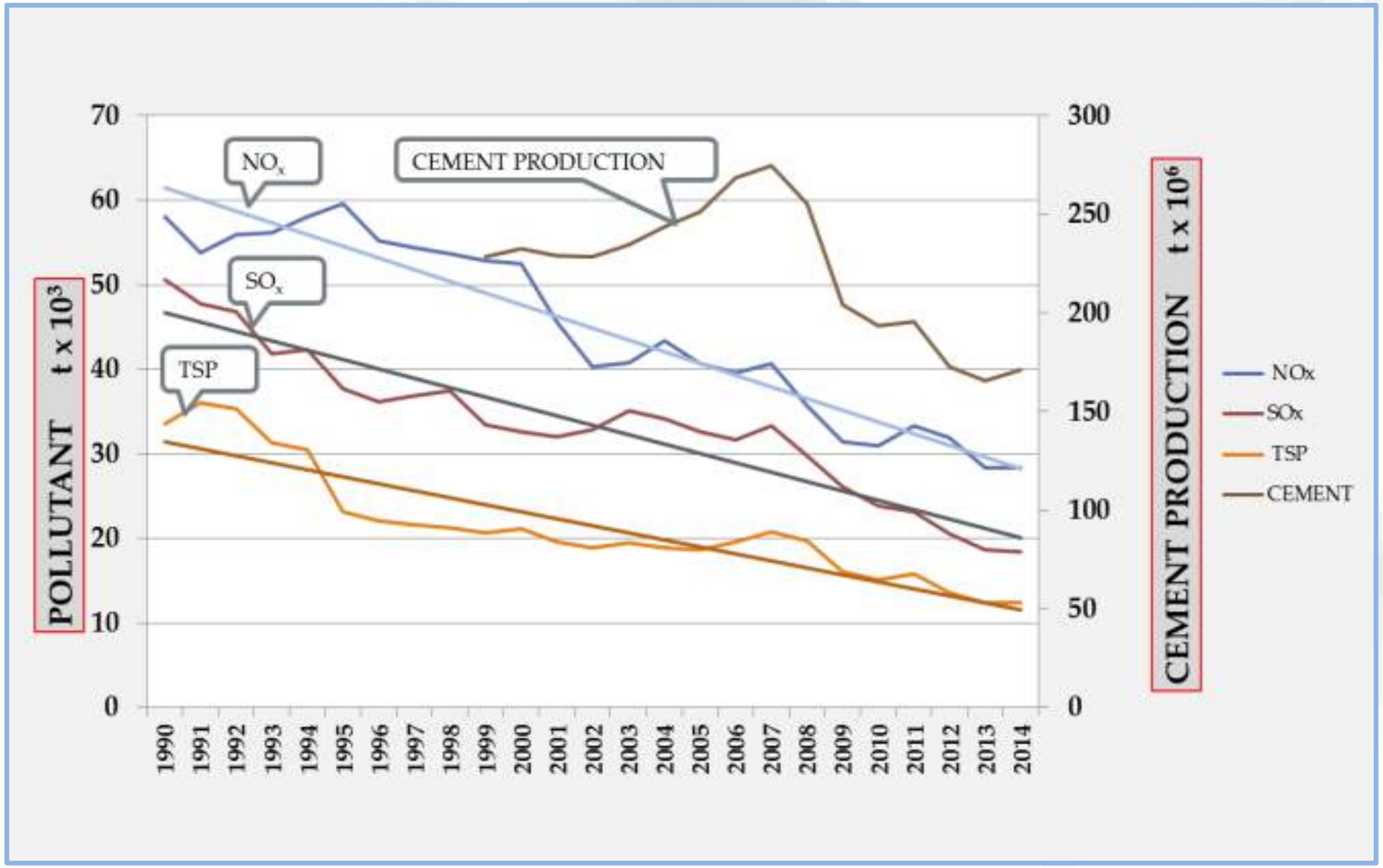
Cement industry emission trends in Europe

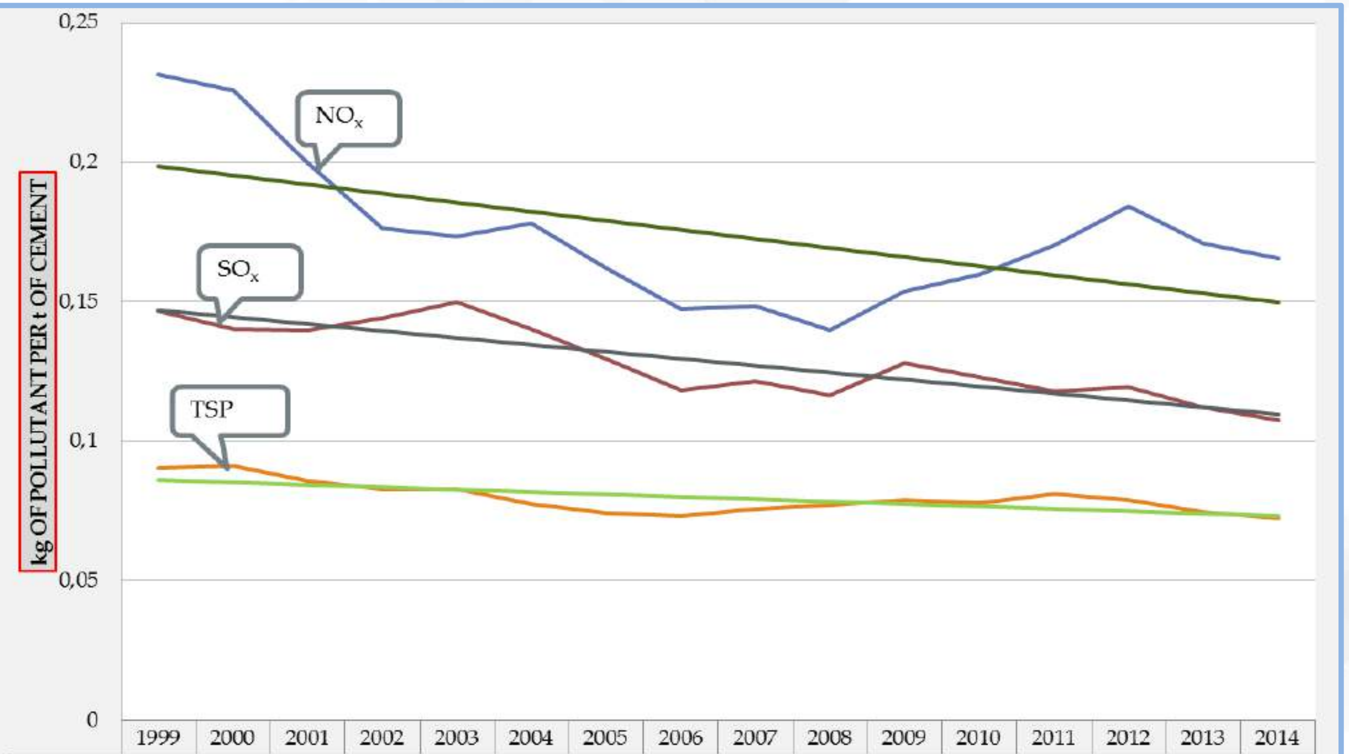


EU 28 cement sector pollutant emission trends since 1990

For all the major pollutants here considered the total amount released to atmosphere is on progressive decrease.

