4.3.8 Hazard Controls

(i) Environmental Aspect; Air Pollution Controls

Introduction

Nowadays, air pollution from steel-making operations has affected both environmental and health hazard. In year 1987, the first WHO Air Quality Guidelines was produced (AQG, 1987) and was updated in year 1997 (AQG, 2000). Based on expert evaluation of current scientific evidence, the latest guideline is AQG 2005 was provided and currently applied worldwide.

Air Pollutions Category

The main categories (or sources) of air pollution are chemicals, particles and 'hybrids'; (1) chemical pollutants were divided in two sub-categories; gases and odors from combustion processes and the product use (2) particles; both solid and liquid. There are three sub-categories which are the particle from PM (dust, tobacco smoke), from combustion appliances (cooking stoves) and from associated with tiny organisms (dust mites, moulds, bacteria) (3) the 'hybrids' pollutants, are both chemical and particle pollutants.

Short & Long Term Health Effects

According to Kazuro *et al.,* (2005), the potential health effects depend on the number of particles in the resizable range, the dust chemical composition, concentration and duration of the exposure. The symptoms include; asthma, hypersensitivity pneumonitis and humidifier fever. Immediate effects include; (1) headaches, (2) fatigue, (3) dizziness, (4) irritation of eyes, nose, and throat. Long or repeated period effects includes; (5) respiratory diseases (6) heart disease and (7) cancer.

In preventing and controlling the exposure of air pollution, the Company has taken an aggressive approach by implementing; (1) Air Quality Monitoring (Ambient Air Quality) (2) Air Emission Control; (i) TSP and PM Sampling (ii) Dust (Isokinetic Stack and Air Emission Monitoring) and (3) Stack and Chimney Monitoring.

(a) Air Quality Monitoring (Ambient Air Quality)

Ambient Air Quality Monitoring was done regularly at the Company, every six months in order to check air pollutions' levels at the areas involved. Based on Appendix 17 and Figure 3.1- 3.6, the results were found for Ambient Air Qualities Monitored at Xx Sdn. Bhd. of point locations A1, A2, A3, A4, A5, and A6 on 24th December 2009- 30th December 2009 to be **within** the Malaysian Recommended Air Quality Guidelines.

(b) Air Emission Control;

TSP and dust are two main concerns to air pollution from plant operation at factory. Employers will ensure that all the quarterly analysis was recognized by DOE follow Standard C (Clean Air) Regulation 1978.

i) TSP (TSP and PM Sampling)

US National Ambient Air Quality Standards (NAAQS) was established the first standards for TSP in year 1971 and these standard was replaced with PM_{10} standard (150mg/m_3 24-h average and 50mg/m_3 averaged annually) in 1987. Then, a standard for particles less than 2.5 micrometers in diameter ($PM_{2.5}$) was established (65mg/m_3 24-h and 16mg/m_3 annual) in 1997. Some components of PM consist of a complex mixture of solid and liquid particles of organic and inorganic substances suspended in the air.

The examples of PM components are sulfate, nitrates, ammonia, sodium chloride, carbon, mineral dust and water. PM_{10} also can contribute to the risk of developing cardiovascular and respiratory diseases and lung cancer. The PM guideline values and identification shown in Table 4.14 below:

Table 4.14: PM Guideline Values and Identification

PM	Annual Mean	24-hour Mean	Identification
$PM_{2.5}$	10 µg/m^3	25 µg/m^3	Aerodynamic diameter smaller than 2.5 µm
PM_{10}	20 µg/m^3	50 µg/m^3	Particles with an aerodynamic diameter smaller than 10 µm

ii) Dust (Isokinetic Stack and Air Emission Monitoring)

Particle size, shape, and moisture content are three factors in contributing the different ignitability and explicability characteristic of the different dusts in the same chemical material. *"Material that will burn in air (in a solid form) can be explosive when in a finely divided form*" is a definition of dust from Cross and Farrer (1982). An Isokinetic sampler where an isokinetic means the velocity of gas entering the sampler is same as in the chimney or flue. Two main types of equipments that covered an automatic sampler for dust and aerosol monitoring (Figure 4.38) and the other one is continuous samplers.

Figure 4.38: Isokinetic Sampling Process at Factory

(c) Stack and Chimney Monitoring.

The purpose of The Stack Emission Monitoring and Control Procedure (Appendix 37) is to ensure all the stack emissions are complying with the Environmental Quality (Clean Air) Regulation 1978. The levels of SO_2, CO, NO, CO, ozone, particulates, metals, polycyclic aromatic hydrocarbons was measured by MCERTS-CAAQMS scheme.

