Lessons Learned Bulletin
Special Issue

Chemical Accident Prevention & Preparedness

Risk of oxygen-related fires in hospitals treating Covid-19 patients

The aim of the bulletin is to provide insights on lessons learned from accidents reported in the European Major Accident Reporting System (eMARS) and other accident sources for both industry operators and government regulators. JRC produces at least one CAPP Lessons Learned Bulletin each year. Each issue of the Bulletin focuses on a particular theme. Although not considered major industrial hazards, increased use of oxygen in hospitals treating Covid-19 patients can create an elevated chemical accident risk and for this reason it is considered a timely and relevant topic for this bulletin.

This special issue of the Lessons Learned Bulletin (LLB) is intended to raise awareness of risks associated with oxygen-rich environments in hospitals due to intensified use of oxygen therapy. The pandemic has created a high reliance on providing supplemental oxygen to extremely ill patients to combat severe effects of the disease. It is important for hospitals to be fully prepared for the elevated risk of fire associated with oxygen-rich environments, particularly in intensive care units where several oxygen ventilation units may be in operation,

The contributions of Mark Hailwood. to this special issue are greatly appreciated.

Introduction

Since the outbreak of the pandemic in March 2020, incidents of hospital fires in various countries around the world have caused the deaths of nearly 70 people, the majority of whom were patients extremely ill with the novel Coronavirus. On 19 December 2020, a fire involving a high flow oxygen ventilation device killed 10 Covid-19 patients in a hospital intensive care unit (ICU) in Gaziantep, Turkey. A similar fire in a hospital ICU killed 10 people in Peatra Niamt, Romania, in November 2020 (see below). JRC research shows that there have been at least 20 incidents of fires caused by oxygen-rich environments in hospitals reported in the media in 2020, most of them in hospital intensive care units. Of these, 8 resulted in multiple fatalities. Although many hospitals successfully responded to such incidents and avoided injury, most events still required evacuation of staff and severely ill patients, while at the same time depriving oxygen ventilation to those in critical condition for the duration of the event.

Fire in a hospital Covid-19 ward, Piatra Neamț Romania

On 14 November 2020, a fire broke out in the COVID-19 unit of the Piatra Neamț Emergency Hospital, killing ten people, all of whom were patients receiving treatment for Covid-19. Another four people were injured, including two doctors. Authorities have indicated that the fire most likely started with a short circuit in electrical equipment, probably a mechanical fan. The fire was believed to have spread quickly due to the high level of oxygen in the room that was used to intubate patients.

Source: Gheorghita, M., A. Grancea and C. Hogea, 2020, Investigation report of the fire of 14.11.2020, at the Piatra Neamț County Emergency Hospital. Commission of Inquiry. Neamt County, Romania.

Electrical malfunction causes fire in intensive care unit, Alexandria, Egypt

A fire at a private hospital in Alexandria, Egypt, on 29 June, 2020, caused the death of seven Covid-19 patients. The blaze was reportedly caused by an electrical malfunction in one of the air conditioning generators in the intensive care unit, according to the hospital. Nine hospital staff were also injured. The staff made immediate efforts to put out the fire but apparently they were surprised by the extent and escalation of the flames, a typical sign of a fire fueled by high levels of oxygen.

Source: https://masralarabia.net/ Item 1546692 (30/06/2020) and various other media sources

Source: Hospital patients in Tehran farnews.com (adapted) CC BY 4.0

MAHBulletin
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European Commission

Special Issue
January 2021
JRC 123940

Risks associated with oxygen-rich environments

Oxygen is essential to life and generally makes up about 21% of the gases in the air we breathe. Many users may not be aware of hazards associated with oxygen-enriched atmospheres. However, chemists and process safety specialists recognize its hazardous aspects in relation to its contribution to corrosion and its role in chemical reactions. Pure oxygen reacts with common materials such as oil and grease to cause fires, and even explosions, when released at high pressures. A leaking valve or hose, and openings at interfaces of masks and tubes, when in a confined space or where air circulation is low, can quickly increase the oxygen concentration to a dangerous level. Even a small increase in the oxygen level in the air to 24% can create a fire hazard. In an oxygen-enriched environment, materials become easier to ignite and fires will burn hotter and more fiercely than in normal air. There is also a potentially heightened risk of using ethanol-based and organic solvents as cleaning agents in oxygen rich atmospheres. Ignition can come from gas velocity, friction, adiabatic heat, and contamination, and can be generated by the oxygen devices themselves (through improper handling or design) but also by the external environment.

Notably, six incidents of fires in Covid ICUs have been reported as attributable to electrical faults and some reports have quoted witnesses as being oerwhelmed very quickly by the rapid spread of the fire. The ease of ignition and rapid escalation are typical signs that an oxygen-rich atmosphere is involved.

The rising incidence of fires in Covid-19 hospitals

Fires involving medical oxygen are not a new phenomenon but are more common in the operating theatre where oxygen is routinely administered. In these settings, strict safety protocols are normally enforced and surgical staff are well trained in dealing with oxygen hazards. Moreover, they involve only one oxygen ventilation unit and the oxygen-rich environment is concentrated around the face of the patient.

However, recently, the Covid-19 pandemic has necessitated increasing oxygen ventilators available in intensive care units. This has led to an increased electrical demand in the ICU, which in some cases may have overloaded the electrical supply systems. It has also meant that, due to the increased number of oxygen ventilators, that the oxygen concentration is more readily elevated. Given that infectious units have a low air exchange rate with the outside environment by design, the potential for a dangerous oxygen rich environment is increased. While the most deadly fires have been associated with intensive care units, there have also been at least two incidents of fires in storage rooms where oxygen tanks are held. In once case, more than 150 patients were evacuated from a dormitory that was being used as a temporary coronavirus hospital in Chelyabinsk, Russia, on 31 October 2020 because of a fire in the oxygen storage room that spread to the rest of the building. *Source: https://www.reuters.com/article/us-health-coronavirus-russia-fire-idUSKBN27G0H1)* An increased use of oxygen can create elevated risk in the oxygen delivery system and storage locations if conditions and practices are not well-suited to meet the higher demand.

Preventing and preparing for oxygen-induced hospital fires

The JRC is currently working on recommendations for applying more rigorous risk management approaches. In particular, it will recommend borrowing strategies developed for chemical process safety to manage flammable and explosive atmospheres, so-called ATEX environments, so that there is no possibility of ignition when such hazards are present. Management procedures need to involve the whole of the management chain including not only medical and nursing staff, but also housekeeping, cleaning, electrical maintenance and other technical departments. Furthermore, emergency preparedness should take into account potential intensive care unit fires, incorporating necessary measures for reducing impacts including response equipment, training of staff, and planning for the practical and psychological needs of recovery.

Other resources from the Joint Research Centre

Pandemic measures and chemical process safety – Lessons Learned Bulletin

Learning lessons from accidents Good Practice Report

https://minerva.jrc.ec.europa.eu/en/shorturl/minerva/publications

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