COST EFFECTIVENESS OF AIR POLLUTION CONTROL MEASURES

by

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SUMMARY:

The paper aims to create the awareness that the 'Cost-Effective' conception of air pollution control implies a broader systems-approach to problem rather than the approach merely to efficiency in control.

OPSOMMING:

Die referaat probeer 'n bewustheid skep dat die 'kostedoeltreffende' konsep van lugbesoedelingbeheer is wat 'n breër sisteem benadering tot d probleem impliseer eerder as die benadering van blote beheerdoeltreffendheid.

The most important question that is asked in connection with air pollution control is always: "What will it cost?" What is not usually asked, is: "Is the solution proposed going to be cost-effective?" Note that there has been no mention of efficiency.Naturally efficiency is important in individual situations to ensure adequate capture and removal of pollutant. It is also natural to expect that higher efficiency will cost more. Figures published indicate that costs could double if efficiency is to be increased from 90% to 99% and double again for an increase from 99% to 99,9% in the case of electrostatic precipitation of iron oxide dust on openhearth furnaces in the USA. At a certain intermediate efficiency, the most cost-effective solution of the problem created by the iron oxide will have been obtained.

The most expensive and least cost-effective solution to a pollution problem is very often found when retro-fitting cleaning devices to inefficient (and polluting) processes. Admittedly there may be exceptions where there are well motivated individual cases where this is necessary but they usually result when there is poor planning, maintenance or process control.

In his book titled 'Pollution Control Pays' dr. Michael Royston[1] argues that a commitment to pollution prevention can work to a company's financial advantage. He states that pollution is a visible sign of inefficiency in industrial operations. Some of these residues are raw materials which are not converted, some are products not fully recovered and some are by-products. If this waste were controlled there would be less pollution and lower cost. Before the "energy crisis" of 1973 this argument carried less weight but it is relevant now. He cites examples in the paper and pulp industry and whisky manufacture.

An example where modernisation has been chosen as a better solution than retrofitment of cleaning devices, is at the Pretoria Works of Iscor. Air pollution in the vicinity of Pretoria West has given rise to criticism by the public. However, Iscor employees were affected both at home and at work.

An announcement[2] was made that Iscor had decided to rationalize the steel production of its Pretoria Works and replace some of the existing metallurgical facilities – several of which have become obsolete, by modern units.

This is probably the best solution to the overall problem and hence probably the most cost-effective.

"Among the particular production units are a few which have been in operation since 1934 when Iscor commenced production and their maintenance costs are high. In addition the relevant steelmaking processes are technologically obsolescent and it is difficult to meet the present-day quality requirements".

It has been proposed that electric arc furnaces be installed to provide the steel required. The new units will be more efficient in respect of production costs and product quality and will offer the additional advantage that the use of scarce coking coal – subject to particularly high cost escalations – will be avoided. Moreover, the air pollution from the existing processes will largely be eliminated and a better work environment created.

Another concept for achieving effective compliance with emission requirements in a limited area such as a plant or complex has been proposed by the E.P.A. in America.[3] It is the "bubble", which is named so because its effect can be related to that of enclosing the sum total of emission sources within an imaginary bubble and then optimising the control of emissions of various components from the various sources to achieve the lowest control cost. Until now each process has been regulated as a separate polluting source. Now, however, if an industry demonstrates that its alternate approaches are equivalent to present requirements, plant management will be allowed flexibility to decide on the lowest cost option

for meeting the total emissions limit. This must not be construed as less pollution control but rather considered to be less costly control. Estimates of the advantage gained are 10–35% for some plants. For instance a study undertaken for Du Pont's 52 largest facilities found that compliance costs could be reduced from 136 to 55 million dollars per year under this policy.

Problems still requiring cost-effective solutions in South Africa

Smoke emissions in Black urban areas

During a television interview it was stated that a survey had shown that the problem of smoke pollution in Black urban residential areas would not disappear during winter months with the advent of electrification. The reason given was that electric cooking appliances do not heat the dwelling and most dwellings are without ceilings, thus losing more heat than necessary. The coal stoves at present in use will therefore be retained for heating purposes.

In order to reduce smoke, no stove may be sold that is not officially classified as a "mini-smoke" stove. A Government Gazette Notice No. 432 of 1982 furthermore contains a standard specification for performance requirements of domestic coalburning stoves and heaters. In theory this should serve to eliminate all smoke from future installations but the life of existing stoves can be very long. The price of coalburning stoves appears to be exorbitantly high at R700 to R900. If I had to choose between replacing my existing "smoky" stove at that price, or having a T.V. set, I would have no difficulty. Electric stoves are available from discount stores and cost between R400 and R500.

The electrification of Black residential areas is very complicated, from financing down to the logistics. (Estimated cost for Soweto is R100 million).

Have we achieved a cost-effecitve solution, or even a solution?

Could the supply of better grade coal or anthracite, or even smokeless fuel briquettes not achieve similar or better results over the short term, allowing a more leisurely electrification programme?

