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Assessing the benefit and cost for a voluntary indoor air quality certification scheme in Hong Kong

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Abstract

A voluntary indoor air quality certification scheme has been proposed in Hong Kong for assessing and evaluating the indoor air quality level in a variety of public places like offices, restaurants and pubs. The scheme intends to promote the public well being, however, its technical and financial practicality has led to serious discussions among the government officials, practitioners and premises owners. Accordingly, this study intends to develop a protocol for examining its financial viability by linking the appropriate dose-response and economic data with the results from indoor micro-environment models. The financial viability of the scheme is evaluated by examining the cost and benefit associated with compliance on the different prescribed indoor particulate (PM_{10}) levels. According to our analysis, the indoor action level of 180 $\mu g/m^3$ as 8-h mean (with the objective of protecting the health of general public) does not require office owners to improve beyond the base setting. Nevertheless, owners should consider altering the base settings in their air conditioning systems so as to secure more benefit on every dollar they spent. On the contrary, the 20 $\mu g/m^3$ level as 8-h mean (with the objective of providing comfort) is not considered to be financially viable for office owners as they will incur financial loss on compliance. Subsequent sensitivity analysis indicates that the total net benefit derived have a great dependency on the value-of-life estimates used. If conservative health estimates are adopted, the optimum level determined to be beneficial to both owners and the society will be 55 $\mu g/m^3$, which can be obtained by operating the air conditioning system with a ventilation rate of 10 l/s, primary filters of 80–85% efficiency and secondary filters efficiency of 60–65% arrestance. This information should be extremely valuable for government officials and policy makers in assessing the financial viability of the voluntary indoor assessment scheme.

Keywords: Indoor air quality; Cost-benefit analysis; Particulate standards

1. Introduction

The growing health awareness led people in Hong Kong, who spend more than 85% of their total times indoor (Chau et al., 2002), to become increasingly aware of the importance of good indoor air quality as a safeguard to their health

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and contribution to the comfort and well-being. The growing concern has prompted the government in Hong Kong to propose a number of initiatives to improve the indoor air qualities, which include:

i. launching a public education and publicity campaign to promote public awareness of indoor air quality;
ii. setting up an indoor air quality information center to disseminate information and reference materials related to indoor air quality; and
iii. promoting a voluntary indoor air quality certification scheme through the development of Guidance Notes of Indoor Air Quality in Offices and Public Places (GN) (HKSAR, 1999) for encouraging the owners and the management of premises to adopt.

Among these initiatives, the proposed adoption of GN has attracted the greatest concern within the public community. The GN intends to set up a voluntary indoor air quality certification for assessing the indoor air quality level in a variety of public places, like offices, restaurants and pubs, by creating a hierarchy structure of three-level air quality objectives as a common benchmark for public places to comply. The objectives prescribed by three different levels vary, with level 1 the most stringent and level 3 the least stringent. Specifically, level 1 represents very good indoor air quality that a high-class and comfortable building should have; level 2 represents indoor air quality that provides protection to the public at large, and level 3 represents indoor air quality that provides protection to workers and employees as enforced under the current occupational safety and health laws (IAQ Management Group, HKSAR, 1999). By complying with levels 1 and 2, the likelihood of indoor air pollution leading to health problems or discomfort in the building would become small.

The ultimate objective of the GN is to promote the public well being, however, its technical and financial practicality has led to some serious discussions among government officials, practitioners, premises owners, and employers. Given that the GN is a voluntary scheme, the cost and benefit associated with its compliance will be expected to be one of the decisive factors for premises owners and employers to adopt the GN. In particular, it would be vital for owners of the premises and employers, especially during the economic downturn, to be fully aware of their financial commitment before complying with different levels defined in the GN.

Even though there are increasing numbers of studies around the world focusing on the assessment of health benefit and cost effectiveness associated with ambient air command-and-control regulations (Ostro and Chestnut, 1998; Pearce and Crowards, 1996; El-Fadel and Massoud, 2000; Quah and Boon, 2003), there is no literature reporting on the development of a systematic methodology for estimating the cost and benefit associated with a voluntary indoor air quality scheme. Accordingly, this paper attempts to address this gap by developing a protocol by linking the appropriate concentration–response and economic data with the results from mass balance micro-environmental models in evaluating the benefit and cost associated with compliance. Also, it is intended to identify the optimum pollutant levels that can provide the maximum amount of benefits and return on investment for premises owners, employers as well as the society.

2. Pollutant in focus—particulates

Under the current scope of the GN, nine different types of indoor pollutants and three airflow parameters are monitored. Among different types of indoor pollutants, particulates of aerodynamic diameters less than 10 μm are selected to be the major focus of this study. Particulates exist in both liquid and solid forms under normal atmospheric conditions. Particulates can be directly emitted by sources, or formed in the atmosphere through chemical conversion of gaseous pollutants, including sulfates, nitrates and organic aerosols.

Particulate matter of aerodynamic diameters less than 10 μm (PM_{10}) and less than 2.5 μm ($PM_{2.5}$) have been singled out for special attention for their detrimental effects on human health. Particles with 5–10 μm in diameter will deposit in the passages of the nose and pharyngeal regions. Particles with diameter smaller than 2.5 μm deposit deeper in the tracheal bronchiolar region, with those smaller