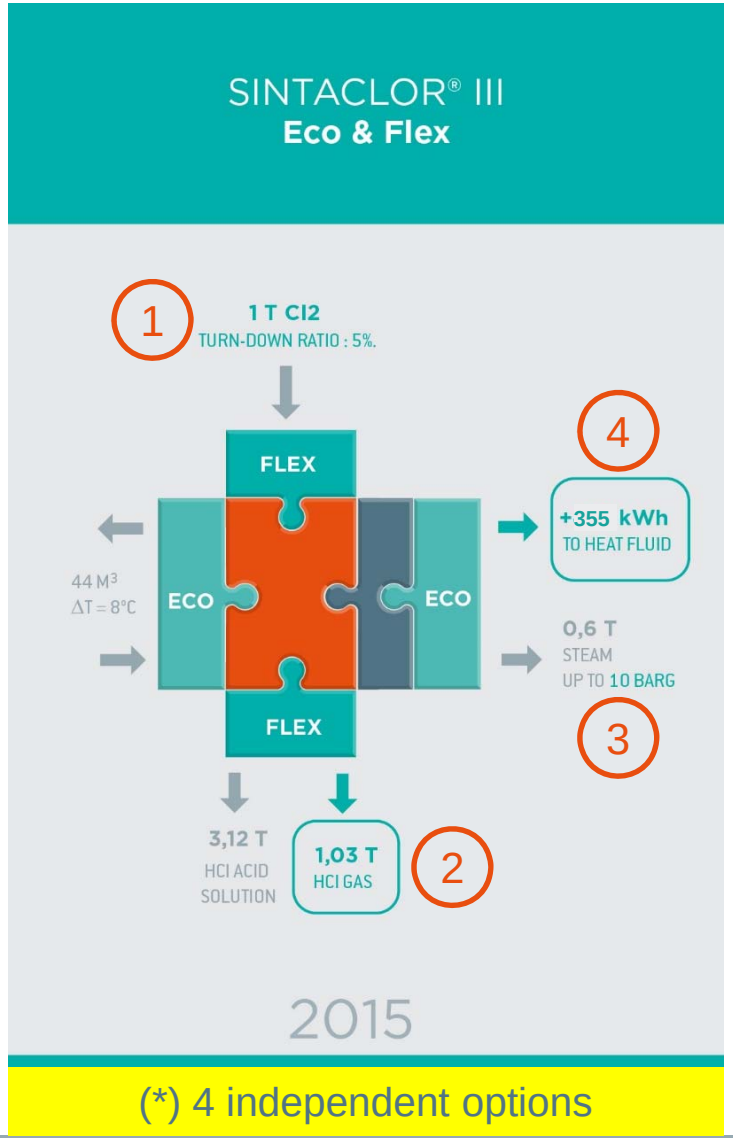



| | SINTACLOR® I<br>HCl Synthesis Unit | SINTACLOR® II<br>With Steam Generation | SINTACLOR® III<br>Eco & Flex |
|---|---|---|---|
| | 1960 | 1995 | 2015 |
| Cooling water consumption | 315 m3/h | 196 m3/h | 103 m3/h |
| Possible Heat recovered (% total duty) | 0 | 1110 kW (38%) | 1975 kW (67%) |
| Heating medium available | N/A | Steam at 6 barG | 3 Steam up to 10 barG & fluid heating 4 |
| Turn-down ratio | ~25% | ~25% | 1 As low as 5% |
| End-Product | HCl acid solution | HCl acid solution | 2 HCl acid solution<br>HCl gas<br>Both at the same time |

# SINTACLOR® III ECO&FLEX
# POSSIBLE(*) INSTALLATION ON NEW AND EXISTING SINTACLOR® I & II



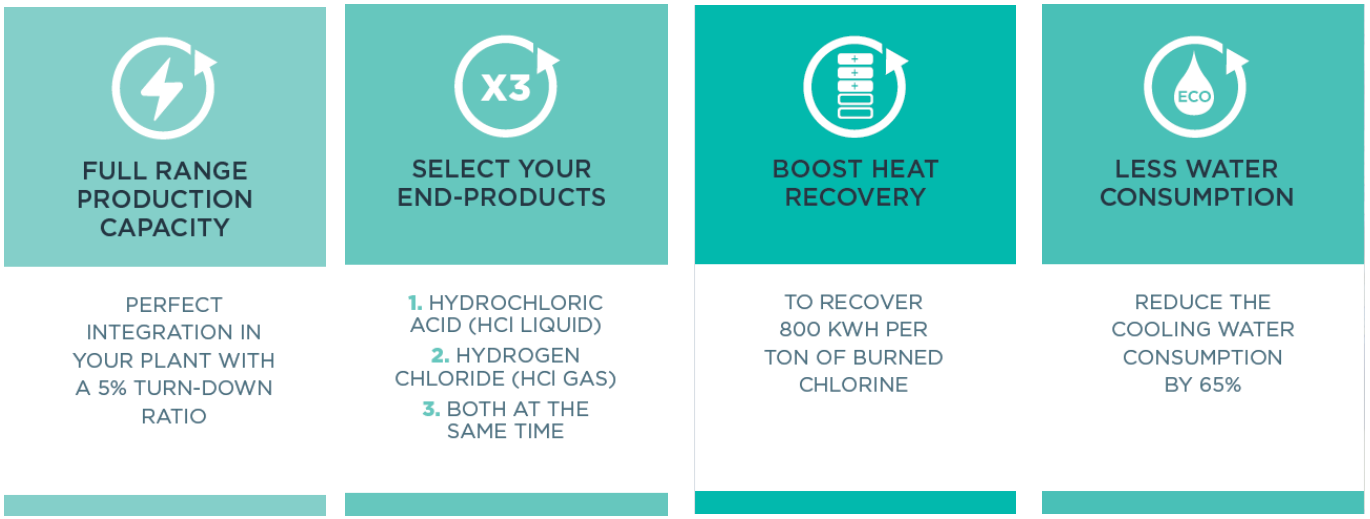




(*) 4 independent options

# HIGHLIGHTS

## SINTACLOR ECO&FLEX ANSWERS YOUR CONCERNS :

- Flexibility
- Energy savings
- OPEX reduction




## SINTACLOR ECO&FLEX CAN BE RETROFITTED ON EXISTING UNITS.

# THANK YOU FOR YOUR ATTENTION
# Visit us at our booth.

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