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Measuring the Effect of Ventilation on Cooking in Indoor Air Quality by Low-Cost Air Sensors

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Abstract : The concern of the indoor air quality (IAQ) has been increasing due to its risk to human health. The smoking, sweeping, and stove and stovetop use are the activities that have a major contribution to the indoor air pollution. Outdoor air pollution also affects IAQ. The most important factors over IAQ from cooking activities are the materials, fuels, foods, and ventilation. The low-cost, mobile air quality monitoring (LCMAQM) sensors, is reachable technology to assess the IAQ. This is because of the lower cost of LCMAQM compared to conventional instruments. The IAQ was assessed, using LCMAQM, during cooking activities in a University of Minnesota graduate-housing evaluating different ventilation systems. The gases measured are carbon monoxide (CO) and carbon dioxide (CO₂). The particles measured are particle matter (PM) _{2.5} micrometer (µm) and lung deposited surface area (LDSA). The measurements are being conducted during April 2019 in Como Student Community Cooperative (CSCC) that is a graduate housing at the University of Minnesota. The measurements are conducted using an electric stove for cooking. The amount and type of food and oil using for cooking are the same for each measurement. There are six measurements: two experiments measure air quality without any ventilation, two using an extractor as mechanical ventilation, and two using the extractor and windows open as mechanical and natural ventilation. 3The results of experiments show that natural ventilation is most efficient system to control particles and CO₂. The natural ventilation reduces the concentration in 79% for LDSA and 55% for PM_{2.5}, compared to the no ventilation. In the same way, CO₂ reduces its concentration in 35%. A well-mixed vessel model was implemented to assess particle the formation and decay rates. Removal rates by the extractor were significantly higher for LDSA, which is dominated by smaller particles, than for PM_{2.5}, but in both cases much lower compared to the natural ventilation. There was significant day to day variation in particle concentrations under nominally identical conditions. This may be related to the fat content of the food. Further research is needed to assess the impact of the fat in food on particle generations.

Keywords : cooking, indoor air quality, low-cost sensor, ventilation
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