IDENTIFICATION OF ASBESTOS CONTENT IN BULK MATERIALS IMPORTED IN NEPAL

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Abstract: The bulk materials include the construction materials such as plaster sand gravel and cement as well as raw materials. Asbestos is the naturally occurring magnesium silicate mineral fibers which has high tensile strength, flexibility and resistance to chemicals, high temperature and stress; this is why it has been considered and used in bulk materials. These mineral fibers are needle shaped and can stick to lung tissue when inhaled and cause inflammation and serious health problems such as asbestosis, mesothelioma and lung cancer or internal fibrosis. It can be detected by simple microscopic method using mineral acid and heat treatment. The method would help in quality analysis of asbestos fiber and save from asbestos induced disease and to develop alternative materials of asbestos fiber material.

Keywords: Asbestos fiber; Bulk materials; Mesothellioma; Microscope; Silicate minerals.

INTRODUCTION

Asbestos is a fibrous mineral silicate with crystalline structure that comes from mineral rock and soil[1]. The silicate compounds contain oxygen and silicon having tetrahedral structure. World Health Organization (WHO), National Institute for Occupational Safety and Health (NIOSH), and Occupational Safety and Health Administration (OSHA) have defined the regulated form of asbestos as fibers of length more than 5 μm, diameter up to 3 μm and length to diameter ratio 3:1[2].

Asbestos is used as an additive in Bulk materials such as cement, paper, textiles and adhesive sealants. These are widely used as construction materials and various commercial products because of their low electric conductivity, high tensile strength, high flexibility, resistant to stress, chemicals and temperature[3,4]. The hardness of asbestos fiber is comparable to that of other crystalline or glassy silicate. Asbestos fibers are chemically inert, do not evaporate, in acid and neutral aqueous medium magnesium is lost from outer layer of chrysotile (*serpentine, curly shaped*). Amphibole (needle shaped) fibers are more resistance to acid attack and alkalis[5]. Asbestos content in a material can be examined using an optical 'polarizing' light microscope. Asbestos have been classified on the basis of rocks as [6].

a. Serpentine Asbestos: Chrysotile [$Mg_3Si_2O_5(OH)_4$]
b. Amphibole Asbestos**:** Amosite [$\{MgSi_8O_{22}(OH)_2\}_n$],
   Crocidolite[$\{(Mg,Fe)_7Si_8O_{22}(OH)_2\}_n$],
   Fibrous Tremolite [$\{Ca_2Mg_5Si_8O_{22}(OH)_2\}_n$],
   Fibrous Anthophyllite [$\{(Mg, Fe)_7\ Si_8\ O_{22}(OH)_2\}_n$],
   Fibrous Actinolite $\{Ca_2(Mg, Fe)_5Si_8O_{22}(OH)_2\}_n$

The fibrous structure of asbestos easily splits into thin needle like fibres that are invisible, inhaled easily which causes fatal lung as well as respiratory diseases such as: Mesothelioma: stomach, lung, or pleural cancer etc.

Asbestos mines are located in Russia, China, Kazakhstan, Canada, and Brazil. The usages of asbestos in China, India, Sri Lanka and Vietnam in 2000 to 2012 had increasing trend. However, the use of asbestos has declined in many countries as a result of increasing health concerns in the world[7]. In Nepal, the increasing demand and improvement of housing and sanitation most of the houses are made of brick, cement and concrete with toilet and water tube well[1]. Asbestos roofing is most commonly used in past due to its fire proof nature and lack of awareness, but now is of great concern due to its carcinogenic nature. However, Government of Nepal had banned the import, sale, distribute and uses of all forms of Asbestos since 22 December 2014[1].

The main objective of the study is to get aware of asbestos containing products used in the country and to minimize the adverse effects on health and environment caused by their presence.

MATERIALS AND METHODS

A large number of laboratory tools, bulk and industrial materials such as washer, ropes and other asbestos materials like wire gauze, brake shoe, grinder, mill boards, high temperature industrial plant gaskets, gloves, welding components, fabricating article etc. were selected for this study. Hydrofluoric acid, Hydrochloric acid, Ethyl alcohol, Muffle furnace, Polarized light microscope, iscope (euromex) with Objective lenses: 4X, 10X, 20X, 60X and eyepiece 10X were used for the identification of asbestos.One g of the material was considered, (for large samples that are fairly homogenous) a representative small portion for the analysis. The sample was then grounded in a mortar so that the fine fiber characteristics are not destroyed.