Mitigation Measures

According to EPA (2008) the prevention in minimizing air pollution includes providing adequate ventilation, controlling the sources of pollution, practicing good housekeeping, and using product safely and appliance properly. In controlling the dust at Company, the mitigation measures was taken by using dust @ bag collection system (Figure 4.39) and the water spray (Figure 4.40), while the Stack emission monitoring and control was done at chimney according to the MCERTS-CAAQMS scheme (Figure 4.41). Other than that, some actions can be taken including increasing research and public education, promoting preventive measures, developing air quality guidelines and co-operate with government and agencies.

Fig. 4.39: Dust @ bag Collection System

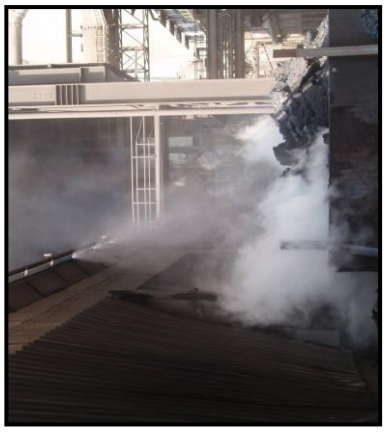

Fig. 4.40: Water Spray

Fig. 4.41: Stack Monitoring

(ii) Environmental Aspect; Noise Level

Noise refers to the jarring and unbearable noise that created in the factories and it becomes more than what we need, it is referred to as "noise pollution". Atmaca *et al.,* (2005) have stated as "*the environmental noise, is defined as displeasing sound created by humans, animals or machines, which tends to disrupt the environmental balance"*. Other than that, Melnick (1979) have defined the noise as *"The unpleasant sounds which disturb the human being physically and physiologically and cause environmental pollution by destroying environmental properties"*

Restrictions and Regulations of Noise Pollution

- ***Law of Malaysia (Act 127) EQA 1974 (No 23):***

(1) No person shall, unless licensed, emit or cause or permit to be emitted any noise greater in volume, intensity or quality in contravention of the acceptable conditions specified under section 21. (2) Any person who contravenes subsection (1) shall be guilty of an offence and shall be liable to a fine not exceeding one hundred thousand ringgit or to imprisonment for a period not exceeding five years or to both and to a further fine not exceeding five hundred ringgit a day for every day that the offence is continued after a notice by the DG requiring him to cease the act specified therein has been served.

- ***Factories and Machinery (Noise Exposure) Reg. 1989 (FMA 1989) (No.7):***

"The Regulations came into force on February 1, 1989. It was formulated under the Factories and Machinery Act, 1967, aimed at minimizing workers exposure to noise in their working environment. Regulations stipulate maximum allowable noise limits in the workplace, and worker's allowable noise exposure dosage"

Noise Control Assessment and Measures

The preventive and protection method have been taken in protecting employees from noise hazards and pollution at factory, by assessment procedure in implementing control measures such as; (1) Noise Level Monitoring (2) Appropriate Control Measures (3) Hearing Conversation Programme (4) Audiometric Test and (5) Employee's Training as in satisfying with the OSHA (1994) and the Factories and Machinery (Noise Exposure) Regulations 1989.

(1) Noise Level Monitoring

In minimizing the noise exposure to the environment, DOE has established a Guideline for Environmental Noise Limits and Control in Year 2004 which recommends the maximum permissible sound levels (LAeq) is 90 dBA for a continuous eight hours working day exposure which stipulated by The Malaysian Factories and Machinery (Noise Exposure) Regulations 1989 as legislated for OSH relating to noise at workplace.

The noise monitoring has been conducted in the Company, where an employee could be exposed to noise level at or above the action level of 85 dBA. An employee exposure monitoring will require if the intermittent and impulsive noise levels ranging are from 80 dBA to 130 dBA for determining the normal and daily exposure to noise level that was conducted by DOSH registered noise competent person. Table 4.15 below shows the allowable time exposure for occupational noise by DOE (based on the equivalent continuous sound pressure level Leq)

Table 4.15: Allowable Time Exposure for Occupational Noise by DOE

Noise Levels L_{eq}	100 % Exposure	50 % Exposure
85 dBA	16 hrs	8 hrs
90 dBA	8 hrs	16 hrs
95 dBA	4 hrs	8 hrs
100 dBA	2 hrs	4 hrs
105 dBA	1 hr	2 hrs
110 dBA	30 minutes	1 hr

Based on Table 4.15, the Environmental Noise Level Monitoring Result in Table 3.39 shows that The Equivalent Continuous Sound Level (L_{Aeq}) was found to be **exceeding** the Malaysian Recommended Limit of 70.0 dB (A) for Daytime and 60.0 dB (A) for Night time at Point N1 and N4. However, the noise created by Conduction and Vibration through air from plant machinery, were reduced and controlled by making alterations and modification in engineering design, limiting the time of exposure (administration control) or using personal protective devices.

