The Performance of Molecularly Imprinted Polymers (MIPs) - Modified Carbon Paste Electrode and Its Application in Detecting Phenol

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doi: 10.20964/2020.06.66

Received: 24 February 2020 / Accepted: 9 April 2020 / Published: 10 May 2020

Phenol is a very important chemical compound in life, especially in industry. Various methods of phenol analysis have been developed due to the harmful effect of phenol wastes that pollute the waters. A method employed to analyze phenol with simple instrumentation having good selectivity and sensitivity was a potentiometric method, which used a carbon paste electrode as the working electrode and was modified with a molecularly imprinted polymers (MIPs). The carbon paste electrode was electrochemically modified using a 15-cycle cyclic voltammetry technique at a potential range of -0.2 V – 1.0 V and scan rate of 100 mV/s with composition of the solution being 0.1 mM phenol: 0.2 mM aniline in a buffer solution having pH value of 9 and 0.1 M KCl as supporting electrolyte. Phenol was extracted from the polymer matrix electrochemically using 0.1 M HCl, thus expecting to form templates that can specifically recognize the molecule. The results showed that the phenolic content analysis, via a potentiometric method using MIPs-modified carbon paste electrode, had a linear range of 10^{-7} M – 10^{-1} M with a detection limit of 2.5×10^{-7} M. Besides, this electrode can respond to analytes within 60 – 70 s. The accuracy was determined based on the relative error value (% Er). The % Er obtained ranged from 1% to 3%, indicating that this method is quite accurate for the determination of phenol. The precision was identified with a good coefficient of variation, which was less than 2%. The effect of interference compounds was observed in the small selectivity coefficient ($K_{A,B}^{pot} < 1$), thus inferring that these electrodes have a higher selectivity towards phenol than other compounds contained in the sample. As a comparison, phenol measurements were carried out using the UV-Vis spectrophotometric method. Based on the percent recovery value and t-test, where $t_{table} 4.30 > t_{exp} 1.12$, it can be concluded that measurement with a potentiometric method using MIPs-modified carbon paste working electrode has no significant difference compared to the UV-Vis spectrophotometric method.

Keywords: electrochemistry, potentiometry, molecularly imprinted polymers (MIPs), polyaniline, phenol.

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