Figure 1: Polarized light microscope, iscope (euromex).

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The Polarized light microscopy (stereo-microscope) method relies on optical microscopy. This method cannot identify fibers less than one micrometer and has a detection limit of about one percent asbestos in bulk sample[8].

The samples were kept on a glass slide and visually examined for homogeneity of the sample, edges of emergent fibers using low-magnification stereo-microscope in a hood. The schematic procedures followed are shown as:

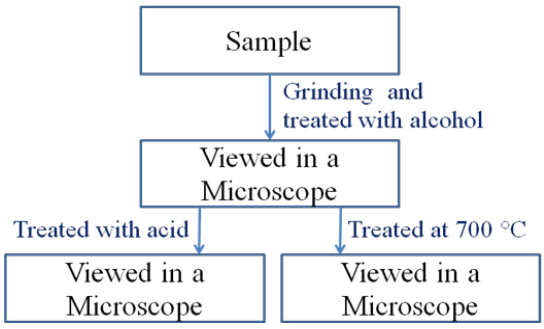


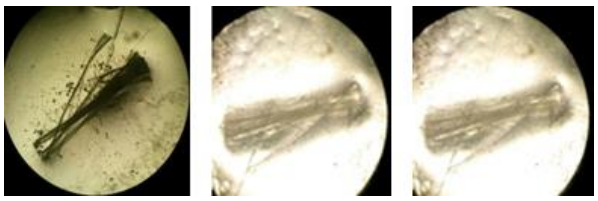
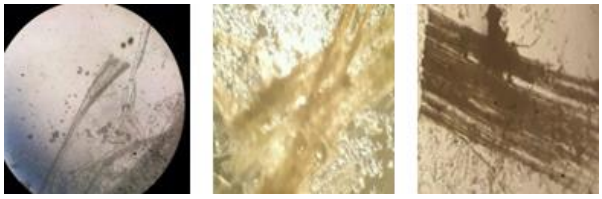
Figure 2: Schematic diagram of sample analysis for identification of asbestos content.

The presences of asbestos in bulk building materials were detected by using microscopy. A light microscope with two polarizing filter was used to observe special optical properties of asbestos fiber[9]. The use of plane polarized light passes through parallel and perpendicular allows the determination of the refractive indices along crystallographic axes morphology and color were also observed.

RESULTS AND DISCUSSION

Some common samples used in daily life are selected for Asbestos fibers content, the fiber content before and after acid as well as heat treatment were observed by Transaction Microscopic method. The images of asbestos fibers are shown as:

Table 1: Microscopic images of asbestos fibers.

Sample before treatment	Sample treated with Conc. HCl	Sample heated at 700 ºC
		
Sample A		
		
Sample B		

Sample C

Sample D

In the above Table 1, samples (A, B and C) have seen bunch of fibers, definite shape and each mini fiber parallel to each other. After treatment with concentrated HCl and heated about 700 °C but fiber did not destroy in structure (viewed with polarized light microscopy). But in many samples D, E, F, G, I, J, K, L, M and N, fibers observed but did not appear after treatment with acid and heat. These fibers may be from other sources.

When polarized light passes through parallel or perpendicular to the sample, different color absorbed by asbestos fiber observed by polarized light microscopy.

Figure 3: Microscopic viewed image of asbestos fiber when parallel polarized light passed before treatment.

Figure 4: Microscopic view image of asbestos fiber when perpendicular polarized light passed before treatment.

On the basis of above evidence, we can identify the asbestos fiber by microscopic technique with easily, cheaply, inexpensively.

CONCLUSIONS

Qualitative analysis of asbestos fiber can be carried out by microscopic method with heat and acid treatment. Asbestos fiber was not observed in the building materials being imported and submitted to test in the laboratory, Department of Customs, Tripureshwor, Kathmandu in the year 2017. However, asbestos has been detected in various laboratory tools and industrial materials such as washer, ropes and other asbestos materials like wire gauze, brake shoe, grinder, mill boards, high temperature industrial plant gaskets, gloves, welding components and many fabricating article used in iron and steel industries. Asbestos is hazardous magnesium silicate minerals fiber which causes lung cancer, asbestosis and mesothelioma

etc. Therefore, the use of materials containing Asbestos should be avoided.

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