Source: EEA

Cement industry emission trends in Europe



	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
NOx	0,2313	0,2257	0,1995	0,1763	0,1735	0,1781	0,1618	0,1474	0,1483	0,1397	0,1539	0,1598	0,1703	0,1843	0,1711	0,1657
SOx	0,1464	0,1401	0,1398	0,1439	0,1497	0,1403	0,1295	0,1182	0,1214	0,1164	0,1279	0,123	0,118	0,1192	0,1122	0,1076
TSP	0,0905	0,091	0,0858	0,0828	0,083	0,0776	0,0744	0,0731	0,0756	0,0772	0,0789	0,0778	0,081	0,0788	0,0747	0,0725

EU28 specific cement industry emission trends since 1999

The emission factor for dust is slowly decreasing during the considered period, mainly because the dust emissions are well controlled since the end of 70's.

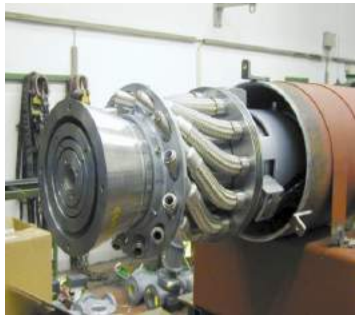
The results in term of progressive introduction of BAT is evident for NO_x and SO_x.

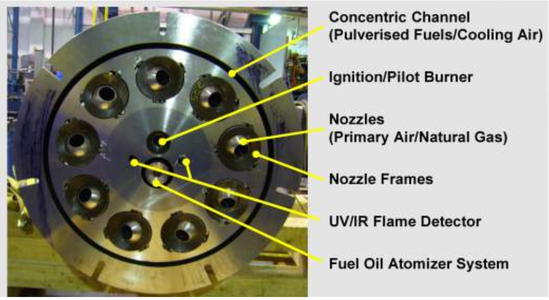
Source: EEA

NO_x control technologies





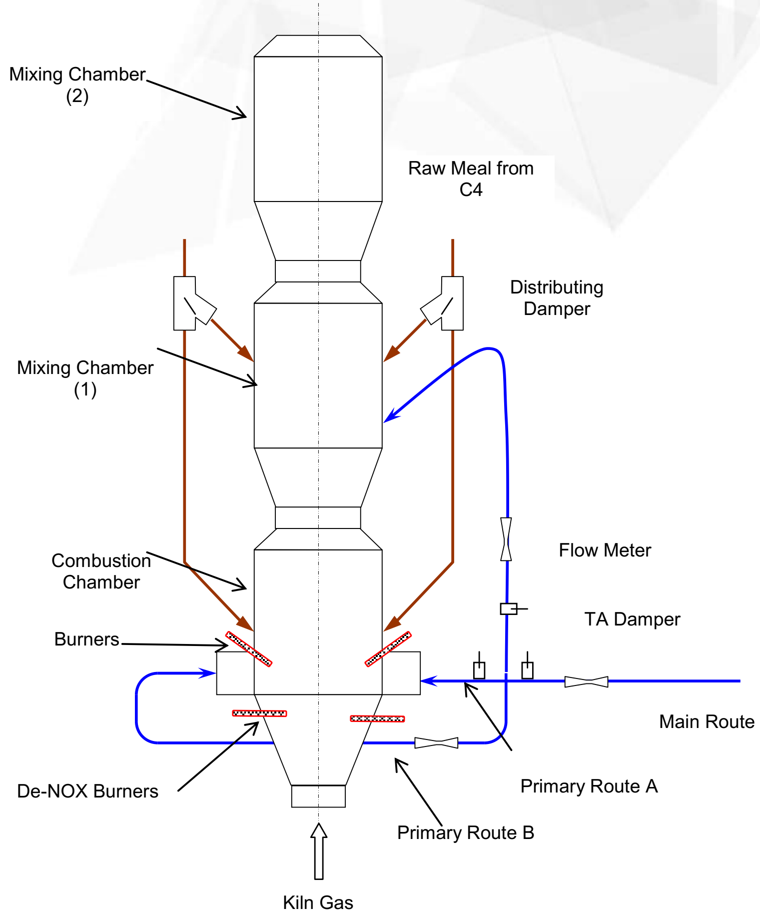



Two kinds of actions are possible for the control of NO_x emissions, which otherwise are exceeding the limits that almost everywhere in the world are set.

It is possible to prevent the formation of NO_x with a set of techniques which are based on the principle to create local reducing conditions in the flame of the main burner or in a defined volume of the precalciner.

These techniques, the so called primary measures, have strongly affected the design of the main burner, along with the need of alternative fuel injection aside or instead of conventional fossil fuels.
Unfortunately the optimum from the point of view of NO_x prevention is frequently in conflict with the best setting for the kiln operations.

