Asbestos and Its Toxicological Concern

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Asbestos or amianthus are a mixture of six or more fiber crystals such as amosite, amphibole, chrysotile (this alone contributes 90% of production all over the world), crocidolite, serpentine and other asbestiform materials (e.g., actinolite, richterite, tremolite and winchite) which were mixed with cement and can be molded and worn into fabrics. The chemical form of asbestos contains silicon, oxygen and minerals such as silicate compounds. Usage of asbestos begins more than 4000 years before (become familiar during the World War II). The commercial application was adopted from the 19th Century and continued usage found to be a primary concern of elevated air pollution in the developing parts of the world. Application of asbestos has been banned and restricted in industrialized countries based on the reports of lung related diseases by Lynch and Smith in 1935 followed by the annual report by Chief Inspector of Factories in Great Britain in 1955 [1] and numerous scientific publications relating asbestos pollution. Usage of asbestos is very general and still in the steady pace of use in developing countries (e.g., China, India, Kazakhstan etc.) due to its resistance to fire and chemicals and medium tensile strength. Consequently, asbestos has been adopted in building materials, insulating media, safety clothing for firefighters, hot water piping, floor, ceiling and roof tiles or shingles, electrical insulation, sound absorption, furnace, friction products, automobile (e.g., brake pads), gaskets, cement products, textiles, coatings, plastics, gloves, heat-resistant clothing and packaging materials. Although the 'west' banned these debatable fibers; however, some countries (e.g., Canada export >70% of India's requirement) still exports the asbestos related raw goods to the 'east' [2].

Asbestos found everywhere in the air, water and soil with minute concentrations and everyone gets exposed during the life time. Exposure of asbestos through water and soil is negligible. Its negative implications get started only during continuous exposure by occupational workers in the asbestos mining, milling and asbestos oriented occupation (i.e., cutting, drilling, trimming, and any mechanical modifications of finished or unfinished asbestos products). Besides, asbestos fibers can be detected highly in the following sectors such as asbestos fabric/textile producers, asbestos oriented materials producers, building and road construction, shipbuilding, insulation works, firefighters, demolition areas, drywall breaking, building demolition (e.g., Twin Tower, World Trade Center in New York city) and automobile industry. The finished products of asbestos do not pose any health risk to individual since air asbestos concentration remains low and intact. When it is damaged or broken during processing the tiny fibers of asbestos became airborne and can be inhaled at a significant rate. Besides, asbestos also releases fibers when it crumbled and stuck in the lungs. Therefore, after 20 to 30 years of exposure (latent period) to asbestos fibers the symptoms of lung related issues may begin.

Immediately after the inhalation, asbestos fibers have accumulated on the epithelial cell surface in the respiratory passage. Particularly, short-thick fibers (> 3mm) are settled in the upper respiratory tract, while long-thin fibers travels up to inner alveolar regions. Particles accumulate in the upper respiratory passage is transported by mucociliary action to the pharynxes, which is swallowed. On the other hand, short fibers are ingested by macrophages and removed through phagocytosis. Further longer fibers are cleared only after fragmentation, splitting or dissolution and retained in the lungs for a long time. Due to the differences in structure and length, chrysotile has high affinity to be deposited in the upper airways of the respiratory tract and also cleared efficiently from the lungs compared with amphibole fibers [3]. Shorter fibers retained in the lungs for prolonged periods and further they penetrate the epithelial cells into the lymphatic system or the blood and simultaneously reach kidney and gets excreted.

Asbestos enter into a person by breathing and deposited in lung tissues and accumulates over time and causes irritation, scarring and inflammation and eventually produces severe health implications [4-9]. Therefore, asbestos has been classified as human carcinogens. A history of asbestos exposure at occupational exposure is reported in about 70% to 80% of all cases of mesothelioma (a rare type of cancer of the mesothelium-the membrane that covers and protects most of the internal organs of the body). The main symptoms of mesothelioma of the lungs are shortness of breath, chest pain and abdominal mesothelioma include weight loss, swelling and pain in the abdomen, blood clotting abnormalities, bowel obstruction, anemia and fever. Continued exposure to high levels of asbestos in the occupational exposure scenario can also cause asbestosis (e.g., disease that can lead to disability and death and it scars the lungs and can cause the heart to enlarge). The primary symptoms of asbestosis are shortness of breath, persistent cough that produces mucus, chest tightness, chest pain, loss of appetite, dry, crackling sound in the lungs while inhaling followed by lung cancer with the symptoms of cough (including coughing up blood), wheezing, unexplained weight loss, difficulty breathing or shortness of breath, hoarseness and anemia. Clinical signs and symptoms of asbestosis include basal crackles on auscultation, dyspnea, cough and abnormal gas exchange, which may ultimately lead to death.

The prolonged asbestos fiber particle exposure is associated with severe health illnesses including pulmonary fibrosis, bronchogenic carcinoma, diffuse malignant, parenchymal asbestosis (prolonged inflammatory response stimulated by the presence of fibres in the lung, leading to fibrosis of the lung parenchyma and permanent damage to the lung system), mesothelioma of the pleura and peritoneum, pleural abnormalities such as effusions (excessive fluid collections in lung tissues and chest cavity), pleural plaques/thickening (changes in lung membrane and visceral pleura and discrete fibrous or calcified thickened areas that arise from the surface of the parietal pleura which is observed in 20 to 60 percent of the occupationally exposed

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The asbestos cancer epidemic may take as many as 10 million lives before asbestos is banned worldwide and exposures are brought to an end. In many developed countries, in the most affected age groups, mesothelioma may account for 1% of all deaths. In addition to mesotheliomas, 5–7% of all lung cancers can be attributed to occupational exposures to asbestos [14]. Based on the International Labour Office (ILO) it is required to more than 100,000 deaths/year may occur from asbestos-related disease. Other research from Australia, European countries and Japan published that the number of deaths will be maximized in and around 2020’s ranged from half to one million. Particularly, more than a million deaths will occur in developing countries. Considering those toxicological perspectives of asbestos, the immediate action of using personal protective equipment (e.g., respirable mask) is warranted for the asbestos workers which would reduce the risks of asbestos related illness. Further complete ban on this debatable airborne crystal/fiber is needed in the each country in order to provide a safe life to the individuals.

References