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N20 MEASUREMENTS IN VARIOUS COMBUSTION PROCESSES 1/ 2/

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1/ Topic H: Monitoring

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N_2O measurements in various combustion processes

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From the time when N2O was first implicated in the depletion of stratospheric ozone and global climat change, a large number of N2O measurements have been carried out in fossil fuel fired power plants. At present, measurements concern mainly large power plants and new technologies used for power generation (for example, fluidized bed and circulating fluidized bed boilers). Nevertheless, development of solid fuel boilers used for the production of process steam or hot water, must be taken into account because their thermal power could reach several hundred megawatts.

This paper presents the results of pollutant (N2O, NOx, CO, SO2) measurements taken in two different types of boilers : a spreader stoker and an Ignifluid boiler.

Characteristics of the boilers

The spreader stoker at CERCHAR's coal research laboratory in Mazingarbe, is utilized for coal and sorbent characterization and for material improvements. With a nominal thermal power of 11 MW, it is one of the smallest units of its size range. At present, 46 are operating in France for a global thermal power output of 2096 MW, with a maximum nominal power of 120 MW.

The Ignifluid boiler is in use by the General Heating Company in Paris. It produces hot water for domestic heating. With a nominal power of 340 MW, it's the largest unit of its range.

N2O sampling and analysis

As recommended by Dr. DE SOETE, the N2O measurement apparatus is composed of :

- a stainless probe equipped with a hot filter,
- a cooler,
- a scrubber containing a solution of KOH 0.1 molar,
- (and) a sample container.

The analysis is made with a gas chromatograph equipped with a HID detector.

Measurements of CO2, O2, CO , SO2 and NOx are taken during sampling.

Results on the spreader stoker

For two different coals whose compositions are given on this transparency (n°1), N2O and SO2 measurements were obtained for the nominal power output and for half of it.

We can see that N2O emissions are between 26 and 40 mg/Nm3 at 6%O2 (normal cubic metre) and that N2O decreases a little when the power rises in the case of the FREYMING coal. We can also see that a large quantity of fixed sulfur produces a large amount of SO2 emissions and seems to increase N2O emissions (the fixed nitrogen is equal for the two coals but the fixed sulfur in the US coal is twice than this of the FREYMING coal) but this increase could also be linked to the granulometry of the coal. We have not yet taken enough measurements to explain this observation.

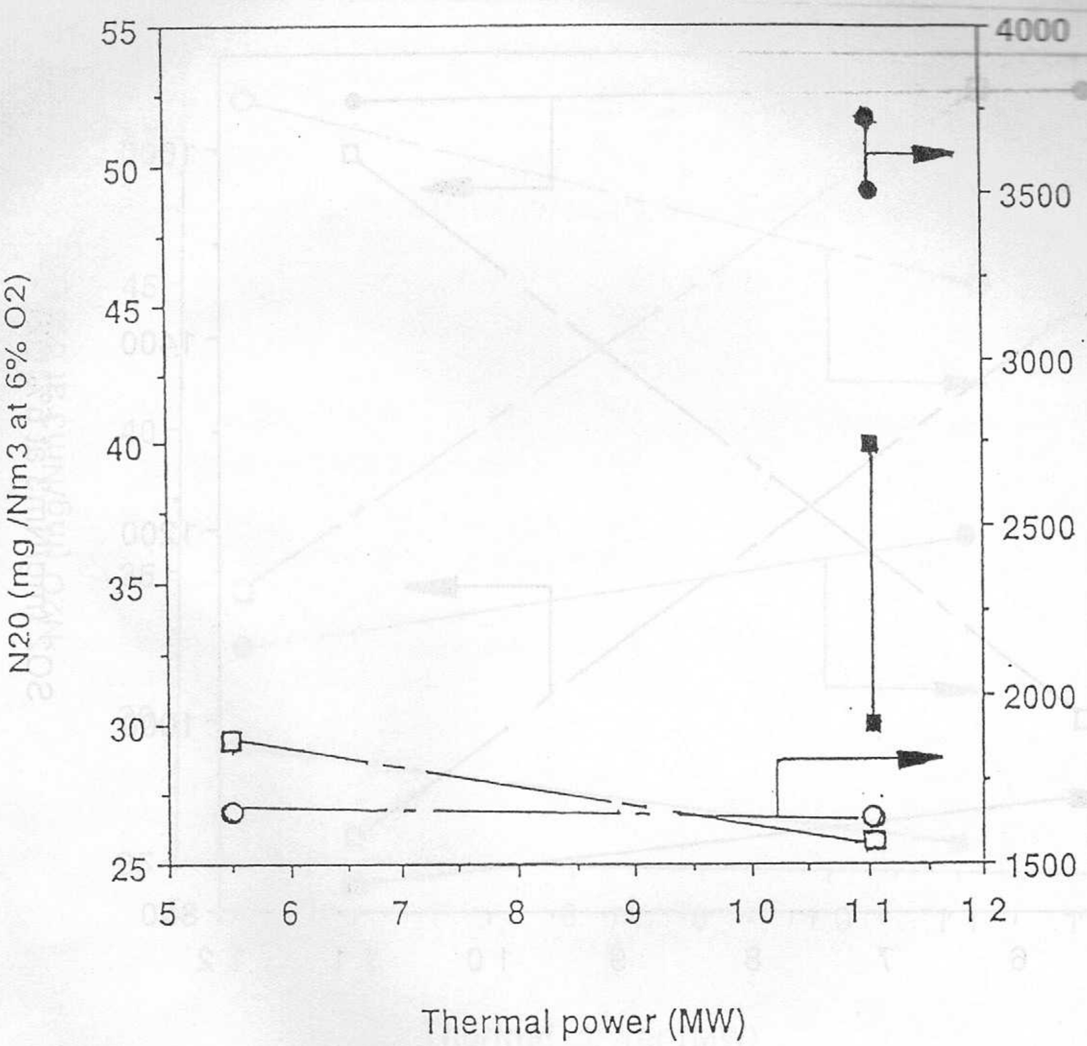
On the second transparency (n°2), we represent N2O and SO2 emissions for the FREYMING coal at two different loads with and without desulfurisation.

