

Synthesis of anthraquinone based dyes from anacardic Acid component of cashew nut shell liquid (CNSL) for Textiles applications

Lutamyo Nambela
PhD (Chemistry)

University of Dar es Salaam, College of Natural and Applied Sciences, 2020

The aim of this study was to develop a method for the synthesis of anthraquinone based dyes from anacardic acid isolated from CNSL and then to test the performance of the synthesised dyes on textile fabrics. CNSL was extracted in 20% yield from CNSs using petroleum ether as the solvent. Anacardic acid was then isolated from CNSL through the addition of $\text{Ca}(\text{OH})_2$ to form calcium anacardate and then acidification with HCl to recover the anacardic acid in 64% yield. With anacardic acid in hand, a procedure was developed for its conversion to phthalic anhydride and then anthraquinone dyes. Conversion of anacardic acid to a 3-methoxyphthalic anhydride in overall yield of 9% involved methylation of the two hydroxyl groups, alkene reduction, benzylic bromination, elimination of HBr, ozonolysis, oxidation and acid anhydride formation. The prepared 3-methoxyphthalic anhydride was subsequently reacted with benzene and substituted benzenes in the presence of AlCl_3 to give three anthraquinone dyes or dye intermediates namely 1-hydroxyanthraquinone, 7-bromo-1-hydroxyanthraquinone and 1,7-hydroxyanthraquinone in 40%, 39% and 15% yields, respectively. Subsequently, 1-aminoanthraquinone was prepared in 80% yield from 1-hydroxyanthraquinone. Dimerisation of 1-aminoanthraquinone gave indanthrone in 93%. The prepared dyes were characterised using melting point measurements, UV, IR, NMR and mass spectrometry. The three prepared anthraquinone dyes were tested on 100% polyester fabric while the indanthrone dye was tested on 100% cotton fabric. 1-hydroxyanthraquinone and 7-bromo-1-hydroxyanthraquinone dyes gave yellow shade on the fabric, while 1-aminoanthraquinone gave an orange shade. Indanthrone on the other hand gave blue shade on 100% cotton fabric. The affinity of the dyes to the fabrics were determined using colour yield values which were measured using a reflectance spectrophotometer. All the dyes showed high affinity to dyed fabrics and this demonstrates that CNSL has a potential as a source of a precursor of intermediates in the synthesis of dyes.