# Implementation of a Chemistry and Physics-Based Occupational Health and Safety Management System in Industry

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## ABSTRACT

Modern industries, particularly process sectors such as chemical, petrochemical, manufacturing, and oil and gas, face complex challenges in managing occupational safety and health (OHS) hazards stemming from the intrinsic properties of chemical materials and physical energy. Implementing an effective Occupational Safety and Health (OHS) management system is essential to prevent accidents, occupational diseases, and incidents. This literature review aims to synthesize findings from various studies on the implementation of an Occupational Safety and Health (OHS) management system with a particular focus on integrating chemical and physical hazard control. This represents an evolution from a reactive safety approach (which only responds to incidents) to a scientific, systematic, and preventive approach. By understanding the fundamental nature of hazards through chemistry and physics, industries can not only comply with regulations but also create a sustainable safety culture, protecting people, assets, the environment, and the business's reputation. Implementation of this system delivers tangible results in three aspects: Safety: The number of accidents and occupational diseases decreases dramatically; Operations: Productivity increases, incident costs decrease, and company assets are protected; and Reputation: The company's image improves, compliance with all laws and regulations becomes a competitive advantage. In conclusion, the implementation of a chemistry and physics-based OHSMS is not just a compliance cost, but an investment that provides real returns in the form of a protected workforce, efficient operations, a strong reputation, and sustainable financial returns.
**Keywords:**Implementation, Occupational Health and Safety Management, Chemistry and Physics, Industry

## INTRODUCTION

The industrial world is a key pillar driving the global economy. However, despite its significant contribution, industrial operations carry complex and diverse risks, particularly those stemming from chemical and physical agents. Toxic, corrosive, explosive, and flammable chemicals, as well as physical hazards such as noise, radiation, vibration, and extreme pressure, pose a constant threat to worker safety and health, environmental sustainability, and the continued operation of the company itself.

Incidents such as gas leaks, explosions, chronic exposure to hazardous materials, and noise-induced hearing loss not only cause human suffering but also significant material losses in the form of asset damage, legal fines, lawsuits, compensation claims, and reduced productivity. Traditional approaches to OHS management, which are reactive (acting only after an incident occurs), have proven inadequate to manage the complexities of the modern industrial era.

In the modern industrial world, the use of chemicals and high-tech equipment has become inevitable. However, this also brings complex risks in the form of chemical and physical hazards that threaten the safety of workers and the environment. Managing these risks requires a systematic, science-based approach. Implementing a chemical and physical

Occupational Health and Safety Management System (OHSMS) offers a fundamental solution for comprehensively identifying, evaluating, and controlling these risks. This step not only demonstrates regulatory compliance but also represents a strategic investment in creating a safe, efficient, and sustainable workplace.

The implementation of a chemical and physics-based Occupational Safety and Health (K3) Management System is a strategic necessity in the modern industrial world. Along with the rapid development of the industrial sector, characterized by the use of complex chemical materials and the intensive application of physics technology, risks and hazards in the workplace are becoming increasingly diverse and specific. Chemical hazards, such as exposure to toxic, corrosive, flammable, and reactive substances, and physical hazards, such as noise, radiation, extreme temperatures, and high pressure, threaten not only the safety and health of workers but also the continuity of company operations and reputation.

Therefore, conventional and reactive safety approaches are no longer sufficient. A proactive, systematic, and science-based system is needed to comprehensively identify, evaluate, and control these risks. An OHS Management System that integrates chemical and physical principles in every element—from hazard identification and risk assessment to control implementation and employee training—is a fundamental solution for creating a safe, healthy, and sustainable work environment.

Implementing this system is not only about complying with laws and regulations, but also a valuable investment that ensures productivity, protects assets, builds a positive image, and ultimately provides competitive added value for companies in the global market.