We can see that without desulfurisation, increasing the load from 5.5 MW to 11 MW produces a small decrease in N2O emissions but has no

influence on SO2 emissions. With desulfurisation, SO2 is divided by 2 at 11 MW but N2O emissions are multiplied by 2 at the same time.
On this transparency (n°3), we can see that desulfurisation produces a decrease of NOx emissions at 11 MW but this level is higher than without desulfurisation.
Those measurements indicate that decreasing one type of pollutant could produce an increase in another and that it's necessary to consider all the pollutants for the characterisation of power systems.

Results on the Ignifluid boiler.
For half of the nominal power (about 175 MW), N2O emissions are between 88 and 91 mg/Nm3 at 6% O2 with a fixed nitrogen of 1.72 %. These levels are high but they are relatively small compared with those obtained in FBC or CFBC boilers. If the evolution is the same, increasing the load to the nominal power normaly produces less N20 emissons.
We can see on the table (n°4) that the amount of NOx and SO2 are under the statutory level, for this load.

Conclusion
In conclusion, we can say that all the power systems must be taken into account for the total emissions level of pollutants. However these measurements show that it's possible to find combustion systems for the production of steam or hot water which are environmentally relatively benign.

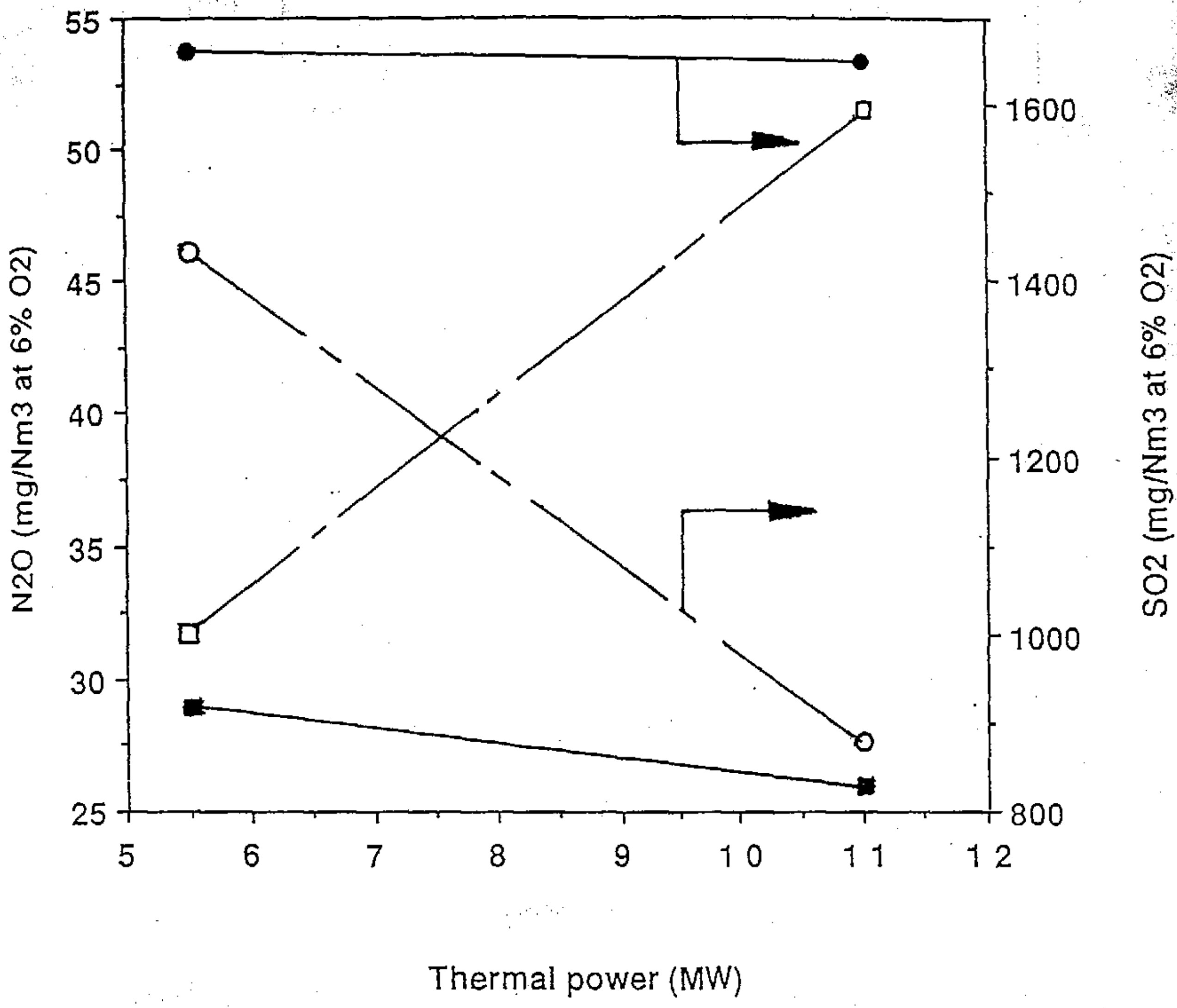


Spreader stoker : influence of coal composition

- □ N20 : FREYMING
- ○ SO2 : FREYMING
- ■ N20 : U.S. COAL
- ● SO2 : U.S. COAL

TYPE CHARBON	U.S. Coal	FREYMING
GRANULOMETRIE	0 - 2 0	0 - 6
CENDRES (%)	12,56	4,1
M.V. (%)	33,1	33,6
P.C.S. (J/g)	29718	33232
P.C.I. (J/g)	28330	31903
CARBONE (%)	71,35	80,92
HYDROGENE (%)	4,89	5,09
OXYGENE (%)	7,84	7,8
AZOTE (%)	1,34	1,3
SOUFRE (%)	2,02	0,8

