We are IntechOpen, the world's leading publisher of Open Access books
Built by scientists, for scientists

6,900
Open access books available

186,000
International authors and editors

200M
Downloads

Our authors are among the

154
Countries delivered to

TOP 1%
most cited scientists

12.2%
Contributors from top 500 universities

CLARIVATE ANALYTICS
BOOK CITATION INDEX
INDEXED

WEB OF SCIENCE™

Selection of our books indexed in the Book Citation Index
in Web of Science™ Core Collection (BKCI)

Interested in publishing with us?
Contact book.department@intechopen.com

Numbers displayed above are based on latest data collected.
For more information visit www.intechopen.com

Introductory Chapter: Fire Prevention Strategies

Anujit Ghosal and Fahmina Zafar

1. Brief introduction

A few decades back, the incidents of fire were regarded as natural calamity and were treated as such with very little thought on other aspects. However, in-depth analysis of most of the recent accidental fire tragedies indicates the human fingerprints such as deforestation, cigarette, firecrackers, static fire in forest at night or other similar incidences [1–3]. The frequency and extent of loss in life or economic damages have been increasing along with the population growth. So, to check the catastrophic misfortunate instances of fire and controlling the after-effects, stringent rules must be followed [4–6]. Broadly, the rules can be divided in three categories as shown in the **Figure 1**.

In most of the places, fire safety and management protocols are common with slight modification based on the environmental conditions. These systems are adopted throughout the world, however, more strictly followed at flammable industries (oil, gas, paint, paper, etc.) while considered being little lenient at household vicinities [7, 8]. The increased population with constant high pressure on the economic backbone of numerous countries has altered the previous protection protocols [9–11]. The high cost of living has resulted in a more congested neighborhood *i.e.* population density particularly in the urban areas is constantly increasing [12, 13]. A collective approach is needed to avoid mistakes via., focusing on the fundamental area of management and planning. **Figure 2** represents the basic blocks involved in planning and management section for any construction.

Any small mishap such as an electric short circuit, heating system malfunction, barbeques, candles, or similar incidences at one place will affect the entire or adjacent community other than environmental contamination. Apart from the prevention of fire incidence, defined safety measures can save lives after the occurrence of such accidental events. Various approaches have been followed for the management of fire preventions at the fundamental level. A few of them are presented below:

   i. Planning escape route

   ii. Routine inspections of doorways and exit passages

   iii. Conducting regular practice drills for fire evacuations

   iv. Maintenance of sprinklers or other extinguishers

   v. Keep track of the exact number of occupants

   vi. Avoid cluttering the areas which can inhibit the fire extinguish mechanisms.

   vii. Recording alteration, submission, and safekeeping of building/factory blueprints

Figure 1.
Three broad categories of the fire protection activities.

Figure 2.
Basics steps involved in fire protection of any construction.

2. Comprehensive views

Although numerous prevention and fire safety manuals have been developed but with modernization redefining fire prevention protocols with time is mandatory [14–16]. However, the process of change is ever dynamic for the inclusion of new information. Incorporation of the output from upcoming research studies for avoiding miss-managements during a fire outburst and remodeling the evacuation strategies are important. The architectural improvements which can further assist the evacuation process and ease the smoke exhaustion process should always be considered. The new engineering strategies based on recent active research should be adopted in the construction of housing societies, particularly in highly populated areas [17, 18]. The implementation of fire safety protocol in pre-build structures

via., virtual, mathematical, or numerical modeling and studies would improve the durability as well as safety of the area. Simulation of possible fire incidences or previous fire case-studies has been known to improve the overall understanding of the incidents and pre-planning strategies [19–21]. Development of such post evacuation strategies would minimize the materialistic loss as well as can zero the causalities under such events.

