LAB Service Groupe CNIM
TERMINOX

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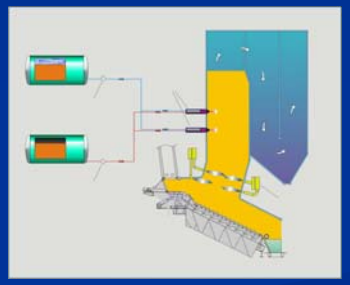
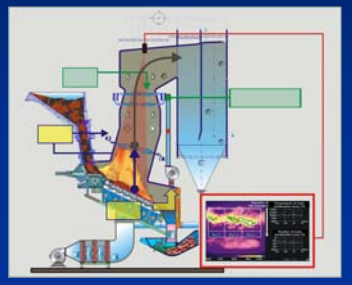
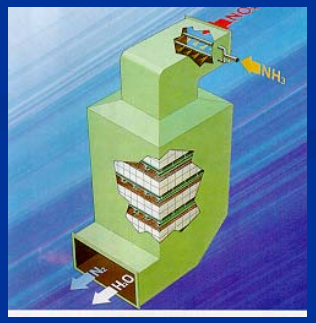
LAB Service

NO_x Control processes

- **COMBUSTION**
  - Primary air flow
    - O_2 content
- **SNCR**
- **SCR**
  - High dust (Boiler)
  - Low dust (after ESP)
  - Tail-End (after FGT)
- **SNCR + Polishing catalyst**
  - SNCR + High dust catalyst
  - TERMINOX







