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NO_x AND SO_2 EMISSIONS OF HUNGARIAN ELECTRIC POWER PLANT BOILERS

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Abstract

Coal fuelled power stations are responsible for about the half of SO_2 emission in Hungary. Specific emission values may be 5 to 10 times the ultimate value admitted in the FRG. Introduction of various desulfurization attachment methods has to be endeavoured in coal fired power stations.

The share of Hungarian power stations in NO_x emission is some lower, about a quarter. The high specific NO_x emission attributable to firing methods (construction) is of importance especially for gas firing. Introduction of (primary) firing methods has to be endeavoured, to prevent NO_x formation.

Keywords: emission values, power station, coal-fired boilers, gas-fired boilers, emission control technology.

Introduction

In Hungary, a decisive part of atmospheric pollution by gaseous materials is due to combustion products:

— sulfur dioxide (SO_2);
— nitrogen oxides (NO_x);
— carbon monoxide (CO); and
— solid pollutants (dust emission).

Damaging effect of these pollutants on health and environment is commonly known, destructive consequences are daily encountered. Health damages due to air pollution alone are estimated by specialists at Ft. 3.8 to 5.2 milliards (billions) a year.

Power stations are responsible only for about 4 % of the overall CO emission in this country (57000 tons/year), hence, of minor importance [1]. Dust pollution due to power stations amounts to 95000 tons/year, 23 % of total dust pollution. With the actual, current incorporation of electrostatic removers, the problem is expected to be solved. Anticipations concerning SO_2 and NO_x emissions are much worse.

Yearly SO_2 and NO_x Emissions by Power Stations

Sulfur and nitrogen oxide emissions have been tested by a subcommittee of the Hungarian Academy of Sciences [2]. SO_2 and NO_x emissions in this country are seen from *Table 1* relying on *Tables 2A* and *4A* in the report.

Distributions obtained from 1985 mean values are seen in *Fig. 1* showing the definite share of coal-fuelled power stations in SO_2 emission, at an important share in NO_x emission, too.

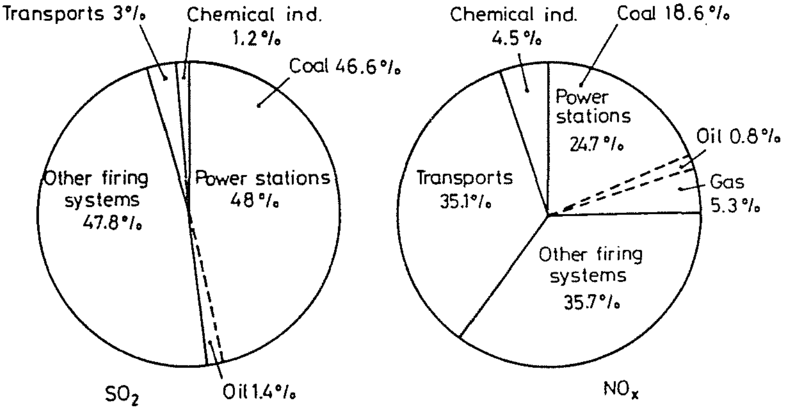

Fig. 1. Branch-wise distribution of SO_2 and NO_x emission in Hungary (1985)

Table 2

Characteristics of coal from Oroszlány and of lignite from Visonta.

		Oroszlány Coal	Visonta Lignite
Calorific value	kJ/kg	10124	6587
Composition	C%	29.85	19.88
	H%	2.44	1.94
	S%	3.89	0.86
	N%	0.33	0.32
	O%	6.16	8.85
Moisture	%	13.92	42.64
Cinders	%	43.41	20.51
Flue gas	CO_2%	14.95	13.04
composition	SO_2%	0.88	0.21
(computed	N_2%	70.01	56.65
undiluted)	H_2O%	14.16	30.10

Table 1
Distribution of SO_2 and NO_x emissions

	SO_2 (10^3 t/year) 1980	1985	NO_x (10^3 t/year) 1980	1985
Power stations				
coal	640–720	644–724	61–72	61–72
oil	69–86	18–22	11–13	3
gas	—	—	16–20	27–21
Total	709–806	662–746	88–105	81–96
Other firing equipment				
coal	457–515	451–508	36–46	35–45
coke	86–105	78–96	16–21	15–19
oil	125–150	121–145	45–55	44–53
gas	—	—	19–22	20–24
Total	668–770	650–749	116–144	114–141
Firing equipment total	1377–1576	1312–1495	204–249	195–237
Transports	28–60	(28–60)	88–115	(112–140)
Chemical industry	18	18	16	16
Total emission in Hungary	1423–1654	1358–1573	308–380	323–393

Testing Hungarian Coals from the Aspect of Emission

Let us test a carbon sample from Oroszlány, and a lignite sample from Visonta, typical of Hungarian conditions (*Table 2*).

This table points out the high cinder, moisture and oxygen contents of Hungarian coals and the concomitant low calorific value.

