Specific Aim 2

Apply emerging technologies for assessing and controlling firefighters’ and first responders’ exposures to ultrafine particles

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Goals:
• 2.1: Test the new ultrafine particle sensors for measurement of combustion particles
• 2.2: Develop and optimize a set-up for assessing workplace protection factors of respirators against ultrafine particles.
Sub-aim 2.1: Test the new ultrafine particle sensors against combustion particles.

Progress. The new ultrafine particle sensor developed at UC (UC-CPC) was used side-by-side with a commercially available ultrafine particle counter (TSI P-Trak) during respirator testing with combustion particles. Good correlation was observed between the particle penetrations measured by the two instruments. A peer-reviewed paper on these results have been published:

Sub-aim 2.1 - Results
Present effort and future plans for Sub-aim 2.1. Another ultrafine particle sensor (particle size selective), developed by Dr. Kulkarni of NIOSH-Cincinnati and commercialized by Kanomax (Japan) is being presently tested in the lab and in the field. A total 12 to 25 firefighters in training are being currently recruited for measuring the Workplace Protection Factor of a half-mask respirator during activities relevant to emergency response situations. The Kanomax ultrafine particle sensor will be deployed for this field study (James Dietrich’s project). In addition, the workplace aerosol will be characterized as to its concentration and particle size distribution through real-time measurements conducted by Nano-ID (Particle Measuring Systems, Inc., USA).
Sub-aim 2.2: Develop and optimize a set-up for assessing workplace protection factors of respirators against ultrafine particles.

Progress. The efficiency of firefighters’ respirators against combustion-generated particles was first tested under laboratory conditions. Besides breathing flow rate and breathing frequency, combustion material was found to have significant effect on the penetration of particles into an elastomeric half mask respirator. The same half mask was also fit tested on 25 subjects representing a NIOSH bivariate panel. The respirator was found to provide adequate passing rate (96%) for a 25-subject panel. These findings have important implications for the performance evaluation protocols for respirators used by firefighters and first responders. The results were summarized in 7 peer-reviewed papers and 5 conference presentations (received two poster awards at the AIHce).
Peer-reviewed papers


Conference proceedings


2. X. He, S.A. Grinshpun, T. Reponen, “Effects of Breathing Frequency on the Performance of an Elastomeric Half-mask Against Combustion Aerosols Using an Advanced Manikin Headform”, Poster. AIHce, Montréal, Canada, 18-23 May, 2013 (Best Student Poster)

3. X. He, S.A. Grinshpun, T. Reponen, “How Does Breathing Frequency Affect the Filter Efficiency of an N95 Filtering Facepiece Respirator?”, Scientific Research Abstract. AIHce, Montréal, Canada, 18-23 May, 2013


5. X. He, S.A. Grinshpun, M. Yermakov, T. Reponen, “Effects of Faceseal Leakage, Flow Rate and Combustion Material on the Performance of Elastomeric Respirators with P-100 Filters”, Student Poster #30, AIHce, Indianapolis, 17-22 June, 2012 (Best of Session)
Respirator testing
Present effort for Sub-aim 2.2. The new respirator testing set up is being developed and optimized for its further deployment at the firefighting training site.
Future development

The respiratory protection research under Specific Aim 2 will transition from the environments that involve firefighters and first responders to health-care environments. This interdisciplinary project will utilize expertise in OH, Nursing, and OM.
If you are interested in this project, please contact:

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