CHAPTER 1

WELDING PRACTICES AND SAFETY REQUIREMENTS

1.1 INTRODUCTION

Globalisation of the economy has intensified over the recent years and together with the development of the new information and telecommunications technology, it is bringing about radical changes in society, comparable to those produced during the industrial revolution. Occupational safety and health cannot ignore those changes. And, in this context, the greatest challenge for the countries is the transformation of the difficulties involved in adapting to the new situation into opportunities for the future development of occupational safety and health.

The phenomenal development of trade transactions across the globe has resulted in the introduction of newer processes and newer chemicals hitherto unheard of in developing countries. This a cause for serious concern and the entrepreneurs and the health and safety personnel have to take appropriate steps to prevent calamities in future. Ergonomics is an essential factor to be taken into consideration. If the operator has appropriate conditions with regard to temperature, lighting, ventilation, cleanliness, workload etc, the probability of human error decreases significantly. As a result, many enterprises now consider their policies for improving working conditions as a key element in their policies for improving quality.
1.2 WORKING CONDITIONS

The first precaution to avoid accidents is the elimination of potential causes, both technical and human. The observance of technical rules and standards, careful supervision and maintenance, safety training for all workers, and the establishment of good working relationships makes the working conditions conducive.

Dangerous operations (for example, those resulting in environmental pollution or producing noise or vibration) and harmful substances which may contaminate the atmosphere at the workplace should be replaced by harmless or less harmful operations or substances. Where group technical measures and administrative measures do not reduce exposure to acceptable levels, workers must be provided with suitable personal protective equipment.

The four basic methods of controlling Occupational Hazards classified by decreasing order of effectiveness are,

1. HAZARD \( \rightarrow \) INDIVIDUAL Elimination of Hazard

2. HAZARD \( \rightarrow \) [INDIVIDUAL] Removal of the individual from the exposure

3. [HAZARD ] \( \rightarrow \) INDIVIDUAL Isolation of the Hazard

4. HAZARD \( \rightarrow \) [INDIVIDUAL ] Protection of the Individual

An accident is often the result of combination of technical, physiological and psychological factors. It depends on both the machine, the environment (Lighting, Noise, Welding Fumes, Oxygen Efficiency ), posture and work-induced fatigue. But it is also due to activities outside the plant – ill
temper, feelings of frustration, youthful exuberance and other specific physical or mental states.

1.3 WELDING SAFETY

Welding is one of the most widely used metal fabrication methods. There are a large variety of welding and allied processes used within modern industry. In general welding processes can be divided into the two basic categories of fusion welding and solid-state welding. These various processes differ in the manner with which heat, pressure or both are applied and in the equipment used for that process.

Safety is assured by choosing equipment complying with the relevant standard. It must be admitted that welders are exposed to potential hygienic hazards associated with welding fumes and gases when they work in ill-ventilated areas over a prolonged period. Shop management must be aware of such hazards, and must provide safe and healthy working conditions to their welders. Constant inhalation of certain constituents of welding fume and gas over a period can be eventually harmful to the lungs and other organs of the human body. Figure 1.1 shows human lungs with its parts.

![Diagram of the nose, mouth, and lungs](image)

**Figure 1.1 Schematic Drawing of the Nose, Mouth, and Lungs**
The ultimate toxicity of a constituent depends primarily on its concentration and the physiological response of the human body. The constituents of welding fumes and gases are either particulates or gases. Particulates get deposited in the lungs; this condition is termed pneumoconiosis.

Figure 1.2 Blown-up Schematic of the Alveolus Showing Passage of Oxygen entering blood stream and CO₂ coming out

Figure 1.2 shows how the Oxygen from the inhaled air enters blood stream and Carbon Dioxide (CO₂) coming out. From this, it is understood that any toxic material of fine particles, if inhaled through air will be deposited in alveous of lungs. Prolonged exposure to the various toxic gases generated during welding can produce one or more of the following effects:

1. Inflammation of the lung (chemical pneumonitis)
2. Pulmonary oedema (swelling and accumulation of fluids)
3. Emphysema (loss of elasticity of the lung)
4. Chronic bronchitis
5. Asphyxiation

1.4 ABOUT THE RESEARCH

The research scholar has worked as Production Incharge for 35 years at Bharat Heavy Electricals Limited, Tiruchirappalli, Tamilnadu, India. BHEL manufactures High Pressure Boilers to a quantum of about 6.0 lakhs Metric Tons of fabricated components to a value of about Rupees 12,000 Crores (approximately 30 Million US dollars) every year. Welding is one of the major processes involved here. Various types of modern semi-automatic welding machines with higher output are available here. The welders working here have the capacity to give Boiler Components of good quality and high productivity. But due to the welding hazards faced by them in the Water Wall Panels Production Shop and in the SAW process of the welding machines, they were unable to give quality and required output from these welding machines. Hence a thorough study is needed to analyse and eliminate these hazards.

1.5 OBJECTIVE OF THE RESEARCH

The objective of this research is as follows:

1. To analyze critically all the hazards involved in water wall panel welding practice.

2. To come out with concrete proposals to control the amount of welding fumes and radiations generated, within the prescribed Threshold Limit Value (TLV).

3. To recommend suitable personal protective equipments for the welders working in the Panel processing Machines, so
that there is considerable increase in the productivity and quality of these water wall panels.

4. To enhance improvement in working condition of the welders operating these machines.

Here a successful attempt has been made by the author by studying in detail about the hazards and measuring the quantum of fumes generated in the welding areas by Sampling Analysis and also about the existing welding radiation by UV method. Based on this study, the remedial measures have been suggested, subsequently these suggestions have been implemented in the plants and the improvements in productivity and quality have been observed and recorded.

A case study has been done on 8 panel welding machines at Water Wall Panels Welding Shop-Floors at the following four industries at Tiruchirappalli, Tamilnadu, India:

1. M/S Bharat Heavy Electricals Limited,
2. M/S Energy Engineering Enterprise,
3. M/S G.B. Enterprises