

CHAPTER – II

MATERIAL AND METHODS

1. STUDY AREA

MIDC Shirolī is one of the industrial area near Kolhapur city. It is five kilometer away from city. There are fifty foundries present in Kolhapur, in which about 8000 workers are working. In India near about 6000 foundries are present. In foundry, variety of foundry processes are carried out i.e. making the pattern, preparation of sand, making and assembling the mould, melting and refining the metal, pouring the metal into the mould and finally removing all adherent sand and superfluous metal from the finished casting. Workers are involved in these different activities. The physiological evaluation of jobs and the study of occupational stresses, these foundry workers were selected.

In the present study attempts have been made for physiological evaluation of jobs of foundry workers and review the overall occupational environment in foundry industry, in order to observe occupational stresses in this industry if any.

2. SELECTION OF SUBJECTS

The present study was undertaken from a private foundry unit in Shirolī MIDC area. Totally 50 (fifty) workers have been assessed for the study of work physiology and stress effects and for socioeconomic information. The assessment method also included unstructured interviews and conversations with workers. A standard

questionnaire was used to collect information of workers concern with age, experience, martial status, family size, monthly income, habits, health status and health problems and information related with occupational stresses. The physiological evaluation of 50 (fifty) randomly selected workers were carried from different sections. Most of the work in the foundry unit is of repetitive type, which is carried out in shift from 8 a.m. to 5 p.m. For obtaining information and recording the results of the study, spot visits were done by visiting foundry unit. Persons working in the office were treated as control subjects (C).

3. METHODS

A) Work Place Study

- i. Sound Measurement* : Sound level at different sections in foundry unit were recorded by sound level meter. The sound level were recorded in decibels (db).
- ii. Heat* : Recording thermal data such as dry bulb temperature was made in foundry sections during working hours. Assessment of thermal load with special reference to different physiological responses of foundry workers was carried out.
- iii. Light (Illumination)* : The illumination levels at different sections inside the foundry unit were recorded by a lux meter. The illumination level recorded in lux.

iv) Foundry Dust

A) Study of Dust in Foundry Environment :

In foundry environment, the Rotorod Air Sampler was used for collection of respirable fly dust. The Rotorod Air sampler was fully described by Parkins W.A. (1957). The device relies upon the high efficiency with which small air borne particles were deposited on narrow cylinder oriented at right angle to high velocity wind. A small constant speed battery operated motor is used to whirl thin sticky coated brass rods about its axis at a constant high speed. It has been developed into a cheap, portable and high efficiency sampler with high sensitivity by Tilak (1982). Collecting arm of the model are made up of 0.159 cm (1/6 inch) square section brass rods slightly bend inwards. The verticle arm are 6 cm long and 4 cm from the axis, cellotape stucked to collecting arm and petroleum jelly was used as an adhesive on cellotape.

The sampler was operated inside the foundry shop in breathing zone of workers. The repeated sampling of silica dust done in various sections of the foundry.

Sampling Method :

The Rotorod air sampler used for studying the size of dust particles which freely fly in air of different sections of foundry. The cellotape cut into four equal parts 1.5 cm length and stuck to

brass rod of sampler. Petroleum jelly applied on cello tape and kept inside for 40 Sec., 120 sec., and 180 seconds. Then cello tape mounted on beneath the converglass with suitable mountant like glycerine jelly which has best optical properties for visual examination. Then the size of dust particles and shape observed under microscope. The size of dust particles measured by occludometer under microscope. The number of dust particles/ field of microscope measured under high power (40 X). Plate..

B) Physical Characteristics :

The physical characteristics (Anthropometric measurement) i.e. height and weight of workers were recorded with standard techniques of occupational physiology by measuring scale and weighing machine.

C) Physical Fitness :

The physical fitness of 50 selected workers were carried out by Step test by following way.

Harward Modified Step Test :

This test is used for evaluating the physical fitness of individual for selection of job. This step test is originally developed in the Harward Fatigue Laboratory, U.S.A. It is slightly modified so as to make it convenient for the short statured and aged persons.

While carrying out the test, the worker without shoes or chappels stepped up and down on stool of 45 cms height (the height of stool in Harward test is 51 cms approximately) at the rate of 30 complete steps per minute for a maximum period of 5 minutes or earlier in case of difficulty or upto their capacity. The time was counted by stop watch when worker started stepping continuously. The duration of time noted in second. The rate of stepping is regulated by a metronome.

Immediately after the exercise is over, the worker were seated on arm chair and his pulse rate were recorded from carotid pulse for a period between one minute to one and half ($1\frac{1}{2}$) minute, after exercise. The fitness score is calculated by following formula :

$$\text{Score} = \frac{\text{Duration of stepping in seconds} \times 100 \times 0.8}{5.5 \times (\text{half min. recovery pulse count recorded})}$$

Grading of score is :

Below 50	- Poor
50 to 60	- Low average
65 to 80	- High average
80 to 90	- Good
Above 90	- Excellent

All the workers were evaluated within uncontrolled laboratory condition in office room of foundry unit at Shirol.

D. Grip Strength Study :

The Grip Dynamometer is an instrument used for assessment of grip strength of an individual. The same 50 (fifty) selected workers for physical fitness were studied for grip strength by Grip Dynamometer. The grip strength of both right and left hand were recorded.

E. Physiological Responses :

The physiological responses of an individual changes with the work and working conditions of the workers were studied. Fifty (50) selected workers from foundry unit studied for physiological responses on any working day.

- i. Pulse Rate : The pulse rate/ min. of subjects were recorded from carotid pulse on any working day.
- ii. Blood Pressure : The blood pressure of subjects were recorded by sphygmomanometer on any working day by following method.

