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Communication of Visual Display Systems in the Pharmaceutical Industry Helps in Risk Management and Inherent Safety Practices – A Case Study

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Abstract: The visual display communication boards, which are used in the pharmaceuticalmanufacturing industry are in the form of a risk management and inherent safety practices. It has resulted in a two-dimensional safety approach for avoiding the risk in occupational environment, which is a new conceptual approach. We have studied the importance of safetyinstruction board requirement, before and after implementation of the visual display communication boards system. The first zone includes the safe handling of the pressurizedgas cylinder in the form of Do and Don't, second zone, where the safe operation is carried outin the boiler operation area and the third zone, which represents the safe handling of an emergency situation during the Chlorine gas leakage. There was a positive response fromeach of the particular occupational zone, where more than 92 % of the occupants have increased their knowledge in the safe handling of the pressurized gas cylinders, various safety interlocks and safety aspects of operating the boiler and handing an emergency situation during the chlorine gas leakage after implementation of the visual display communication board. It has resulted in the risk management approach and also increased the inherent training awareness by reading the visual display instructions in each of their particular zones. The safety visual display communication board instructions not only act as a two-dimensional approach, but it also helps in avoiding classroom safety training. We can conclude that the safety visual display communication board system has increased the knowledge of the risk management approach and learning practices in the pharmaceuticalindustry, enhanced the safety knowledge of the operational equipment's and handling the chlorine gas leakage during the emergency.

Keywords: risk management approach; safety; visual display communication board

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INTRODUCTION

Hazardous chemicals, which are used in the pharmaceutical and chemical industries for manufacturing of the finished goods as per the market demand requirement (Lodha et al., 2022). The safety visual display technique plays a vital role in the red category industries (Sharma, 2022; Murphy et a., 2021; Burkhardt et al., 2014), one is in the form of a risk management approach and inherent safety training strategy (Figure. 1). Sparks & Yearout (1990) stressed the importance of visual display units and its cognitive way of learning, Walny et al. (2011) has communicated the benefits of using the visualization of the white boards and recently the importance of the visualization tools has been prioritized by the Singh & Kumar (2021) but there is very less information about the importance of visualization effects and its advantages of implementation of the safety visual communication boards, which are used in pharmaceutical and chemical manufacturing industries, where highest hazardous chemicals are used globally for manufacturing the lifesaving drugs, fertilizers and polymers.

By implementation of the visual display communication board, which has resulted in the inherent safety training strategy among the occupants in each of the zones, further it also helps in achieving the safety goals of the organization (Ndana, 2021; Chen & Reniers, 2020; Khair et al., 2018). In our sample case study 52 occupants are involved in the three zones of the hazardous chemical industry, which includes handling of the pressurized gas cylinder, operation of the boiler and chlorine evaporation plant (CEP). The visual display instructions for the safe handling of the gas cylinders such as hydrogen, nitrogen, oxygen and other cylinders, which play a vital role in avoiding incidents / accidents (Li et al., 2024; Evstifeev & Zaevab, 2022; Mair, 2017).

Figure 1. Visual display communication board, which is a two-dimensional approach resulting in achieving the zero tolerance of incidents / accidents.

Such type of visual safety awareness helps us for safe handling of the pressurized cylinders, which are operated by 15 operators in the occupational environment. In the recent years there were many incidents /accidents, which are reported globally for not maintaining the functioning of the interlocks and neglecting the frequent maintenance of the boiler equipment's as per the preventive maintenance schedule (Ozawa et al., 2021; Paul et al., 2020; Amyotte et al., 2018), so having the knowledge on the operations, functioning of the interlocks, hotter display of visual display communication, which results in the safe operating procedure of the boiler. There are 25 number of people involved in the boiler operations. By implementing the safety visual display communication board for various interlocking systems of the boiler and its safety aspects, which helps the operator to gain the knowledge in the inherent mind, so that safe operating procedure can be followed.

The third case study delas with the visual display communication board instructions for handling of an emergency for chlorine gas leak from the chlorine evaporator plant (CEP). Safety precautions are taken while loading the filled chlorine tonners. Any leakages of the chlorine gas can be ascertained with the chlorine gas monitoring system. Such type of chlorine gas leakage is handled by the emergency response team members (Patil et al., 2022; Achanta & Jordt, 2021; Tuong et al., 2019). There are 12 operators involved in the CEP operations, where the safety instruction, which are in the form of visual display communication board, which helps in handling the toxic, pressurized, environmental hazardous nature of chlorine gas leakages in the occupational environment. Further the visual display communication board, which helps in the safer evacuation management during chlorine gas leakage. These are many visual displays communication board in the chemical industry, but we have taken three case studies, which helps is building a good safety culture in the organisation (Syaifullah et al., 2022).

