Chapter 1

Introduction
Exposure to atmospheric pollution is an inevitable consequence of life in modern industrialised society. The rapid growth of industry and the pollution explosion lead to a serious threat in many cities ever since 1950s. Air pollution is the result of industrialisation which is hazardous to health (Ware et al. 1981) and occur as a result of consumption of large amount of fuels by the industry for its energy (Lynn, 1976).

Exposure to high concentration of a airborne particles that are toxic (Baker and Landrigan, 1990) coming out of the industries is hazardous to the health, often insidious (Swaminathan, 1992). Manifestation of toxic effects are evidenced from organs or tissues of contact. Because of high surface area and high absorptive efficiency of lung tissue, the capturing of airborne contaminants through respiration becomes much easier (Chandrasekharan, 1992). The respiratory exchange of gases take place in alveoli through ventilation where it will have close contact with blood vessel. If anything goes wrong, the system fails to achieve its target. The ventilatory capacity integrates the characteristics of the whole respiratory apparatus, including lung, thoracic cage and respiratory muscles with their control mechanism.

Major industrial pollutants discharged into the air are carbon monoxide, hydrocarbons, nitrogen oxides, sulphur oxides and particulate matter. Sulphur oxides and particulate matter are logically grouped together for two reasons, they generally come from the same source, primarily fuel combustion sources and they act synergistical in affecting human health, each pollutant augmenting the effect of
Depending on the size, the particulate matter is divided into two categories: (1) that settle down rapidly and (2) that remain suspended in the air for longer periods.

Suspended smaller particles, aerosols, out number the large ones (Swaminathan, 1992) and can enter deepest into the lung through respiration and cause severe effects on health (Lynn, 1976). The size of the particle determines the fate (West, 1985) and effects on lung on the basis of their great mass and kinetic energy impinging on the mucous membrane of the air ways (Ferris, 1979). Inhaled dust particles deposit heavily in the respiratory tract, especially in the terminal bronchioles (West, 1985) by the process of sedimentation, impaction and brownian diffusion (Cotes, 1979).

Although the lungs offer a very large area for absorption of the noxious agents, and by virtue of the fact the respiratory tract becomes the major avenue of entry, the respiratory tract also has mechanism which work in the opposite direction, to prevent absorption. Normally, the vigorous action of hair like structures present in the mucosal surface of the trachea along with the mucoid secretion assists in trapping and removing larger particles by swallowing at the pharynx. In very dusty environments, mucus secretion may be increased so much that cough and expectoration assist in the clearance. The quality and the characteristic activity of the mucociliary system is influenced by the pollution viz., tobacco smoke, sulphur oxides and nitrogen oxides (West, 1985). Particles which are deposited in the alveoli are not cleared by the mucociliary system since it does not extend down to that level. Normal macrophage activity which helps in the engulfment of these particles can be also impaired by tobacco smoke, oxidant gases, and radiation.

Ganguli (1992) reported the response of lung towards dust particles that it depends on (1) the nature and the amount of dust and (2) the immunological reaction of the subject. The release of pollutants from industry may increase the airway resistance of workers (Strandberg, 1964).
Respiratory hazards are no longer limited to coal miners and asbestos workers (Harber and Fedoruk, 1994) but the workers in different industries such as fertilisers, chemicals, newsprints, cotton mill and radiation exposure as well.

In order to understand the efficiency of lung, the measurements of volumes of air flow, the speed and the resistance offered, etc. are to be considered. Respiratory function tests give a clear idea about the condition of the physiological function of the lung. It also offers a useful check on the severity of pulmonary dysfunction. Lung function tests include the measurement of physical characteristics such as volume or compliance. The results from these tests are determined by the volume of lungs, diameter of airways, profusion of alveolar capillaries, mobility of lung, chestwall and diaphragm and strength of respiratory muscles. These features in turn depend on age, gender of subject, structure, body mass and composition, personnel habits viz., smoking or exercise, genetic make up both racial and familial and the effects of environment and type of work (Cotes, 1979).

