VENTILATION CRITERIA: BIOLOGICAL DEMANDS AND FORMULATION OF STANDARDS

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There are many methods of controlling indoor air pollution, including control, air cleaning and dilution with uncontaminated air. The choice of method, for any given situation, will depend upon practicability, source location and distribution, and cost.

Ventilation is, perhaps, the most common method and is particularly useful where contaminant sources are ill-defined, dispersed or non-stationary. The major question that arises for the practitioner is - how much air is required for the dilution process? In the past, say 15 years ago, the answer would have been obtained by reference to the classic studies of Yaglou and his colleagues (9) since body odour and tobacco products were considered to be the pollutants of prime importance. The mid-1970s saw an increasing realisation of the importance of other pollutants, the identification of new pollutants, often resulting from the use of new materials, and the recognition of pollutants, such as radon, which had always existed, but whose importance had been ignored. Together with pressure to conserve energy this has lead to the re-examination of ventilation standards and their underlying rationale.

The essential factors which contribute to the formulation of standards are

(a) identification of the pollutant(s) of concern in a particular situation of interest,

(b) specification of a limiting, maximum concentration, and

(c) estimation of production rates.

Taking (b) and (c) together enables a required air supply rate to be derived. This procedure may not be explicitly stated but is implicit in the generation of ventilation criteria and standards. This may be modified by a number of complicating considerations, including ventilation efficiency, spatial and temporal variation of source strength, removal of pollutant by other processes (e.g. deposition and absorption) and coupling between production rates and air supply rates. In some cases steps in the formulation may be omitted. This is illustrated by several reports (1,2,3,7). In these, ventilation requirements are based directly upon subjective assessment, without the need for an intermediate step specifying a limiting concentration.

The four main contributors to the Symposium on Ventilation Criteria illustrated various aspects of this procedure. Dorre and Horn (4) dealt with the underlying basis and difficulties in specifying limiting concentrations. Yoshizawa (10) described a specific situation, the produc-

tion of carbon monoxide by unflued combustion equipment. Here the source strength and limiting concentration, based upon acute health effects, were shown to be relatively well-defined, leading to a required fresh air supply rate. The paper also illustrated coupling between the air supply rate and source strength, since carbon monoxide production is related to oxygen depletion in the combustion air.

Fisk (5), dealing with radon, demonstrated the importance of taking into account both the need to assess other means of pollutant removal, and, again, the interaction between production rate and air supply rate. Janssen (6) reviewed a major national standard - ASHRAE 62 - and included discussion of the rationale underlying both 1973 and 1982 versions. Traditionally standards have been specified in terms of air flow rate. In ASHRAE 62/81 an alternative procedure was allowed. In this, limiting concentrations were proposed and the practitioner could, if he wished, derive his own solution for air supply rate tailored to a particular situation.

Many other valuable and apposite contributions were made in the free communication sessions. In particular, two papers (1,7) dealt with experimental derivation of air supply rates for odour control, in relation to school children and adults. The need to understand thoroughly the assumptions underlying the derivation of limiting concentrations was illustrated by a comparison of two papers (6.8) dealing with air supply rates in relation to tobacco smoking. In one the basis was taken to be the control of particulates and in the other, the carcinogenic effect of passive exposure to tobacco smoking products. The derived air supply rates differed by three orders of magnitude!

Based upon the INDOOR AIR '84 Conference papers three questions were posed for discussion:

(1) How should standards best be presented? i.e. should they be purely prescriptive? Or, is the "air quality procedure" to be preferred?

(2) What are the areas of weakness in existing standards?

(3) What are the trends for standards in the future?

The discussion centred primarily on the first question. There were clearly two schools of thought. The air quality procedure was criticised on several grounds. Firstly because it was considered to be too complicated for most practitioners to use and, secondly, because without a full understanding of the bases of the limiting concentrations these could be misinterpreted. On the other hand the rationale of prescriptive standards was rarely, if ever, stated, and the user was allowed no flexibility. It was generally agreed that a compromise, retaining the prescriptive approach but strengthening it by including a clear statement of the assumptions underlying the stated air supply rates would be an appropriate solution.

Conclusions

1. Ventilation standards should be simple in concept and presentation, but should include a statement of the underlying assumptions, both to permit more effective updating in the light of new knowledge and to allow intelligent application by the user.

2. Air supply rates given in standards generally assume perfect mixing. More attention needs to be given to identifying and correcting for situations where this is not true.

3. Consideration should be given to the formulation of operating standards as opposed to standards for design purposes only, in order to take into account, for instance, the change of use of spaces within buildings.

4. It is clear from the papers in the INDOOR AIR '84 Conference that there is a continual improvement of knowledge on the effects and incidence of indoor air pollutants. Ventilation standards should not, therefore, be regarded as immutable. In particular it was generally agreed that trends in basic air supply rates are likely to be upward rather than downward, particularly in codes and standards which in the past had responded to pressure for energy conservation by reducing such rates.

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