## RESEARCH METHODS

This research uses a literature review method by collecting and analyzing various academic sources related to the implementation of chemical and physics-based OHS management in industry. The implementation method of chemical and physics-based OHS management in industry involves identifying, evaluating, and controlling risks that may occur from chemicals and physical processes. Initial research was conducted by searching and selecting relevant reference sources using academic databases such as Google Scholar, Sciense Direct, and DOAJ. After that, an analysis was carried out and identified all chemicals and physical processes used in the work area. For chemicals, we need to understand their properties, such as toxicity, flammability, and reactance. For physical processes, such as radiation, noise, vibration, and extreme temperatures. After that, a risk assessment was conducted to evaluate the likelihood of an incident occurring and the severity of its impact. This research is expected to provide a further understanding of OHS policies to find patterns that can form the basis for more adaptive recommendations for industrial transformation. OHS management aims to create a safe, healthy work environment that complies with applicable regulations.

## RESULTS AND DISCUSSION

From the discussion of journals that are in accordance with the discussion topic, the following is a comparison between journals and the topic.the same as the title above.

**Table 1 comparison of research findings**

| NO | | WRITER | OBJECTIVE | METHOD | RESULTS |
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| 1 | Safety management systems research landscape: A scientometric analysis | Floris Goerlandt, Jie Li, Genserik Reniers | to consider the design, implementation, and effectiveness of SMS and its components in the context of different work | scientometric analysis, descriptive method | In this work, a scientometric analysis of the academic literature on safety management systems is presented, covering the period from 1979 to 2020. Various tools and techniques are |

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| | | | settings characterized by varying degrees of flexibility and stability, and approaches related to uncertainty management. Further consideration of how SMS can benefit from organizational learning and general management concepts, as well as how organizational change processes affect its functioning, are also avenues for future research. | | applied to detect geographic, structural, and temporal patterns within the research domain. The focus is on contributing countries or regions and institutions, patterns in scientific categories related to this research domain, key journals and information flows between journal clusters, narrative themes and focus topics, and knowledge clusters of key contributing documents. |
| 2 | How digital twin technology can improve safety management : A multi-industry perspective | Patrick XW Zou, Songling Ma | (1). Identify the key enabling technologies of digital twin technology applied to safety management; (2). Explore what functions and how digital twin technology can help improve safety management, including safety risk prediction, accident prevention and real-time safety status monitoring; (3) Summarize current practices and propose a framework for digital twin technology applications for safety management in high-risk industries; (4) Identify challenges in the development of digital twin | This paper follows the method and steps specified by Zou and Xu (2023) and the specific steps include (1) selecting databases for the initial literature search; (2) establishing screening criteria for literature selection; (3). coding literature. | The current state of research and application of digital twin technology in safety management is systematically analyzed using two keywords “digital twin technology” and “safety management” the following main conclusions are drawn: (1). Safety status monitoring simulation analysis is the main research object; (2). Virtual modeling technology, machine learning technology, IoT, computer vision technology are the main enabling technologies; (3). Digital twin technology can play an important role in safety management. |

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| | | | technology in safety management and suggest future research directions. | | |
| 3 | Reconciling the Master of Science in Occupational Safety and Health (K3) curriculum with employer demands | David W. Wilbanks, Yousif Abulhassan, Jan K. Wachter | to analyze the relationship between relative contributors and the majority effect | Occupational health and safety curriculum data and concurrent job requirements were collected, and a Pareto analysis was performed. Pareto analysis aims to identify relationships between relatively few contributors and the majority of the effects studied and is a research methodology frequently observed in peer-reviewed literature (Ab Talib et al., 2015, Akcay et al., 2018, Ali and Johl, 2022, Bajaj et al., 2018, Brkić et al., 2015, Kumar et al., 2019). It is named after the Italian economist Vilfredo Pareto. | The alignment between the offered Master of Occupational Health and Safety (K3) curriculum and employer needs may seem unclear, but consensus can be achieved, if desired. Employment closure, at a minimum, involves alignment created through consensus across academic institutions and, pragmatically, between academic institutions and employers. Ideally, a persistent and disciplined process of self-reflection that naturally measures and calibrates academic prescriptions should be in place. This study suggests that this expectation is not yet widespread. |
| 4 | Occupational radiation exposure monitoring and safety measures among radiological technologists in Malaysia | Muhammad Safwan Ahmad Fadzil a, Wan Anwah Filzah Wan Anuar ab, Nurul Elni Md Yusof ac, Siti Hajar Zuber a, Rozilawati Ahmad a, Abdul Khaliq Ahmad Saparuddin a, Ahmad Bazlie Abdul Kadir. | The specific aim here was to evaluate the occupational radiation exposure experienced by radiologic technologist trainees during their clinical training in the | equivalent dose frequencies for trainees in the radiology and radiotherapy departments, highlighting differences in exposure patterns. In | This study underscores the importance of monitoring radiation exposure among aspiring radiology technicians during clinical training. The annual effective dose remains well below the recommended limit of 6 mSv/year, |