The monitoring was divided into three parts which are the Positive, Negative and Initial. ***(a) Positive Noise Monitoring; Section 10, (FMA 1989)*** stated that *if initial employee noise monitoring results shows the possibility of any employee exposure to noise level at or above action level, determine noise exposure levels for employees engaged in same work within six month of date.* ***(b) Negative Noise Monitoring; Section 11, (FMA 1989)*** stated that *whenever there are changes in production, process, equipment, control measures in the factory within six month from date of changes.* **(c) *Initial Noise Monitoring; Section 9, (FMA 1989)*** stated that *an Employer shall carry out initial noise monitoring at workplace and must comply with the following limits; Action level - 85 dB(A), PEL - 90 dB(A), and Maximum at any Time - 115 dB(A).*

(2) Appropriate Control Measures

The noise control measures at Company was done by using technical and administrative measures that following the typical hierarchy of control by implement the (1) Engineering control (2) administrative control and (3) personal protection equipment (PPE).

(3) Hearing Conversation Programme

In order to comply with FMA (Noise Exposure) Regulation 1989, all workplaces with noise hazards (PEL equal or more than 90 dB(A)) must have Hearing Conservation Program (HCP). HCP is another programme which was conducted in the Company, with a purpose to identify the potential noise hazards exposed to the employees, the source of noise and to reduce the noise to acceptable levels (Refer Appendix 38 for Company's HCP Procedure).

The HCP' components as a primary prevention at Company includes; (1) Auditable written policy (2) Comprehensive noise exposure assessments (3) Noise control measures following the hierarchy of controls (4) Employees' education and training (5) Audiometric testing program (6) Medical evaluation and treatment (7) Provision, training and utilization of Hearing Protective Devices, and (8) Good records keeping.

(4) Audiometric Test Program

According to the interview with Mr. Mohd Zain b. Muhammad, Safety Health Officer, the DOSH authorized consultant or technician (under a supervision of registered medical practitioner) will conduct an audiometric test whereby it aims to evaluate and control noise exposure, to prevent hearing loss and to satisfy with ***Section 20, (FMA 1989);*** *An employer shall establish and maintain an audiometric, Testing Programme for all employees exposed to noise level at or above the action level.*

All employees working in non administrative area will be re-tested once every two years, as minimum basis for Audiometric Testing Program. A subsequent audiometric test was conducted: (1) annually for an employee exposed to noise level at or above the PEL specified in Regulation 5, (2) every 2 years for an employee exposed to noise level at or above the action level but less than the PEL, (3) within 3 months as a retest and annually for an employee having a standard threshold shift. The procedures of Noise Monitoring & Audiometric Test Program and Audiometric Test Form are stated in Appendix 39 and 40.

(5) Employee's Training

The training is an important part of noise control, and should be as specific as possible to satisfy with the ***Section 27, (FMA 1989);*** *an employer shall conduct training programme to ensure the participants of all employees do not exposed to noise level at or above the action level at least once in two year*. DOSH and NIOSH have approved the training centre for noise management training and this noise training may also be conducted by other training providers who have registration as Noise Competent Persons. The noise training at Company has been given on how to use, store, and maintain the hearing protection.

Summary and Mitigation Measures

The risk of hearing damage in noisy environment is depending on the characteristics of the sound, which have increased both noise level and the time spent, dependending on the individual. According to USEPA (1974), the exposure to continuous and extensive noise at a level higher than 85 dBA may lead to hearing loss. The general effect of noise on the hearing of employees has been a topic of debate for a number of years (Jansen, 1992) and Alton & Ernest (1990).

Having the continuous exposure that can result in; (1) health problems' ranges (2) causes general disturbances to the community, (3) affects the quality of life and environment (4) affects man physically, psychologically, and socially (5) damage to the sensory organs of the inner ear, which can causing the permanent hearing loss (6) also can affect hearing, (7) interferes with communication, (8) causes tiredness, and (9) reduces efficiency.