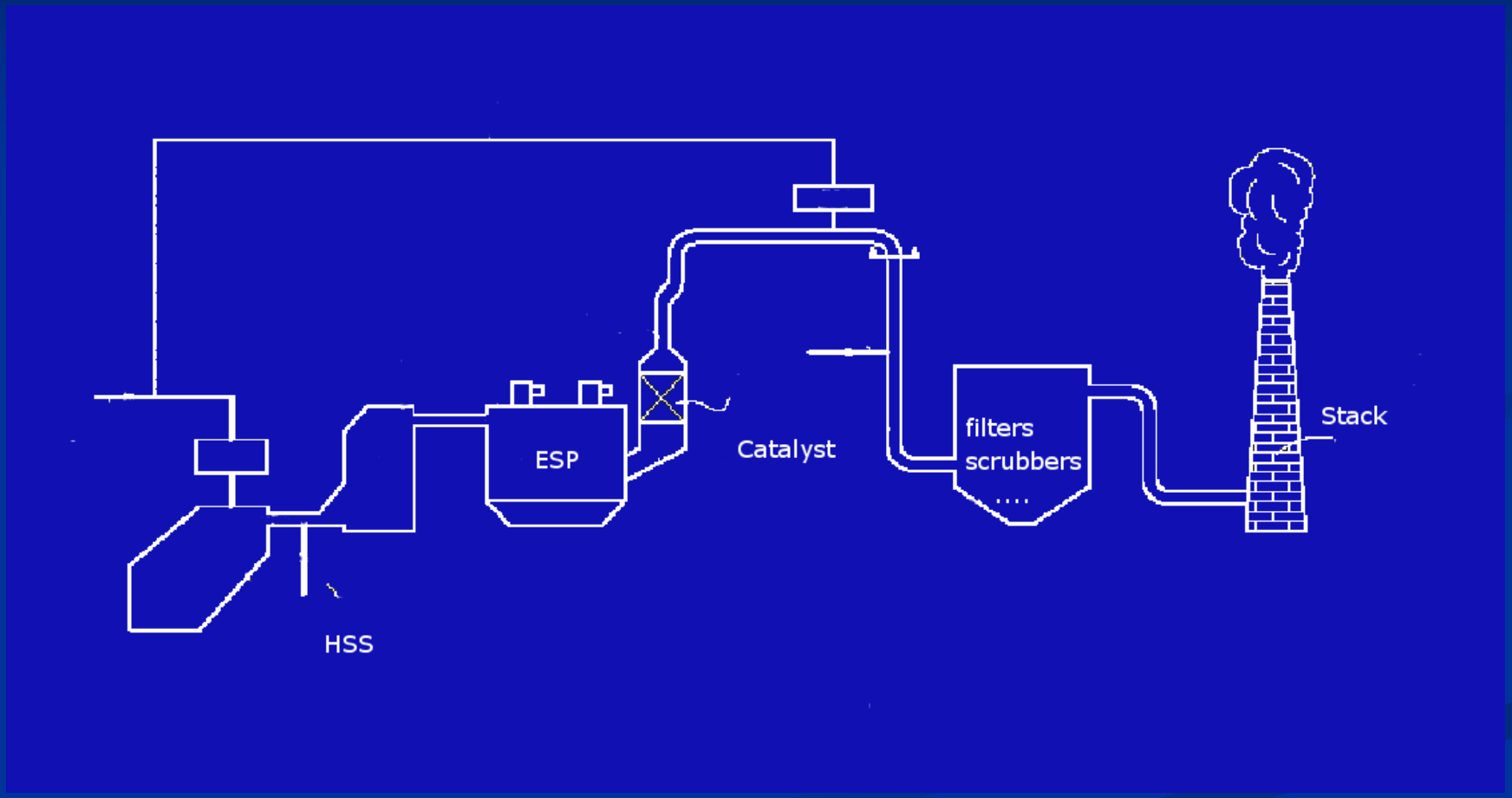
The problem

- Existing SNCR have limited performances
  - Say 50-60% NOx removal with NH3 slip < 10 mg/Nm3 at boiler outlet
    - Or 100-150 mg NOx at outlet
  - If one pushes the SNCR ammonia slip increases
    - Also N_2O and possibly CO if urea is used
- If a dry system is used, the ammonia slip, reacting with HCl, will yield NH_4Cl that may block the filter
  - Seen in several plants
- To a lesser extent excessive ammonia may contaminate the residues and cause problems for moistening in landfill
- Also possible are WWT problems
  - Too much ammonia prevents good precipitation of some metals

SNCR + plain SCR

- SNCR + High dust SCR polishing only a partial solution
- Operating temperature limitations
  - < 260°C poisoning by ammonium sulfate and bisulfate
  - >300 °C poisoning by molten salts
    - ($MeCl_2$ / NaCl / KCl)
- Located in the economizer area
  - Existing plants
    - Vertical flow : interference with economizer : layout, dedusting device…
    - Horizontal flow : clogging of catalyst
  - New plants
    - Vertical flow : a dedicated pass between two economizer passes

The solution : TERMINOX



The solution

- TERMINOX actually uses to its benefit the NH_3 escaping SNCR
  - The slip become a reagent !
- So as the SNCR can be pushed, the amount of SCR catalyst can be minimized
- The catalyst is integrated with the existing ESP
  - No additional pressure drop.
- A reagent if injected upstream to lower SO_3 and, also the SO_2 concentration, allowing the catalyst to work safely at a rather low temperature

What is TERMINOX ™ ?

- TERMINOX is a concept for catalytical NOx removal, well suited for upgrade or retrofit of existing plants, already fitted with SNCR
- TERMINOX is patented
- TERMINOX is a trademark
- TERMINOX uses
  - An SNCR
    - Ammonia or urea
  - Sorbent injection for SO_3/dewpoint control
  - A SCR catalyst located in the outlet plenum of an ESP
  - CEMs to monitor and pilot the process

What is TERMINOX ?

- TERMINOX can be seen as a way
  - To polish up the NOx , after a SNCR
  - To kill an excessive ammonia slip after an SNCR
  - A way to optimize the NOx removal, by a well tuned balance between a SCR and a SNCR
  - A way to implement a SCR in a limited space

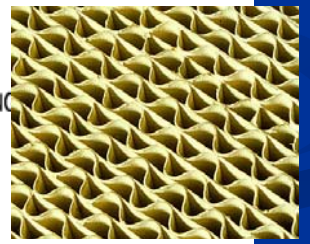
TERMINOX

- High Dust (before ESP) or Low Dust (after ESP)
  - High dust : 2 years for catalyst expected lifetime
  - Low dust : 5 years for catalyst expected lifetime
- Large operating temperature range : 200 to 300°C
  - HSS lime injected in the furnace for SO_3 and SO_2 removal
- Located at boiler outlet
  - No interference with economizer
  - Quick installation (< 3 weeks in Sesto San Giovanni)
  - Low pressure drop (no ID Fan replacement needed)
- Low investment and operating costs

