Asbestos fiber counts in work zone area of an asbestos-cement factory

Furquan A Ansari, Mohammad Ashquin, Huma Siddiqui and Iqbal Ahmad*

Fibre Toxicology Division, Industrial Toxicology Research Centre (ITRC), Mahatma Gandhi Marg, P B No 80, Lucknow 226 001

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Levels of asbestos fibers in air at work zone in asbestos-cement (AC) sheets manufacturing factory, M/s Sturdy Industries Ltd, Patiala, Punjab have been studied. Air samples were collected from fiber godown, ingredients mixing, AC sheet manufacturing and the main gate. Phase contrast and polarized microscopic observations on asbestos fibers collected on membrane filters suggests that they are chrysotile. A detailed analysis shows the prevalence of chrysotile fibers (0.04-0.07 f/cc) in the working environment. These fiber counts are less than the existing Indian Standard (0.5 f/cc) and proposed Indian Standard (0.1 f/cc).

Keywords: Asbestos – cement sheets factory, Asbestos fiber, Chrysotile, Phase contrast, Polarized light microscopy

Introduction

Asbestos is a naturally occurring hydrated mineral silicate comprising of two subgroups (serpentine and amphibole). Serpentine is represented by chrysotile and amphibole by amosite, actinolite, anthophyllite, crocidolite and tremolite. Chrysotile is curly and pliable characterized by typical scrolled structure of the layers and amphiboles are straight and rod like1. In India, asbestos is mostly used in asbestos-cement (AC) sheets and pipes, jointing, brake lining, brake shoes, clutch facing and fireproof suits. Asbestos is being used in about 3000 commercial products due to its high durability and tensile strength1. Exposure to asbestos fibre is mounting in the developing countries2. In India, about 1, 00,000 tons of chrysotile is used yearly and mostly imported from Canada, Brazil, Kazakhstan, Russia, and South Africa3. Currently, manufacture of asbestos-based products is undertaken in more than 100 countries and global production is about 27-30 million tons annually. Asbestos-based products are manufactured mostly in wet process by mixing asbestos with other ingredients. Asbestos fibers are lightweight and short in size, and get released in air at working environment mostly due to poor handling and control measures4. Chronic exposure of asbestos is reported5-7 to lead progressive pulmonary fibrosis (asbestosis), pleural plaques and effusion) and malignancies (mesothelioma and bronchogenic carcinoma).

Present study monitors asbestos counts in the occupational environment.

Materials and Methods

Study Area

Asbestos levels were monitored in the occupational environment of M/s Sturdy Industries Ltd. (factory area, 25,990 m²; plant area, 1800 m²; production, 36,000 metric tons/year), situated at village Saidpura, Dera Bassi, Patiala (Punjab), India. Factory runs in three shifts (32 workers per shift) and manufactures AC roofing sheets and accessories. Workers were found using nose masks. Workers and shift supervisor(s) were emphasized to ensure the use of personal protective measures. All ingredients used in the factory are stored separately, including imported chrysotile fiber bags. Key ingredients used are: chrysotile asbestos fiber, 8-10; Portland cement, 50; fly ash, 30-35; and water, 8-10%. Factory is equipped with pollution control devices (vacuum cleaner, dust collector, automatic bag opening machine). Automatic bag opening and wet processing reduce the chances of getting asbestos fiber airborne.

Manufacturing Processing

Chrysotile bags are automatically cut and opened in a tank, mixed with cement, fly ash and water to make thick slurry. The slurry is automatically transferred to sheet forming drum to form sheet of desired thickness,
which is then corrugated. AC sheets are now placed in heating chamber for hardening and then stripped from the templates. AC sheets are finally kept under water spray for 3-4 weeks for maturation.

Fiber Monitoring and Analysis
Sampling was done as per the standard method, IS-11450. Air samples were collected in triplicate at locations in fiber godown, ingredients mixing, AC sheet production and factory gate, using a low volume vacuum/pressure pump “XX5600002” attached with monitor “MAWPO25AC” of Millipore Corporation, USA at a flow rate (1 l/min) for 1 h. Samples were stored in upward position in sealed boxes. Membrane filters were made transparent using immersion oil for counting of fibres as per the procedure. Mounted samples were analyzed for asbestos fibers at a magnification of 400X under light microscope. Asbestos fibres (>5 μm length, <3 μm diam, and length to diam ratio >3:1) were counted after screening a minimum of 100 fields using phase contrast and polarized light microscope, Laborlux S of M/s Leica, Germany. The concentration of asbestos fibers is presented as fiber per cubic centimeter (f/cc).

Results and Discussion
Analysis of air samples gave asbestos concentrations as follows: fiber godown, 0.049-0.058; ingredients mixing, 0.058-0.089; AC sheet production, 0.039-0.060; and factory gate, 0.031-0.060 f/cc. Among locations in manufacturing area, the highest concentration was found at ingredients mixing site, which might be largely due to partly dry and wet process. Location in AC sheet production registered the lowest concentration in manufacturing area probably because of complete wet process of manufacture. Fiber concentrations were almost matching at fiber godown and factory main gate locations. Among rare reports available on fiber counts in AC industries, Institute of Public Health Engineer (IPHE), India reports high fiber concentration (0.63-2.8 f/cc) in an AC production factory. The concentrations monitored at different locations in working environment of present AC factory are less than the existing Indian Standard (0.5 f/cc).

Asbestos exposure mostly occurs to workers engaged in asbestos mines, asbestos mills and asbestos-based product manufacturing industries. Occupational exposure through inhalation is the most hazardous to industrial workers. During asbestos-based industrial activities (mining, milling or manufacturing), asbestos fibers get airborne at work places and thus pose a risk of respiratory exposure to industrial workers. Chrysotile fibers remain suspended in ambient air for long time due to their small size and lightweight. The presence of fibers in the surrounding environment may be due to emissions of asbestos fibers during improper handling and processing and also may be from transportation and waste disposal. Asbestos exposure also occurs in the population living near asbestos sources. Notably, adverse health effects are directly correlated with the concentration and the period of asbestos exposure of occupational or non-occupational nature.

Asbestos fibers airborne at occupational environment are considered critical in the assessment of industrial hygiene status of asbestos-based industries. In India, about one lakh people are reportedly exposed to asbestos at different work places. Considering the commercial scope of AC products for industrial and agricultural growth required in India, solution lies in safest use of asbestos by ensuring implementation of regulatory guidelines in the strictest possible manner.

Conclusions
Asbestos fibers invariably prevail throughout the occupational environment of asbestos-cement sheet manufacturing industry. A continuous monitoring on industrial hygiene and further improvement in pollution mitigation technology are desired to achieve safest working conditions in asbestos-based industries in India.

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