Emissions from burning coal mine spoil heaps

During 1981 approximately 128 million tons of coal was sold, of which 30 million tons was exported. All metallurgical coal and most export coal is beneficiated or "washed" to lower the sulphur and ash content. The quantity washed in 1981 was 107 million tons, which produced a discard of 22,8 million tons and 84 million tons of product. The estimated composition of the waste produced in the Witbank district, according to McGillivray, varied as follows:-

Energy content	9 – 17 MJ/kg
Volatiles	15 – 22%
Ash	44 – 57%
Moisture	1,2 – 2,8%
Sulphur	0,8 – 5,1%

This material is spontaneously combustible if dumped without precautions and can potentially produce more SO_2 than the combustion of the coal from which it was separated with great care and expense. Funke[4] estimates that this discard contains 880 000 tons of sulphur which could be released during combustion or leaching. He proposes that the material should be crushed and compacted in layers when forming dumps. The additional cost for this is estimated at 20–40 cents per ton of waste, or 3,6 to 7,2 cents additional cost per ton coal sold.

Work on spontaneous combustion of coal and tailings is being undertaken at Wits University. The use of this material for power generation by combustion in fluidised bed furnaces has been suggested.

With the predicted boom in synthetic fuels based upon coal conversion to methanol by a number of industrial concerns, additional precautionary measures should be taken at an early stage to ensure efficient use of the energy, and effective disposal of the unused portion in a manner which will cause the least pollution.

A figure quoted[5] for the consumption of coal in South Africa in the year 2020, assuming a 5,8% growth rate, is 740 million tons per year as against 100 million tons per year at present. Whole new coalfields in areas such as the Springbok flats will be required. Needless to say, smoking spoil heaps can not be contemplated.

I have posed more problems than possible solutions but if an awareness has been created that cost-effective solutions imply a broader, systems-approach to problems rather than merely applying efficient solutions on an ad hoc basis, then the time spent will have been amply rewarded.

REFERENCES

1. Pollution Prevention Pays, by Michael Royston, Pergamon Press, London, U.K.
2. Iscor Public Relations Department press release, 1982–01–28.
3. E.P.A. adopts flexible clean air rule, Anon., Chemical and Engineering News, December 10, 1979.
4. The Environmental Impact of Coal Mining and Combustion in South Africa by J.W. Funke; Paper presented at the national Association for Water Pollution Research Conference, Cape Town, 1982.
5. Synfuel 'Heading for an R8 Billion Boom' by Brendan Ryan, Engineering Week, 1982–09–02.

TYDSKRIF VIR SKOON LUG 6 (1982)

ERRATA

Artikel: Analitiese ondersoek van Briggs-pluimstyging. O L Fourie en J C Venter, Afdeling Atmosferiese Wetenskappe, NFNL, WNNR, Posbus 395, Pretoria 0001.

Bladsy 9:

1. $\rho_g = \dfrac{\rho_o \; pT_o}{p_o \; T_g}$ (1)

2. $\dot{V} = \pi R^2 w$ (2)

3. $F = 8{,}8 \times 10^{-6} \dot{Q} P_o / P$ (4)

Bladsy 10:

4. $x_m = \pi \tilde{u} s^{-1/2} = \tilde{u} \left[\dfrac{T}{\partial \Theta / \partial z} \right]^{\frac{1}{2}}$ (9)

Bladsy 12:

5. (laaste paragraaf, sesde reël):
.... uitdrukking vir $\partial H_m / \partial T_g$

6. (sewende reël):
.... toenemende T_g en dat $H_m \rightarrow (78 \dot{V}^{3/5})/u$ by ....

Bladsy 13:

7. Figuur 8 (onderskrif):
(T_o = 273K)

Bladsy 14:

8. Figuur 12 (onderskrif):
$\dot{V}(m^3.s^{-1})$

Bladsy 15: (tweede formule):

9. $y = 100 \left[\left[\dfrac{1-T/T_{gb}}{1-T/T_{ga}} \right]^{1/3} - 1 \right]$

Bladsy 16:

10. s = stabiliteitsparameter (s^{-2})

ERRATA

Journal Vol 5 No. 4 1980

Kemeny: Long Term Trends in Smoke and Sulphu Dioxide . . . . . .

Table 2: Suspended particulates: annual mean 40 g/m^3
Carbon Monoxide- nondispersive method 40 g/m^3

Table 3: Heading United States ambient air quality objectives and Standards.

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REFERENCES

1. PETROLEUM INSTITUTE ENVIRONMENTAL CONSERVATION EXECUTIVE (PIECE). An Australian assessment of automotive lead catchment devices by Emtech Associated Pty. Limited, Liverpool, New South Wales, Australia, July 1981.
2. NESTE OY, RESEARCH CENTRE, FINLAND. Lead filter evaluation by Neste Oy in Finland. Finland, Neste Oy Research Centre, 1982. (Research report 21/82).
3. HEARD, M.J. en WIFFEN, R.D. The effect of exhaust gas filters on the size distribution and concentration of airborne particles from vehicle exhausts. Harwel,, AERE, 1982. (Report G2474).
4. DEPARTMENT OF TRANSPORT. Lead in Petrol. An assessment of the feasibility and costs of further action to limit lead emissions from vehicles. London, Department of Transport, July 1979.
5. BOYES, A.P. The safe disposal of exhaust gas filters. Department of Chemical Engineering. University of Birmingham. March, 1982.

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