

ABSTRAK

Sekitar 70% pewarna azo digunakan secara global dalam industri tekstil, karena lebih stabil terhadap detergen, suhu, dan bahan kimia daripada pewarna alami. *Methyl orange* merupakan pewarna azo yang banyak digunakan dan memiliki toksisitas tinggi, karsinogenisitas, serta mutagenisitas. Sebelum dibuang ke lingkungan, limbah yang mengandung zat warna harus melalui pengolahan terlebih dahulu. Berbagai penelitian tentang degradasi limbah zat warna pada perairan pernah dilakukan, seperti metode fotokatalisis TiO_2 , secara biologis menggunakan bakteri, dan adsorpsi yang dianggap kurang efektif dan kurang efisien. Metode degradasi elektrokimia merupakan metode yang potensial untuk pengolahan limbah zat warna. Tujuan penelitian ini untuk menentukan tingkat dekolourisasi dan mineralisasi larutan *methyl orange* menggunakan elektroda Pb (katoda) dan PbO_2 (anoda) dengan elektrolit pendukung berupa NaCl. Tahapan dalam penelitian ini, yaitu preparasi larutan induk *methyl orange* 100 ppm sebanyak 500 mL, karakterisasi elektroda Pb dan PbO_2 menggunakan SEM-EDX, penentuan panjang gelombang maksimum, pembuatan kurva kalibrasi, penentuan potensial aplikasi, penentuan pH terbaik larutan, optimasi waktu elektrodekolourisasi, elektrolisis dengan potensial aplikasi yang telah ditentukan, pH terbaik, dan waktu optimum. Analisis larutan sampel menggunakan spektrofotometer UV-Vis, analisis kandungan Pb, kadar ion sulfat, kadar ion nitrat, COD, TDS, dan TSS. Semua analisis dilakukan pada larutan sampel sebelum dan setelah dilakukan elektrodekolourisasi. Hasil penelitian menunjukkan bahwa kondisi optimum proses elektrodekolourisasi larutan *methyl orange* 40 ppm sebanyak 100 mL adalah dengan potensial aplikasi 4 V, larutan memiliki pH 3, dan waktu elektrodekolourisasi 45 menit. Keberhasilan proses dekolourisasi dapat dilihat dari penurunan absorbansi pada daerah ultraviolet dan tampak. Selain terjadi penghilangan warna, larutan *methyl orange* juga mengalami mineralisasi yang ditunjukkan dengan kenaikan kadar ion sulfat sebesar 46,92% dan kenaikan kadar ion nitrat sebesar 18,29%. Hasil analisis COD menunjukkan kenaikan dari 102 ppm menjadi 566,67 ppm. Kadar logam Pb dalam larutan mengalami kenaikan dari 0,016 ppm menjadi 0,2 ppm. Nilai TDS menunjukkan kenaikan dari 13,4 ppm menjadi 17,675 ppm dan nilai TSS mengalami kenaikan dari 3 ppm menjadi 160 ppm.

Kata kunci: *methyl orange*, elektrodekolourisasi, mineralisasi, elektroda Pb- PbO_2

ABSTRACT

About 70% of azo dyes are used in the textile industry globally because they are more stable to detergents, temperature and chemicals than natural dyes. Methyl orange is an azo dye that is widely used and has high toxicity, carcinogenicity and mutagenicity. Before being discharged into the environment, waste containing dyes must go through processing first. Various studies have been carried out on the degradation of dye waste in waters, such as the TiO_2 photocatalysis method, biological methods using bacteria, and adsorption which is considered less effective and less efficient. The electrochemical degradation method is a potential method for processing dye waste. The aim of this research is to determine the level of decolorization and mineralization of methyl orange solution using Pb (cathode) and PbO_2 (anode) electrodes with a supporting electrolyte in the form of NaCl. The stages in this research, namely preparation of 500 mL of 100 ppm methyl orange stock solution, characterization of Pb and PbO_2 electrodes using SEM-EDX, determination of maximum wavelength, creation of a calibration curve, determination of application potential, determination of the best pH of the solution, optimization of electrodecolorization time, electrolysis with a predetermined application potential, best pH, and optimum time. Analysis of the sample solution using a UV-Vis spectrophotometer, analysis of Pb content, sulfate ion levels, nitrate ion levels, COD, TDS and TSS. All analyzes were carried out on sample solutions before and after electrodecolorization. The research results show that the optimum conditions for the electrodecolorization process of 100 mL of 40 ppm methyl orange solution are with an application potential of 4 V, the solution has a pH of 3, and an electrodecolorization time of 45 minutes. The success of the decolorization process can be seen from the decrease in absorbance in the ultraviolet and visible regions. Apart from color removal, the methyl orange solution also experienced mineralization as indicated by an increase in sulfate ion levels of 46.92% and an increase in nitrate ion levels of 18.29%. The COD analysis results show an increase from 102 ppm to 566.67 ppm. Pb metal levels in solution increased from 0.016 ppm to 0.2 ppm. The TDS value showed an increase from 13.4 ppm to 17,675 ppm and the TSS value increased from 3 ppm to 160 ppm.

Keyword: methyl orange, electrodecolorization, mineralization, Pb- PbO_2 electrode