NO_x control technologies

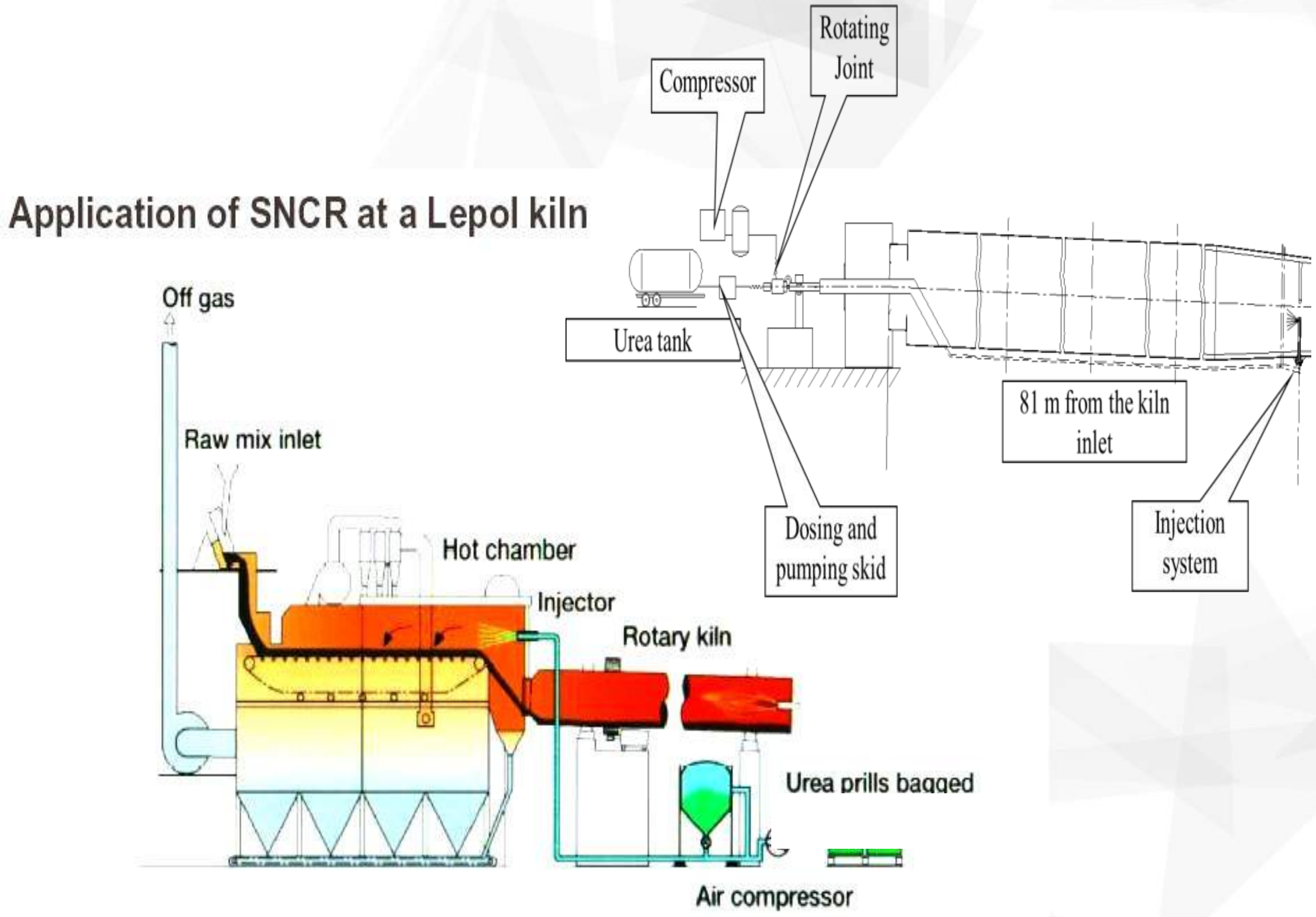


Also the calciner design has been developed in order to minimize the NOx formation. A wide variety of calciner designs are today available, to realize local reducing conditions, splitting the combustion air, the fuel and the raw feed.

Also in this case there are limits to this approach mainly due to the formation of CO and SO_2 which are also limited to the stack. In many case the best primary measure is the use of alternative fuels, mainly chopped tires.

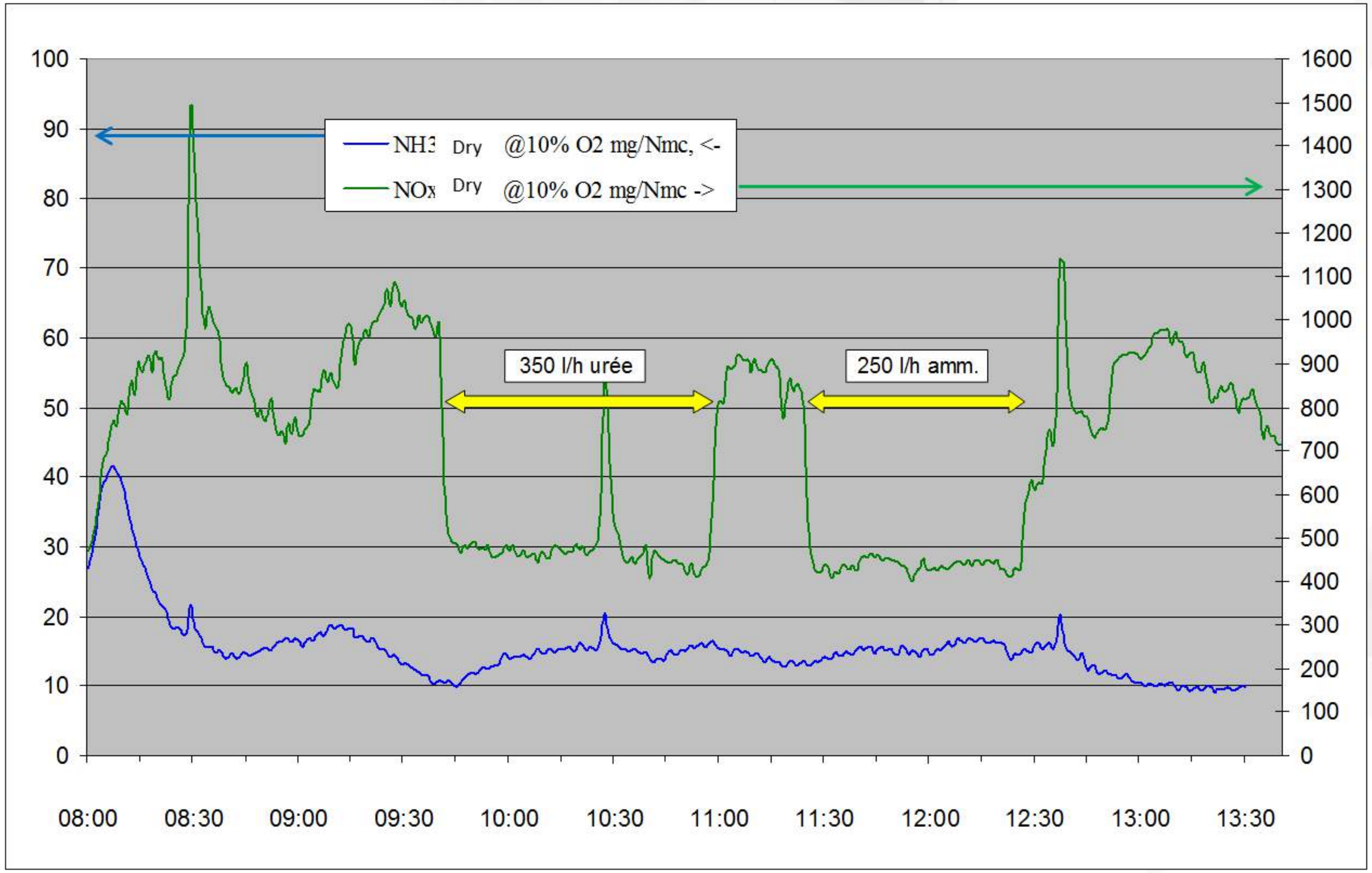
As a general rule, the primary measures can't guarantee the respect of emission limits as low as 500 mg/Nm^3@10% O_2, daily average.

