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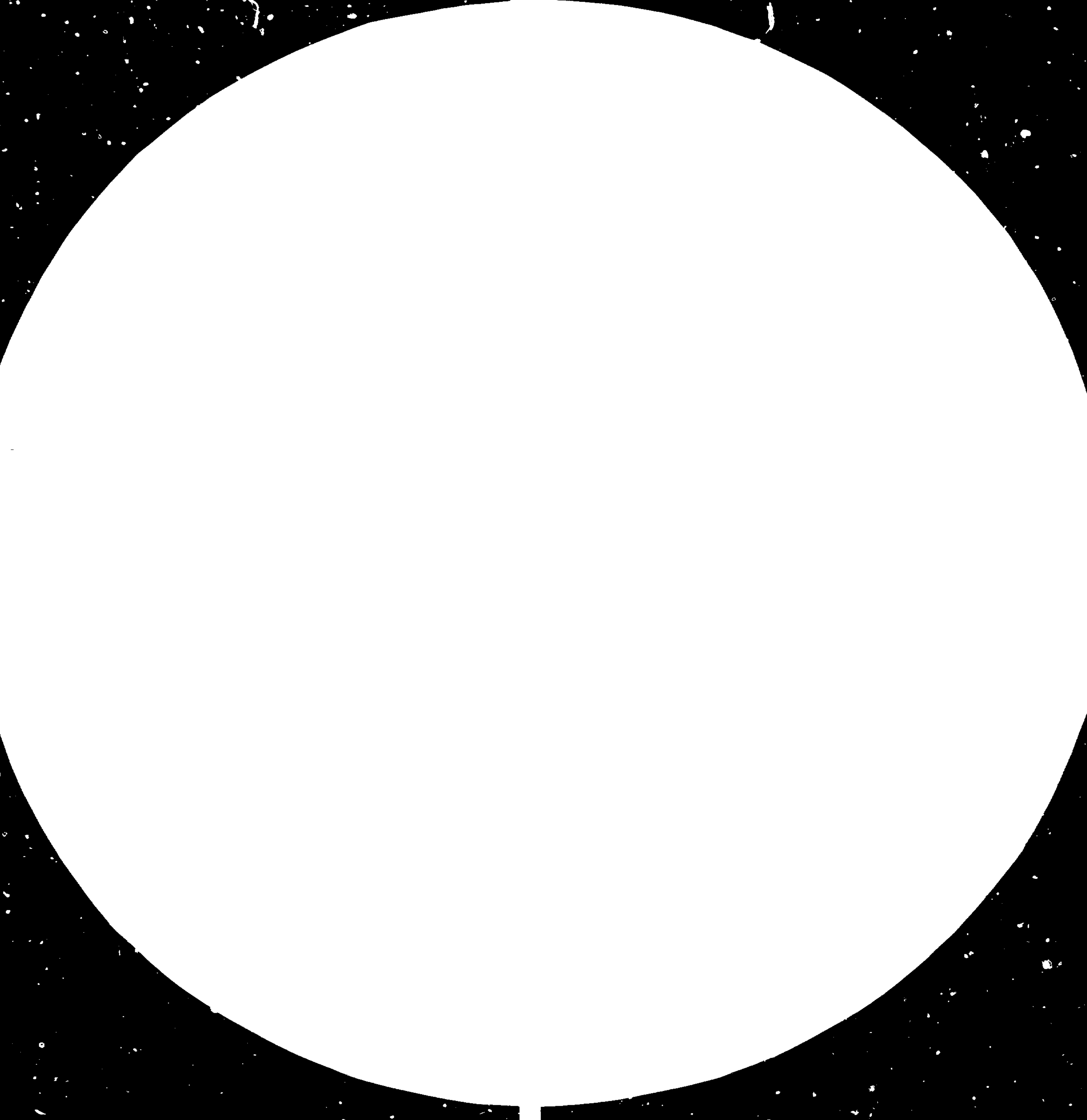

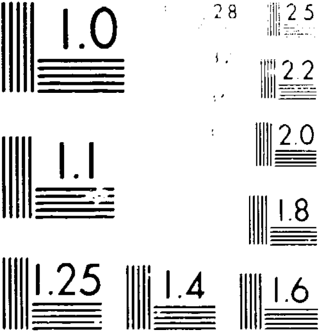
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Interregional Seminar on Cement Technology
Beijing, China, 9 - 24 October 1980

ATMOSPHERIC POLLUTION IN CEMENT PLANTS *
INTERNAL POINT OF VIEW

by

Jean-Claude Hillenmeyer **

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ATMOSPHERIC POLLUTION IN CEMENT PLANTS :

INTERNATIONAL POINT OF VIEW

For many years, and probably to greater degrees than other industries, cement production suffered from a very bad public image. Commonly, people would associate a cement plant with open pits resounding of mine-blasts, odd arrangements of rather ugly industrial structures and, of course, stacks pouring tons of dust over the landscape.

