WHY CAN'T PERCEIVED AIR QUALITY INDICES TELL YOU ABOUT INDOOR AIR QUALITY?

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EXTENDED ABSTRACT

Present ventilation standards for public and residential buildings base the prescribed ventilation rates on the percentages of dissatisfied persons with air quality or the percentages of building occupants rating air quality as unacceptable. Earlier, since 1930s, the moderate level of perceived odour intensity was used to set ventilation requirements. All three outcomes are the measures of air quality, as it is perceived by building occupants. This means that the present ventilation standards base their recommendations on discomfort related with the perceived air quality. The requirements do not link the prescribed ventilation rates with concentrations of pollutants that ensure no harmful effects. Some standards do however provide information on the concentration of some pollutants for which toxic information is available. They refer for example to recommendations made by cognizant authorities, such as World Health Organization, or the pollutants and their limit levels recommended for occupational exposures. In the absence of other indoor air quality metrics or other credible methods to determine ventilation requirements in public and residential buildings, the use of perceptions of building occupants seem to be the most reasonable, functional and pragmatic approach to prescribe ventilation rates. This postulation is however correct only if comfort of building occupants is concerned, if level of comfort is related with or approximates other outcomes, and if only pollutants that can be perceived by humans are considered.

The obvious question that follows is whether the current approach for determining ventilation rates is truly reasonable, sustainable and effective. And consequently, whether the perceived air quality indices are reliable measures of the air quality and can be thus used in the context of deriving ventilation requirements or as general metric of indoor air quality. This presentation will attempt to answer this question. The answer will be provided by presenting the pros and cons of perceived air quality indices. The presentation will define the cases in which perceived air quality can potentially be used and in which it should not, or is difficult to use. Recommendations for further development or abatement of this metric will be made.

Among the pros, the two that can be named are that perceived air quality indices provide a warning against potential risks and that they integrate and consolidate an exposure and a response in one metric. This is what is making this index very attractive compared with the other approaches to define indoor air quality level considering also that none of these other approaches can at the same time provide an instant information on the exposure and effect, thus do not provide information that allows to evaluate the air quality conditions and take the decision regarding mitigation actions. Chemical analysis, even as much sophisticated, thorough and complete as it could be (and at the same time rather expensive as well) will only provide information on the levels of pollutants and the type of pollutants that are present. It will not be able at the same time to identify many pollutants due to their low concentrations and/or limitations of analytical approach. Chemical analysis will be static, as well. It will not be able to capture dynamic transformations or interaction processes between pollutants and the building structures that can potentially occur. Even if these limitations were neglected, chemical analysis will not be able to provide the complete answer to the question on whether a certain cocktail of pollutants would cause sensory discomfort or other negative effects. This information will have to be provided from other sources that are not accessible or incomplete at present. Quantitative Structure Activity (QSAR) models are being advanced but they are not able to deliver the quality information compared to the assessments made by people. The same applies for Neural Networks, approaches attempting to predict sensory responses based on the properties of pollutants or any other approaches despite their continuous development. Taking this into account, the perceived air quality indices provide very useful, immediate information on whether the pollution cocktail is smelly or not, whether the odour is intense or not, whether it is pleasant or not and whether it is acceptable or cause the nuisance. No other measuring method is capable to provide this information at present.

The perceived air quality indices have their cons as well. They should be carefully weighed and judged against their pros. Among the few that can be named is difficulty to measure the perceived air quality especially

in situ because at present no sensor or array of sensors can be used for this purpose and human subjects performing the actual assessments must be recruited instead, variability of sensitivity and preferences among building occupants, inability to detect hazardous pollutants that cannot be sensed (e.g. Radon and carbon monoxide), impact of environmental factors such as temperature and relative humidity on the perception of air quality that can disturb the measurement and prediction, sensory fatigue (adaptation) causing inability to detect pollutants producing sensory effects, nonuniformity, i.e. different responses to different pollutants, in other words lack of a common underlying dose-response relationship, and finally the lack of credible relationships between the perceived air quality and other outcomes such as health and cognitive performance. The latter seems to be very important, especially in the context of universal indoor air quality metric, among others because the perceived air quality index was promoted as a solution to reduce the level of complaints of unsatisfactory conditions indoors. However, with the present knowledge the only statement that we can make with a good deal of confidence is that perceived air quality index will address only one modality – comfort, and is incapable to predict reliably other effects.

Considering all pros and cons of perceived air quality indices, the conclusion that can be drawn is that they should not be proposed as a universal IAQ metric. However, considering their advantages they should not be completely dismissed because they can be used for certain purposes in certain measuring context on a limited basis. This however requires their further development and standardization, especially as regards the measurements.

KEYWORDS

Perceived Air Quality; Indoor Air Quality; IAQ Metrics; Ventilation