NO_x control technologies



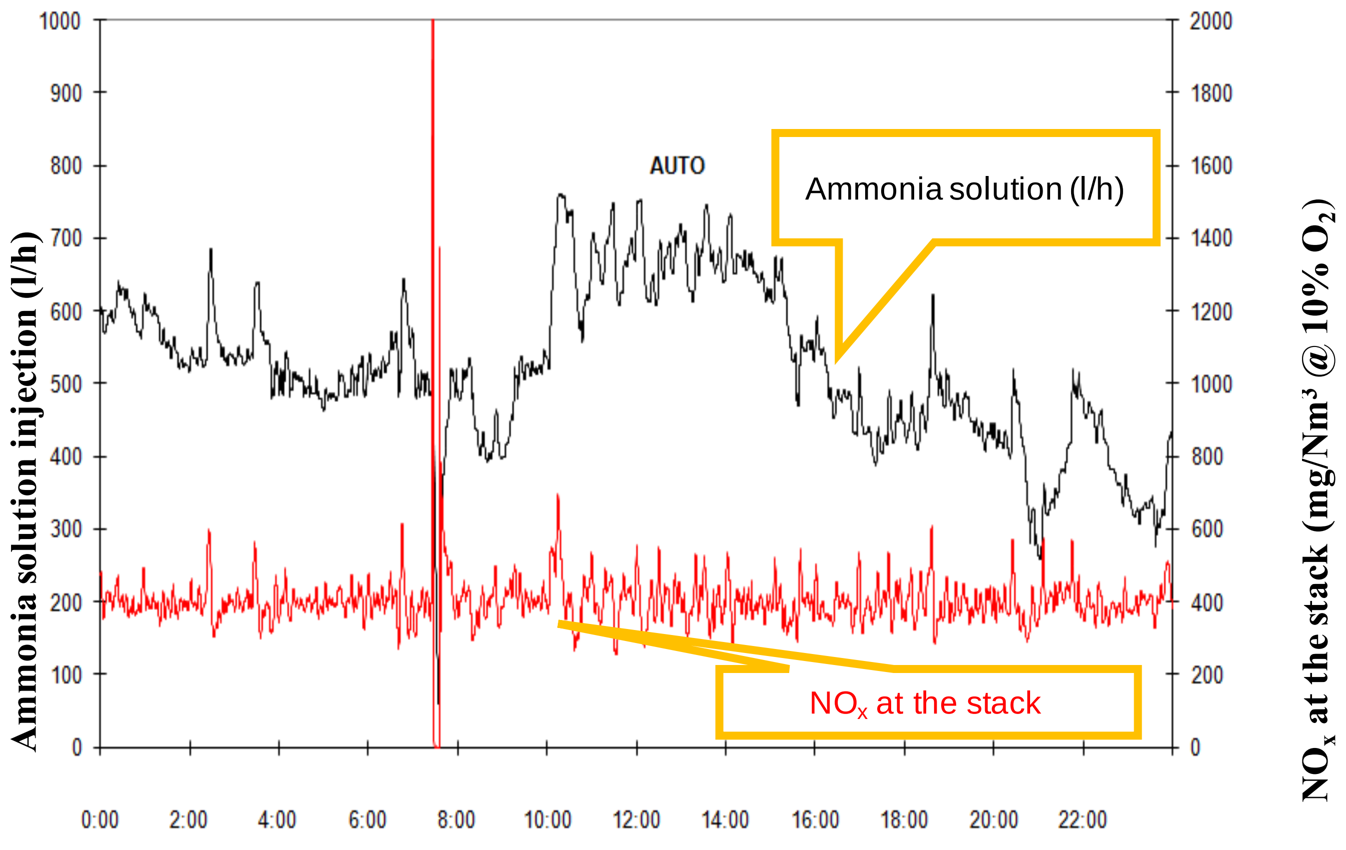
The second kind of actions is based on the reaction between amide NH_2^- and NO, to form nitrogen and water, this reaction can take place spontaneously at around 900°C, or catalyzed by Ti and V oxides at 300-350°C. The first technology, the Selective Non Catalytic Reduction (SNCR), has been applied to almost all kind of kilns, trying to inject urea or ammonia solution where the best temperature window is located.

NO_x control technologies



In these kind of applications the reduction efficiency is in the order of 40%; starting from emission levels of 800 mg/Nm^3 it is consequently possible to stay below 500 mg/Nm^3, without ammonia slip, both using urea or ammonia solution.

NO_x control technologies

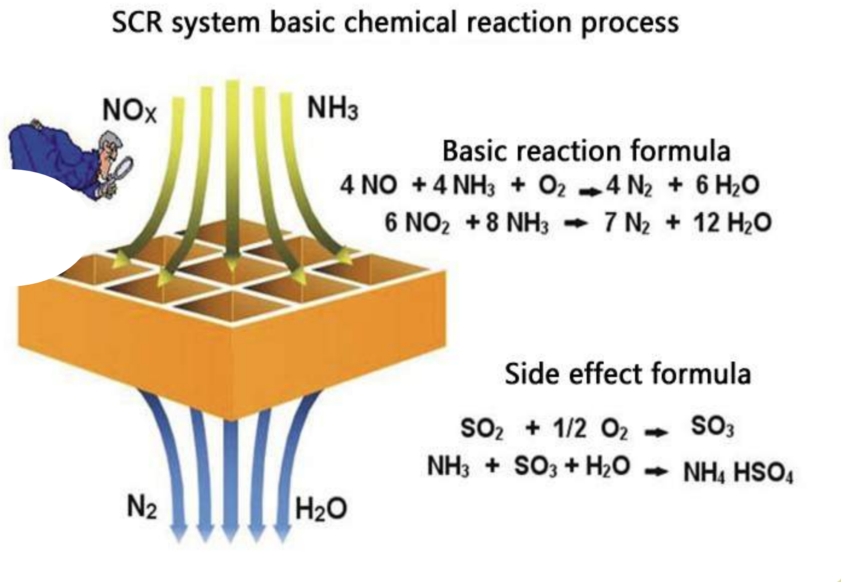


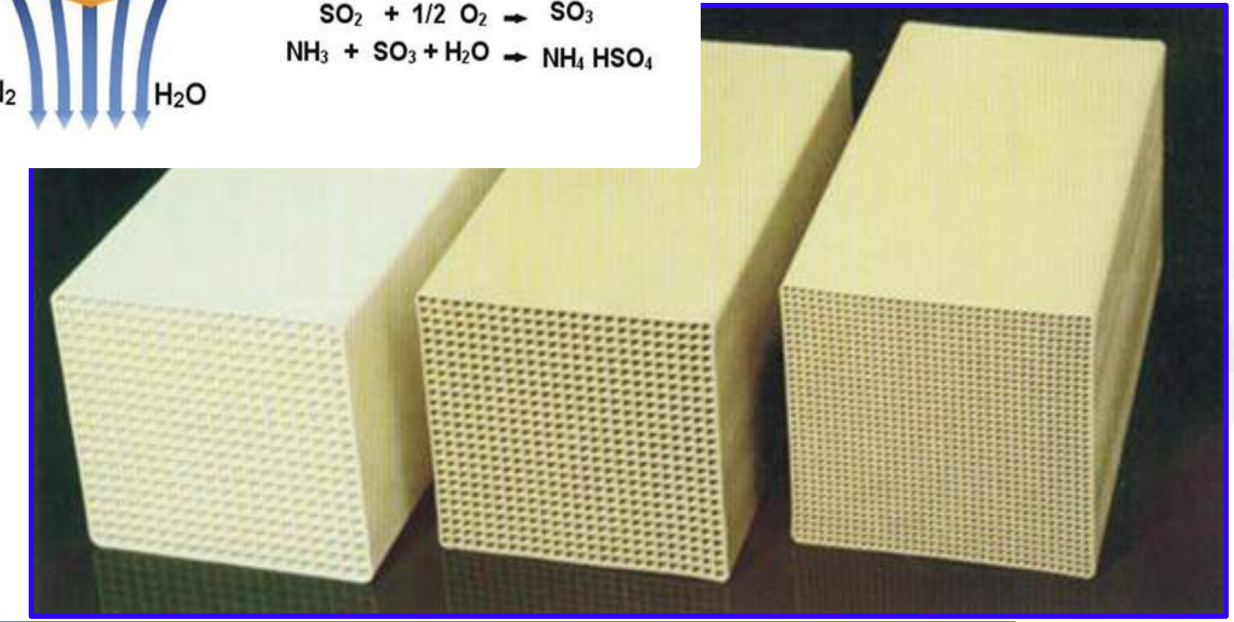
The application of SNCR technology to the precalciner produces much better results, provided that an even distribution of the reagent is realized and oxidizing conditions are guaranteed.