This poor public image might have been in the long run an opportunity for an industry which, maybe more rapidly than others, adapted itself to an entirely new concept of industry and which makes it a pioneer in the field of atmospheric pollution control.

The main steps and achievements

One can say that, prior to 1950, there was hardly anything done of importance in the field of emission control. Cement plants were generally outside cities and the most commonly used solution was to build high stacks which would ensure some dispersions of the dust in order to minimize concentration at ground level.

Tables 1 and 2 illustrate the 1950-1976 evolution. They represent corresponding changes in French cement industry — which is representative of European industry at large — and in the North American cement industry.

What appears immediately upon these tables, is the lateness of any action in North America since, in 1957, the average emission in Europe was inferior to the average emission level in North America in 1970. However, a drastic change is programmed in 1980 since the North Americans have planned a control which is as strict, if not more, than the one implanted in Europe.

Present features and future trends

Specific features of cement plants emissions

In cement plants, as in other industries, one has to distinguish well isolated sources from general or temporary sources.

We shall rapidly cover the latter emissions, not because we think that they are less important that the others, but since the impact of these emissions (truck haulage, mine-blasts, storage halls emissions) is within a short distance and generally occurs within the boundaries of a given cement plant. The nuisances corresponding to these emissions are more in relation to general appearance, noise, and working conditions of workers who have to be protected, and bother relatively few neighbours if the plant location has been well chosen. In most cases, a good solution has been to build enclosed storages.

The specifically isolated emissions relate essentially to kilns and associated coolers. Table 3 gives a quantitative outlook of a 1.000.000 ton/year cement plant stack emissions, assuming that this plant has been equipped with the most modern available equipment. As an example, we have tried to show on the same chart, what emissions correspond to the population of a 1.000.000 people city and are due to the heating, lighting, and transportation of that population. It is important to notice, in the case of a cement plant, the small amount of dust, and, even more so, of sulphuric components which are produced. This latter property is remarkable and comes from the fact that sulphur from the fuel reacts with alkalis and forms alkali-sulphates which are totally acceptable in cement.

Present regulations and future trends

As shown in table 5, there are no uniform regulations and one can isolate 4 groups :

. Western Europe where regulations provide concentrations, hence a weight of emitted particles per volume of treated gases.

. Eastern Europe where regulations provide a weight of emitted particles per unit of duration.

. North America where regulations provide a weight of emitted particles per unit of output.

. Other countries which either relate to one of the preceding groups, or which are presently working out their own regulations and which we are unable to classify.

A survey of these regulations shows that, in countries belonging to the first group, there is little incentive to technological improvements since they encourage dilutions. Similarly, for the second group of countries, technological improvement is impaired since the proportion "emission weight/proportion of emission" is unfavourable for large plants. For the third group, the regulations, if they are not more severe regarding concentration, are more demanding since they put a penalty on any malfunctionning of the whole plant. This trend is sound, provided that regulations are applied with open-mindedness. Many times one can witness an escalation on the part of provinces or states which is often necessary.

To illustrate such inconsistencies, may I tell you that we once had to reduce the height of a stack in order to improve the general appearance and meet the desires of a government agency, only to be later fined for having created in wintertime a heavy smog caused by the water vapour coming from that stack. However, disregarding a few complaints, we generally welcome the actions of government agencies and a recent study made in Montreal for the urban community made it possible to develop very sophisticated models, which simulate almost any condition as shown on table 6.

Remarks regarding government action in Pollution Control

When asked to give an opinion regarding the proposed way to follow, one can hesitate between 2 alternatives :

The first one would be to recommend to leave industrialists free to define what they can and shall do with regard to pollution control. This path is not reasonnable to follow, as the other constraints placed upon industrialists have shown in the past, that such a free-wheeling attitude is not practical. As a consequence, the industrialists find themselves then in conflict with communities and environment protection associations,which appear spontaneously and are more inclined to make demands than to enter discussions.

