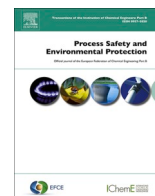




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Systematic review of chemical safety and chemical security risk management approach

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ABSTRACT

The best practice of chemical management is crucial to prevent or minimize the risk of chemical exposure to people and the environment either caused by safety or security issues. Good chemical management must be implemented by all sectors, especially in chemical process industries and chemical laboratories since they deal with various types of hazardous chemicals. The systematic literature review focuses on initiatives to manage chemicals safely and securely. Hence, this systematic review aims to analyse the appropriate chemical safety and security risk management approaches. The Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) method was adopted in this study, utilizing three databases: Web of Science (WOS), Scopus, and ScienceDirect. Four main themes and 19 sub-themes have been developed from the review of 26 full-text articles, of which the main themes are the authority approach (16%), Organizational approach (63%), Individual approach (5%), and Technology-based approach (16%). From the findings, the organizational approach contributes the most to ensuring sound and peaceful chemical risk management. At the end of this study, a few limitations and recommendations have been remarked for future research.

1. Introduction

The chemical industry is one of the largest sectors contributing to the global economy because it generates crucial inputs and facilitates processes for other manufacturing operations that raise living standards and benefit customers globally. In 2017, the chemical industry contributed more than five trillion US Dollars to the World's Gross Domestic Product (GDP) and supported 120 million jobs worldwide (Oxford Economics, 2019). As this sector keeps mushrooming, good chemical management is vital to prevent more risks from being exposed to people and the environment. The goal of sound management of chemicals is to prevent the exposure of hazardous chemicals and compounds suspected of having such features and minimize the risk of exposure in cases where it is not possible to be prevented (UNEP, 2010).

Sound management and the peaceful use of chemicals not only ensure chemical safety but also chemical security. Chemical safety and chemical security have different meanings and objectives; therefore, it is crucial to understand both topics when dealing with chemicals. Chemical safety is the practice of handling chemicals in such a way as to prevent accidents, incidents, and the unintended consequences of those events on human health and the environment (WHO, 2023). It covers

broad disciplines, including public, occupational, process, consumer, storage, distribution, and environmental aspects (OPCW, 2021). On the other hand, chemical security is preventing intentional harm or illegal use of chemicals and preventing the impact of the events whenever they occur (OPCW, 2021). Despite various legislations, policies, and frameworks for using and handling chemicals, there is still a lack of systematic literature review (SLR) on integrated chemical safety and security, especially in risk management.

A literature review is a great technique to synthesize research findings to present evidence on a meta-level and identify areas that require additional study (Snyder, 2019). At the same time, SLR is a systematic, explicit, and reproducible approach for assessing, analysing, and synthesizing the content of completed and recorded work created by researchers, academics, and practitioners (Booth et al., 2012). Also, it is the methodology for identifying, choosing, evaluating, and synthesizing data to address a research question in a way that maximizes transparency and reduces bias and error (World Health Organization, 2021). As far as the researchers know, an attempt has yet to be made to systematically identify the appropriate approach to chemical safety and chemical security risk management.

In general, the purpose of risk management is to create and protect

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