In this specific application ammonia solution performs better than the urea, because of its much higher diffusivity and lower reaction time.

Values around 200 mg/Nm^3 can be obtained.

NO_x control technologies

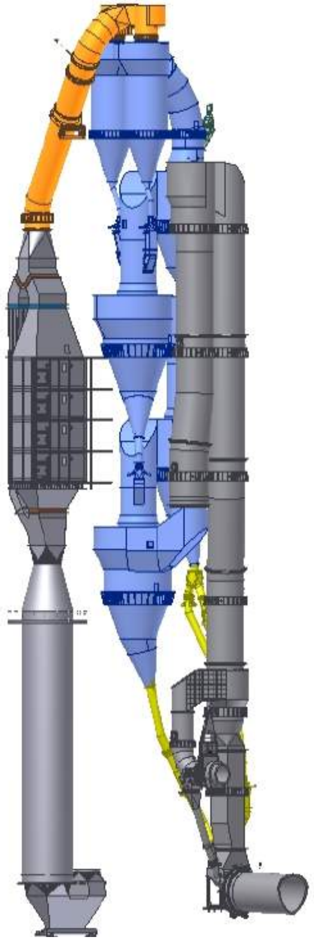




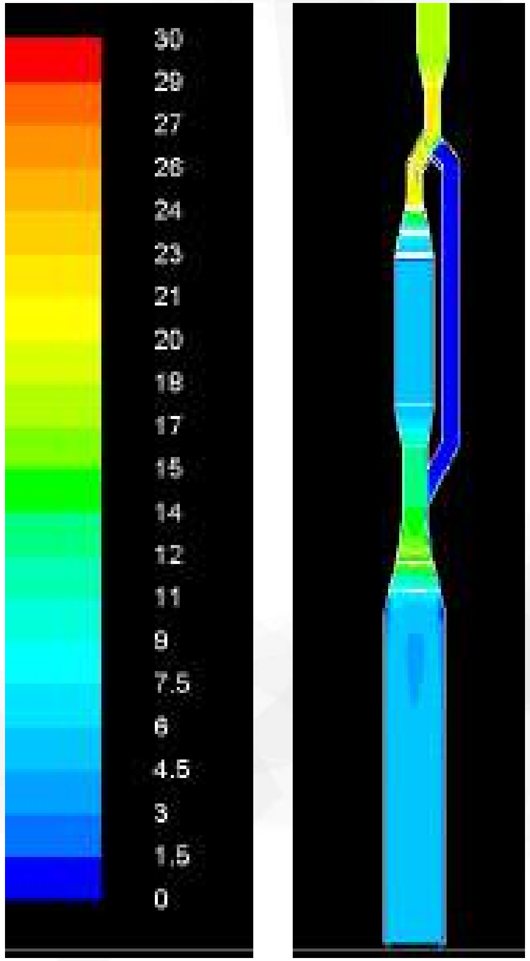
Already developed for other industrial sectors the SCR technology is going to find applications also in the clinker burning process.

TiO_2 and V_2O_5 catalyst in form of honeycomb elements is put in contact at 300-350°C with the kiln gases in which ammonia solution has been evaporated. Two or more layers of catalyst elements are located just after the preheater outlet (high dust configuration) or after the process filter (low dust configuration).
To prevent catalyst deactivation it is essential to keep the SO_2 concentration as low as possible. The catalyst life is expected to be in the order of three - four years, or even more depending on specific conditions.

NO_x control technologies



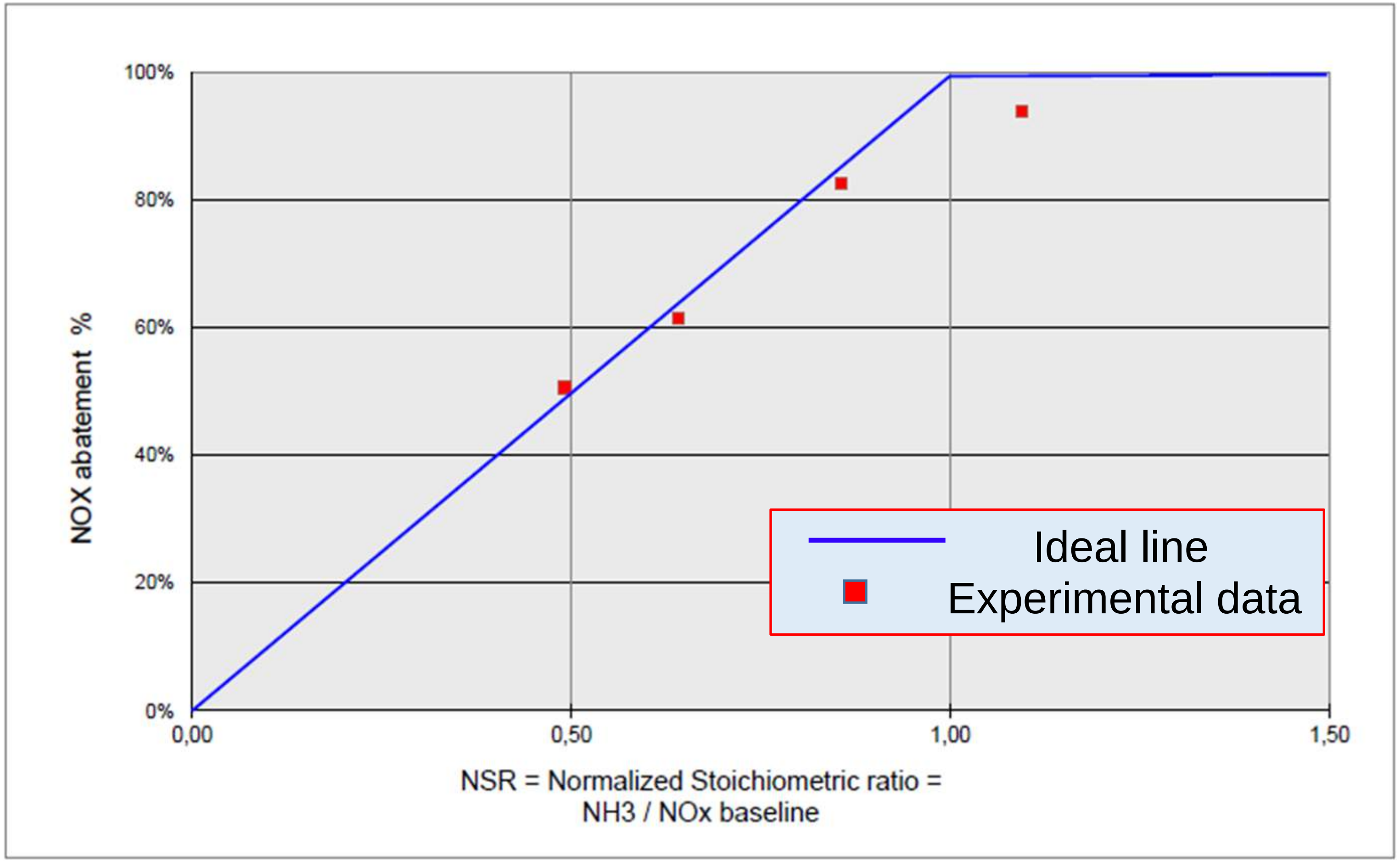
PARAMETER	VALUE
Gas Flowrate (Nm^3/h)	220.000
Operating Temperature (°C)	295
Δ NOx Inlet- Outlet (mg/Nm^3, dry 10% O_2)	1.000
Catalyst Volume (m^3)	119
Number of layers	3 (active) + 1 (spare)
Module size (mm x mm)	1.930 x 960
Number of modules per layer	16
Layer Heigth (mm)	1.300
Pitch size (mm)	11,4
Space velocity (h^{-1})	1849
Inlet buffle plates	YES



Very few applications of SCR technology are today in operation. In Rezzato (Italy) plant a high dust configuration has been started with a new line of 3.000tpd.