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| | | | radiology and radiotherapy department. | the radiology department, most trainees received doses between 0.4 and 0.6 mSv, with Hp ( 10) and Hp ( 0.07) | with most exposures below 1.00 mSv. |
| 5 | Introduction , evaluation and management of occupational health risks in radiation workers in Gansu province, China | Gang Liu, LiMei Niu, YinYin Liu, Ye Li, XiaoQin Wu, Rong Zhang, Xue Zhang, | In order to protect the health of radiation workers, scientific management of radiation workplace protection is implemented, and occupational health risks in radiation workplaces in Gansu Province, China are identified and evaluated through monitoring. | The basic situation of occupational health management of radiology workers in 1,366 radiology diagnosis and treatment institutions was studied, and 596 monitoring hospitals were selected for occupational health monitoring. Internal thyroid irradiation monitoring was carried out using a 2-IN scintillation spectrometer. ∗2-in NaI(Tl) and its supporting software. Fifty-one underground workers in a deep-pit iron mine were selected to monitor the impact of high radon exposure. | Individual dose monitoring has found that radiation workers involved in interventional radiology are exposed to higher doses and have higher occupational risks. Occupational health examination results indicate a certain level of radiation injury in interventional radiology and nuclear medicine workers. Nuclear medicine radiation monitoring results indicate that some workplaces experience radioactive contamination. Radon exposure in deep mine miners has a higher risk of lung cancer due to high radon levels. Chromosomal aberration analysis is an important index in monitoring the occupational health of radiation workers. |
| 6 | Emerging nanoparticle threats in marine and terrestrial environments: Toxicity mechanisms and risk management | Amel Gacem, Zehra Khan, Maha Awjan Alreshidi, Krishna Kumar Yadav, | discusses risk management strategies and outlines the regulatory framework and safety guidelines essential to mitigate the | toxicity assessment. | The increasing use of NPs in the food supply chain as additives or integrated into packaged foods has raised concerns about their exposure to consumers. Transformation plays a significant role in |

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| | | | risks associated with NM. | | the physicochemical properties of NPs, resulting in environmental impacts that differ from those of native NPs. The nanoscale dimensions of NPs represent a major obstacle in determining their environmental fate. Current analytical methods are inadequate to investigate NPs in various contexts. |
| 7 | Analysis of the implementation of the occupational health and safety management system based on ISO 4501.2 2018 at the Mitsubishi Dipo International Pahala Automotive Workshop, Serang City | maftuh Ikhsan Ramdani, Sulaeman deni Ramdani, verly vernando. | Aims to ensure that the implementation of the occupational health and safety management system is carried out correctly and ensures that all workers remain safe and that no accidents occur. | descriptive-experimental method | The results of the study indicate that the OHS management system in the workshop environment has met the requirements in the ISO 45001:2018 management system in clause 6 point 6.1 Actions to address risks and opportunities, 6.1.2 Hazard identification and assessment of risks and opportunities, and 6.1.2.2 OHS risk assessment and other OHS management system related risks. However, ISO 4500:2018 has become a guide for all work environments that involve OHS rules in it as a form of preventing the risk of work accidents. |
| 8 | Evaluating the evidence base for food safety and risk assessment of polyethylene terephthalate oligomers: Protocol for a systematic evidence map | Verena N. Schreier, Christian Appenzeller-Herzog, Nicolas Roth | is to gain an overview of the topic and available literature, clarify conceptual boundaries, identify the breadth and depth of analysis required, facilitate the formation of a research team, and further explore aspects | Data visualization of the extracted data will be performed using various software (e.g., Tableau Software or MS Excel). Various visualization techniques will be considered, including bar charts to | Evaluating the evidence base regarding polyethylene terephthalate (PET) oligomers reveals that food safety data are limited and fragmented. Several toxicology studies indicate that PET oligomer migration from packaging to food is below the threshold limits set by regulatory agencies, but uncertainty remains regarding |