The presence of sulphur dust, gaseous effluents and other airborne contaminants in the environment of different industries has raised concern about the respiratory condition of the industrial workers in particular, Kerala. Hence the present work was undertaken with a view to study the physiological condition namely the respiratory status of workers in different industries in Kerala. The functional respiratory status of industrial workers are conducted effectively on standard spirometry.

Fertiliser and chemical industry of Cochin and Udyogamandal Division is highly sophisticated and automated. The different plants in such a factory would be ammonia plant, urea plant, sulphuric acid plant, phosphoric acid plant, NPK plant, etc. where various chemical processes involving high pressure and temperature are needed. Various raw materials and chemicals which are hazardous are needed for the production of chemicals including fertilisers viz., ammonia, urea, phosphoric acid, sulphuric acid, ammonium sulphate, NPK, gypsum by-products, ammonium.
chloride, super phosphate, ammonium phosphate, etc. The presence of sulphur dust, gaseous effluents, chemicals and other airborne contaminants in the factory is absorbed high in the airway, increasing the airway resistance thereby adversely affecting the respiratory function of workers. Since studies on the functional impairments of respiratory system in fertiliser and chemical industrial workers in Kerala are scanty, it was proposed to carry out respiratory function study in the two divisions of this industry.

Another point causing much concern is the risk of lung cancer due to exposure to monozite. The southern coastal region of peninsular India are well known for the rich deposits of the radioactive material, monozite. A large population of about 100,000 living in these areas at present are exposed to high levels of natural radiation. Average external radiation exposure in these areas ranged from 150 to 1500 mrem per year as compared to 80 ± 25 mrem per year in other parts of the country. Along with the monozite, rare earths contains certain elements like thorium (~ 8%) and uranium (~ 0.3%) which are used in the nuclear energy programmes. The radioactivity of monozite is thus due to the presence of thorium and uranium and their products of decay. The processing of monozite for chemical separation of rare earths fraction and thorium is carried out by rare earths plant at Udyogamandal Division, Kochi. The exposure to radiation in the workers of Rare earths factory is of great concern since these workers are at risk in developing pulmonary dysfunctions. Hence, it was designed to conduct respiratory function study in these workers also to know how far the radiation exposure affects pulmonary function.

An acute and chronic changes in respiratory function among the cotton textile mill workers have been reported due to cotton dust (Kennedy et al. 1987). Byssinosis is a respiratory disease primarily associated with inhalation of cotton dust which is characterised by tightness of chest and shortness of breath (Parikh et al. 1990). Reports from developed nations reveal that there exists chronic respiratory distresses among cotton mill workers (Christiani et al. 1986).
Hence it is of our interest to examine the respiratory function of workers of a cotton mill situated in the outskirts of Thrissur town in Kerala.

The fourth category of workers were those exposed to newsprint factory where they come in contact with sulphurdioxide, hydrogen sulphide, chlorine, other organic sulphur containing gases and wood dust during the process of pulping. Of these, chlorine, chlorine dioxide and sulphur dioxide are potentially the most harmful to the lungs. Klassen et al. (1986) reported acute exposure to chlorine gas can cause irritant response throughout the respiratory tract. The complex nature of the newsprint factory and its workers, the respiratory distress shown by them and the non availability of sufficient information leads us to examine their respiratory function.

Respiratory problems are extremely common and have great impact on the ability of many individuals to work. Under these circumstances it is our prime interest to examine the respiratory functions of workers in different industries viz., FACT, Indian Rare earths, Cotton Mill and Newsprint and relate it with the normal population.

The respiratory status of workers in each of these factories dealt separately to pinpoint or grade them depending on the severity of respiratory dysfunction.

Within the factories itself exposure to different pollutants assessed for its impact on respiratory functions.

To find out the relation between the duration of exposure and the intensity of defect in respiration.

Finally to examine the impact on smoking and age related changes, associated with industrial pollution and their implication on respiratory status of the individual.