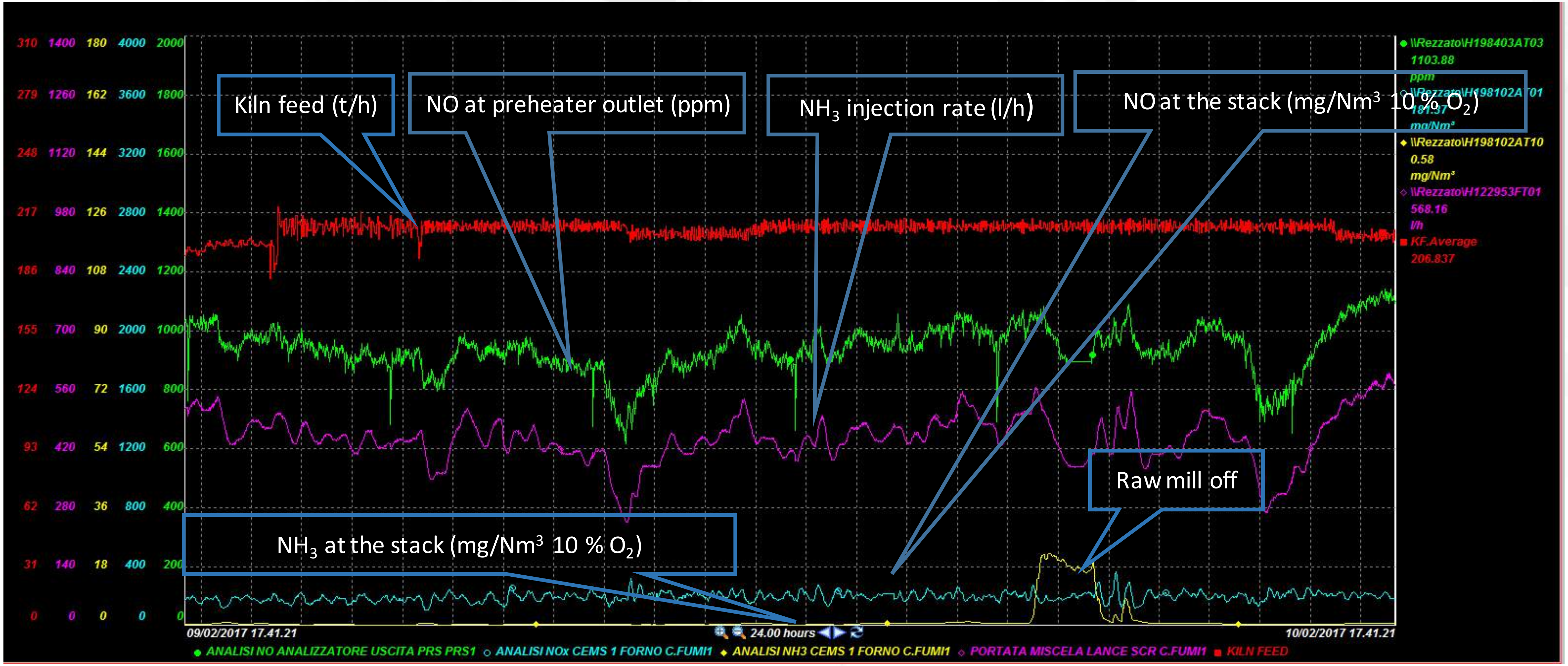
After almost 2 and a half years of operation the efficiency is still unchanged and the NO_x emission limit of 200 mg/Nm^3 @10% O_2 daily average can be respected.

