Shortcommunication

Anaerobic decolorisation of reactive dyes in conventional sewage treatment processes

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Abstract

Reactive dyes have been identified as problematic compounds in textile effluents as they are water-soluble and not removed by traditional aerobic biological waste-water treatment systems. The use of anaerobic digestion for the decolorisation of selected reactive dyes was investigated. It was found that 80 % of the dyes studied were decolorised and, based on the results from a detailed study into C.I. Reactive Red 141 decolorisation, it was proposed that this occurred via a reduction mechanism. This was supported by the tentative chemical identification of the dye degradation products.

Introduction

Waste waier from textile industries is highly coloured and of a complex and variable nature. Conventional biological treatment processes presently in use at waste-water treatment works (i.e. aerobic systems such as activated sludge and trickling filters) do not usually achieve satisfactory colour removal, resulting in coloured effluent entering the receiving water body. This gives rise to complaints, either due to aesthetic reasons, or because it precludes some downstream use of the water. Pollution prevention, waste minimisation and closed loop recycle of water and chemicals are the initial stages in the treatment of textile effluents. The treatment of concentrates has still to be addressed. In particular, reactive dyes have been identified as the most problematic compounds in textile effluents as they are difficult to remove due to their high water solubility and low exhaustion (between 10 and 50 % of the dye will be present in the dyebath effluent) (ENDS Report, 1993). Reactive dyes remain in solution due to their hydrophilfc nature and will therefore pass through the aerobic treatment systems in a waste-water treatment works rather than be associated with the solids which are treated in the anaerobic digester. A study of the literature has indicated the potential of anaerobic systems for the non-specific decolorisation of azo dyes (Brown and Laboureur, 1983; Harmer and Bishop, 1992; Kremer, 1989) and therefore an investigation into the feasibility of anaerobic digestion for the decolorisation of a reactive dye, C.I. Reactive Red 141 (Fig. 1), was initiated (Carliell, 1993). It must be noted that not all reactive dyes are based on the azo chromophore and that other dye classes can contain an azo group. Separation and identification of the dye metabolites was also investigated and a reaction mechanism proposed. This decolorisation study was then extended to include other reactive dyestuffs which are representative of the spectrum of dyes used in a dyehouse producing upmarket furnishing and fashion fabric. Based on these results, an on-site study into the fate of C.I. Reactive Red **141** in a 5-stage Bardenpho nutrient removal activated sludge process was carried out at the Hammarsdale Waste-water Treatment Works, In addition, biomass was collected for laboratory-scale studies.

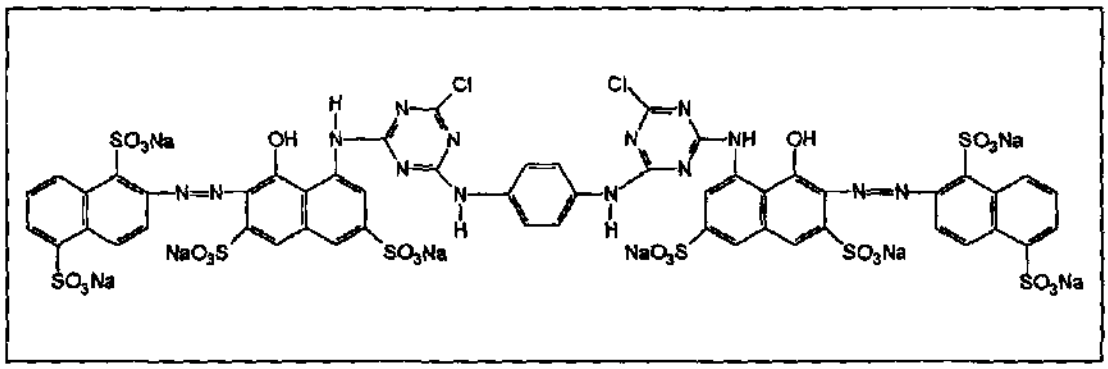

Figure 1
Proposed structure of C.I. Reactive Red 141

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