Sulfur in the coal is known to be partly bound in slag and cinders, and only a part leaves as SO_2 across the chimney. For Hungarian coals, 80 to 90 % of sulfur passes to the atmosphere that is reduced to about 70 % in coals rich in lime from Ajka alone.

For coal and oil firing, nitrogen oxides may develop either from the fuel nitrogen, or thermo NO_x, from atmospheric nitrogen. In gas firing, only thermo nitrogen oxide develops. For lignite firing, because of the low calorific value, i. e. low firing chamber temperature, the proportion of fuel nitrogen oxides with nitrogen oxides is higher.

Specific SO_2 and NO_x Emissions by Power Stations

Specific SO_2 emissions by Hungarian power stations as a function of modes of firing are seen in *Fig. 2*, with minima plotted in dash lines. Clearly, both g/m^3 and g/MJ values of brown coals much exceed those for oil or lignite firing, and are 3 to 7 times the 2000 mg/m^3 emission (for 6 % of O_2) admitted in FRG, attributed to the high sulfur content and low quality of Hungarian coals.

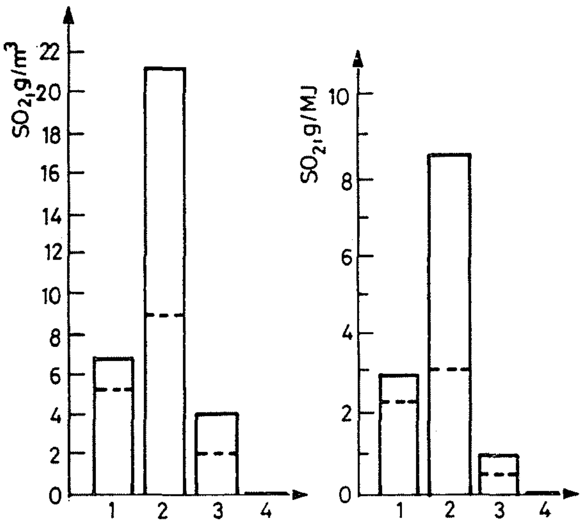

Fig. 2. Specific SO_2 emission by Hungarian power stations (moist flue gas, excess0 air 0 %) (1: lignite, 2: brown coal; 3: oil, 4: gas firing)

In case of brown coal firing, unit heat release (unit power output) is accompanied by 6 to 8 times the SO_2 emission for oil firing, in spite of the a priori high sulfur content about 2 % of Hungarian fuel oils.

Specific NO_x emission of Hungarian power stations vs. firing method is seen in *Fig. 3*, with dash lines indicating minima. Minimum g/m^3 values about correspond to FRG specifications [3] for coal, oil and gas firing. It is rather surprising to see maxima to be multiples of minima, attributable to constructional causes. Primarily, NO_x g/m^3 emissions from high-power boilers tend to maxima. Trends of NO_x g/MJ values are similar to those above. In case of brown coal, oil and gas firing, NO_x maxima are about equal, as against observations made abroad, where there is a decrease, in the order of coal, oil, gas. This is again due to the poor quality of Hungarian coals. In case of high cinders and moisture content — in particular, for lignite firing — there is a priori a low NO_x firing by reducing firing chamber temperatures and thermo NO formation.

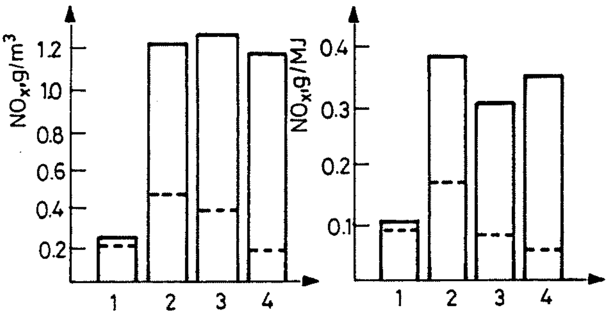

Fig. 3. Specific NO_x emission by Hungarian power stations (moist flue gas, excess air 0 %) (1: lignite, 2: brown coal, 3: oil, 4: gas firing)

Conclusions

Coal fuelled power stations are responsible for about the half (46,6 %) of SO_2 emission in Hungary. Specific emission values, especially for brown coal firing, may be 5 to 7 times the ultimate value admitted in the FRG [3], and multiples of those for oil firing.

Firing methods being essentially ineffective in controlling SO_2 emission, introduction of various sulfur detachment methods has to be endeavoured in (brown) coal fired power stations [4].

The share of Hungarian power stations in NO_x emission is somewhat lower (24.7 %). Besides of coal-fired power stations, there is a high proportion of gas-fired power stations. The high specific NO_x emission attributable to firing methods (construction) is of importance for coal firing, and in particular, for gas firing.

This is why introduction of (primary) firing methods (low NO_x burner, low NO_x firing methods, flue gas recirculation, etc.) [4] has to be endeavoured, likely to prevent NO_x formation.

Only after primary procedures have been exhausted, is it advisable to introduce more expensive secondary (NO_x remover) technologies.

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