

12

Fenton-Like Processes for the Removal of Cationic Dyes



Md. Saddam Hossain, Md. Yeasin Pabel, and Md. Mominul Islam

Abstract Due to a rapid industrial development in last few decades, large amounts of synthetic dyes have been discharged into water bodies that cause water pollution and substantially damage the aquatic environments. Consequently, the treatment of dyestuffs in the effluents discharged especially from the textile industries are crucial to protect our environments from pollutions. In this regard, advanced oxidation processes (AOPs) have been considered as a promising method of which Fenton process is well-known from earlier. In this chapter, a comprehensive discussion on the removal of textile dyes, mainly cationic dyes, from wastewaters through degradation with Fenton-like processes is presented. The fundamentals and techniques associated with these processes are elaborated. The features and efficiency of degradation of Fenton-like processes developed based on various catalysts are compared by an extensive review on recent literatures. Advantages and limitations of these methods in practical applications are especially highlighted. All of these attempts altogether create a good knowledge base for the researchers working in the textile and environmental fields.

Keywords Fenton process · Fenton-like processes · Hydroxyl radical · Organic dyes · Textile dyes · Efficiency · Decolorization · Mineralization

1 Introduction

In the last few decades, the huge industrialization has caused a massive stress on the environment. Contamination of surface water with organic dyes is one of the major environmental pollutions. Dyes especially synthetic organic dyestuffs have been widely used in textile, pulp, rubber, plastic, printing, pharmaceutical, and food

Md. S. Hossain

Department of Chemistry, Khulna University of Engineering and Technology, Khulna 9203, Bangladesh

Md. Y. Pabel · Md. M. Islam (✉)

Department of Chemistry, Faculty of Science, University of Dhaka, Dhaka 1000, Bangladesh
e-mail: mominul@du.ac.bd

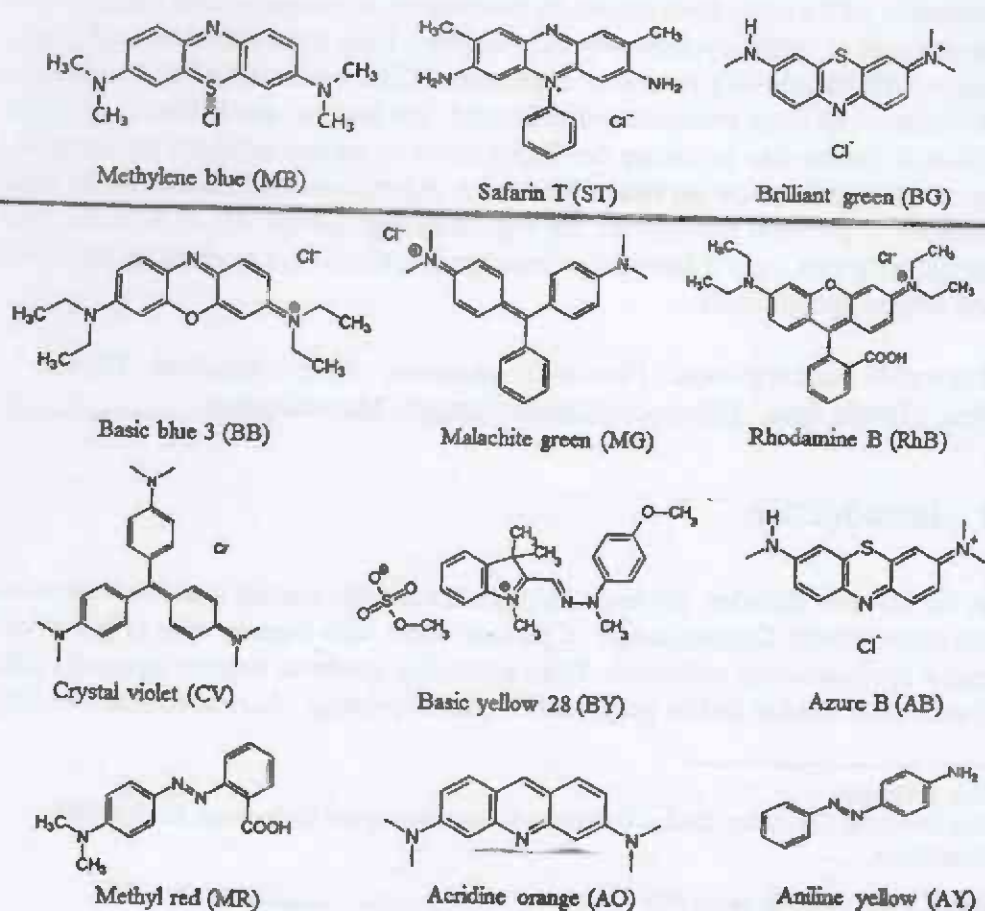
© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2022
S. Muthu and A. Khadir (eds.), *Advanced Oxidation Processes for Treating Wastewater, Sustainable Textiles: Production, Processing, Manufacturing & Chemistry*, https://doi.org/10.1007/978-981-19-0882-8_2

29

13.02.2023

industries as coloring agents [1–175, 177–179]. Basically more than 30,000 commercial dyes based on 8,000 different chemical structures are used in these industries, and a part of them are discharged with the industrial wastewaters [61, 69, 89]. Chemical structures of some common cationic dyes are presented in Scheme 1. Most of them are persistent and being detected in ground and surface waters. Nowadays, the contamination of water has attracted attentions of the scientific community because it has serious consequences for the humans as well as for the ecosystem [103]. Consequently, the treatment of wastewaters containing dyestuffs discharged especially from the textile industries is crucial to protect our environments.

Over the different methods practiced [5, 8, 20, 21, 60, 62, 73, 81, 98, 101, 102, 108, 113, 118, 119, 125, 127, 132, 158, 160, 167, 179], advanced oxidation processes (AOPs) have showed an exciting potential for the treatment of textile wastewater containing organic dyes due to its important inherent advantages. In AOPs, organic dyes are basically degraded into different gaseous and ionic or neutral fragments that are considered to be non-toxic to the aquatic environments. Among the several oxidizing agents used for treatment wastewaters, hydroxyl radical (OH^\bullet) is much



Scheme 1 Chemical structures of commonly studied dyes