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EVALUATION OF THE FIELD USABILITY OF A NOVEL CENTRIFUGAL MICROFLUIDIC DEVICE COMPARED TO CONVENTIONAL METHODS FOR DETERMINATION OF CHEMICAL OXYGEN DEMAND

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Chemical oxygen demand (COD) is a crucial parameter used in evaluating water quality. It measures the chemically oxidisable organic matter in water. Both conventional COD analysing methods, the open reflux titrimetric method and the closed reflux spectrophotometric method, are time-consuming, bulky, laborious, and not suitable for immediate decision-making, which is a requirement in environmental analysis. To the best of our knowledge, for the first time, portable equipment which holds two centrifugal microfluidic chips (CMCs) was developed for *in situ* COD measurement. CMCs were fabricated from poly(methyl methacrylate) (PMMA) and poly(ethylene terephthalate) (PET). The portable equipment automates digestion, centrifugal control, and real-time data transmission. Field COD analysis avoids the need for sample preservation, minimises errors from transport and storage, and enables quick environmental assessments. This study focused on evaluating the field usability of the novel device through a survey. A questionnaire was prepared to evaluate the portability, throughput, cost efficiency, ability to perform various processes, miniaturisation, ease of use, energy efficiency, and durability of both conventional and microfluidic devices. Responses were gathered by distributing the questionnaire among 30 participants, which included researchers, graduate students, lab technicians, research assistants, and engineers. As advised in the questionnaire, participants rated each parameter on a 0 – 10 scale, where 0 was worst and 10 best. A paired *t*-test was performed on all responses, and $p < 0.0001$ for all parameters confirmed that the novel microfluidic device outperformed conventional analysis. The most significant differences were in miniaturisation and programmability, where microfluidic devices averaged 9 compared to 3 for traditional analysis. Performance gaps greater than 5 were observed in portability, usability, and energy efficiency. For durability, conventional analysis scored 6, while microfluidic devices achieved 9. These results highlighted the overall advantage of the microfluidic method, mainly in terms of adaptability, integration, and operational efficiency. The higher scores in all categories showed that the novel device is effective for field testing.

Keywords: Centrifugal microfluidic chips, Chemical oxygen demand, *in-situ* analysis