Environmental Engineering and Management Journal

April 2022, Vol. 21, No. 4, 661-669
http://www.eemj.icpm.tuiasi.ro/; http://www.eemj.eu

"Gheorghe Asachi" Technical University of Iasi, Romania

AN EVACUATION ROUTE PLANNING APPROACH CONSIDERING INDIVIDUAL RISK UNDER TOXIC GAS RELEASE SCENARIOS

Bo Zhang[1], Lin Sun[1*], Xin Liu[1], Ying Liu[1,2]

[1]China University of Petroleum (East China), Department of Safety Science & Engineering, Qingdao 266580, P.R. China
[2]Lamar University, Dan F. Smith Department of Chemical Engineering, Beaumont, TX, 77710, USA

Abstract

Accidental release of toxic gas in chemical plants happens unexpectedly, threatening workers' safety and health. Evacuation route planning (ERP) is an important way to reduce the risk of exposed personnel in accidents. This paper presents an ERP approach considering dynamic individual risk under toxic gas release scenarios. The individual risk is quantitatively expressed as the cumulative exposure toxic load on the evacuation route. With the objective of minimizing the individual risk, a Minimal Cumulative Toxic Load (MCTL) model is proposed. Time-dependent concentration data of the complete accident scenario set (CASS) are obtained based on computational fluid dynamics (CFD) simulation. Particle Swarm Optimization (PSO) algorithm is used to search the route. A case study is performed in a Chlor-Alkali plant to demonstrate the whole ERP process. The results validate that this approach is feasible and can optimize the evacuation route effectively. Thus, the evacuees can be exposed to less risk of poisoning and death.

Keywords: computational fluid dynamics (CFD), evacuation route planning (ERP), optimization model, particle swarm optimization (PSO)

Received: March, 2021; Revised final: January, 2022; Accepted: February, 2022; Published in final edited form: April, 2022

[*] Author to whom all correspondence should be addressed: e-mail: sunlin0819@126.com