ISSN: 2521-5051 (Print)
ISSN: 2521-506X (Online)

Contents List available at RAZI Publishing

Acta Scientifica Malaysia (ASM)

Journal Homepage: http://www.razipublishing.com/journals/acta-scientifica-malaysia-asm/archives/

https://doi.org/10.26480/asm.01.2017.14.15

Short Paper

Environmental effect of Sudan I-IV: adsorption behaviors and potential risk on soil

Yong Teng, Qixing Zhou*

the Key Laboratory of Pollution Processes and Environmental Criteria (Ministry of Education),
College of Environmental Science and Engineering, Nankai University, Tianjin 300071, China Email: zhouqx@nankai.edu.cn, tengyong0109@ 126.com

ARTICLE DETAILS

Article history:

Received 24 October 2016
Accepted 7 December 2016
Available online 3 January 2017

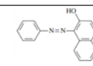
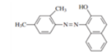
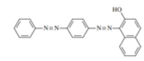
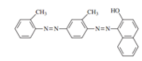
Keywords:

Sudan dyes ; Soil ; Adsorption ; Toxicity

1.INTRODUCTION

Sudan dyes (Table 1) [1], a class of synthetic azo dyes and classified as category 3 carcinogens by the International Agency for Research on Cancer[2], have been received considerable attention all over the world, especially in the past decade, which are found to be non-authorized and illegally added into food products, such as chili-, curry-, curcuma- and palm oil-containing foodstuffs, meats, spice mix, as well as feedstuffs and feed poultry, to enhance or maintain the appearance due to their intensive color and low price[3,4]. In addition, they are extensively applied in industrial and scientific areas, such as oils, textiles, plastics, waxes, inks, films, cosmetic products, shoe and floor polishing, and spirit varnishing[5-7]. Obviously, there exist a variety of potential sources for environmental contamination by Sudan dyes, thus threatening human health and the safety of ecosystems. It is reported that sub parts per billion levels of Sudan dyes were present in paprika fruits during the vegetation process, particularly, Sudan I existed in almost all samples, including paprika fruits, soils and agronomic materials from some fields in China[8],the levels in soils were significantly elevated by vegetation treatments, and pesticides and fertilizers constitute the major source of Sudan I contamination[9]. Till now, the investigation on contaminative behavior and environmental effects is rarely involved, and biogeochemical cycles of Sudan dyes are rarely concerned either.

Table 1 The chemical information of Sudan I-IV

Chemical		Name	CAS Nr.	MW	Structure
Sudan I		1-(phenylazo)-2-naphthalenol	842-07-9	248.0949	
Sudan II		1-[(2,4-dimethylphenyl)azo]-2-naphthalenol	3118-97-6	276.1261	
Sudan III		1-(4-phenylazophenylazo)-2-naphthalenol	85-86-9	352.1323	
Sudan IV		o-tolyazo-o-tolylazo-beta-naphthalenol	85-83-6	380.1636	

Sudan dyes could enter into ecosystems via various routes to cause environmental pollution, and azo dyes including Sudan dyes were usually selected as model pollutants, as being large classes of organic pollutants in effluent and resistant to biodegradation[10,11]. However, relevant studies about their environmental behaviors and effects are rarely reported, although it is of great importance and necessity accounting for their potential environmental contamination from various sources, and little is known about their environmental behaviors and toxicological effects on soil, and soil-water and soil-air interfaces. Herein, we carried out the studies on the adsorption behavior of Sudan I-IV, and their short term and mid-long term toxicicological effects on a coastal soil, including the effects on soil enzyme activities (catalase, urease and alkaline phosphatase) under 2d and 7d, the effects on soil functional bacteria (nitrogen-fixing bacteria, ammonia-oxidizing bacteria and denitrification bacteria) under 14d, and the effects on soil microbial community diversity (community composition sturcture and diversity indexes) under 30d. It is expected that relevant researches on their environmental behaviors and ecological effects in environmental systems would be concerned and addressed.

Our results showed that the amount of Sudan I-IV adsorbed on soil increased accordingly with the increasing concentration of Sudan dyes in aqueous solution, and Sudan II and IV were more likely adsorbed on the tested soils than Sudan I and III based on their maximum adsorption amount. However, for Sudan I, III and IV, in some high concentrations (under the treatment of 75 mg/L for Sudan III, 100 mg/L for Sudan I and IV), the adsorption was significantly increased, and then came back to the “normal” level (under the treatment of 100 mg/L for Sudan III)[1]. In addition, Sudan I-IV can pose potential risk on soil enzyme activitiesy, functional bacteria and microbial community diversity, and there exist variation among different Sudan dyes, treatments and exposure time.

References

[1] Yong Teng, Qixing Zhou. 2017. Adsorption behavior of Sudan I-IV on a coastal soil and their forecasted biogeochemical cycles. Environmental Science and Pollution Research,24(11), 10749-10758.

[2] IARC (1975) Monographs on the Evaluation of the Carcinogenic
Risk of Chemicals to Man: Some Aromatic Azo Compounds, vol.8, International Agency for Research on Cancer, Lyon, France, 224-231.

[3] Rebane R, Leito I, Yurchenko S, Herodes K (2010) A review of analytical techniques for determination of Sudan I–IV dyes in food matrixes. J Chromatogr A 1217(17):2747-2757.

[4] He LM, Su YJ, Fang BH, Shen XG, Zeng ZL, Liu YH (2007) Determination of Sudan dye residues in eggs by liquid chromatography and gas chromatography-mass spectrometry. Anal Chim Acta 594(1):139-146.

[5] de Souza NC, Cavalheri AS, Brito JB, Job AE, Oliveira ON, Giacometti JA, Silva JR (2012) Photoinduced orientation in natural rubber. Chemi Phys Lett 531:110-113

[6] Gao HY, Kim S, An JH (2013) Preparation of sub-micron colored particles by controlled emulsion polymerization. J Ind Eng Chem 19(4):1184-1190.

[7] Orzel J, Daszykowski M, Grabowski I, Zaleszczyk G, Sznajder M (2014) Identifying the illegal removal from diesel oil of certain chemical markers that designate excise duty. Fuel 117:224-229.

[8] Lian YH, Gao W, Zhou L, Wu NY, Lu QG, Han WJ, Tie XW (2014) Occurrence of Sudan I in Paprika Fruits Caused by agricultural environmental contamination. J Agric Food Chem 62:4072-4076.

[9] Wu NY, Gao W, Zhou L, Lian YH, Li FF, Han WJ (2015) Identifying potential sources of Sudan I contamination in Capsicum fruits over its growth period. Food Chem 173:99-104,

[10] Li XC, Xiao W, He GH, Zheng WJ, Yu NS, Tan M (2012) Pore size and surface area control of MgO nanostructures using a surfactant-templated hydrothermal process: High adsorption capability to azo dyes. Colloids Surf A-Physicochem Eng Asp 408:79-86.

[11] Chequer FMD, Lizier TM, de Felício R, Zanoni MVB, Debonsi HM, Lopes NP, de Oliveira DP (2015) The azo dye Disperse Red 13 and its oxidation and reduction products showed mutagenic potential. Toxicol in Vitro 29:1906-1915.