Colour Removal from Simulated Dye Wastewaters by Electrochemical Treatment

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Dye wastewaters can be treated by biological, chemical and electrochemical methods. An electrochemical approach (1-3) refers to the electro-generation of metal hydroxides flocs that adsorb dyes and produce decolourisation. The main objective of this paper was to assess the colour removal from simulated wastewaters containing direct (Direct Red 4A) and fibre reactive (Reactive Red M3A, Reactive Orange MG and Reactive Blue 4) dyes by electrocoagulation.

The separation of dyes on electrochemically-generated coagulant was carried out in a cell with horizontal electrodes. A grid of stainless steel wires (diameter 3 mm) with active surface area of 40 cm^2, acting as cathode, was placed over an aluminium rectangular plate anode of 60 cm^2 surface area at a gap of 5 cm. The arrangement was placed at a slight tilt on the bottom of the cell and operated in galvanostatic working conditions. The effective anodic surface area/effective cell volume ratio was of 12 m^2/m^3. Batches of 0.5 L aqueous solution (0.1 g/L dye and 0.6 g/L sodium chloride at initial pH of 6) were run into the cell. A Jasco V530 spectrophotometer controlled by computer plotted absorption spectra for samples taken after certain quantities of electricity passed through the cell. The colour removal efficiency was calculated from the relative decrease of absorbance at peaks in the visible region.

Figure 1 shows the decolourisation of the Direct Red 4A containing solution. Spectrum 1 corresponded to the initial dye sample and spectrum 2 was plotted after 100 Ah/m^3 passed through the cell. At that stage the hue was slightly red and the colour removal efficiency represented 89%. The continuation of the electrolysis determined the total removal of colour.

Comparatively, the same quantity of electricity determined only 44.5% colour removal for Reactive Red M3A (Fig. 2) and 20.5% for Reactive Orange MG (Fig. 3). After passage of 500 Ah/m^3, the colour removal efficiencies reached 72% and 66%, respectively (spectra 7 in Figures 2 and 3). A different behaviour was noticed for Reactive Blue 4 (not shown here), for which the colour removal efficiency was 94% at 100 Ah/m^3. However, there remained a persistent light mauve hue.

In conclusion, the colour removal from simulated dye wastewater using electrochemically-generated coagulant was affected by the nature of the dye and working conditions.

References
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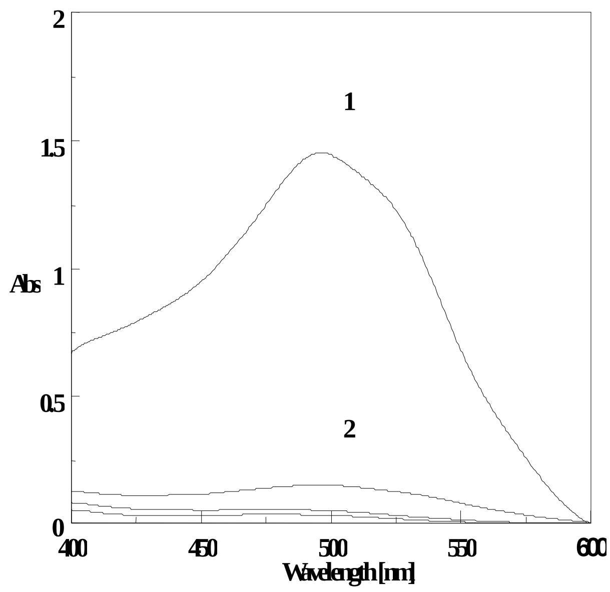

Fig. 1. Absorption spectra for Direct Red 4A dye solution (1-initial sample; 2-100 Ah/m^3 passed through the cell)

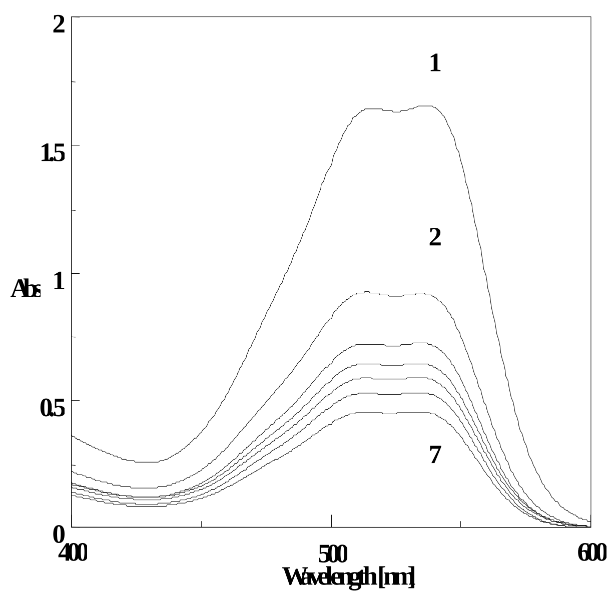

Fig. 2. Absorption spectra for Reactive Red M3A dye solution (1-initial sample; 2-100 Ah/m^3; 7-500 Ah/m^3)

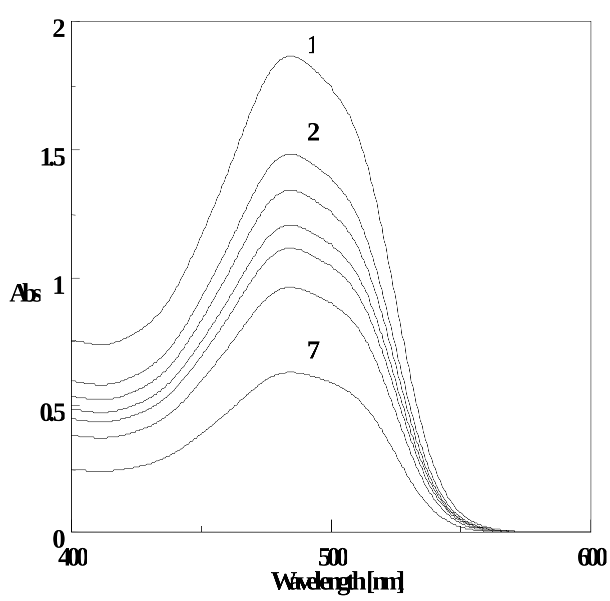

Fig. 3. Absorption spectra for Reactive Orange MG dye solution (1-initial sample; 2-100 Ah/m^3; 7-500 Ah/m^3)