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| | | | related to resources, timeframe, and feasibility. Scoping is part of the problem formulation, which can be defined as "a systematic approach that identifies all factors important to a particular risk assessment and considers the objectives of the assessment, the scope and depth of analysis required, the analytical approach, available resources and results, and the overall risk management objectives" ( Solomon et al., 2016 ). | show frequencies, spider charts for comparison, heat maps to show data density, and tables to provide summaries. Based on the data obtained, the technique that most effectively visualizes the resulting conclusions for the reader will be selected. Each oligomer is listed individually, and the number of studies for each stream of evidence and the findings of additional studies are presented in a qualitative overview to visualize areas where knowledge is already sufficient and areas where research is needed. | long-term effects and cumulative exposure. |
| 9 | The impact of Industry 4.0 on occupational health and safety: A systematic literature review | Lucas Gomes Miranda Bispo, Fernando Gonçalves Amaral. | aims to investigate the requirements sought, the risk factors identified, and the adverse impacts on workers caused by the characteristics of Industry 4.0. | detailed analysis | This review reveals the complex relationship between Industry 4.0 principles (e.g., requirements, risk factors, and impacts) and human factors. It also suggests pathways for how these relationships unfold, bridging the gap left by the limited studies that have focused on connecting these topics. These findings can help organizational |

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| | | | | | managers understand the impact of Industry 4.0 on worker safety and health. |
| 10 | Evolution of competencies related to health, safety and environment in Italy: From HSE technician, to HSE professional and, finally, to HSE manager | Simone Colombo, Luigi Enrico Golzio, Giancarlo Bianchi | To increase their effectiveness, HSE professionals should transform their status from technicians to professionals. However, this transformation requires a market and, with it, an adequate educational offering to meet it. The Italian State and its Regions recognized this need and agreed to mandate mandatory courses for HSE professionals and all those involved in risk prevention: entrepreneurs, managers, supervisors, and HSE worker representatives. Thanks to this stimulus and the activity of associations, a significant market for HSE education and services (both public and private) has developed over the years. | hazard identification Analyze the risks associated with the identified hazards. | The Italian State and its Regions recognized this need and agreed to mandate mandatory courses for HSE professionals and all those involved in risk prevention: entrepreneurs, managers, supervisors, and HSE worker representatives. Thanks to this incentive and the activity of associations, a significant market for HSE education and services (both public and private) has developed over the years. However, despite the adequate HSE education offering, demand still strongly favors mandatory and updated courses, so that voluntary courses are still considered a luxury rather than a profitable investment. The composition of demand shows that for entrepreneurs and their line managers, as well as for (somewhat surprisingly) role holders, it is difficult to leave behind the technician role (mindset) for the professional role. |
| 11 | A comprehensive review of dose limits, triage systems and measurement tools for the management of the consequences of nuclear | Y. Wei, SA Dewji | triage goals In the case of nuclear and radiological accidents, rapid and efficient allocation of care and resources is necessary when dealing with potentially large populations | | In scenarios where an event results in widespread radioactive contamination exposing a population, it is crucial to systematically identify and categorize affected groups of individuals to allow for appropriate medical care |