TERMINOX – SESTO SAN GIOVANNI

First TERMINOX reactor installed on line B during 2009 shut down (< 3 weeks)

TERMINOX - PFD

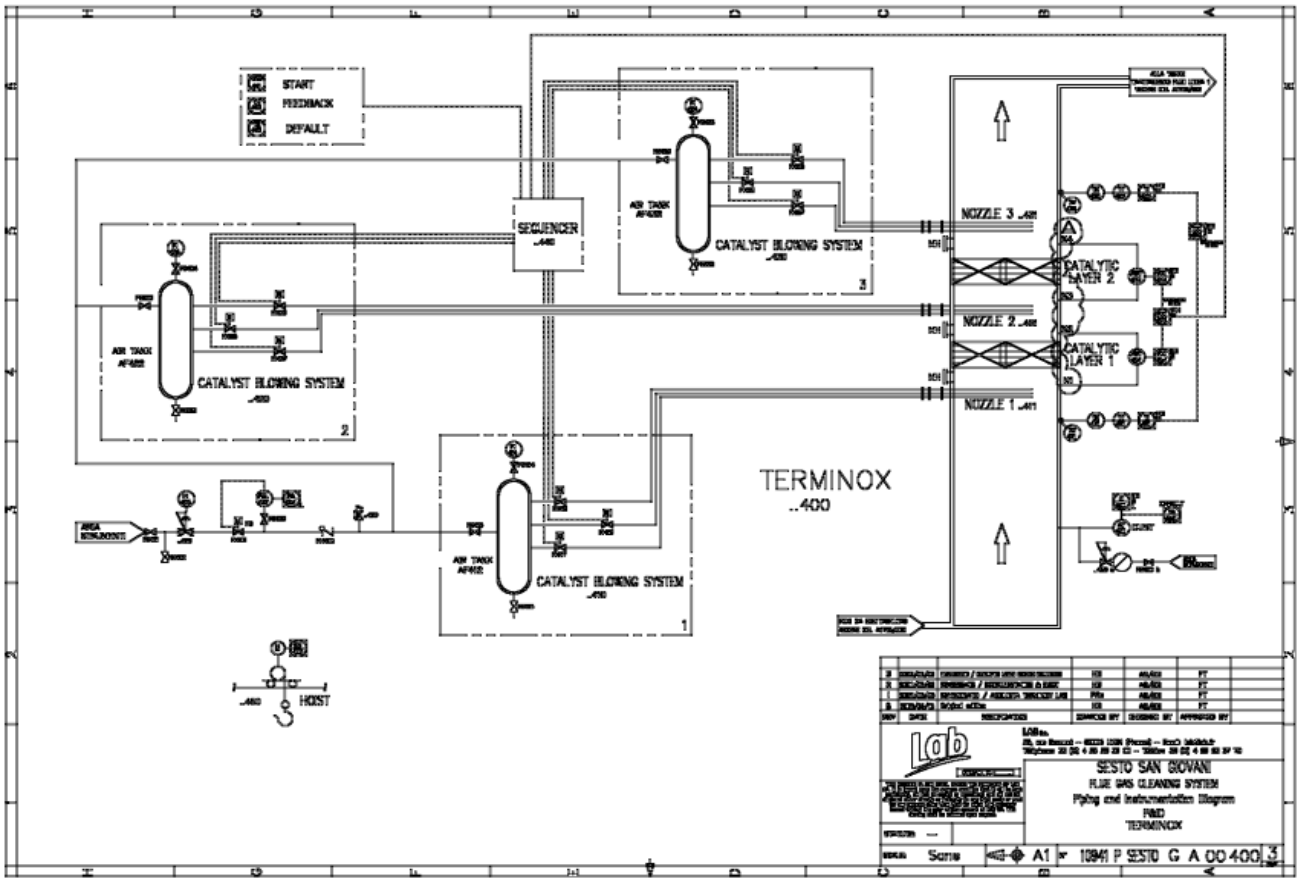


	PERFORMANCE RANGE
Adjustable Flow Rate Lime HSS (High Specific Surfaces)	0/3

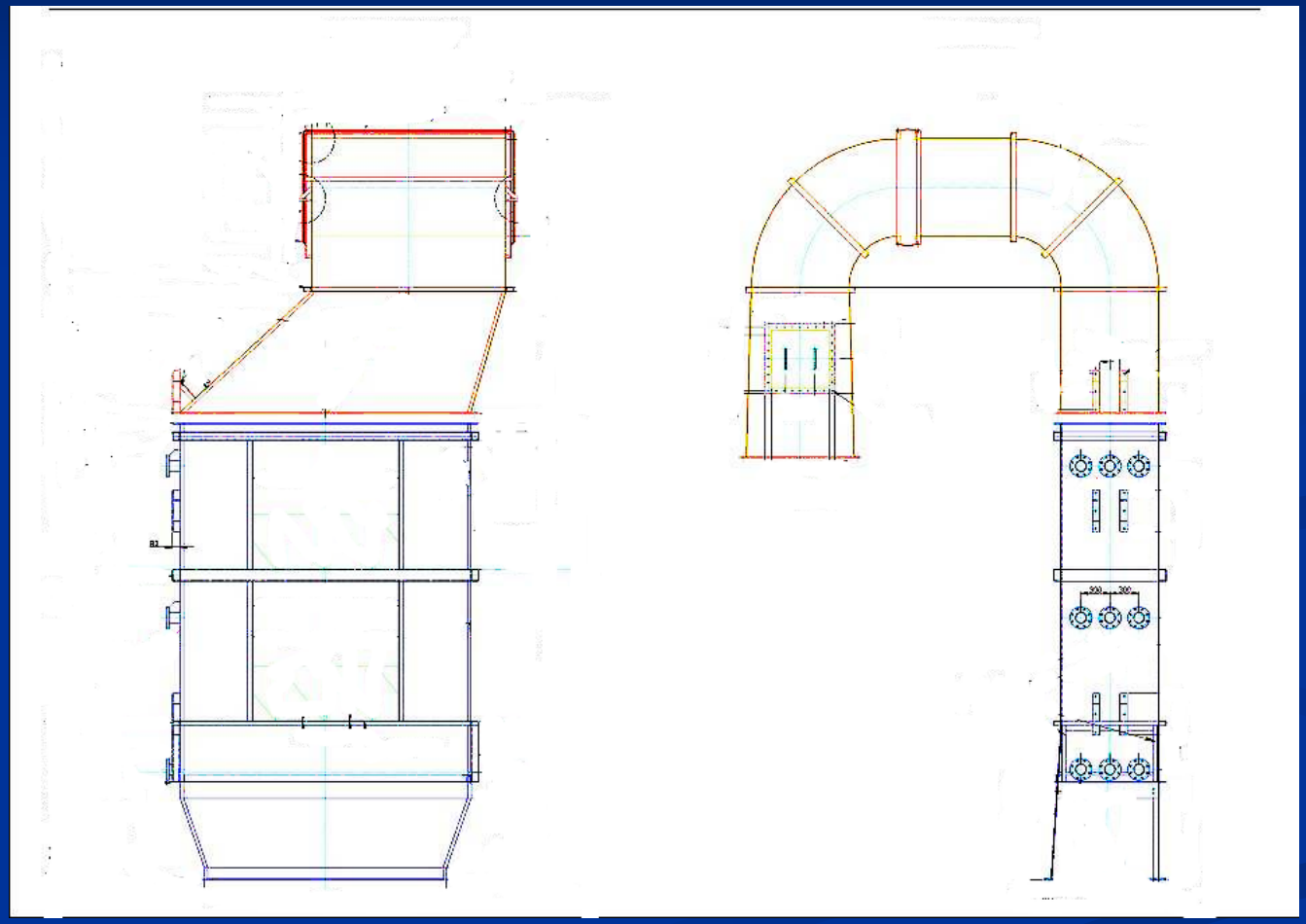
	NOMINAL	PERFORMANCE RANGE
Flue Gas Flow Rate	25.000	15.000/30.000
Temperature Outlet ESP	250	220/280
Waste Gas Composition		
O2	8	5/10
H2O	15	10/20
Pollutants Out Filter		
SO2	150	0/300
NOx	120	80/140
NH3	20	10/40
DUSTS	100	0/150
TOC	5	0/20
RELATIVE PRESSURE	0,4 KPa	

