



パルスエアによる微粒子除去特性に関する研究

A Study of the Characteristics of Particulate Removal by Pulsed Air

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Compressed air cannons that emit high-speed pulses of air at fixed intervals are attracting attention in manufacturing industries because of their excellent cleaning performance and reduced air consumption. Thinking that pneumatic sound might provide useful information for the design of such particulate removal systems, we compared the test results of the acoustic characteristics of pulsed air and the results of particulate removal tests. The pulsed air used in this comparative study had an ultrasonic frequency of 20 kHz. Both the air pressure and the waveform attenuation efficiency were found to be involved in the removal performance. The possibility of using the Mahalanobis-Taguchi (MT) system to discriminate the removal ratio from acoustic information was also studied. It was found that conditions yielding low removal ratios could be identified from acoustic information by use of Mahalanobis distance. It was also demonstrated that: the removal ratio fell as power-on time increased to approach continuous air blowing; ultrasonic waves created by collision played a supporting role in particulate removal; and the pressure setting affected the sounds produced by air collision with walls and ejection of air from the nozzle. We therefore propose that acoustic evaluation of pulsed air by the MT system can be an effective tool in the design of pulsed air settings.

Key words : pulsed air, ultrasound, particulate removal, Mahalanobis-Taguchi system, error root mean square, quality engineering, Taguchi methods, S/N ratio

1. はじめに

現在、多くの製造業では物体表面に微粒子が付着することで生じる製品の品質低下や製造装置の寿命

低下が問題となっている。たとえば、半導体素子の製造では部品の汚染を防止するためにクリーンルームが利用されているが、製造工程中に発生する粉塵による汚染は避けられず、製品の歩留まりが低下する原因となっている。現在主流の微粒子除去方法は、薬液や超純水を用いた湿式洗浄法である。この方法は高い洗浄性能を有するが、濡れに弱い製品には使用不可、乾燥工程での再汚染、廃液処理による

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