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| | and radiological emergencies . | | (including "concerned persons") awaiting triage and medical examination. Triage can be defined as the use of simple procedures to quickly sort people into groups based on the degree of physical injury and actual or potential impact on health, and the allocation of care to these people to expedite treatment. | | according to triage assessment protocols. For a century, ongoing efforts have been made to ensure the safe use of radiation, including developing regulations and guidelines in response to lessons learned from historical incidents. |
| 12 | Evaluation of the implementation of the occupational safety and health management system and improvement efforts using the HiRADC method (case study at the Aimtopindo Nuansa Kimia company) | Dyah Setyo Pertiwi Ph.D., Dr. Choerudin, Dr. Rer.Nat Riny Yolandha Parapat, Arrizky Mulyawan | to find out to what extent the implementation of the occupational safety and health management system at PT aimtopindo Nuansa has carried out the identification of work accident risks including physical factors, chemical factors, biological factors, physiological factors, psychological factors and carried out risk control measures. | qualitative by means of observation | that the handling of occupational health and safety at PT aimtopindo Nuansa Kimia is very good because the process control management is well structured so that it can reduce accidents and occupational diseases that can occur. |
| 13 | Review of printing methods, materials, and artificial intelligence applications in sodium ion battery manufacturing and management systems | Anesu Nyabadza, Achu Titus, Mayur Makhesana, Blánaid Fogarty, Mandana Kariminejad, Sean Ryan, Lola Azoulay-Younes, Ronan McCann, Marion McAfee, Ramesh Raghavendra, Valeria Nicolosi, Mercedes Vazquez, Dermot Brabazon | The achieved average absolute error percentage is competitive (2.56%), which shows the potential of real-world application of LSTM model on SOH prediction of real batteries. In | Numerical and experimental methods were used to analyze the changes in battery performance due to mechanical loading or bending. A finite element | This review focuses on printing as an emerging mechanism for producing sodium-ion batteries. It covers many aspects of the printed battery manufacturing process, including ink formulation techniques for printed batteries, optimization of printing parameters using artificial |

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| | | | another study, Pelosi et al. [ 162 ] used machine learning to predict SOH of LIBs, aiming to prevent rapid degradation caused by fast charging and electrical, mechanical, and thermal stress. | model (Dassault Systemes SIMULIA Abaqus v6.13) was reported to be able to simulate flexible batteries in various bending curvatures by adding material data for each layer and applying boundary conditions on both sides of the battery. | intelligence, battery characterization techniques, and battery waste management. |
| 14 | Analysis of the implementation of occupational safety and health K3 in the laboratory section at PT. Tirta Investama Aqua Mamba | Devi, Trianasari | The implementation of the K3 system carried out by PT Titra Investama AQUA Mambal has not yet... maximum. From the research results obtained, several problems were found which became obstacles in the implementation of K3 standards. Among them are employees who do not wear PPE or Personal Protective Equipment as stated in the procedure, lack of understanding how the K3 implementation system in the work environment and the culture of indifference will safety and health in the work environment. | This research is categorized as descriptive research with a qualitative approach. This method is a study that uses perceptions and also written materials to knowing things that cannot be measured with certainty (intangible). This method provides results in-depth findings through non-numerical or non-statistical data. Research location This is PT Tirta Investama (AQUA Mambal) which is located in Mambal, District abiansemal, Badung Regency. | implementation of K3 at PT Tirta Investama AQUA Mambal is one of the attitudes and behaviors of workers who are reluctant to use protective equipment complete self-service provided by the company. Many workers ignore the equipment safety provided by the company to prevent work accidents. The reason is that workers feel uncomfortable when using personal protective equipment, so workers do not want to use the complete personal protective equipment. |