	NOMINAL	PERFORMANCE RANGE
Pollutants Outlet Catalysts	80	50/80
NOx	5	0/10
NH3		
RELATIVE PRESSURE	0,50 KPa and 0,83 KPa	

TERMINOX – P&ID



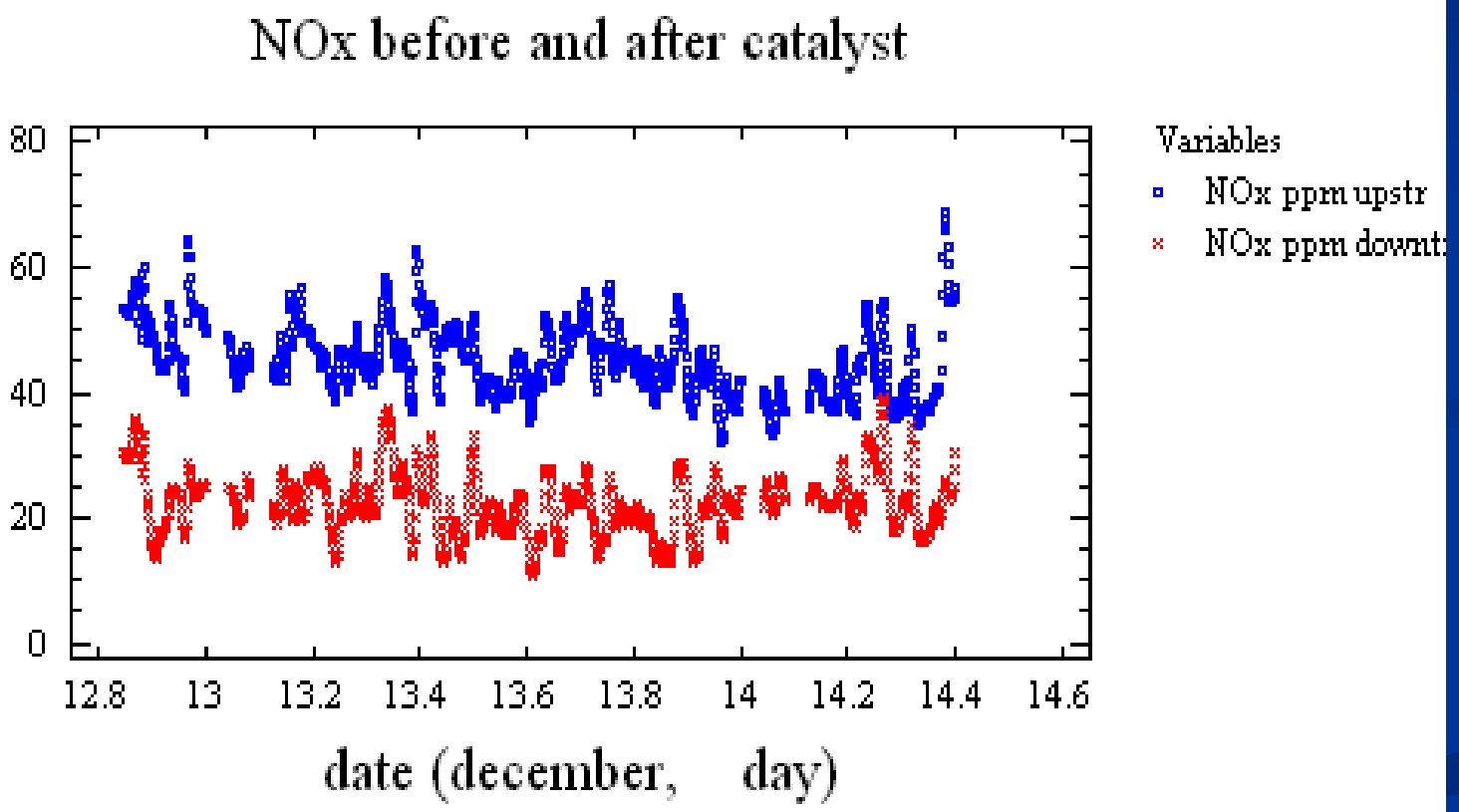
TERMINOX – Reactor



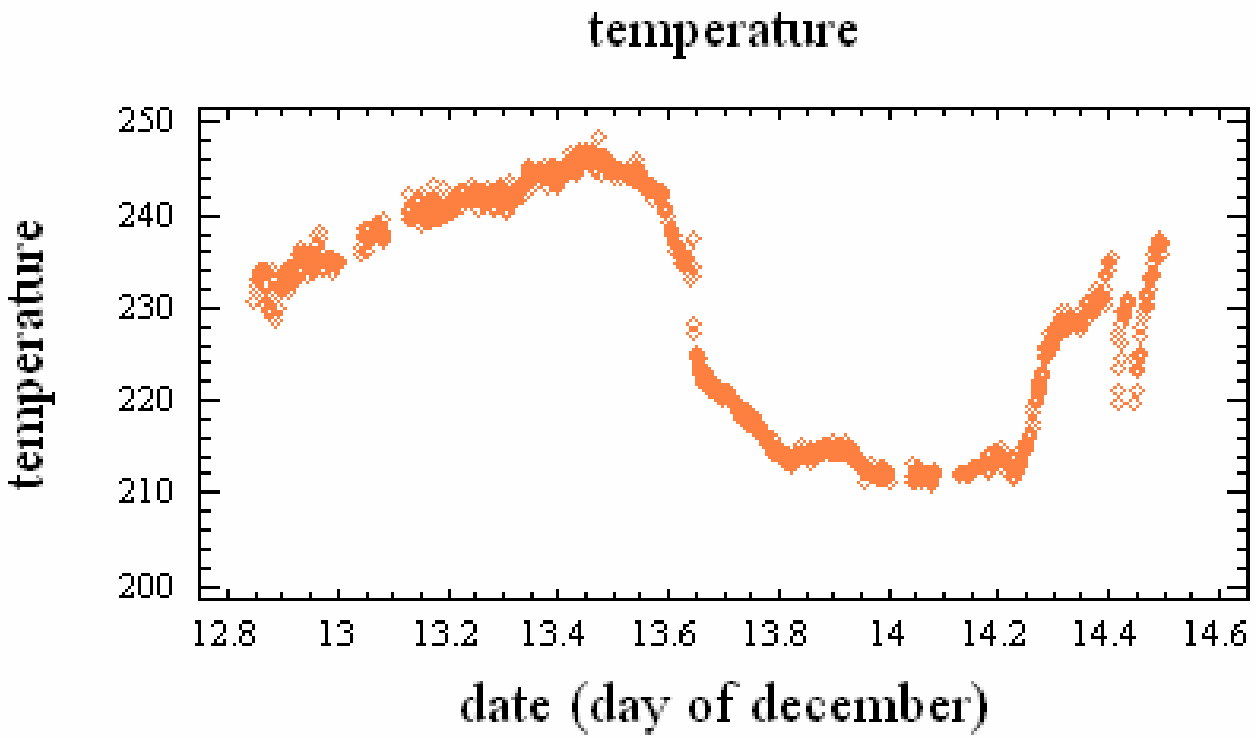
TERMINOX - 3 steps

- Step 1 : SNCR (Reagent : $CO(NH_2)_2$)
  - NOx : 100 to 120 mg/Nm3 at boiler outlet
  - NH_3 : 20 to 30 mg/Nm3 at boiler outlet
- Step 2 : SO_3 removal (Reagent : HSS lime injected into furnace)
  - SO_3 : << 1 mg/Nm3 at boiler outlet
  - SO_2 : < 50 mg/Nm3 at boiler outlet
- Step 3 : SCR (Reagent : NH_3 slip from SNCR)
  - NOx : < 50 mg/Nm3 at Terminox outlet
  - NH_3 : << 5 mg/Nm3 at Terminox outlet