METHODS

There are 52 occupants, who are involved in answering the questions which are raised before and after implementation of the visual display communication board. We have ascertained the importance of risk management approach and the inherent safety training strategy using the visual display communication board. The study has been conducted in the three different zones.

Zone 1 – The importance of handling of the gas cylinder has been implemented by visual display communication board by using DO's and Dent's in the gas cylinder storage area, which had resulted in achieving the two-dimensional safety approach.

Zone 2- The visual Instructions for the functioning of the interlocks and its operations of the boiler has increased the safety aspects of the boiler operations. The boiler operators have increased their knowledge by implementation of the inherent safety strategy.

Zone 3 – The various techniques and methodologies which are used during the chlorine gas leakage have been explained. Tackling an emergency chlorine gas leakage in the occupational environment has been implemented in the form of safety instructions in the visual display communication board in the CEP.

Percentage of the increase in the impact of the implementation of visual display system in the various different zones.

RESULT AND DISCUSSION

The visual communication display for handling of the gas cylinders in occupational environment plays a vital role for the safe handling of the gas cylinders. The gas cylinders are used mainly in the production activity, specifically in the intermediate blocks of the pharmaceutical industry to achieve the desired results by following the batch management record (BMR). The gas cylinder used in the quality control (QC) for gas-liquid chromatography (GC). Each of the pressurized gas cylinders may be flammable, explosive, toxic, oxidizer, corrosive, irritant and environmental hazard, as it depends on the type of gas, which is used for the process as per the BMR. All the instructions on the safety visual display communication board have been read by the operator before operating the gas cylinder. The various Do's and Don'ts, which are important visual instructions, which help for the safer operations of the gas cylinder, and the visual display instruction, which acts as an instrumental framework in training the inherent minds while operating the gas cylinder.

Dos and Don'ts of visual display of handling the gas cylinder is given in Figure.2. Fifteen number of people involved in handling of the flammable gas cylinders, the knowledge for the safe handling of the cylinders increased to 95 % (4 to 14 numbers) due to the implementation of the visual display board system We have obtained Form VI certification for the operation of the 45 TPH boiler that has been obtained from the Inspector of boiler, Puducherry Boiler inspection department. Their interlocking of the fluidized bed boiler plays a key role in knowing the functioning of the interlocks for the safer operation in the occupational environment, where the boiler is used to produce stream, which are used in the reactor, centrifuge, and tray dryers as heating media in the pharmaceutical and chemical industry. The visual display communication board helps the boiler operator to know the safety instructions before starting the boiler operations (Figure. 3).

In case a person is experienced as a boiler operator, in that scenario, it refreshes the operational knowledge in the inherent mind leading to inherent safety strategy to know about the various safety interlocks while involving in the boiler operations (Figure. 3). The main devices, which are used during the operations of the boiler are induced draught (ID) fan, forced draft (FD) fan and pressure release valve (PRV), which are in the form of interlocks (Figure.3). As there were 25 people involved in the operation of the boiler, knowledge for the safe operation of the boiler increased to 93 % (13 to 23 numbers) by implementation of the visual display system. The CEP is considered major critical equipment in the chemical and the pharmaceutical industry. In case of the chlorine gas leakage during the operations of the CEP while handling of the chlorine tonners, which will have a devastating effect in the occupational environment,

Figure. 2. Safety visual communication board in form of the DO and Don'ts for handling the gas cylinders.

when this leakage of the chlorine gas happens inside the occupational environment, which is treated as on on-site emergency, which leads to the environmental disaster results in increase in toxicity in chlorine concentration in air, further it leads to the corrosive environment in the occupational environment. When the chlorine gas leakages spread in a faster way and goes beyond the occupational environment, in that scenario it is treated as an off-site emergency in an organization. The operators and emergency response team (ERT) members handling the critical operations in the hazardous industries will read the visual display communication boards on the daily basis, so that they are prepared in handling an emergency of an onsite or offsite emergency in case of leakage of the chlorine gas in the occupational environment. By reading the visual display board communication instructions (Figure. 4), which not only helps the CEP operators in the form of a risk management approach but also the visual display instructions will act as an inherent safety strategy in handling the chlorine gas leakage during the on-site and offsite emergency.