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| | | | The impact of K3 violations is that they cause injuries. experienced by workers. | This study aims to determine the application of Occupational Safety and Health (K3) because AQUA is a leading company or companies that are used as references by other companies. | |
| 15 | health risk assessment of physical and chemical hazards in the painting area of a manufacturing company | Aulia Indra Ayuningtyas, Sjahrul Meizar Nasri | The aim of this study is to analyze hazards that impact workers' health through hazard identification, exposure assessment, risk assessment, and control recommendations. | semi-quantitative | The physical hazards found were in the form of lighting, vibration, noise, and heat stress hazards. Meanwhile, the chemical hazards found were in the form of diluent vapors, solvents, NaNO3, H2SO4, NaOH, H3NSO4, and indoor air quality. |
| 16 | Occupational safety and health (K3) risk management analysis using the Hazard Identification, Damage Assessment and Risk Control (HIRARC) method in the garment workshop at the Textile Campus | Mayesti Kurnianingtias | to find out how far K3 management has been established in K3 locations, especially for conditions that have a high level of danger. | qualitative | from the hazard identification carried out there are 9 hazards namely the cable on the machine is not in place, limited space for the iron so the iron is placed directly on the ironing board, setting the temperature on the iron does not work, many cables are peeling and scattered on the uncovered ceiling floor. and risk control is prioritized for conditions and activities that have an extreme level of danger from the development of the research it is hoped that a more comprehensive K3 risk management will be obtained and cover all workshops on this textile campus so that a safer and more comfortable workshop area will be created for students. |
| 17 | New approach | ngela Bearth, Nicolas Roth, | This study aims to address the | linking familiarity | Our survey highlights some of the barriers |

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| | methodologies in human health risk assessment across the European regulatory framework: Status quo, barriers and drivers of regulatory acceptance and use | Tom Jansen, Laura Holden, Aleksandra Čavoški, Emma Di Consiglio Ingrid Hauzenberger, Robert Lee, Enrico Mombelli, Olga Tcheremenskaia, Lina Wendt-Rasch, Martin F. Wilks | existing knowledge gap on the use and application of NAM regulations in the context of European human health risk assessments of chemicals (e.g., pesticides, industrial chemicals, and human pharmaceuticals ). | with a method to its use in everyday work, divided among human health risk assessors from industry, regulation, and academia. Not surprisingly, more familiar methods were encountered more frequently and vice versa (r = 0.54 to 0.79, $p < 0.001$). | and drivers to top-down and bottom-up NAM implementation in regulatory chemical risk assessment. |
| 18 | Improving construction management outcomes through mitigating barriers to robotics implementation: A sustainable practice model | Ahsan Waqar a, Khaled A Alrasheed b, Omrane Benjeddou c | This research aims to evaluate the barriers faced in the implementation of robotics in construction and determine their impact on success. | quantitative research | This research shows that if the aforementioned challenges are overcome, the implementation of robots in construction can be successful. Researchers interested in how technology is adopted and implemented in complex organizations can learn a lot from this study, as can managers and practitioners working in the construction industry. These findings can guide future studies and assist businesses in leveraging robotic technology for construction material manufacturing. |
| 19 | implementation of occupational safety and health management systems in infrastructure development project work | Komang Alit, a male writer, Good Lord Angga Surya Dharma | The aim of these three is that every worker receives a guarantee of occupational safety and health and that there is a match between the type of work and the activities carried out. | questionnaire method, observation, documentation, and qualitative description | Contractors in their efforts to realize the project targets and objectives that have been set has a fairly high level of seriousness with an average value of ≥ 70% focusing on construction results in road construction, in addition to its business in the quality |

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| | | | | | of pre-cast "U-ditch" products. Implementation of new road construction projects managed by the company, in the application SMK3 project, planning management is determined by using SMKK (Occupational Health and Safety System) Construction Safety Management) which refers to PUPR Ministerial Regulation Number 10 of 2021. |
| 20 | analysis of the implementation of the occupational safety management system PP 50 of 2012 in garment companies | Ismi Elya Wirdati, Sri Lestari | is to describe the implementation of SMK 3 in the Jepara garment company | qualitative descriptive | The results of the research carried out were an analysis of the implementation of SMK3 in the Jepara garment company, according to the audit results in the initial level category, 64 criteria were still included in the less than satisfactory category with the number of conformities (51.56%). |
| 21 | analysis of the implementation of occupational safety and health<br><br>(k3) in the laboratory section at pt tirta investama aqua mambal | M. Devi, Trianasari | Analyzing the implementation of the K3 management system for laboratory employees at PT Tirta Investama AQUA Mambal.<br><br>Knowing the potential hazards, risks of hazards, and levels of risk in the laboratory work environment. | The approach used is descriptive qualitative.<br><br>Data was collected through interviews and document studies. | |
| 22 | oil and gas industry risk management in industrial processes and risk management | Aulia Ikka Maharani, Almira Hana Aziza, Aisyah Fahira Lubis, Yunanda Tantra Zaharani | -ensure the safety of workers and the surrounding community<br>-minimize material losses due to accidents | :hazard identification, risk assessment, risk control, engineering control, administrative control, | Risk management in the oil and gas industry is not only a legal obligation, but a strategic need. With a systematic approach (identification-analysis-control-evaluation), |

