Automated Sequential Monitoring of Ammonium, Phosphate and Nitrite in Wastewater by Multi-Commutated Peristaltic and Solenoid Pumped Flow System – a Comparative Study

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Keywords: FIA; Multi-commutation; Pulsed flow; Ammonium; Nitrite; Phosphate; Spectrophotometry

A comparative study on analytical performance of a basic multi-commutated solenoid pump flow system (MPFS) and multi-commutated FIA system (MCFS) has been performed. Both flow systems utilised three-port solenoid valves acting as fluidic switches. The MCFS system was obtained by replacing a solenoid pump with a peristaltic pump, synchronized with valves, as a propelling unit. These two continuous flow strategies were applied to spectrophotometric determination of ammonium, nitrite, and phosphate in wastewater samples from urban wastewater treatment plant. Optimised peristaltic and solenoid pumped flow systems yielded similar results with respect to sensitivity, linear range (1–18 mg mL$^{-1}$ NH$_4^+$; 0.5–10 mg mL$^{-1}$ PO$_4^{3-}$; up to 2000 ng mL$^{-1}$ NO$_2^-$), and limits of detection (1 mg mL$^{-1}$ NH$_4^+$; 0.5 mg mL$^{-1}$ PO$_4^{3-}$; 4 and 10 ng mL$^{-1}$ NO$_2^-$). MPFS was, however, superior to MCFS in terms of day-to-day reproducibility (RSDs calculated for the slopes of 20 calibration curves obtained in different days were: 6% NH$_4^+$; 5.5% PO$_4^{3-}$ and 4.4% NO$_2^-$), sample consumption (reduced twice for determination of ammonium and nitrite), and sample throughput (86 h$^{-1}$ NH$_4^+$; 75 h$^{-1}$ PO$_4^{3-}$ and 112 h$^{-1}$ NO$_2^-$). MPFS was advantageous with respect to versatility, possibility of miniaturisation, and increased simplicity due to reconfiguration of single-commutated elements without the need of physical reconfiguration of the flow manifold.

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