NO_x control technologies

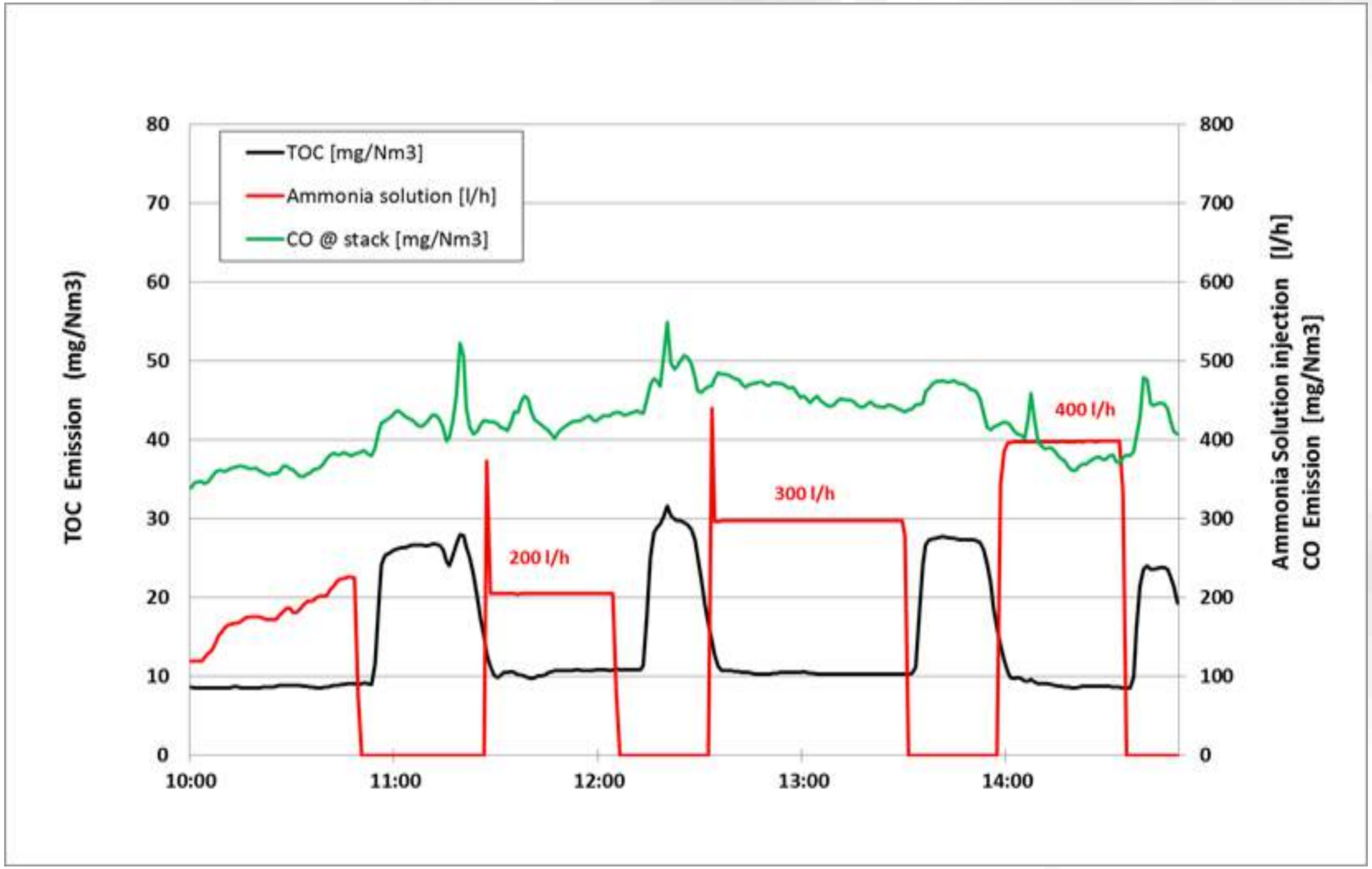


Ammonia consumption in a SCR application is very close to the reaction stoichiometry. Ammonia is almost absent at the stack, apart those periods when the line is operated in direct mode, when ammonia is not captured in the milling phase and appears at the stack (around 18 mg/Nm^3 10% O_2)

NO_x control technologies

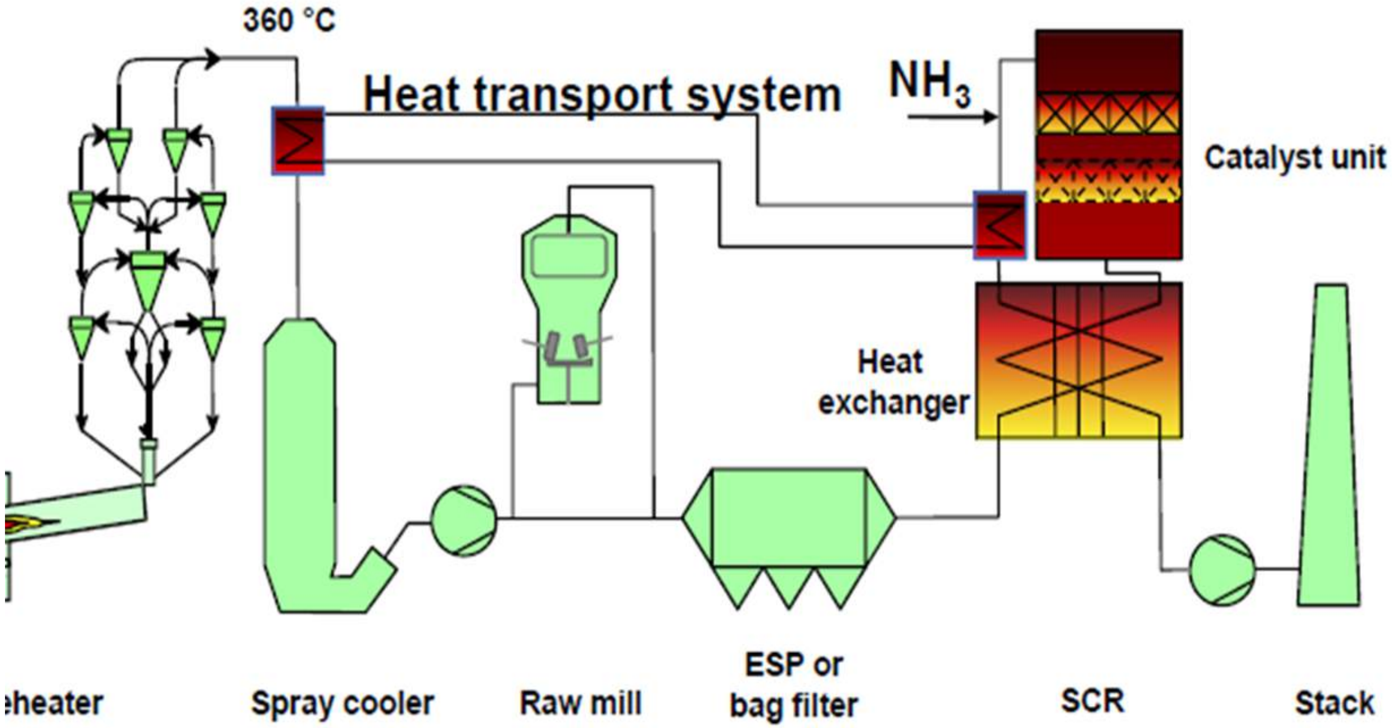


NO_x control technologies



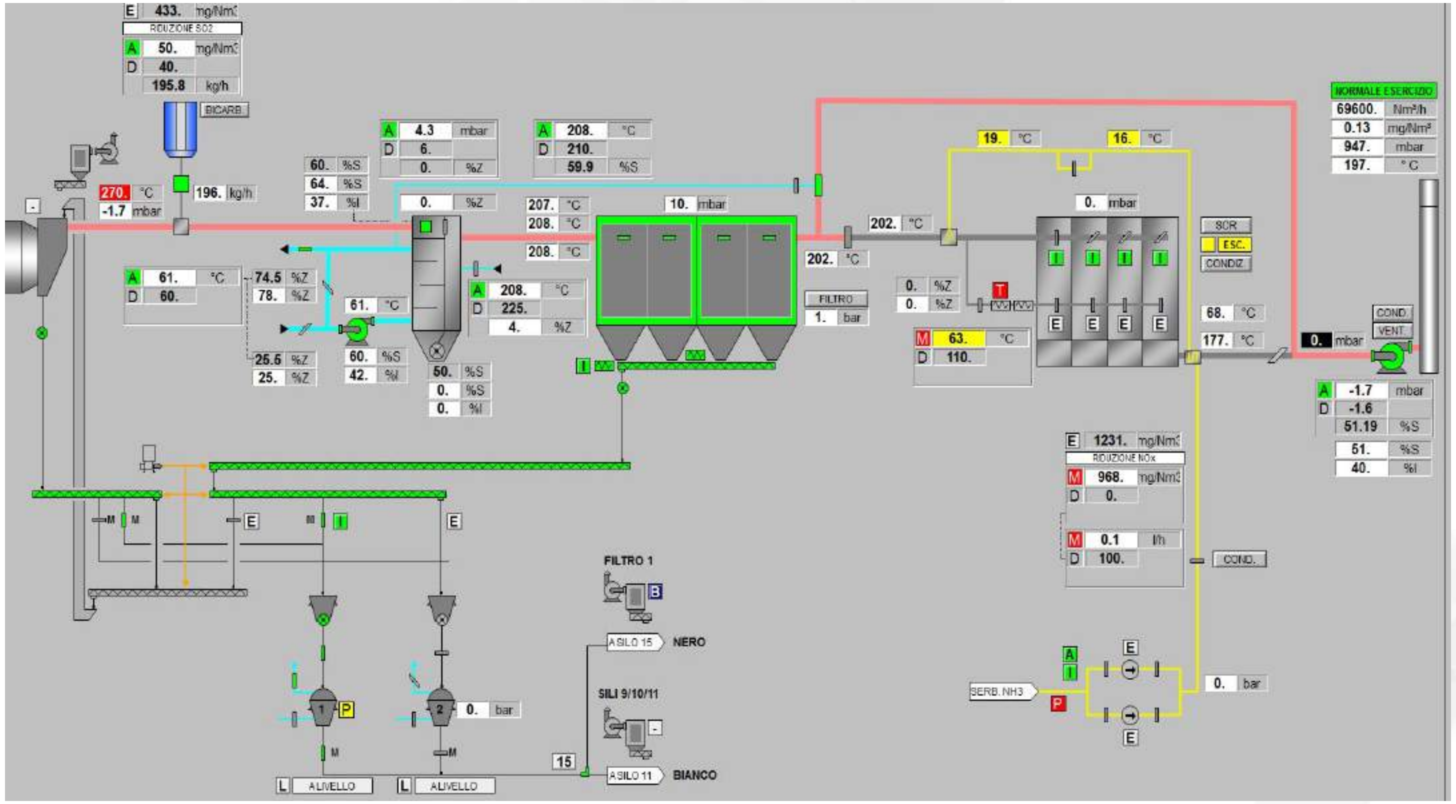
The SCR system has also the capability to reduce TOC. In this and other cases the reduction efficiency is between 60 and 80%. No evident effects are produced on CO.