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| | | | -improve operational reliability of oil and gas industry processes<br>-ensure compliance with OHS and environmental regulations | PPE, evaluation & monitoring | companies can reduce the potential for fatal accidents, protect the environment, and ensure operational sustainability. |
| 23 | Description of CSMS (Contractor Safety Management System) procedures at PT. Petrokimia Gresik, East Java | Anggit Permata Sari | ensuring contractors have OHS competency before, during, and after work. reducing the risk of work accidents involving contractor workers. ensuring the alignment of OHS systems between to SMK3 (PP.No.50 of 2012) and international standards | contractor pre-qualification<br>-contractor selection | The CSMS procedure at PT Petrokimia Gresik is a form of the company's commitment to maintaining the safety of contractor workers. With consistent implementation - starting from pre-qualification, selection, implementation, to evaluation - this system is able to reduce the potential for work accidents. However, challenges remain, especially in building a strong OSH culture in contractors, so more intensive supervision and guidance are needed. |
| 24 | Safe and sustainable through next-generation chemical and material design: SSbD4CheM project innovations in the textile, cosmetics and automotive sectors | Mansoor Ahmad Bhat,Tanja Radu ,Ignacio Martín-Fabiani, Panagiotis,Kolokathis,Anastasios,Papadiamantis, Stephan Wagner and ,Yvonne Kohl , Hilda Witters ,Wouter A. Gebbink g,Yentl Pareja Rodriguez ,Giuseppe Cardelini ,Roel Degens ,Ivana Burzic I,Beatriz Alfaro Serrano , Claudia Pretschuh , Eduardo Santamaria-Aranda, Elena Contreras-García, Judith Sinic I, Christoph Jocham i, Dror Cohen l | is to develop screening and testing strategies for a range of substances and materials to ensure safer and more sustainable products in line with the Sustainable Products Initiative. | new approaches, including in vitro studies without animal models and in silico tools | Ultimately, SSbD4CheM will assist industrialists and regulatory bodies while equipping customers with safer and more environmentally friendly products, thereby promoting a healthier and more sustainable society. |
| 25 | Environmental impacts and human health effects of polycyclic aromatic hydrocarbons and remediation strategies | Gopinath Venkatraman ab, Nelli Giribabu c, Priyadarshini Sakthi Mohan d , Barathan Muttiah e, Venkat Kumar Govindarajan f, Mani Alagiri g , Puteri Shafinaz Abdul Rahman h , Saiful Anuar Karsani | UV radiation and bacterial metabolic processes play a key role in the complex and unpredictable behavior of PAHs in the environment. PAHs adhere very effectively | PAH removal methods have been developed, most of which are still inadequate or are still in the early stages of research and development. | In conclusion, the assessment of PAHs as significant cancer-causing micropollutants highlights the urgency of addressing their presence in various environmental matrices. Extensive research on PAH movement and |

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| | to surfaces, and studies have shown that their numbers increase over time in the environment and within microorganisms (Patel et al., 2020a). | exposure pathways in air, water, soil, and biological systems is essential for effective intervention. |

Implementing a chemical and physics-based occupational health and safety (K3) management system in industry involves establishing policies, thorough planning, program implementation, performance monitoring and evaluation, and continuous review and improvement. This process involves risk analysis to identify chemical hazards and potential physical hazards, then developing safety procedures, employee training, appropriate chemical storage, and regular workplace inspections to build a strong safety culture.

In an effort to achieve a comfortable, safe, and healthy work environment, the implementation of an OHS management system plays a crucial role. Occupational safety and health (OHS) is a priority for companies to ensure the safety of workers and the environment from hazards. Furthermore, companies are required to implement OHS effectively, in an integrated, and systematic manner. Therefore, an OHS management system is needed as a risk framework used to manage OHS in a company with the aim of ensuring the safety and health of workers. Moreover, each industry has different potential risks.

