NEW PROCESS FOR PCDD/PCDF REMOVAL AND DESTRUCTION

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Many processes have been proposed for the removal of dioxins and furans from flue gases. Among the techniques available one may find : Adsorption on activated carbon fixed bed or fluidized beds [1], injection of activated carbon mixed with lime in an atomizer [2], injection of activated carbon in the gas stream followed by filtration [2], catalytical destruction processes [3]. Each of these processes have drawbacks, either because it is merely a pollution transfer and one needs to get rid of the contaminated adsorbent, or is very expensive in terms of investment. We have developed a unique process for the removal of dioxins and furans from flue gases that also achieves destruction of these pollutants and is readily integrated with the rest of the flue gas treatment system.

Introduction :

It is well established that dioxins and furans (PCDD/PCDF) are found in the emissions of incinerators . These PCDD/PCDF are formed during the incineration process or re-created by de-novo synthesis at temperatures between 200 and 350°C [4] and need to be removed in order to meet the regulations in many countries. Taking advantage of its ability to handle a large amount of solids in the liquids we have developed a new *wet* PCDD/PCDF removal/destruction process that is naturally integrated in its standard design and enables to remove and destroy PCDD/PCDF from the system. This process uses specific additives injected into the gas scrubbing waters.

EMCO

LAB's process outline :

The wet process involves gas scrubbing which leads to the saturation temperature and to the absorption of acid gases and heavy metals in a first tower. This first tower is usually operated at a low pH in order to have proper collection of heavy metals. Dust and pollutants are collected in the scrubbing water which is passed to a water treatment unit that yields a cake containing the suspended solids and heavy metals. The gases still containing SO_2 and the PCDD/PCDF are passed to a second tower whose task is to remove these pollutants. Special additives i.e. active carbon are injected in the scrubbing water that promotes dioxin capture and destruction through mechanisms that will be discussed hereunder. The final gas cleaning stage comprises electrofiltering modules which capture submicron dust particles which may be heavily loaded in heavy metals and PCDD/PCDFs. The liquid bleed is also passed to the water treatment. Clear water is generated and can be discharged to the environment.
This process gives excellent results irrespective of the fluctuations or quantities of pollutants entering in the system. Injecting special additives also increases the removal efficiency of certain heavy metals, thus enhancing the final product stabilization.
It is the specific anti clogging LAB G spray nozzles that ensures that the additives are used efficiently and that the process is reliable.

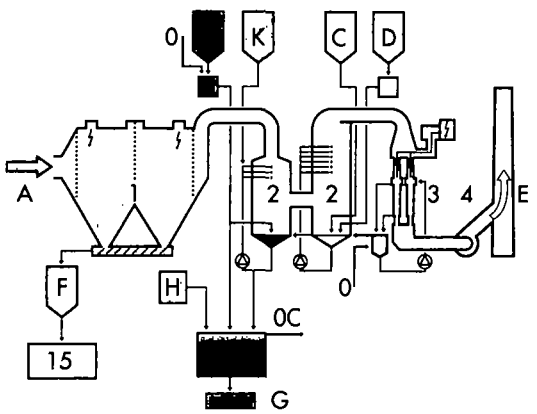


Figure 1 : System synopsis

Key

1) electrostatic precipitator
2) granilab scrubbers
3) electrofiltering venturi
4) fan/stack
5) water treatment

B) lime
C) soda
D) active carbon & Dediox additives
H) water treatment reagents
K) DeNOx reagts

Process fundamentals :

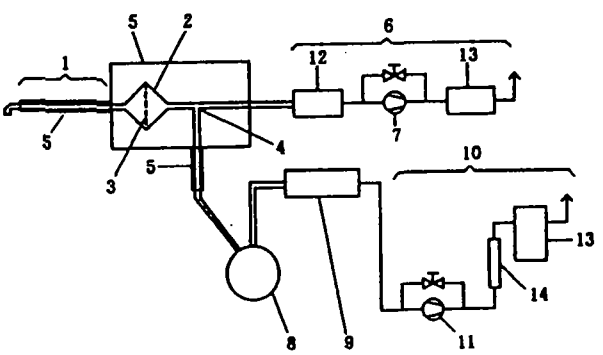
The PCDD/PCDF destruction/capture is basically a three step process. In the first place the PCDD/PCDF molecule is transferred from the gas phase to the liquid phase. This is a normal absorption process, but because of the poor water solubility of the pollutants high liquid to gas ratios are required. Secondly through a diffusion migration the target molecule is adsorbed on activated carbon particles. This adsorption will free space for further incoming molecules and is really the driving pump of the system. Thirdly, active sites promote the destruction of the pollutant by an oxidative mechanism.

We have found a way of taking advantage of existing active sites on activated carbon, of boosting their activity through an in-situ activation process, and to "vaccinate" them against poisoning. The net result is a long lasting activity of the solid. The originality of the process is therefore multifold as it carries the chief absorption/destruction process in the liquid phase, as it converts potentially noxious sites on the solids into active destruction solids, and prevents poisoning.

This process has been quite extensively tested both at pilot scale & plant scale and has shown very good results both on a removal activity from gases and on a destruction basis.

Process performances :

This process has been tested on several sites and the following data is available. The performances have been evaluated using a protocol that conforms to the French standard X43-313 [5] with flow division, and that is under certification by European authorities (CEN) [6]. The sampling flow diagram is shown in figure 2 [7].



