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Research article

Determination of dialkyl phthalate esters in indoor air of PVC industry: Risk assessment for human health using Monte-Carlo simulations

Shahnaz Sargazi [a,b,*], Ramazan Mirzaei [c], Mahdi Mohammadi [a], Mashaallah Rahmani [d]

[a] Health Promotion Research Center, Zahedan University of Medical Sciences, Zahedan, Iran
[b] Environmental Sciences and Technology Research, Center, Department of Environmental Health Engineering, Shahid Sadoughi University of Medical Sciences, Yazd, Iran
[c] Social Determinants of Health Research Center, Mashhad University of Medical Sciences, Mashhad, Iran
[d] Department of Chemistry, Faculty of Sciences, University of Sistan and Baluchestan, Zahedan, 98135-674, Iran

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ABSTRACT

Dialkyl phthalate esters are incorporated to enhance the pliability and prevent brittleness in polyvinyl chloride (PVC) tubing. Exposure to these compounds occurs throughout human lifetimes via ingestion, inhalation, and direct skin contact. A study was conducted to evaluate concentrations of four specific phthalates—dimethyl phthalate (DMP), diethyl phthalate (DEP), di-n-butyl phthalate (DBP), and di(2-ethylhexyl) phthalate (DEHP)—in the indoor air of both industrial and administrative sectors within the PVC manufacturing facilities. Air sampling was conducted in the spring season at two polyethylene factories in Zahedan Industrial Park (Sistan and Baluchestan Province, Iran). The outcomes demonstrated that mean concentrations of these substances in industrial along with administrative departments 485.7 μg/m^3 and 49.83 μg/m^{3}for DMP, 807.38 μg/m^3 and 30.17 μg/m^3 for DEP, 849.62 μg/m^3 and 37.50 μg/m^3 for DBP along with 1268.08 μg/m^3 and 45.50 μg/m^3 for DEHP respectively. The probabilistic lifetime cancer risk (LTCR) of DEHP in the indoor air of Zahedan PVC factories for men and women was determined using the Monte Carlo simulation technique. The computed mean LTCRs of DEHP for men and women in the indoor air of industrial and administrative departments in Zahedan PVC were 1.3×10^{-3}, $1.2 \times 10^{-3}$and 4.7×10^{-5},4.2×10^{-5}respectively. Data showed that DEHP was a potential risk to human health.

1. Introduction

Dialkyl phthalate esters or phthalate acid esters (PAEs) represent a category of organic semi-volatile substances extensively employed as plasticizing agents across a vast array of domestic and industrial applications. Annually, the worldwide production of PAEs exceeds 470 million pounds [1]. Due to their distinctive physicochemical characteristics, PAEs are present in many products, such as floorings made of the PVC, building supplies, personal care items, packaging of food, cleaning agents, and solvents [2,3]. PAEs with low molecular weights, such as dimethyl phthalate (DMP) and diethyl phthalate (DEP), are predominantly utilized in the

* Corresponding author.
E-mail address: sh.sargazi@ssu.ac.ir (S. Sargazi).

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