Foreword

Genesis of the Work

Dusts have always been considered to be an unwarranted constituent of air, even though present in trace amounts. However, with increasing industrial and agricultural production, fuel burning and other types of human activity, large amounts of various particulates are being introduced into the air in high concentrations so that dusts have come to assume an alarming status as one of the major air pollutants.

In developing countries like India, where large scale utilization of mineral sources are the sure thrust for the economic progress, problem concerning the occupational exposure to dust is the most acute health hazard. The dust associated diseases have been known since long time. Asthma, pulmonary fibrosis and bronchogenic carcinomas are the main health hazards among populations exposed to asbestos and/or other mineral fibres. Because of the well documented deleterious effects of asbestos on the lung, industries have been developing other mineral fibres as a substitute for asbestos to meet an increasing need for cheap and reliable materials. Although, there is no substitute which could have all the properties attributed to asbestos, but since all properties are never required together, substitutes exist for many applications and various fractions of asbestos fibres.
can be fabricated by combination as substitute materials. Among the substitutes, wollastonite is extensively used, primarily, in the ceramic and the plastic industries and how nowadays it has also been advocated for replacement of asbestos in ceiling, floor tiles, etc. Recently it has also been used in bone surgery (Ono et al., 1988; Kitsuzi et al., 1989). Considering, its wide application, detailed research and developmental studies on wollastonite dust toxicity are urgently needed to take suitable anticipatory action to safeguard public health. To achieve this objective indepth studies on the biological reactivity of wollastonite dust in short term, in vitro model system were undertaken. In this dissertation, the author used human erythrocytes and isolated rat hepatocytes for hemolytic and cytotoxic evaluations while peripheral human blood lymphocytes were used for cytogenetic studies.

Aims and Scope of the Investigation

As no report exists on the toxicity of Indian varieties of wollastonite, present investigations were carried out to obtain informations regarding the biological reactivity of Indian wollastonite mineral fibres. For achieving at the preliminary idea, in vitro studies on hemolysis of erythrocytes by following
the release of hemoglobin under isotonic conditions could be an ideal parameter for comparative toxicity of various dusts in terms of their relative capacity to damage biomembranes. Therefore, this parameter was utilized to screen the hemolytic potency of various silicate dusts. Our studies indicate that wollastonite dusts are less hemolytic to that of chrysotile asbestos. To substantiate the findings on the hemolysis of erythrocytes, further studies were conducted with hepatocytes, which are considered to be metabolically most active cells, for cytotoxic evaluation. The release of cytoplasmic enzyme (i.e. lactate dehydrogenase) from the cells, a convenient parameter, was measured to screen the alteration in membrane permeability.

Peroxidative damage of polyunsaturated fatty acids of membrane lipids has been considered to be a major cause of membrane damage due to toxicity of xenobiotics. Therefore, in the present study lipid peroxidation in human erythrocytes and isolated rat hepatocytes was also studied. Glutathione (reduced) content was estimated in view of its protective role in oxidative damage leading to cellular lysis. Further studies on human peripheral blood lymphocytes were conducted for cytogenetic evaluations using chromosomal aberrations and sister chromatid exchanges as genetic markers.
Presentation of Thesis

This dissertation starts with the review of literature pertaining to the genotoxic studies carried out so far with silicate dusts using different cell systems, including prokaryotic and eukaryotic cells. It also comprises of thorough literature search on wollastonite, including epidemiological studies, animal experimentation and in vitro studies. Review of literature is followed by individual chapters dealing with the specific aspects of the problem and detailed description of the methodology involved. All the chapters are subdivided into introduction, materials and methods, results and discussion. Dissertation concludes with summary, where the findings are discussed in totality and their significance in the understanding of the mechanism/causative factor responsible for membrane damage is highlighted.

Conclusion

Industries are striving to explore other mineral fibres as possible replacement of asbestos due to its recognised health hazards. Among the promising substitutes, wollastonite has drawn great attention. For the toxicological screening studies of mineral fibres, short term in vitro model system are preferred over in vivo experimental animal model systems, which
normally require a longer time period. In this dissertation, wollastonite samples are evaluated for their toxicological potential using different in vitro cell systems.

The present findings, thus, evidence the fact that the wollastonite dusts are hemolytic, cytotoxic and genotoxic. However, their toxicity was less than chrysotile, the most toxic form of asbestos. Among the wollastonite samples, kemolit ASB-3 was the least toxic, followed by kemolit-N and kemolit A-60. The information presented in this thesis may be useful to take preventive measures to safeguard the health of exposed workers.