1 Heated sampling probe
2 Heater filter housing
3 Plane filter
4 Flow divider
5 Heaters
6 Main extraction line
7 Main pump
8 Condenser
9 XAD2 resin
10 Secondary extraction line
11 Secondary pump
12 Condenser
13 Flow counters
14 Flow meter

Figure 2 : Sampling line with division of flow (French standard X43-313)

As it can be seen in figure 3 the removal ratio is above 98 percent. The data is represented in the usual Box-and-Whisker plot, and represents more than 15 data points.

The values are in ng TEQ/Nm^3 and total dioxins and furans (gas + particles) are included.

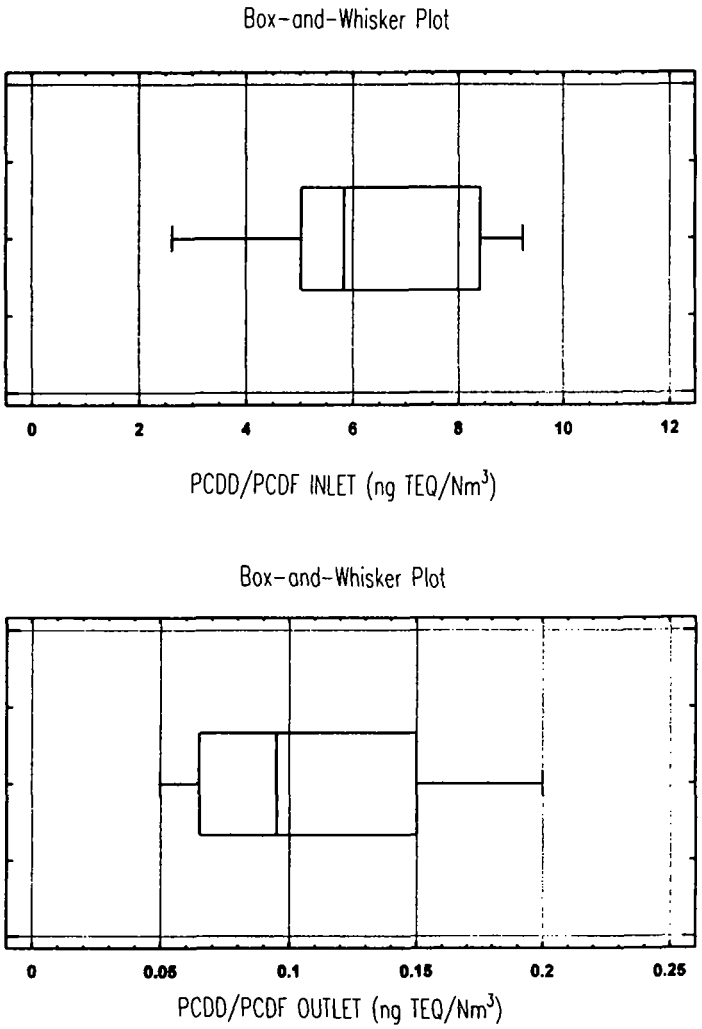


Figure 3 : Dioxin removal performances

It is quite clear that the wet process is sufficient to meet the most stringent regulations concerning the PCDD/PCDF in the world.
The destruction data has been established through a complete mass balance involving the gas inlet and outlet, the liquid purges, the solids purge, and of course the inventory variation. A typical balance is given below :

Inlet PCDF/PCDD (gas)	2140 µg
Outlet (gas)	71 µg
Outlet (purges)	39 µg
Inventory variation	240 µg
% destruction = 100*((1)-(2)-(3)-(4))/(1)	84 %

Conclusion :

Dioxins can be efficiently removed from flue gas by a well integrated wet scrubbing process that uses only readily available raw materials and technologies. Furthermore it is established that such process does destroy these pollutants.

References :

1) Hartenstein H.U : "Fixed bed activated coke filters for the control of toxic metals and organics from waste incinerators" Dioxin'93 (EMCO page 11)
2) Blumbach J., Nethe L. -p. : "Sorbalit® - A new economic approach for reducing mercury and dioxin emission" Dioxin'92 (FRM page 229)
3) Pacher W. Hartl H. Wurst F. Boos R., Sparrer J. Lindbauer R.L. MSWI Plant HBW Spittelau Vienna, Austria : "Three years'experience : emission below 0.1 ng TEQ (m^3 dry)" Dioxin'92 (FRM page 229)
4) Stieglitz L. Vogg H. : "The DE-NOVO-synthesis of PCDD/PCDF and other organohalogen compounds on fly ash" Dioxin'90 (Volume 3 page 175)
5) French standard X 43-313 (July 1991) "Air quality - Stationary source emissions - Determination of polychlorodibenzo-p-dioxins (PCDD) and polychlorodibenzofurans (PCDF)"
6) European CEN standard draft "Determination of the mass concentration of polychlorinated dibenzo-p-dioxins (PCDDs) and dibenzofurans (PCDFs) - Stationary source emissions - Sampling"
7) J.F. Vicard, H. Vincent, L. Guyot, M. Knoche, K. Moriya, T. Murakawa, S. Mino : "Measurement and removal of dioxins and furans on MSW incinerators fitted with the EDV gas cleaning system" The Kyoto Conference on Dioxins Problem of MSW Incineration 1991