NO_x control technologies



The SCR technology can be also applied as a tail end system (low dust SCR).
In this case the gas stream has to be reheated with a heat exchanger where in a first passage the temperature is increased at 300°C, and then, in a second passage in the same heat exchanger, the heat is given back to the incoming gas. The thermal energy losses are compensated recovering heat from the preheater gases, or from cooler vent air, or from a dedicated burner, using gas. The efficiency of the system is the same as for high dust SCR, with the important advantage to prevent any possible risk of plugging the catalyst even if with smaller pitch. A longer catalyst life is also expected. The total investment is of course quite higher.

NO_x control technologies



The use of catalyst active at lower temperature level (180-220°C) and only available in form of granules makes it possible to apply the SCR technology also to long dry, semidry and wet kilns. In this case the high dust option is not applicable and it is necessary to prevent the presence of SO_2 in concentrations higher than 50 mg/Nm^3 , to avoid the formation of solid ammonium sulphate on the catalyst surface. It is necessary to install a dry deSO_x system, sodium bicarbonate injection, a heat exchanger to control the gas temperature, a fabric filter, a dosing system for liquid ammonia solution and the catalyst container.

It is possible in this case to reduce the NO_x emission below the level of 200 mg/Nm^3 @ 10% O_2 .

Suppliers support to the Cement Industry

Very stringent NOx limit will impose SCR technology utilization.

Suppliers aim to support the cement industry in this challenge.

Teamnetwork engaged since 1955 in supplying services as:

- *quarries management*
- *maintenance*
- *turnkey projects*
- *logistic*

is proactively working in the installation of HD SCR systems.

Suppliers support to the Cement Industry

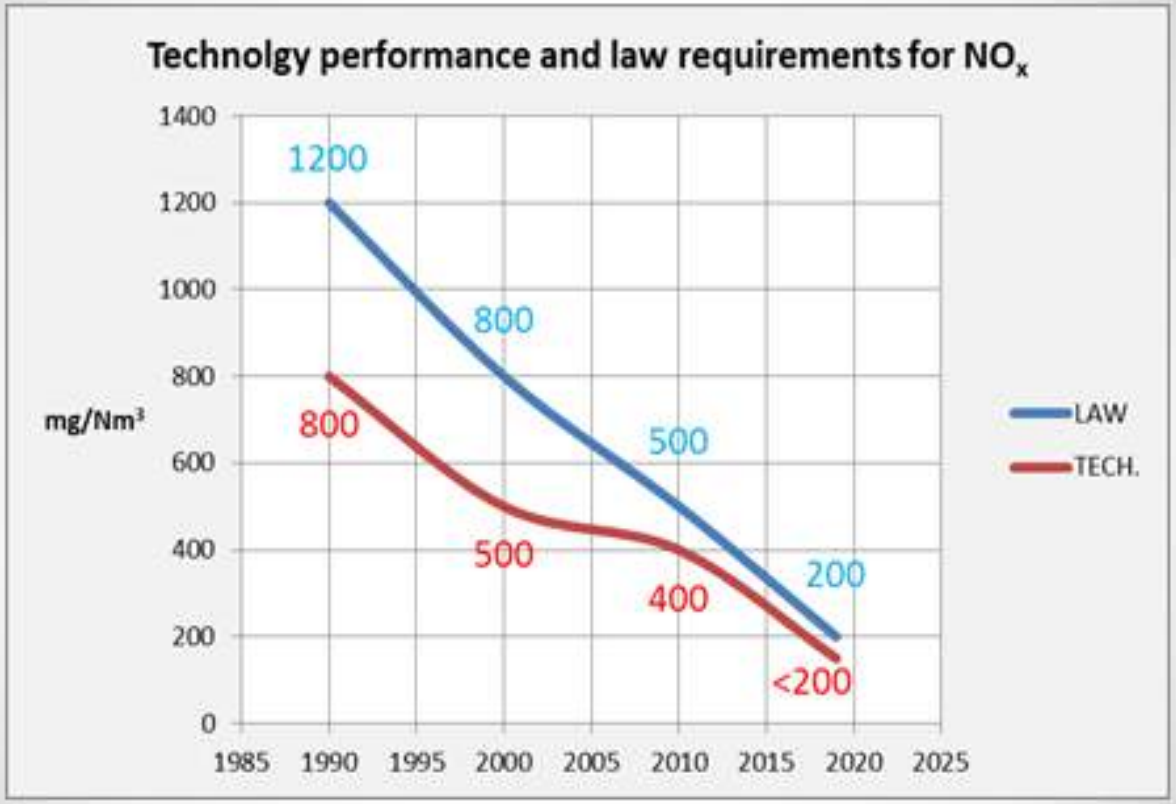
A strong cooperation is initiated between **Teamnetwork** and **Bilfinger Engineering & Technologies Gmbh** to offer and install HD SCR

Teamnetwork:
Construction & Erection provider with more than 50 years in cement field for customers worldwide based on the knowledge of cement process experts

Bilfinger :
Engineering & Technology Gmbh provider with wide experience for more than 35 years in power plant flue gas treatment especially for NOx reduction with HD SCR

Cooperation Teamnetwork/Bilfinger Engineering & Technologies GmbH:
Both of the companies enter the market of HD SCR technology for cement industry international with their own strong capabilities.

Conclusions



The progress in the emission control technologies is continuous and relevant, sometime in term of reliability and cost reduction, sometime in term of higher efficiency in the pollutants abatement. The main driver of this trend is the commitment of the whole cement sector for the reduction of the environmental footprint, not only in the most industrialized countries but also and mainly in developing countries, transferring the most modern technologies for the environmental protection. Under the increasing demand of efficiency (low heat and energy consumption, high substitution rate of conventional fuels and raw materials) as well as the progressive reduction of the emission limits, now very close to the best achievable performance, the old burning lines are going to be substituted, and will be more and more in the next future, by new modern units, may be opening the way to Carbon Capture technologies.