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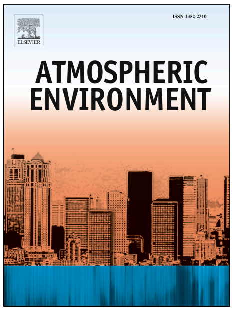

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Jun Gao, Yating Jian, Changsheng Cao, Lei Chen, Xu Zhang

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Jun Gao*, Yating Jian, Changsheng Cao, Lei Chen, Xu Zhang
Institute of HVAC Engineering, College of Mechanical Engineering, Tongji University, Shanghai, China
*Corresponding e-mail: gaojun-hvac@tongji.edu.cn

Abstract

Cooking processes highly contribute to indoor polycyclic aromatic hydrocarbon (PAH) pollution. High molecular weight and potentially carcinogenic PAHs are generally found attached to small particles, i.e., particulate phase PAHs (PPAHs). Due to the fact that indoor particle dynamics have been clear, describing the indoor dynamics of cooking-generated PPAHs within a specific time span is possible. This paper attempted to quantify the dynamic emission rate, simultaneous spatial dispersion and individual exposure of PPAHs using a cooking source. Experiments were conducted in a real-scale kitchen chamber to elucidate the time-resolved emission and effect of edible oil temperature and mass. Numerical simulations based on indoor particle dynamics were performed to obtain the spatial dispersion and individual inhalation intake of PPAHs under different emission and ventilation conditions. The present work examined the preheating cooking stage, at which edible oil is heated up to beyond its smoke point. The dynamic emission rate peak point occurred much earlier than the oil heating temperature. The total PPAH emission ranged from 2258 to 6578 ng upon heating 40 to 85 g of edible oil. The overall intake fraction by an individual within a period of 10 min, including 3 min for heating and 7 min for natural cooling, was generally ~ 1/10000. An important outcome of this work was that the overall intake fraction could be represented by multiplying the range hood escape efficiency by the inhalation-to-ventilation rate ratio, which would be no greater than the same ratio. The methodology and results of this work were extendible for the number-based assessment of PPAHs. This work is expected to help us understand the health risks due to inhalation exposure to cooking-generated PPAHs in the kitchen.

Keywords: PAH, Cooking, Exposure, Emission rate, CFD, Ventilation

1 INTRODUCTION

Cooking (Wallace, 2006; Hussein et al., 2006; Wan et al, 2011; Buonanno et al, 2013; Gao et al, 2013) represents one of the major contributing sources to indoor air particle concentration. Many studies have indicated positive associations between serious respiratory diseases, such as lung cancer, and exposure to cooking-generated particles (Gao et al., 1987; Xu et al., 1989; Wang et al., 1996; Koo and Ho, 1996; Kenny, 2007). The risk of lung cancer has increased approximately three-fold with the increasing number of meals women prepare per day; this risk is also greater for women who generally wait until fumes were emitted from the cooking oil before they began to cook (Ko et al., 2000). Cooking generates a range of organic and inorganic compounds, including species that are identified as possible carcinogens such as polycyclic aromatic hydrocarbons (PAHs) (Li et al., 1994; See and Balasubramanian, 2006; Karimatu et al; 2013). Siegmann and Sattler (1996) found that the PAH concentration contained in hot cooking oil fumes was higher than that in an office where 96 cigarettes were consumed within 6 h. Li et al. (2003) reported 29.5 ~ 130 ng/m^3 of PAHs emitted from cooking Chinese food, approximately 2-fold greater than that from cooking Japanese and fast food. Lu et al. (2011) reported that total concentration of 8 PAHs could range from 7.1 to 320 ng/m^3 and from 0.15 to 35 ng/m^3 in residential environments in China and Japan, respectively. PAHs can exist in a vapor and a particulate phase, depending on