Other than the planning of construction and infrastructure skeleton, consideration of the use of specific materials in and around any place is also need to be checked [22]. Utilization of flammable materials such as plastics, oil based paints, use of cotton or storage of highly volatile chemicals seem to be a cause in many instances. Alternatively, non-flammable paints, coatings, fabrics, and construction materials like nanocomposite materials should be used [23–25]. Research on flame retardant materials and nanocomposites are also considered to be one of the alternatives against fire protection and evacuation management systems. Like coating over wooden furniture and cotton fabrics would render them less prone to fire and thus, can act as barrier during incidence of fire [26, 27]. Superhydrophobic and flame retardant tiles in kitchen and heating areas would result in reduction in possible accidents [28, 29]. Further, designing of fire-fighting robots and other engineered bots are required to be brought in lime light for protection and prevention against tragedic incidences [30].

Finally, the strategies which can assist in improving pre, on-going, and post-fire incident management system are more pivotal in creating a fail-safe fire protection mechanism. The research encircling different views with building modeling, escape route planning in heritage buildings and mines, construction material used and prevention protocols are critical in safe keeping future generation including wild life as well as plants. The difficulties which are created due to the excessive urbanization and population boom in addition to poor engineering or planning of residence and work places particularly near forest or wood stock areas are to be addressed. Virtual *in silico* studies and numerical simulation in analyzing as well as recreating previous fire hazardous cases would provide additional benefits in visualization of the mistakes in following then existing protocols and to further improve fire safety measures.

Acknowledgements

Author details

Anujit Ghosal[1,2]* and Fahmina Zafar[2]

1 School of Lifesciences, Beijing Institute of Sciences, Beijing, PRC

2 Department of Chemistry, Jamia Millia Islamia, New Delhi, India

*Address all correspondence to: anujit.ghosal@outlook.com

IntechOpen

References

[1] M.J. van Marle, R.D. Field, G.R. van der Werf, I.A.E. de Wagt, R.A. Houghton, L.V. Rizzo, P. Artaxo, K. Tsigaridis, Fire and deforestation dynamics in Amazonia (1973-2014), Global biogeochemical cycles, 31 (2017) 24-38.

[2] A. Patrão, Human and Social Dimensions of Wildland Fire Management and Forest Protection.

[3] T. McDonald, Drought, fire, flood and COVID–complex systems and disruption, Ecological Management & Restoration, 21 (2020) 73.

[4] W. Zeńczak, A. Krystosik-Gromadzińska, Improvements to a fire safety management system, Polish Maritime Research, 26 (2019) 117-123.

[5] H.M. Dijmarescu, Prometheus's Blind Spot: Invoking Rules and Political Histories of Fire, in, Northwestern University, 2020.

[6] Aspragathos N, Dogkas E, Konstantinidis P, Koutmos P, Lamprinou N, Moulianitis VC, et al. From pillars to AI technology-based Forest fire protection systems. In: Artificial Intelligence-Applications in Agriculture and Bio-System Engineering. London: IntechOpen; 2019

[7] Y. Khalil, A probabilistic visual-flowcharting-based model for consequence assessment of fire and explosion events involving leaks of flammable gases, Journal of Loss Prevention in the Process Industries, 50 (2017) 190-204.

[8] C. Chen, G. Reniers, Risk assessment of processes and products in industrial biotechnology, (2018).

[9] W. Knorr, A. Arneth, L. Jiang, Demographic controls of future global fire risk, Nature Climate Change, 6 (2016) 781-785.

[10] M. McNamee, B. Meacham, P. van Hees, L. Bisby, W. Chow, A. Coppalle, R. Dobashi, B. Dlugogorski, R. Fahy, C. Fleischmann, IAFSS agenda 2030 for a fire safe world, Fire Safety Journal, 110 (2019) 102889.

[11] M. de Torres Curth, L. Ghermandi, V. Zimmerman, Living in a world of fire: the population dynamics of Mulinum spinosum in Northwestern Patagonia grasslands, Plant Ecology, (2020) 1-12.

[12] A.A. Sheeba, R. Jayaparvathy, Performance modeling of an intelligent emergency evacuation system in buildings on accidental fire occurrence, Safety science, 112 (2019) 196-205.