n°1

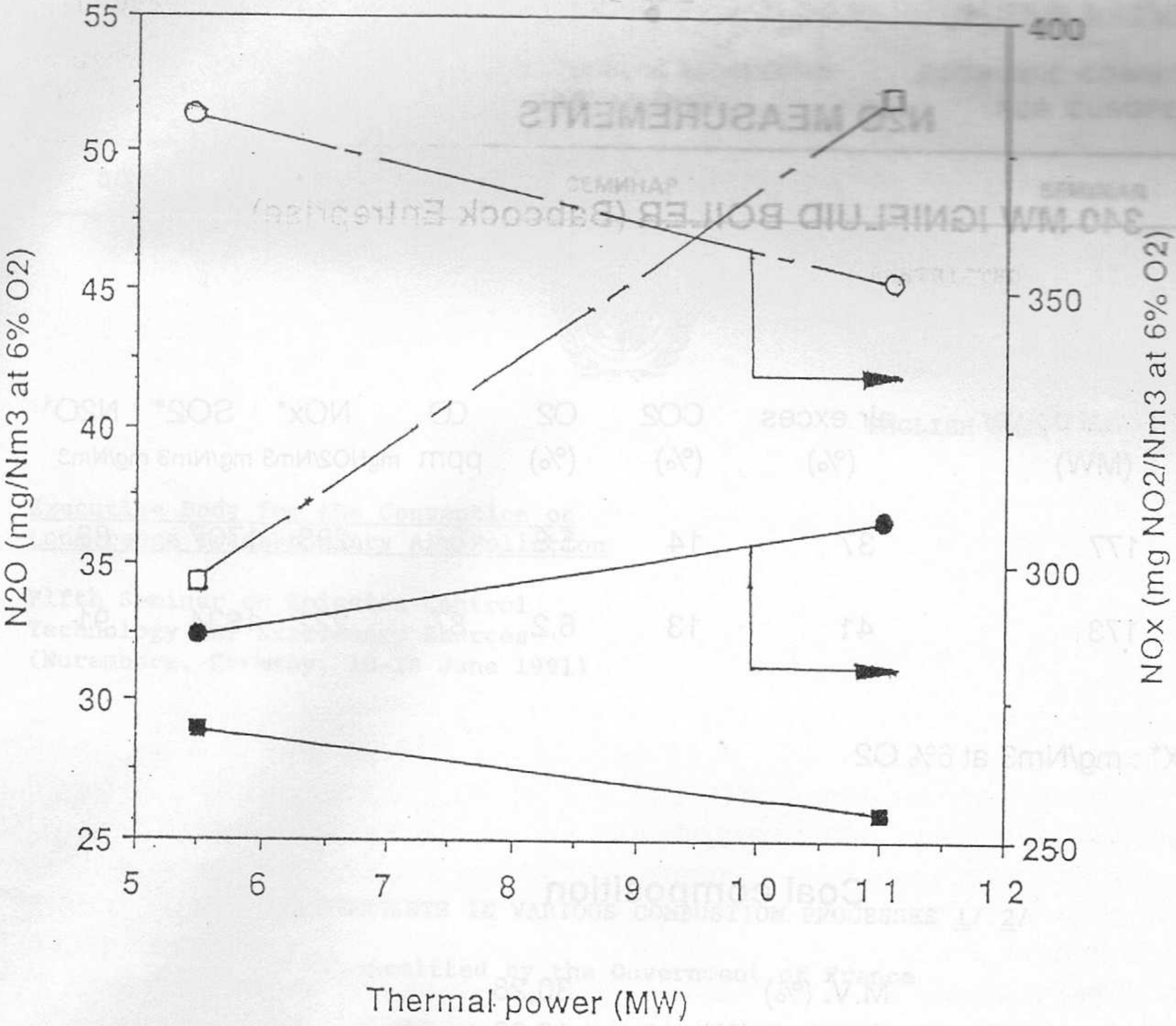


Spreader stoker : influence of desulphurisation

CA/S = 1,8

- ■ N20 : WITHOUT DESULPHURISATION
- ● SO2 : WITHOUT DESULPHURISATION
- □ N20 : WITH DESULPHURISATION
- ○ SO2 : WITH DESULPHURISATION

n°2



Spreader stoker : influence of desulphurisation

CA/S = 1,8

■ N2O : WITHOUT DESULPHURISATION

● NOx : WITHOUT DESULPHURISATION

□ N2O : WITH DESULPHURISATION

○ NOx : WITH DESULPHURISATION

n°3

N_2O MEASUREMENTS

340 MW IGNIFLUID BOILER (Babcock Entreprise)

thermal power (MW)	air exces (%)	CO_2 (%)	O_2 (%)	CO ppm	NOx* mgNO2/Nm3	SO_2* mg/Nm3	N_2O* mg/Nm3
177	37	14	5,8	84	208	1707	88
173	41	13	6,2	87	222	1634	91

X* : mg/Nm3 at 6% O_2

Coal composition

M.V. (%)	30,28
Cendres (%)	12,83
H_2O (%)	13,69
Carbone (%)	71,56
Hydrogène (%)	4,38
Azote (%)	1,72
PCS (J/g)	29502