The second alternative consists in recommending to put the government totally in charge of defining regulations and of controlling their implementations. It is, of course, the second alternative which most countries have chosen and one can only wish,that in every country the pollution control agency would not solely take pollution as the only constraint, but also take into account other related factors. This is even more important at a time when the public interest requires cleaner plants but also more jobs.

A constant dialog is advisable in all countries between industrialists ready to have a responsible attitude, competent government agencies using their power with care and caution, while largely relying on industrialists and representative bodies having in mind not only the protection of nature, but also a concern for public well-being.

Atmospheric pollution control and its limits

What policies should govern in developing areas ?

Depending on the degree of skills of the work force, a strict emission control may be either a requirement for survival or a major obstacle on the road to industrialisation.

Indeed, in order to meet very strict regulations, very costly and sophisticated equipments are needed, which are difficult to tune-up and costly to maintain. In developing areas, it is important to keep in mind the following rules :

. Install pollution control equipments as well as processes, which are compatible with the skills of the local workforce.

. Make future installations of high performance pollution control equipment possible.

. Install cement plants within large enough areas, so as to limit the impact of some pollution during the initial phase.

Problems to resolve, in order to meet or improve on present limits

Aside from the problem of cost, we are concerned by an important problem, which is the reliability of equipments. These equipments, as their performances improve, become more sophisticated and less reliable.Without trying to stretch the comparison with the automotive industry too far, we can say that pollution control equipment manufacturers have much progress to achieve, to improve the quality and the length of service of available equipments. Furthermore, the urge to be competitive shall not push them to propose equipments, whose performances decline rapidly, or which require abnormal maintenance on the part of the users.

The costs

Regarding costs incurred by industrialists, they represent 8 to 11 % of the total investment cost for specific emission sources, and 2 to 7 % for other sources (enclosure of storege hall for instance). Operating costs are increased by 2 to 3 % because of higher energy consumption and maintenance costs.

Where do we stand ?

In order to illustrate efforts made in old cement plants, table 7 shows the evolution of their "degree of nuisance" over the past few years.

The first category includes cement plants, which cause complaints and must be modernized as soon as possible.

The second category corresponds to these which cause few nuisances but still receive complaints.

The third category correspond to plants which receive few complaints despite the nuisance they cause.

The fourth category corresponds to plants which cause neither nuisances nor attract complaints.

A chart similar to table 7, can be put together for many countries, which have resolutely decided to reduce nuisances of any kind.

Conclusion

What precedes may give an idea of where the cement industry stands, from a qualitative and quantitative point of view. Our task is not limited to atmospheric emission control only. We are conscious of the necessity of other actions, such as :

. reuse of waste materials

. noise protection

. quarrier reclamation

. outside appearance

I am personnally optimistic regarding aptitude of industry to adapt to its environment, and I believe that with some goodwill on the part of everyone, it may be possible that the dream of the ecologists may not become the nightmare of the industrialists.

Tableau 1 – Évolution du contrôle des émissions dans l'industrie cimentière française

Année	Production annuelle	Émission % prod. ann.
1950	8 100 000 t	3 %
1957	15 000 000 t	1,5 %
1968	26 500 000 t	0,5 %
1975	30 000 000 t	0,15 %
Objectif 1980	34 600 000 t	0,05 %

Tableau 2 – Évolution typique du contrôle des émissions dans une société cimentière Nord Américaine

Année	Capacité totale (tonnes/an)	Nombre d'usines	Nombre de fours	Nombre de dépoussiéreurs				Émissions fours	% prod. annuelle
				Électrof.	Filtres à gravier	Cyclones	Filtres à manches		
1965	4 073 000	9	23	14	0	32	40	270 t/j	3 %
1970	4 432 000	11	22	16	0	36	247	190,2 t/j	2 %
1977	5 442 500	9	18	22	8	25	278	58,6 t/j	0,4 %
							Niveau 1980	5,1 t/j	0,04 %

	Cimenterie	Population (respiration)	Par auto et chauffage éclairage pour
Consommation	1 000 000 t/an	1 000 000 pers.	1 000 000 pers.
Matières premières ...	45 000 t/j	-	-
Combustible (fuel-oil) .	270 t/j	-	969 t/j
Énergie électrique	360 MWh/j	-	4 000 MWh/j
Air total	3 973 t/j	3 755 t/j	11 500 t/j
O_2	926 t/j	875 t/j	2 420 t/j
N_2	3 047 t/j	2 880 t/j	9 080 t/j
Émission			
Poussières	0,8 t/j	-	2,15 t/j
CO_2	3 300 t/j	1 080 t/j	2 740 t/j
H_2O	1 062 t/j	100 t/j	1 024 t/j
N_2	5 964 t/j	2 880 t/j	9 056 t/j
CO	-	-	304 t/j
SO_2	0,1 t/j	-	0,35 t/j
SO_3	-	-	-
NO_x	24,0 t/j	-	51 t/j
Hydrocarbones	-	-	33 t/j

