

The impact of various hood shapes, and side panel and exhaust duct arrangements, on the performance of typical Chinese style cooking hoods

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Abstract

In Chinese commercial kitchens, a large amount of moisture and heat is produced and must be removed, which can require ventilation rates resulting in huge levels of energy consumption. Excessive airflow rates can increase unnecessary energy consumption and system life-cycle costs. For many middle and small scale commercial kitchens in China, the indoor, thermal environment is far worse than acceptable levels. The use of an efficient kitchen hood is essential to ensure a comfortable working environment and better energy conservation. In this study, many types of hood shapes and side panels were developed to improve the capture efficiency of traditional Chinese style cooking hoods. The arrangement of the exhaust ducts was also investigated. Basic site tests and computational fluid dynamics (CFD) analysis were conducted. The simulated results showed that increasing hood volume did not improve capture performance. However, side panels did improve the capture efficiency, especially at higher positions. In addition, when the exhaust opening was located at the rear of the hood, the hood capture efficiency improvement was enhanced.

Keywords

capture efficiency,
kitchen ventilation,
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1 Introduction

As a result of greater understanding of the importance of indoor air quality (IAQ) to health, comfort and productivity of the workforce, concerns over IAQ have increased during recent years. Working conditions are particularly demanding in a commercial kitchen (Kosonen et al. 2006). A hot and uncomfortable kitchen contributes to productivity loss, employee turnover, and the eventual loss of profits for the restaurant operator (Livchak 2005). In a commercial kitchen, a high ventilation rate is necessary to exhaust both the combustion gases and the contaminants generated by cooking.

China, with nearly 1.3 billion people, has the largest population in the world, consuming copious quantities of cooked foods every day. As China's economy expands, the catering industry is becoming an important component of the service sector of the economy. For example, there are currently over 51 thousand restaurants in Beijing (Beijing Statistics Bureau 2005). In 2010, catering sales were ¥20.012 billion, which was two times the sales level in 2005. Great

attention should be paid to the working conditions in Chinese commercial kitchens, and the indoor air pollution generated by the cooking processes.

Chinese kitchens utilize quite complicated culinary skills in delicately controlling the cooking process by varying the heat, temperature and cooking time. China's local dishes each have their own typical characteristics, which are generally divided into eight regional cuisines. Each cuisine might involve preparing 200 to 300 dishes with variations of 24 common cooking techniques. A wide range of seasonings are applied (Ishige 1992), especially in commercial kitchens, and many dishes require large quantities of oil or lard for cooking. The resulting emissions from the multitude of different cooking techniques make a quite significant contribution to indoor air pollution in China. Oils are usually first heated to high temperatures in a wok, to reduce noxious odors, resulting in large quantities of emissions (He and Hua 2004). The emissions include smoke, grease particles and vapor, all of which are products of combustion, heat, and moisture (Bramfitt 2006).