[13] A. Chakraborty, R. Devnath, Fire crisis Management-cesc's experience as Distribution Utility, Water and Energy International, 62 (2020) 15-21.

[14] T. Deave, A. Hawkins, A. Kumar, M. Hayes, N. Cooper, M. Watson, J. Ablewhite, C. Coupland, A. Sutton, G. Majsak-Newman, Evaluating implementation of a fire-prevention injury prevention briefing in children's centres: Cluster randomised controlled trial, PLoS One, 12 (2017) e0172584.

[15] M.-Y. Cheng, K.-C. Chiu, Y.-M. Hsieh, I.-T. Yang, J.-S. Chou, Y.-W. Wu, BIM integrated smart monitoring technique for building fire prevention and disaster relief, Automation in Construction, 84 (2017) 14-30.

[16] Littlewood J. Smart Fire Performance-Assessment of Occupant Safety in Specialised Dwellings, in: International Conference on Sustainability in Energy and Buildings. Cham: Springer; 2018. pp. 435-444

[17] W. Węgrzyński, P. Sulik, The philosophy of fire safety engineering in the shaping of civil engineering development, Bulletin of the polish

academy of sciences. Technical sciences, 64 (2016).

[18] E.K. Zavadskas, J. Antucheviciene, T. Vilutiene, H. Adeli, Sustainable decision-making in civil engineering, construction and building technology, Sustainability, 10 (2018) 14.

[19] D. Sahu, S. Kumar, S. Jain, A. Gupta, Experimental and numerical simulation studies on diesel pool fire, Fire and Materials, 40 (2016) 1016-1035.

[20] B. Lattimer, J. Hodges, A. Lattimer, Using machine learning in physics-based simulation of fire, Fire Safety Journal, (2020) 102991.

[21] P. Ghasemi, A. Babaeinesami, Simulation of fire stations resources considering the downtime of machines: A case study, Journal of Industrial Engineering and Management Studies, 7 (2020) 161-176.

[22] E.J. Sugeng, M. de Cock, P.E. Leonards, M. van de Bor, Electronics, interior decoration and cleaning patterns affect flame retardant levels in the dust from Dutch residences, Science of The Total Environment, 645 (2018) 1144-1152.

[23] K. Shikinaka, M. Nakamura, R.R. Navarro, Y. Otsuka, Non-flammable and moisture-permeable UV protection films only from plant polymers and clay minerals, Green Chemistry, 21 (2019) 498-502.

[24] W. Guo, X. Wang, J. Huang, Y. Zhou, W. Cai, J. Wang, L. Song, Y. Hu, Construction of durable flame-retardant and robust superhydrophobic coatings on cotton fabrics for water-oil separation application, Chemical Engineering Journal, (2020) 125661.

[25] R. Olawoyin, Nanotechnology: The future of fire safety, Safety science, 110 (2018) 214-221.

[26] T. Ma, L. Li, Q. Wang, C. Guo, Construction of intumescent flame retardant and hydrophobic coating on wood substrates based on thiol-ene click chemistry without photoinitiators, Composites Part B: Engineering, 177 (2019) 107357.

[27] D. Lin, X. Zeng, H. Li, X. Lai, T. Wu, One-pot fabrication of superhydrophobic and flame-retardant coatings on cotton fabrics via sol-gel reaction, Journal of colloid and interface science, 533 (2019) 198-206.

[28] S. Wi, S. Yang, U. Berardi, S. Kim, Assessment of recycled ceramic-based inorganic insulation for improving energy efficiency and flame retardancy of buildings, Environment international, 130 (2019) 104900.

[29] F. Zafar, E. Sharmin, Flame Retardants. London: IntechOpen; (2019). DOI: 10.5772/intechopen.82783

[30] S.S. Priyanka, R. Sangeetha, S. Suvedha, M.G. Vijayalakshmi, Android Controlled Fire Fighting Robot, Ineternational journal of innovative science Engg. and Technology, Volumn, 3 (2017).