Sphygmomanometer consist of an inflated cuff attached to mercury manometer and tube connected with rubber bulb with screw to decrease pressure in the cuff. For recording blood pressure, cuff was wrapped round the left arm and stethoscope was placed on branchial artery at a middle of elbow. Pressure in cuff was raised above systolic pressure and the column of mercury was

raised rapidly above the point of systolic pressure, then air pressure in the cuff was slowly decreased with screw, equal or slightly less than systolic blood pressure. The blood from branchial artery was released during systolic and first click sound heard in artery by the stethoscope, then reading on mercury manometer noted as 'systolic blood pressure'. Again screw was loosened slowly, as cuff pressure reduced the sound became louder and finally disappeared. As sound was disappeared reading on mercury manometer noted as "diastolic blood pressure".

iii. Body Temperature :

The axial temperature of subjects were recorded on any working day. The body temperature were recorded by clinical thermometer.

iv. Lung Function Tests

a) Peak expiratory flow rate (PEFR) :

The basis of Peak Expiratory Flow Rate for the monitoring of ventilatory function was established by Wright and Mckerrow (1959).

By 1972 the Peak Flow Meter had been developed to meet the requirements of general practitioners. Its wide use in general practice revealed that unsuspected impairment of ventilatory function is very common.

These instruments have played an invaluable part in the management of asthma and chronic bronchitis by the general practitioners. They have also been used in many studies for evaluating antiasthmatic drugs.

To find out peak flow expiratory flow rate the mouth piece should be sterilized in solution of dettol or similar antiseptic. Then mouth piece is attached to mouth piece holder. The peak flow meter is brought in front of mouth in standing posture, hold in the right hand with grip. Mouth piece is inserted in mouth, lips are tightly closed and worker was told to fill up the lungs by deep breath taken forcefully and expire the air from lungs into the Wright Peak Flow Meter. The procedure was repeated three times and their mean value recorded. The PEF_R of all fifty workers were recorded and they are expressed in the table.

b) Spirometry :

The lung volumes and lung capacities of fifty (50) selected subjects from different sections of foundry were recorded on any working day. The lung volumes like Tidal Volume (TV), Inspiratory Reserve Volume (IRV), Expiratory Reserve Volume (ERV) and lung capacities like Vital Capacities (VC), Total Lung Capacities (TLC), Forced Vital Capacities (FVC) and forced expiratory volume in one second (FEV₁) values were recorded by spirometer by following way.

i. Normal Expirograph :

The spirometer was setted in the office of foundry unit. The workers were seated on arm chair comfortably. The nose clip applied on nose to tightly close the nose. The mouth of worker apply on mouth piece. For recording tidal volume, worker suggested for normal breathing then for inspiratory reserve volume worker was suggested to take large amount of air to fill up lungs and then to blow forcefully from lungs for expiratory reserve volume, the graph obtained on graph paper called normal expirograph. This experiment was repeated three times and normal, excellent graph studied for lung volume and lung capacities.

ii. Forced Vital Capacity (FVC) :

After taking normal expirograph, the worker was suggested to take air in lungs and expire forcefully into mouth piece. The graph obtained on graph paper show forced vital capacity of lungs. This procedure repeated three times and better graph was selected for calculating FVC values. Then from graph of FVC, the amount of air expired in one second (FEV_1) was calculated.

F. Hematological Examination :

The peripheral blood smears of workers from various sections of the foundry were prepared by finger puncture. A clean and sterile disposable Lancet needle was used for the purpose each time.

i. Haemoglobin Concentration :

The haemoglobin concentration was determined by making use of a Sahli's hemometer as described by Wright (1966). The hemometer consist of a standard brown glass comparator, a graduated tube, stirrer and a micropipette.

The graduated diluting tube was filed with a decinormal (0.1 N) solution of Hydrochloric acid upto 20% mark. The micropipette was filled with blood upto 0.02 ml mark. The blood column was adjusted carefully to obtain the exact amount of blood without any air bubbles. The tip of the micropipette was carefully cleaned with a cotton plug and introduced into the graduated tube so that it dipped into the hydrochloric acid solution. The blood was slowly expelled in the hydrochloric acid solution. The reaction mixture was mixed well with glass stirrer. The tube containing the blood and hydrochloric acid solution was allowed to stand for 10 to 20 minutes. Distilled water was added drop by drop, with continuous stirring, till the colour of mixture matched the standard colour of the comparator. This matching of colour was done against natural light only. The level of the fluid was noted as its lower meniscus and the reading corresponding to this level on the scale was recorded in g/ dl.

ii. Differential Leukocyte Count :

Clean glass slides were used to prepare blood smears. A drop of blood was placed in the middle of a slide, about 1 to 2 cm from one end. Another slide which was used for the purpose of spreading, was held at an angle of 30 to 45 degrees and moved backwards so that it made contact with the drop of blood. Following contact, the drop spread out along the interface of the two slides due to surface tension on completion, the spreader was rapidly moved forward creating a blood smear of 3 to 4 cm in length. The blood smear thus formed was allowed to dry. The dry slide was then completely covered with undiluted Wright's stain for 2 minutes. Double the volume of distilled water was added and mixed by gently blowing air over the surface. This diluted stain was allowed to act for 8 to 10 minutes. The diluted stain was then poured off and the slide was washed gently with distilled water. After a thorough washing, the slide was allowed to dry and then mounted for viewing. The stained blood film was initially examined under the low power of a microscope to assess the adequacy of cell distribution, the quality of stain and the overall slide preparation. Finally, the stained blood was examined under the high power of a microscope for identification of cells and to determine the cell morphology.