There were around 12 people involved in the operation of the CEP, there were only 2 people who had the knowledge of handling an emergency situation during the chlorine gas leak but after the implementation of the visual display system the knowledge of hf handling an emergency increased to 93 % (2 to 11 numbers). We have raised ten questions among the occupants in each of the zones before and after implementation of the safety visual communication board system. The people who are involved in the handling of the pressurized gas cylinder were not fully aware of the safety aspects to be followed while performing the activity. All the 15 people in that zone have insisted on the safety visual communication board system. After the implementation of the Safety visual communication board in form of the DO and Don'ts for handling of the pressurized gas cylinder, it was found that there is an increased awareness on the safety aspects for handling of gas cylinder, which has resulted in the risk management approach and practicing inherent safety aspects in the gas cylinder storage area. Many of the 14 respondents have replied that they had the knowledge of DO and Don'ts on safe handling cylinders.

Figure 3. Safety visual communication board in form of interlocks for the safe operation of the fluidized boiler.

While handling of the operations of the boiler before implementation of the safety visual display communication board, it was observed that the safety display board of the visual display communication system (Figure. 3), had drastic effect on the inherent mind of the individuals operating the boiler, which had resulted in the awareness of the interlocks and its safety systems of the boiler (Figure.3), the respondents have said that they have increased the knowledge on the safety aspects. Among 12 people who have operated the CEP, only 2 people had knowledge on the emergency of chlorine gas handling during chlorine gas leak. The implementation of the safety visual display communication board for the emergency management for the chlorine gas leak (Figure. 4), which has resulted in the increased awareness for the safe evacuation procedures during the chlorine gas leak, further which has resulted in the increased safety precautions to be taken during chlorine gas leak, the hierarchy for communicating the chlorine gas leak has been known to the occupants in that zone, so that it will be easy to declare an onsite or an off-site emergency in an occupational environment. The risk-taking ability management during the chlorine gas leak had led to the inherent practice's abilities by reading the instructions in the safety visual display communication boards. We can conclude that the implementation of safety visual display communication boards, has resulted in the risk management approach and increased the safety awareness through inherent safety practices among the workers, which has resulted in achieving the safety goals of the organization.

By following the visual display communication board, which act as a dual purpose, one is the risk management approach, and another is inherency safety training of the individuals who are reading the instruction of the visual display board, in this way the operators and executives are not only trained but also, we are avoiding the safety classroom training, thus we are saving the time in the working environment. Further we can say that that the operator has known the benefits and importance of reading the visual display communication board instructions, which are displayed in the working environment (Figure. 1, 2 & 3). Kukimoto et al. (2014) have stressed the importance of the visual communication display boards for tackling and handling the emergency, which are in the form of an electronic

mode, which uses current for running the visual display unit but, in our case, we have used foam boards in the form of a visual display communication aid, thus we have saved electrical charges by implementing safety visual display communication boards. The instructions, which are in the form of visual display communication aid for handling the gas cylinders in a hazardous environment will increase the awareness and knowledge for safe handling of the gas cylinders (Fouzi et al., 2024; Rahman & Istighfarin, 2019) but very few have stressed the full-fledged instructions of Do and don'ts for handlings of gas cylinders in the hazardous operational environment. Zhang et al. (2022) have communicated the importance of safety analysis and periodic evaluation helps in safe handling of the hydrogen gas cylinders, in our case study, the safety visual communication display board of Do's and don'ts, which covers the safe evaluation methodology for handling of the gas cylinders and precautionary steps for the handling the gas cylinder activity, which should not be performed while handling of the gas cylinders in the occupational environment has been covered. Chawla & Chawla (2023) have compared the various ways safe handling methodologies for LPG gas cylinders, which are frequently monitored during the study to prevent the hazard. The interlocks play an important role for the safe operations of the boilers. The operators who are involved in the operations of the boiler will go through the safe operating procedure, which are in the form of interlocks displayed in the visual safety communication board (Figure. 3).