TERMINOX – NOx removal

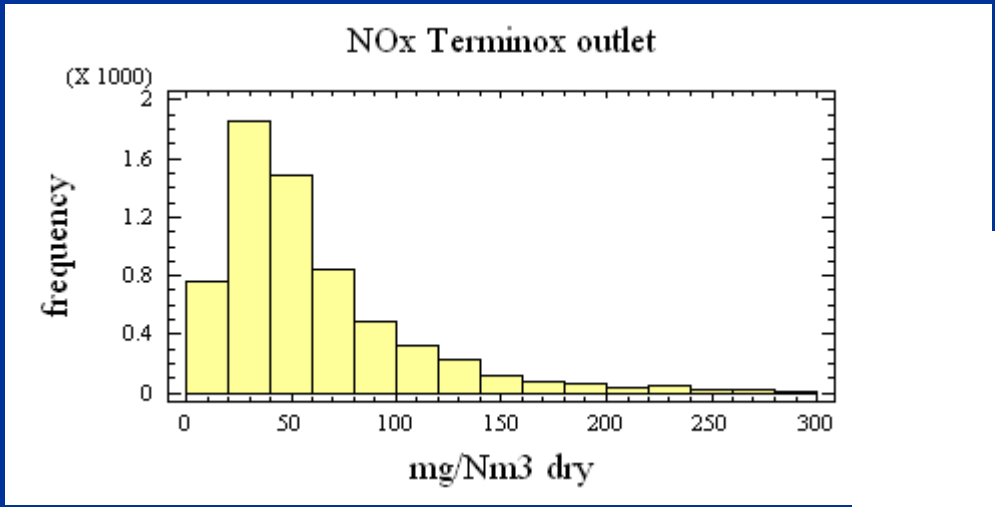


TERMINOX
Operating temperature

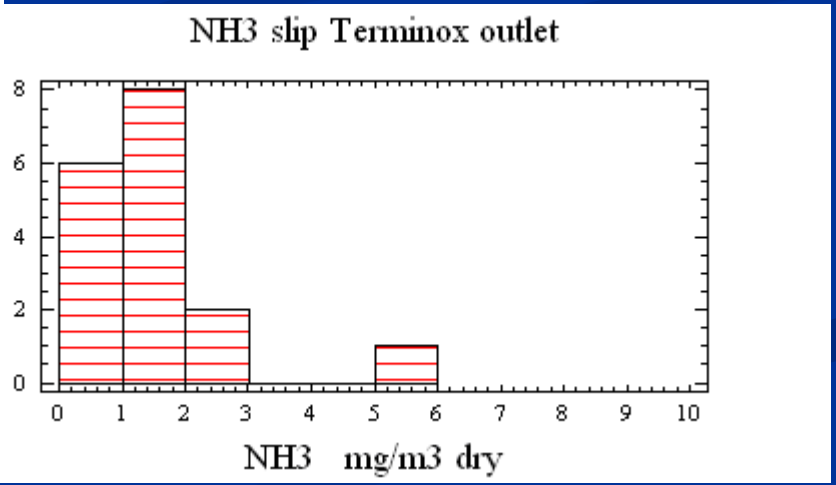


TERMINOX - NO_x / NH_3

$4\ NO + 4\ NH_3 + O_2 \rightarrow 4\ N_2 + 6\ H_2O$



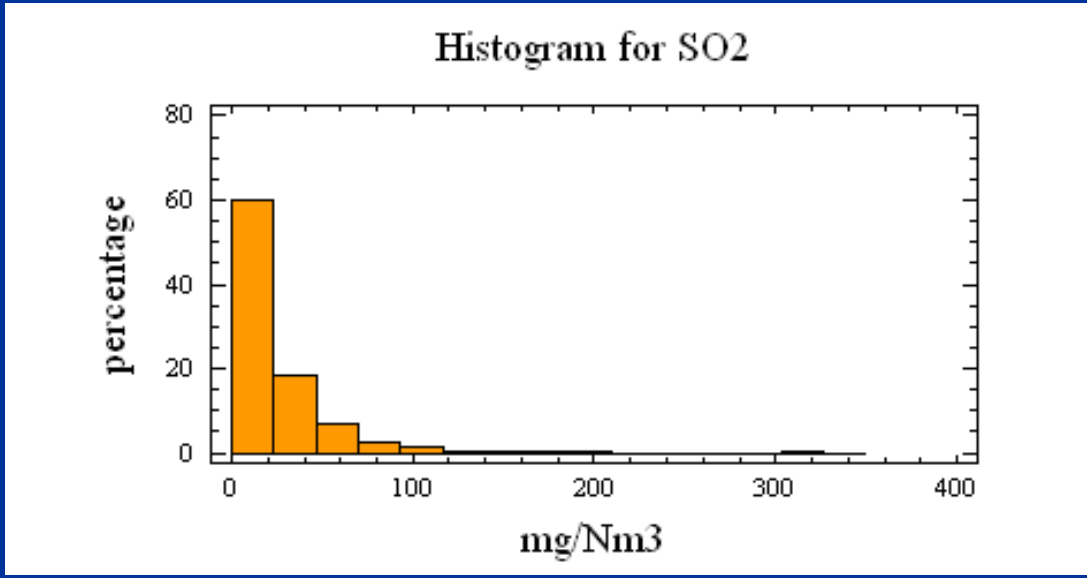
NO_x < 50 mg/Nm³



NH_3 < 5 mg/Nm³

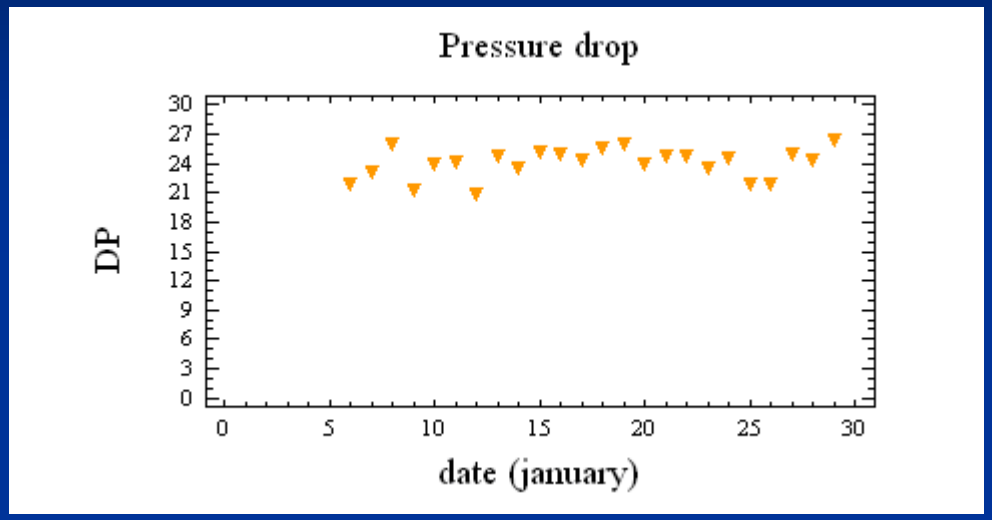
TERMINOX – SO_x removal

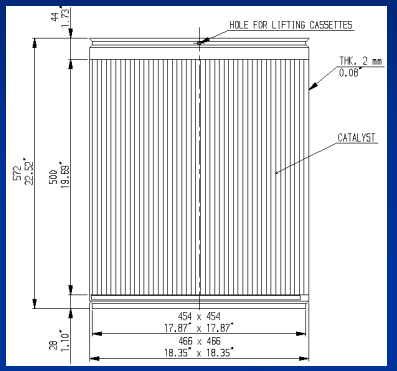
$$SO_x + Ca(OH)_2 + O_2 \rightarrow CaSO_4$$

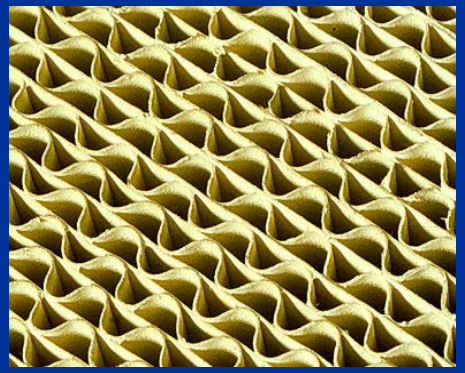


$SO_2 < 50\ mg/Nm^3$

TERMINOX - Catalyst







TERMINOX – Next steps

- Lines A and C in SESTO SAN GIOVANNI plant will be equipped during October 2010 shut down
- Injection of urea before Terminox will be tested in order to optimize NOx removal
  - LAB's patent on urea injection before catalyst
- The TERMINOX is the client's preferred technology for the future new line

Questions ?

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