The implementation of a chemical and physics-based OHS management system in industry usually includes various positive aspects that support the improvement of occupational safety and health.

The main results that can be achieved after implementing SMK3

- Reduction in accident and incident numbers
- Increased employee awareness
- A safer and healthier work environment
- Compliance with regulations
- Operational efficiency
- Better waste management and environmental risks

## DISCUSSION

This implementation integrates hazard identification, risk control, training, and continuous monitoring to ensure occupational safety and health based on chemicals and physical factors.
ISO 45001 and the Management Systems Approach. According to ISO (International Organization for Standardization), the implementation of an OHS management system should be based on the principles of process, worker participation, and continuous improvement. ISO 45001 provides a framework for identifying risks, establishing safety policies, and systematically evaluating and controlling risks.
Proactive and Preventive Approach (Rowlings & Jimmieson, 2000), These experts emphasize the importance of a proactive approach in identifying hazards and taking preventive measures before accidents or incidents occur. They emphasize a strong safety culture and the active participation of all workers and management.
Zurich, 2017, According to Zurich, the success of OHS implementation depends heavily on clear policies, a supportive organizational structure, and effective risk control. Establishing an OHS policy must be a formal management commitment as part of the company's strategy.
Sutrisno, 2018, believes that worker participation and management commitment are key to effective

implementation. Workers must be actively involved in the risk identification process and the development of safety procedures.

Geller (2001) stated that a safety culture in the workplace is crucial. K3 implementation must build a culture that makes safety a core value and part of everyday behavior.

Sutrisno (2015), According to Sutrisno, the implementation of chemical and physics-based K3 must begin with comprehensive hazard identification, followed by risk control through safe chemical management, the use of personal protective equipment, and appropriate work environment arrangements. He emphasized that controlling physical risks such as noise and temperature must be done with appropriate technology and ongoing worker training.

Snyder and Chock (2013), From their perspective, OHS implementation must integrate chemical and physical risk management into a complete safety management system. They suggest that a risk-based approach and hierarchy of controls are key to success, including chemical hazard control through ventilation and isolation, and physical hazard control through shielding and vibration reduction.

Tawab (2017), According to Tawab, the implementation of chemical and physical-based K3 must involve international standards such as OSHA (Occupational Safety and Health Administration) and MSDS for chemicals. He emphasized the importance of continuous worker training and the implementation of emergency response procedures to reduce the risk of accidents caused by chemicals and physical factors.

Gunarso (2019) stated that the successful implementation of chemical and physics-based K3 depends on the safety culture within the company. He emphasized the need for routine inspections, the use of the latest technology (e.g., temperature and radiation sensors), and active worker participation in training and risk monitoring.

## CONCLUSION

The implementation of the K3 management system according to experts emphasizes the importance of a systematic approach, active participation from all parties, a strong safety culture, and sustainable risk control through standard frameworks such as ISO 45001. This is done to improve occupational safety performance and prevent accidents and occupational diseases.

The overall conclusion from the implementation of a chemical and physical safety and health management system in industry is that its success depends heavily on proper hazard identification, accurate risk assessment, and effective control of chemical and physical factors that could potentially harm workers and the environment. By implementing standard procedures, ongoing training, and strict supervision, industries can minimize accidents and health problems. Furthermore, this system must be dynamic and sustainable to remain relevant and adapt to changing production conditions. In general, the effective integration of chemical and physical safety and health management will create a safe, healthy, and productive work environment, as well as support regulatory compliance and an enhanced safety culture in the industry.

In its application, the OHS management system consists of five main stages: planning, implementation, evaluation, action, improvement, and supervision. In addition, there are several basic principles in the OHS management system, namely:

- Leadership and management involvement in maintaining K3
- OHS risk assessment and purchase of necessary controls
- Planning and implementation of K3 programs
- Measurement and evaluation of K3 performance
- Continuous improvement to improve K3 performance

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