The preventive action such as proactive and comprehensive approaches had been adopted at factory such as an engineering control, administrative control and implement the PPE; (1) Engineering Control was implemented at the source that includes (1) using a machine with lower noise emissions; (2) avoiding metal on metal impacts; (3) damping to reduce noise, (4) isolating vibrating parts and (5) carrying out preventive maintenance.

Other than that, the Administrative Control implement includes (1) use of noise enclosures and barriers; spill wall (Figure 4.42) (2) limiting access to noisy locations (3) rescheduling noisy work for limited the time spend (4) implementing of control exposure. Last but not least, (3) the implementation of PPE includes; (1) Wear an ear protection includes plugs and an ear muff (2) suitable and comfortable for the job, type, level of noise, and compatible with other PPE and complies at the DOSH approved complies at the DOSH approved list.

Figure 4.42:
Spill Wall

(iii) Others Hazard Controls

In this case study, the Company has selected the suitable control in minimizing the hazards such as (1) Eliminate Control, (2) Substitution Control, (3) Engineering Control, (4) Administration Control and (5) PPE Control. This detail hazard controls were discussed during interview process with. Mr. Abdul Razak b. Ariffin, ESH Exacutive and Mr. Mohd Zain b. Muhammad, Safety Health Officer and also by site surveys and observations at factory, as summarized in Table 4.16 below. Other than that, the Control of Gases, Steam, Air and Hydraulics Procedure are shown in Appendix 41 which includes the detail item; procedures, maintenance, procedure of specific procedure of; (1) steam (2) boiler (3) Steam lines (4) Nitrogen gas (5) compressed gas cylinder (6) compressed air and (7) hydraulic control systems.

Table 4.16: Type of Hazard Controls and Preventions

NO	TYPE OF CONTROL	EXAMPLE	DETAIL PREVENTIONS
1	**Eliminate Hazards**	At the source of the hazard	Getting rid of a hazardous job, tool, process, machine or substance
2	**Engineering Control**	Automation	Computer-controlled robots to automated or mechanized the dangerous process
		Isolation	1. Refer Sec. 4.3.8 Hazard Controls- An isolating of noise in vibrating parts 2. Refer Figure 4.39- Using dust @ bag collection system 3. Air-conditioned control room to protect from a toxic chemical
		Dilution	Dilute toxic gasses by Local Exhaust Ventilation System before reach operators
		Barriers	Refer Fig 4.42- 1. Noise enclosures@ spill wall 2. Proper equipment guarding to protect employees from contacting moving parts 3. Avoiding metal on metal impacts
		Absorption	Refer Sec. 4.3.8 Hazard Controls- Baffles to block/ absorb noise emission
		Water spray	Refer Fig. 4.39- Used in control the dust
		Machine Guarding	Refer Sec. 4.3.8 Hazard Controls- Using machine with lower noise emissions
		Preventive maintenance/ system	Refer Sec. 4.3.8 Hazard Controls- 1. Lockout systems can isolate energy sources during repair and maintenance, 2. By using the detection system and enclosure/ closed system
3	**Administration Control**	Safe work procedures / instruction	Refer Appendix 29- Safe Working Measure Manual
		Emergency preparedness	Refer Sec. 4.3.4-

		and Response	Emergency Response Programme (ERP)
		Training	Refer Sec. 4.3.5- Effectiveness of Training & Program
		Signage	Refer Fig. 4.25- Signage to Avoid Accidents
		Redesign/ Job rotations	Refer Hazard Controls (Sec. 4.3.8)- Adapt work to individual and rescheduling noisy work for limited the time spend
		Housekeeping, repair and maintenance programs	Refer Appendix 30- Housekeeping and Physical Arrangement
		Supervision and training	Refer Sec. 4.3.5- Effectiveness of Training & Program
		Hygiene practice	Refer Sec. 4.4.1- PPE Street clothing were kept in separate lockers to avoid being contaminated by work clothing
4	**PPE**	Safety helmet	Refer Sec. 4.4.1- PPE Safety helmet in compliance with ANSI Z89.1-1986, MS 183:1973 or equivalent
		Safety shoes	Refer Sec. 4.4.1- PPE Safety shoes with hard toed and soled in compliance with ANSI Z41-1991 standards or equivalent
		Goggle	Refer Sec. 4.4.1- PPE Safety goggles with side shields in compliance with ANSI Z87.1-1989 standards
		Mask/Respirator	Refer Sec. 4.4.1- PPE Mouth mask and appropriate clothing in prevent dust, vapor, fume, gas
		Ear protection includes plugs and an ear muff	Refer Sec. 4.4.1 and Sec. 4.3.8 Ear plug to be worn in an area where the sound level is at or more than 85 dBA