

摘 要

利用泡綿(Polyurethane Foam)當做慣性衝擊器收集板時的收集效率較為平緩的原理，本研究設計了一個個人粉塵採樣器，並於實驗室進行校正測試，且於工作場所與其他採樣器進行粉塵濃度比對測試。本採樣器含可吸入性粉塵入口，截取氣動直徑 $10\ \mu\text{m}$ 的胸腔區慣性衝擊器，截取氣動直徑 $4\ \mu\text{m}$ 的可呼吸性慣性衝擊器。本研究在實驗室進行微粒的收集效率實驗，結果顯示本採樣器採樣流量為 $3.2\ \text{L}/\text{min}$ ，使用 100ppi 泡綿為衝擊板時在一倍的噴嘴板—收集板距離(jet-to-plate distance)下，可以符合 ISO/CEN/ACGIH 的胸腔區及可呼吸性粉塵採樣效率規範，胸腔區粉塵慣性衝擊器和可呼吸性粉塵慣性衝擊器的截取氣動直徑分別為 $9.6\ \mu\text{m}$ 及 $4\ \mu\text{m}$ 。研究亦發現固體微粒收集效率曲線與液體微粒收集效率曲線十分吻合，證明本研究所使用之泡綿收集板具有抑制固體微粒彈跳的問題。

本研究於 A(鉛粉廠球磨機)、B(鉛蓄電池切板區)、C(鑄鐵廠澆鑄區)三個不同工作場所中同時利用個人粉塵採樣器、IOSH 旋風器、Marple 個人採樣器和 Respicon 採樣器進行可吸入性粉塵、胸腔區粉塵和可呼吸性粉塵濃度的比對測試。由現場採樣比對結果可知，在可吸入粉塵方面，A、B、C 三個廠的新型採樣器和 Respicon 採樣器的粉塵濃度均無顯著差異。在胸腔區粉塵方面，A 廠和 C 廠的新型採樣器和 Respicon 採樣器的粉塵濃度有明顯的測值差異。可呼吸性粉塵方面，C 廠的新型採樣器和 Respicon 採樣器的粉塵濃度有明顯的測值差異。

關鍵詞：個人粉塵採樣器、慣性衝擊器、胸腔區粉塵、可呼吸性粉塵、氣膠採樣

ABSTRACT

This study designed a personal dust sampler which used PUF(Polyurethane Foam) as the impactor substrates to make the collection efficiency curves of the impactors smoother. The sampler was calibrated in the laboratory and was compared with other samplers for dust concentrations in the workplaces. The sampler includes an annular inlet, a thoracic inertial impactor with 10 μm cutsize, a respirable inertial impactor with 4 μm cutsize, and a final filter.

The laboratory calibration results show that with 100 ppi PUF substrates at the flow rate of 3.2 lpm that the collection efficiencies of the thoracic and respirable dusts match with the ISO/CEN/ACGIH criteria when the jet-to-plate distance is 1.0. The cut-off aerodynamic diameter is 9.6 and 4.0 μm for a thoracic inertial impactor and a respirable inertial impactor. It was also found that the collection efficiency for solid particles is equal to that for liquid particles, indicating that there is no solid particle bounce from the PUF substrates.

This research also compared the inhalable, thoracic and respirable dust concentrations measured by the present personal dust samplers, IOSH cyclones, Marple personal impactors and Respicon samplers at these A, B and C workplaces. The field results show that inhalable dust concentrations of the present sampler and the Respicon sampler are not significantly different at three workplaces. For respirable dust concentrations, the present sampler and the Respicon sampler have significant differences at a plant C, but not plants A and B. For thoracic dust concentrations, the present sampler and the Respicon sampler have significant differences at plants A and C.

Keywords: personal dust sampler, impactor, thoracic dust, respirable dust, aerosol sampling.