

Characterization of Airborne Nanoparticles Using Four Different Methods

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Keywords: Nanoparticle, aerosol, real time monitoring

Objective: The purpose of this research was to assess the effectiveness of current nanoparticle aerosol measurement methods including Condensation Particle Counter (CPC), Optical Particle Counter (OPC), and Scanning Mobility Particle Sizer (SMPS), that is, real-time instruments used in evaluating properties of nanoparticle aerosol clouds; and compare the resulting concentrations and size distributions to these obtained by electron microscopy (EM).

Methods: Sodium chloride nanoaerosols were generated using a Collison Nebulizer. The aerosol cloud was passed through a radioactive neutralizer and a diffusion dryer prior to entry into the test chamber. The chamber was evaluated for air leakage, relative humidity, air flow patterns, and dispersion patterns. Real-time measurements were obtained with the OPC, CPC, and SMPS. Air samples were also collected on membrane filters for EM analysis.

Results: The research is ongoing and generated data is limited. The CPC was stable and consistent but the results were limited to nanoparticle concentration. The SMPS was effective in measuring the concentration and size distribution of the nanoparticle cloud. Comparable concentrations of nanoparticles within the size range of 20nm to 200nm, with a median diameter range of 80nm to 100nm were observed as determined by the SMPS and EM. The SMPS and EM sample results were comparable. OPC provided particle concentrations in selected nanoparticle size ranges but did not perform well at elevated nanoparticle aerosol concentrations.

Conclusion: The direct reading instruments examined in this study should be used with caution for characterization of size and concentrations of a nanoparticle cloud. EM should be used to verify size and concentration reported by the instruments.

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Heat Stress and Incident Rates for Heat-Related Disorders and Acute Injury during Deepwater Horizon Clean-up Operations

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Keywords: heat stress, heat disorders, acute injury

Objective: The objective of this study is to examine the relationship between outdoor thermal conditions and (1) heat-related disorders and (2) acute injuries using injury and illness data collected during the BP Deepwater Horizon cleanup operations.

Methods: There were 5,485 heat-related or an acute injury cases over 11 months. Daily weather data were used to estimate the wet bulb globe temperature (WBGT) based on the time of day. Heat Stress Levels were baseline (HSL0: < 24 °C-WBGT), HSL1 (24 - 27 °C-WBGT), HSL2 (27 - 30 °C-WBGT), HSL3 (30 - 33 °C-WBGT) and HSL4 (> 33 °C-WBGT). Labor-hours by month were estimated by the prevailing shift length in the month and the number of workers. The incidents were assigned a Heat Stress Level and the number of labor-hours by heat stress level were determined. The next step was to calculate the incident rate ratios (RRs) by Heat Stress Level.

Results: For heat-related disorders, the RR increased from 6.2 at HSL1, to about 10 at HSL2 and HSL3 to 19 at HSL4. For acute injury, there was an increase from baseline to HSL1 (RR = 1.5) and then to HSL2 (2.3) and was similar for HSL3/4 (1.9).

Conclusion: As a frame of reference, the occupational exposure limit was about 30 °C-WBGT, the transition from HSL2 and HSL3. The rate of heat-related disorders increased above thermal comfort (HSL0) and below the exposure limit (HSL1 and HSL2). Some of this increase was likely due to aggressive recognition and treatment. Interestingly, there was a substantial increase at HSL4 (more than 3 °C-WBGT above the exposure limit) that likely represents the effects of the heat. The major increases in acute injury occurred between thermal comfort and the exposure limit, meaning that the exposure level is not protective for acute injury.

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