Decontamination and Decolourisation of Textile Effluent by Ionising Radiation: Steps towards 3R concept

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Abstract

The limitations of conventional chemical or biological textile effluent treatments such as producing secondary waste (sludge) and emerging crisis of fresh water for textile dyeing have forced the technologist to find new solution that can not only completely decontaminate the textile effluent but it will also facilitate to recycle and reuse of the effluent. The present study suggested that the ionizing radiation electron beam or gamma radiation can break down the dye particles to non-toxic water soluble molecules. True effluent sample was irradiated by gamma radiation at different doses and change of absorption spectra, pH, total dissolved solids (TDS), total suspended solid (TSS), dissolved oxygen (DO), turbidity, electrical conductivity (EC), biological oxygen demand (BOD) and the chemical oxygen demand (COD) were examined. All the parameters were found between standard acceptable limit after irradiation at (6-10) kGy. Ammonium and total nitrogen concentration were also examined and were found to be increased with radiation dose. While un-irradiated effluent contained 18.96 mg/L and 28.48 mg/L of ammonium and total nitrogen respectively, irradiated (10 kGy) effluent showed the value of 31.60 mg/L and 68.03 mg/L respectively for the same. Field trials of the radiation processed waste water suggested that these water soluble molecules are readily absorbed by plants as a nutrient source which leads to increased growth of the grown plants without showing any sign of toxicity. Grown plants were subjected for toxicity, heavy metal content test etc. and were found safe for human consumption. Animals (rabbit) fed by this plants (grown in the treated sludge containing soil) showed no sign of complexity at any phase of life or during pregnancy. Besides, treated effluent possessed suitable transparency and physico-chemical properties to reuse as water source for textile dyeing. Experimental results revealed that the fabric dyed using treated effluent and the fabric dyed using fresh water comprised similar characteristics with respect to colour matching and colour fastness for various shades of colour like black, khaki and light pink. All of these experiments suggest that, ionizing radiation can be successfully employed to decontaminate and to detoxify the textile waste to develop a simple and safe zero waste production system for sustainable development.

Keywords: Textile effluent, Ionizing radiation, Radiation processing, Zero waste facility.

About the speaker

Dr. Mubarak Ahmad Khan is Chief Scientific Officer (CSO) and now acting as the Director General, Atomic Energy Research Establishment, Bangladesh Atomic Energy Commission. He did his Ph.D. in Radiation and Polymer Chemistry. He is working in several promising areas of Radiation Chemistry and Processing Technology, natural fiber reinforced polymer composites, nanotechnology, material science, biomedical science, applied science etc. Also experience in fiber reinforced polymer composite materials for various applications such as parts and body of auto car, panelized constriction materials, and bodies of electric appliances. Totally biodegradable composite materials based on natural fibers and degradable (both and synthetic) thermoplastic and resin for biomedical purposes. His focus is to use radiation-processing technology for biomedical purposes, renewable energy, Dye sensitized solar cell, modification of natural fibers; stimuli-responsive materials, hydrogel, scaffold form natural polymers. He has conducted research works in many countries including America, Germany, Japan etc. He has worked in Germany (Technical University of Berlin, Fraunhofer Institute of Applied Polymer Research) as DAAD and Alexander von Humboldt (AvH) fellow, in Japan as MIF and JSPA Fellow, as visiting scientist, in Australia (University of New South Wells) as IAEA fellow. Trained in Nuclear and Radiation Chemistry through various training course organized by IAEA. He is a part time Professor of Dhaka University, Department of Nuclear Engineering and visiting professor and examiner of various universities of Bangladesh. He is author/co-author of about 600 publications including 16 book chapters and a patent. He supervised more than 250 M.Sc. 8 M. Phil and 12 PhD. Students. He is part time/visiting Professor of different universities at home and abroad. He has invented advanced wound dressing material from cow bone, liquid bio-fertilizer from textile effluent, natural plant growth promoter from prawn shell etc. He is also the inventor of Jutin (Jute Reinforced Polymer Corrugated Sheet).

Full paper is not available. The speaker can be contacted for further details.