conducted for various reasons, mostly time consuming and costly. This study aimed to shorten the fit testing procedures by improving the instrumental settings, sampling system design, and data analysis protocols.

Methods Experiments of fit factor measurements were divided into two parts: constant flow and cyclic flow using a breathing simulator. To simulate leakage, capillaries (10 mm in length, diameter 1.0–1.5 mm) were used to insert on N95 and N100 filtering facepieces. The ratio of total to leak flow was considered the 'true fit factor, FFt'. Flow rates ranging from 5–50 L/min were employed to study the flow dependency. The measured fit factors were determined by concurrent particle concentration measured by a Portacount and a OPS 3330. The default 1.7 m sampling tube was used to connect filtering facepiece to the aerosol instruments. In addition, the effects of breathing pattern (tidal volume: 0.5–1 L, frequency: 5–20 times/min) and lung deposition (with/without HEPA filter behind the respirator) on in-mask particle concentration during fit testing were analysed, to explore the minimal sampling time that approximated the FFt.

Results The particle measurement response times for Portacount and OPS were approximately 5 and 2 s, respectively. For P100 respirators, most measured fit factors were close to the FFt. Whereas, there was an underestimation while using N95 respirator due to filter penetration. Therefore, N95-companion was necessary while testing N95 respirator. For the cyclic flow tests, the fit factor was overestimated because the sampling tube was connected onto the facepiece where filtered air was partly sampled. The higher the breathing flow rate, the more the fit factor was overestimated. On the other hand, the measured fit factor would be close to the FFt when using the highest concentration during a breathing cycle (FFmin). In theory, it could be decided in only one breathing cycle.

Conclusion With improved design in instrumental setting and operating procedures, a fit test for an individual exercise would take approximately only 12 s. Therefore, the whole fit testing process could be shortened from 7.5 to about 3 min.

440 DEVELOPMENT OF A COOL AND CLEAN AIR MOTORCYCLE HELMETS

[1]AL Jian*, [1]SH Huang, [2]YM Kuo, [1]CW Lin, [1]WC Lee, [1]CC Chen. [1]*National Taiwan University, Taipei, Taiwan*; [2]*Chung Hwa University of Medical Technology, Tainan, Taiwan*

10.1136/oemed-2018-ICOHabstracts.577

Introduction Motorcyclists could be exposed to high $PM_{2.5}$ up to 460 $\mu g/m^3$. The aim of this work was to develop a full faced helmet (FFH) that provides clean air and cool temperature inside the helmet to reduce particulate exposure and increase comfort for motorcyclists.

Methods A commercial FFH was modified to generate cool and clean air in a way similar to the powered-air-purified-respirator, commonly used in industrial settings. Three different clean air supply locations (A: upper rear of the head, B: zygomatic side, and C: lower chin) were applied to investigate the location effect. A small wind tunnel was used to simulate the turbulence that motorcyclists might encounter while riding on the road. The operating parameters included: the supply air flow rate to the helmet (Q_s), the velocity in the wind tunnel (U_0) and breathing flow rate which is a combination of tidal volume and breathing frequency. To minimise infiltration of aerosol outside the helmet into the breathing zone, the FFH was tightly surrounded with a neckerchief made of different materials. The stiffness of the neckerchief was measured by using a 45° angled Cantilever. A condensation particle counter was used to measure particle number concentrations both inside and outside the FFH, to calculate the protection factor, PF.

Results The PF of the FFH increased with increasing Q_s, but decreased with increasing wind speed and breathing flow rate. At breathing flow rate of 7.5 L/min with the FFH sealed using neckerchief, PF increased from 1 to 900 as Qs increased from 0 to 50 L/min under calm air condition, with air supply through location A. Meanwhile, the PF decreased from 900 to 3 when wind velocity increased from calm air to 10 m/s. The PF increased significantly when the FFH was sealed with a neckerchief made of soft shell (stiffness 19.2 mm, 28 cm long). In addition, the temperature on the top of head decreased with increasing supply air flow.

Discussion Applying a higher Q_s up to 100 L/min is necessary, not only to maintain a positive pressure inside the helmet but also to decrease the concentration of carbon dioxide exhaled by the wearer. The use of the soft shell neckerchief is also critical to reduce the infiltration due to external turbulence.

496 SHIFT OF AEROSOL PENETRATION IN SIZE-SELECTIVE CYCLONE SAMPLERS

[1]TJ Chen, [1]SH Huang, [1]CW Lin, [2]YM Kuo, [1]CC Chen. [1]*National Taiwan University, Taipei, Taiwan*; [2]*Chung Hwa University of Medical Technology, Tainan, Taiwan*

10.1136/oemed-2018-ICOHabstracts.578

Introduction Size-selective aerosol samplers are used to assess the health effect, because the retention of deposited particles in the respiratory tract is strongly size dependent. The main objective of this work is to examine the particle loading effects on PM2.5 cyclone samplers.

Methods In this work, five PM2.5 cyclones of different body diameters (9.3–35.6 mm), derived from the BGI VSCC, were designed and fabricated to investigate the effects of particle loading. An ultrasonic atomizing nozzle was used to generate micro-meter-sized potassium sodium tartrate (PST) particles and Sodium chloride (NaCl) particles as solid challenge aerosols, and di-ethyl-hexyl-sebacate (DEHS) particles as liquid challenge particles. Aerosol number size distributions and concentrations, both upstream and downstream of the cyclones, were measured using an aerodynamic particle sizer. In addition to the cyclone body diameter, other parameters investigated in this work included: challenge aerosol size distribution, chamber humidity, and the material of the cyclone.

Results The PM2.5 cyclones could be used to sample liquid particles without any bias, because the deposited liquid aerosols dripped down and did not accumulate on the inner wall of the cyclone. However, when challenged with solid particles, the deposited and accumulated aerosols on the wall reduced the aerosol penetration, and changed the curve to be less sharp. The extent of underestimation was affected by many parameters, such as challenge aerosol size distribution, humidity, test agent, and the elastic properties of the cyclone and the test agent. On average, there was an underestimation of 20% of 2.5 μm aerosol penetration when challenged with PST particles, regardless of cyclone body size. This suggested that cyclones might not be ideal for sampling solid particles.

Discussion Cyclone samplers currently used for size-selective sampling are likely subject to aerosol loading effect, and resulted in underestimation of the PM2.5 measurements. The use of virtual cyclone or wet cyclone might solve parts of the problem.

Occup Environ Med: first published as 10.1136/oemed-2018-ICOHabstracts.577 on 24 April 2018. Downloaded from http://oem.bmj.com/ on September 14, 2024 by guest. Protected by copyright.