Building and Environment 46 (2011) 2562–2569

Contents lists available at ScienceDirect

Building and Environment

journal homepage: www.elsevier.com/locate/buildenv

Assessing air quality in Hong Kong: A proposed, revised air pollution index (API)

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ARTICLE INFO

Article history:
Received 16 April 2011
Received in revised form
5 June 2011
Accepted 7 June 2011

Keywords:
Air pollutants
Air quality
Air pollution index (API)
Revised air pollution index (RAPI)

ABSTRACT

The Environment Protection Department of Hong Kong has been using an air pollution index (API) to report the status of ambient air quality since 1995. Such an index system was first developed by the USA Environmental Protection Authority. The API compares five main air pollutants, i.e. sulfur dioxide (SO_2), respirable suspended particulates (RSP), nitrogen dioxide (NO_2), carbon monoxide (CO) and Ozone (O_3) as sub-indexes, which are calculated separately from a segmented linear function that transforms ambient pollutants concentrations into a normalized scale extending from 0 to 500. The resultant pollution level is described by the maximal value of these five sub-indexes. The limitation of this API system is that it considers only one pollutant with the maximum value at a time but reflects other pollutants concurrently. In this study, a revised air quality index (RAPI) is proposed based on the entropy function, which combines the effect of all pollutants on public health. The design of the revised index is based on database of air pollutants collected at two air quality monitoring stations in Hong Kong, i.e. a roadside station in Mong Kok and a general station in Sha Tin. Compared with the existing API, values of RAPI (calculated from data collected for API) at both stations are at higher levels and provide more information of levels of all pollutants. Therefore, RAPI should be representatively and widely used to provide the public with a better indicator of air quality. In addition, variations and oscillations of pollutants concentrations were also examined and the results show that RSP and NO_2 contribute more to the overall pollution level than other components. It is suggested that more abatement strategies be focused on these pollutants to improve air quality in the future.

1. Introduction

Air pollution has received extensive attention in Hong Kong in recent years because of adverse effects of smog and vehicle exhausts on human health. In Hong Kong, sulfur dioxide (SO_2), respirable suspended particulates (RSP), nitrogen dioxide (NO_2) and carbon monoxide (CO) are the major air pollutants because of the dominance of diesel vehicles in goods transportation and deployment of double-decker buses, which have diesel engines. These major pollutants and the related secondary pollutant, e.g. ozone (O_3), have significant harmful impact on human health, property and the environment ([1,2,4,6,8,12–17,20–24,26]). In order to address the air pollution problem and to plan abatement strategies, the Hong Kong Environmental Protection Department (HKEPD) has established 14 monitoring networks to monitor air quality and to provide information on the current air quality, using the air pollution index (API). The API, developed by the USA Environmental Protection Authority, is calculated from data of pollutants by a segmented linear function that transforms ambient concentrations onto a scale extending from 0 to 500. The purpose of the API is to help citizens understand how local air pollution level is changing in time series, which provides significance guidance for public's exposure to air pollution.

The major shortcoming of the API system is that it does not take into account the combined effects of all pollutants on human health since the value of API is defined by one of the pollutants, i.e. the one with the highest concentration relative to its standard in a given hour. In order to alleviate this problem, several attempts have been made to introduce indices that take into account the combined effects of various pollutants on human health ([3,5,9,10,19]; Gurjar, 2008) [9]. developed an index of air pollution in relation with the epidemiological perspective and [3] proposed a novel air pollution index system based on the relative risk of increased daily mortality [10]. introduced an aggregate air quality index which takes into account the combined effects of the criteria pollutants. Gurjar (2008) established a multi-pollutants index considering the combined level of three criteria pollutants in view of the World Health Organization (WHO) Guidance for air quality. Among these,

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doi:10.1016/j.buildenv.2011.06.011