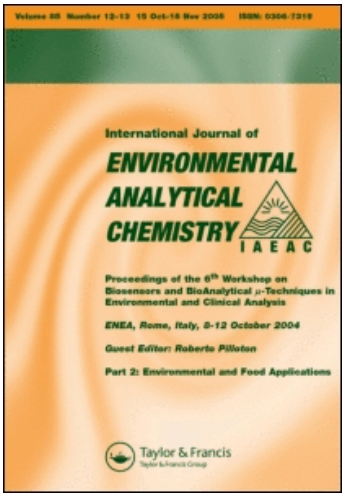

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Are Disposable-Tip Pipettes Suitable for Calibration of Orthophosphate Determination in Water?

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ANALYTICAL DATA

ARE DISPOSABLE-TIP PIPETTES SUITABLE FOR CALIBRATION OF ORTHOPHOSPHATE DETERMINATION IN WATER?

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Since plastics are suspected to adsorb orthophosphate, disposable-tip pipettes have been checked to determine their ability to be used in orthophosphate calibration. No adsorption has been detected through an experiment of standard preparation with and without changing the pipette tip. That is, the pipettes appear to be convenient for orthophosphate calibration.

KEY WORDS: Orthophosphate, calibration, pipettes.

INTRODUCTION

Determination of soluble orthophosphate in water by colorimetric methods requires calibration with standard working solutions prepared from a concentrated orthophosphate solution. For dilution, graduated volumetric pipettes are now being replaced by dispensing micropipettes with disposable plastic tips. However, in the case of orthophosphate, consideration must be given to the problem of adsorption to plastic, as reported by several authors.[1–4] Indeed, if adsorption occurs while establishing the calibration curve, the loss of orthophosphate will affect the accuracy of subsequent determinations of sample concentration. This paper deals with the possibility of using dispensing pipettes for orthophosphate calibration, focussing on the fact that they are provided with polypropylene tips.

EXPERIMENTAL SECTION

Orthophosphate determination is performed with an Autoanalyzer II Technicon according to a method developed for seawater analysis.[5] A concentrated orthophosphate standard solution (KH_2PO_4, 0.5 mmol l^{-1}) was diluted using a 0.500 ml capacity Gilson micropipette type Pipetman F and 100 ml volumetric flasks. The working standards are poured in 50 ml glass vials which are placed on the sample tray of the sampler.[6] Two series of five 2.5 μmol l^{-1} P-PO_4 working solutions were prepared by diluting the concentrated standard with phosphate-depleted (<0.005 μmol l^{-1}) seawater (PDSW). A new disposable tip was used for each

Table 1 Gravimetric control (individual values and mean ± s) of the volume delivered by a 500 µl Gilson micropipette with or without changing the tip[a]

Mass delivered (mg) when	
Tip changed	*Same tip*
495.9	493.0
497.6	494.3
497.4	497.2
496.0	493.5
494.8	495.0
496.3 ± 1.1	493.9 ± 1.6

[a]Distilled water temperature: 20.5 °C; density: 0.9981 g ml^{-1}.

dilution of the first series, while the same tip was used for all dilutions of the second series. Since an increase of the ionic strength favours the dissolution of adsorbed ions, seawater was considered to be a convenient medium to recover the phosphate potentially adsorbed on the tip. Thus, after pipetting the standard solution, each tip of the first series was washed by pipetting 0.500 ml of PDSW, and the wash seawater was transferred to a glass sample cup containing about 3 ml of PDSW.

In order to check the non-wetting property of the tip after multiple re-use, a gravimetric determination of the volume was performed with distilled water, according to the recommendations of Schwartz,[7] using a Sartorius 2004MP digital electronic balance.

RESULTS AND DISCUSSIONS

The non-wetting property of the disposable polypropylene tips is preserved after using the same tip five times, as shown by the gravimetric control of the volume pipetted (Table 1).

The precision of the pipette is about 0.2–0.3 %, even when using the same tip up to five times, a figure consistent with the manufacturer's specifications. This precision is considered to be better than the normal analytical precision of the colorimetric orthophosphate method and cannot introduce any bias in the subsequent determinations. Note that the volume delivered is about 1 % lower than the nominal volume and needs to be carefully checked for accurate measurements. This systematic bias has not been taken into account hereafter.

The preparation of series of orthophosphate standards, with and without replacing the disposable tip, does not show any difference between the two series (Table 2) within the precision of the determination, which is assumed to be close to 1 %. If any adsorption would take place, orthophosphate would progressively saturate the surface sites when using the same tip in successive pipettings. Consequently, the loss of orthophosphate would decrease in the standard solution

Table 2 Comparison of two series of 2.5 μmol l^{-1} orthophosphate standards (individual values and mean $\pm$ s) with and without changing the tip of the pipette[a]

Concentration found (μmol l^{-1}) when		
Tip changed		*Same tip*
Standard	*Wash seawater*	*Standard*
2.50	<0.005	2.50
2.51	<0.005	2.50
2.50	<0.005	2.47
2.50	<0.005	2.47
2.49	<0.005	2.46
2.50 $\pm$ 0.007		2.48 $\pm$ 0.02

[a]All measurements are related to the first standard of the series with tip changed.

contained in the tip and the observed concentration of the working standards would gradually increase.

In the depleted seawater used for washing the tips after pipetting the concentrated orthophosphate solutions, the concentration remains below the detection limit. Since the wash seawater is diluted only by a factor of about 7—as against a factor of 200 for the standard solution—this 30-fold concentration effect on the potentially lost orthophosphate would have been sufficient to detect very slight adsorption and desorption processes.

CONCLUSION

The polypropylene disposable tips of micropipettes cannot be suspected to introduce a bias in orthophosphate determination, since no adsorption has been detected under normal-use conditions. As the pipettes offer a high degree of repeatability, they appear to be suitable for calibration for the determination of orthophosphate in natural waters (fresh and sea), provided they are gravimetrically checked to ensure accurate volume delivery.

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