Tableau 3 - Consommation/émission journalière

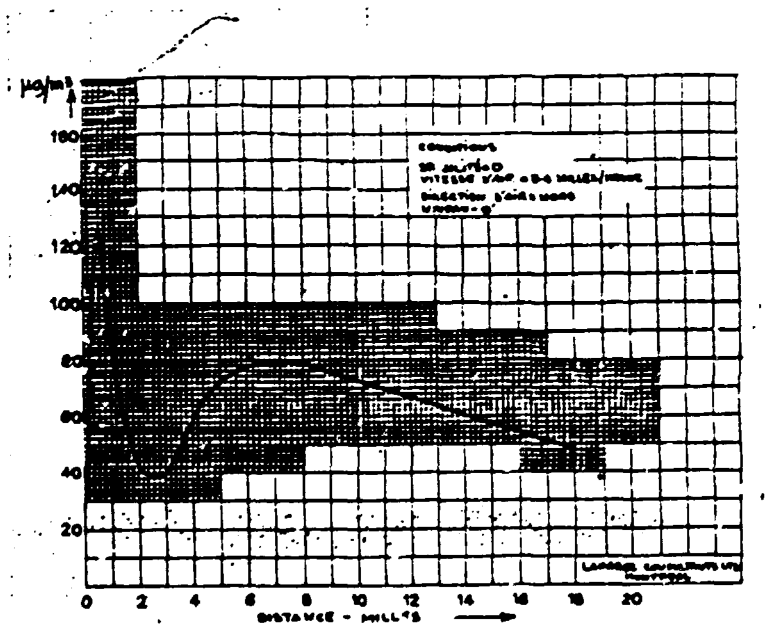
Tableau 4

	Composition typique d'un cru de cimenterie	Composition typique des poussières captées
SiO_2	13,75 %	9,20 %
CaO	42,95 %	26,90 %
Al_2O_3	4,00 %	2,95 %
Fe_2O_3	2 10 %	1,60 %
MgO	1,15 %	1,25 %
S	0,20 %	0,70 %
SO_3	0,45 %	18,90 %
CO_2	33,50 %	13,00 %
Eau, M.V.	ɩ,65 %	3,65 %
Alcalins	0,68 %	20,4 %

	Four	Refroidisseur à clinker	Broyeur à ciment	Autres sources
Europe occidentale				
Belgique (*)	-	-	300 mg/Nm³	-
France	150 mg/Nm³	150 mg/Nm³	150 mg/Nm³	150 mg/Nm³
Grande-Bretagne	460 mg/Nm³	-	-	-
	230 mg/Nm³	-	-	-
Hollande	150 mg/Nm³	-	-	-
Italie	300 mg/Nm³	-	-	-
R.F.A.	150 mg/Nm³	-	-	-
Suède	250 mg/Nm³	-	-	-
Suisse	100 mg/Nm³	75 mg/Nm³	-	-
Europe orientale				
Tchécoslovaqcie	120 kg/h (fours produisant moins de 600 t/j) 270 kg/h (fours produisant plus de 3 600 t/j)			
Amérique du Nord				
Canada	450 g/tKK	300 g/tKK	50 g/tKK	100 g/tKK
États-Unis	150 g/tCru	50 g/tCru	-	-
Autres pays				
Israël	300 g/tCru	300 g/tCru	-	-
Japon	600 g/tCru	-	-	-

(*) Bien que n'ayant pas de norme définir, la Belgique a toutefois un contrôle sévère des émissions, qui la met sur le même plan que ses voisins.

Tableau 5 - Normes d'émissions de poussières pour nouvelles cimenteries.



Évolution du degré de nuisance des cimenteries anciennes (France)	1973	1976
1re catégorie	10	1
2e catégorie	4	1
3e catégorie	14	9
4e catégorie	36	48
Total	64	59

Effort d'investissement et coût d'opération (France)

Période 1970-1975 : 250 millions de francs.
Projection 1976-1980 : 200 millions de francs.
Coût additionnel d'opération : 1,60 à 2,40 F/t

Tableau 7

Fig. 6. - Variation dɛ la concentration ie long de l'axe des abscisses - CCLL' - Usine de Montréal-Est.