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### **Potential scan and electrochemical impedance spectroscopic (EIS) investigation of Gramoxone at glassy carbon electrode surfaces**

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Electrochemical investigation of aqueous Gramoxone solutions at glassy carbon (GC) electrode surfaces under applied potentials conditions is successfully achieved through a combination of different electrochemical techniques including cyclic voltammetry and electrochemical impedance spectroscopy (EIS). Cyclic voltammetric experiments conducted at GC electrodes using aqueous Gramoxone solutions in the phosphate supporting electrolyte, after the addition of NaOH to reach the desired pH, clearly indicates the appearance of a redox couple. The peak potentials of the couple are not significantly affected by pH changes from 1 to 12, suggesting that neither H<sup>+</sup> nor OH<sup>-</sup> is involved in the electrochemical process of paraquat, the active ingredient and the electroactive component in Gramoxone formulations. However, increase in the peak separation of anodic and cathodic peaks with an increase in potential scan rates is indicative of the paraquat electrochemistry being not fully reversible, which is further supported by the magnitudes of anodic and cathodic peak currents.

EIS measurements conducted at bias potentials ranging from +0.8 V to -0.8 V at different pHs lead to Nyquist plots having shapes expected for an electrolyte solution at anodic potentials. At more negative bias potentials, at which the redox activity of paraquat is observed, the shape of the Nyquist plots is altered and the linear component decreases its slope. Further, the polarization resistance ( $R_p$ ) shows the lowest values at pH between 7 and 8 within the range of -0.6 V to -0.8 V. However, the magnitude of  $R_p$  increases when the pH changes towards either acidic or basic values in contrast to having unchanged peak potentials.

**Keywords:** Paraquat; Glassy carbon; Cyclic voltammetry; Impedance