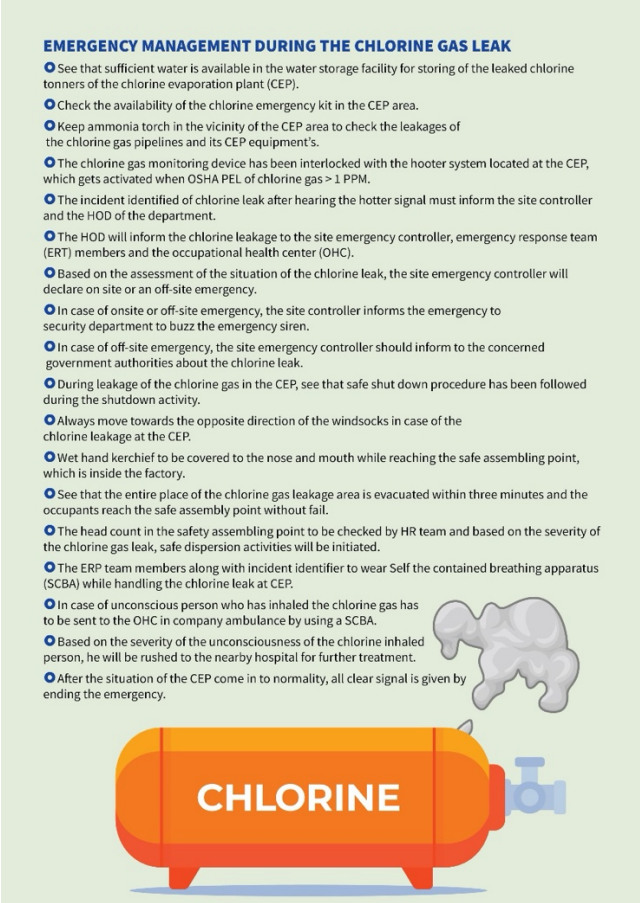

Figure 4. Safety visual board for emergency management during the chlorine gas leak

Rangaswamy et al. (2019) have reported that the interlocks for the boiler operations played a vital role in maintaining the safety operational aspects of the boiler of the thermal power plant. Landi et al. (2022) have communicated that the interlocks of the boiler will help us for the safe operating system, so in this regard our visual display communication board has played a vital role for getting into the inherent minds of the operators while running the boiler in the occupational environment. Visual display communication board will not only help us to learn the lesson, but it acts a proactive technique to manage and mitigate the risk in case of the chlorine gas leakage in the CEP. Masoumi et al. (2020) have described the lessons, which are learnt from the chlorine leakage in the Dezful city of Iran.

Elsayed et al. (2019) stressed the immediate importance of the chlorine gas leakage disaster plan of an onsite emergency but by reading the visual display board instructions on daily basis we can avoid the disaster, as the operator in the CEP is fine tuned in the form an inherent knowledge on handling the emergency of chlorine gas leakage. The visual display communication board for chlorine gas leakage also covers the emergency declaration situation of chlorine gas in the form of onsite or off-site emergency. Ruj and Chatterjee (2012) have described various ways of handling the toxic release of Chlorine gas during an offsite emergency. We can say that the visual communication display boards had a major role in safety (Vigoroso et al., 2020; Sutherland, 2016) for handling the pressurized gas cylinders, running of the boilers, and handling an emergency like chlorine gas leak in our case study. Each of the visual communication boards, which are in the factory premises, will have lessons to be learned (Wagner, 2008), instructions to be followed and various ways of acting in an emergency in the occupational environment. Safety is a continuous process of improving its standards in the organization for the healthier organization and increasing its productivity and zero incidents and accidents in the occupational environment (Motalifu et., 2022; Gao et al., 2021). Let us be safe and make the world a safer place to work in the occupational environment.

CONCLUSION

There are 14 (95 %), 23 (93 %) and 11 (93 %) number of occupants increased their knowledge on safe handling of the pressurized gas cylinder, safe operation of the 45 TPH boiler and handling of the emergency of the CEP. We can say that visual display communication board has helped us to adhere to the goals of the safety policy of the organization. The case study of the safety visual display communication system, which includes DO and Don'ts of handling of the pressurized gas cylinder, knowing the safety aspects with respect to the interlocks of the fluidized boiler of the chemical industry and the various techniques, which are used during the emergency handling of the chlorine gas leakage from the chlorine evaporation plant has resulted in risk management approach and inherent safety training strategy.

DECLARATION OF GENERATIVE AI

The authors declare that no generative AI or AI-assisted technologies were used in the writing process of this manuscript.

DECLARATION OF COMPETING INTEREST

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