Asbestos based brake friction material : Pros and Cons

Talegaonkar Rahul P.*, K. Gopinath**
Department of Mechanical Engineering
IIT Madras, Chennai-600036, India.
email : me04s03@iitm.ac.in,gopinath@iitm.ac.in

ABSTRACT

Asbestos fiber is considered as the miracle fiber in friction materials, since the asbestos based friction materials satisfied most of the desirable properties required. From the start of 20th century, asbestos friction materials became popular all over the world. Later, it was found that all forms of asbestos are carcinogenic. The increasing health concerns in the developed world resulted in the ban on asbestos friction materials. But, in developing countries like India, asbestos friction materials are still in use due to the boost in the automobile market and economy of the asbestos friction materials. This has necessitated to take some preventive measures to minimize the asbestos exposure in the friction material production plants as well as in the auto repair workshops. This paper deals with the pros and cons of asbestos based friction materials. The guidelines for good practices are emphasized here after survey of a number of friction materials production plants and auto repair workshops.

Introduction [1-9]

Friction materials used in brakes play vital role in its performance in controlling the speed of a vehicle and thereby ensure the safety of the vehicle and the road users. Hence, a good brake friction material should have high and stable friction coefficient over a wide range of operating temperature, contact pressure, sliding speed and humidity condition. Even though it should have high wear resistance to give a long life for the liner, it should not cause undue wear of the drum or disc. It should have high thermal and oxidation resistance as large amount of kinetic energy is converted into heat during the braking. It should have high fade resistance, fast recovery and good thermal strength. Finally the material should be economical.

At the beginning of the 20th century, asbestos based composite friction material started replacing other friction materials. This is because of abundant availability of asbestos at low cost, high thermal and corrosion resistance, low thermal conductivity, high friction against cast iron drum material, compatibility with wide varieties of drum material, low wear, high strength, excellent reinforcing properties, compatibility with a wide range of binders, availability in wide range of fibre lengths etc., Since asbestos was satisfying majority of the properties of a good brake friction material, it was acclaimed as wonder material. Additives compensated whatever lacking in asbestos as a friction material. Soon the asbestos based friction material became popular and widely used.

In 1950's, it was found that all forms of asbestos were toxic to human beings. The inhalation of asbestos can result in three types of diseases namely asbestosis, lung cancer and mesothelioma. Some studies revealed that the chrysotile (a serpentine variety of asbestos) used in friction material is not carcinogenic and during usage, it gets dehydrated and decomposed and its harmful effects insignificant. Thus, the asbestos friction material usage continued and peaked in 1970's. With availability of more medical reports, it was found that even chrysotile fibres cause asbestosis. Hence, it was banned subsequently in developed countries in the west from 1985. However, in developing countries like India ban is not imposed because the usage was not much. Further, the replacement by non-asbestos friction material is costlier and the technology was not available for its production. In India, the asbestos friction material production has increased because of the boom in automotive sector. A few concerns have started manufacturing non-asbestos friction materials. But it may take a few more years to perfect it before the ban is imposed. Till then, the use of asbestos friction-material will grow in exponential manner.

It is imperative to contain the hazardous effects of the asbestos to preserve the health our countrymen in the wake of non-restriction of asbestos usage from government side. For this purpose, the hazards of the asbestos, sources of asbestos pollution and methods of reducing the asbestos pollution and its hazards are dealt in detail in this paper.

Hazards of Asbestos [5-21]

According to International Labor Organization (ILO), when asbestos fibres have a diameter less than 3 μm in diameter and aspect ratio of 3:1 and more, there is a tendency for it to become suspended in air. US Occupational Safety & Health Administration (OSHA) considers asbestos fibers with the length greater than 5μm, diameter less than 3 μm and aspect ratio more than 3:1 as the respirable asbestos fibre and a potentially dangerous dust.

During breathing, the air from nose or mouth travels through trachea, bronchi, bronchioles to a network of air sacs called alveoli at the end of the bronchioles. Small tubes called capillaries carrying the bloods run through the walls of these alveoli as shown in Fig.1. Oxygen from air is transferred to blood and the Carbon dioxide from the blood is taken out in these air sacs. Human body is having natural filters such as nasal hairs and mucosa which helps to prevent entry of airborne particles into the lungs. Still, some asbestos particles can reach the lungs due to their minute size, high length to diameter ratio, and lightness. They settle in any of the 300 million gas exchanging structures alveoli.

Each alveolus has many cleaning cells called macrophages that eat up any particles that made it down to the alveoli. Unfortunately, the macrophages cannot eat the asbestos fibres because it is inert and too long, but they still try. In trying to eat this particle the macrophage

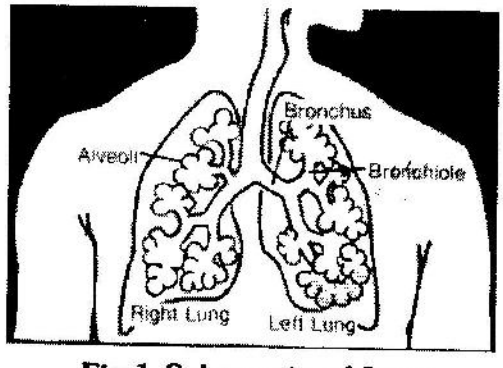

Fig.1 Schematic of Lung

essentially cuts itself open and the digestive molecules that were contained inside the macrophage have now spilled on the alveolus. These molecules injure the alveolus and cause it to form a scar. Fig. 2 shows healthy and scarred alveoli. Fig.3 shows the enlarged view of scarred alveoli. This scarring formation is called fibrosis. The same asbestos fibre that could not be eaten attracts other macrophages from neighboring areas. They try to eat the particle and also fail, and this further damages the lungs. The scar tissue asbestos fibre that could not be eaten attracts other macrophages from neighboring areas.

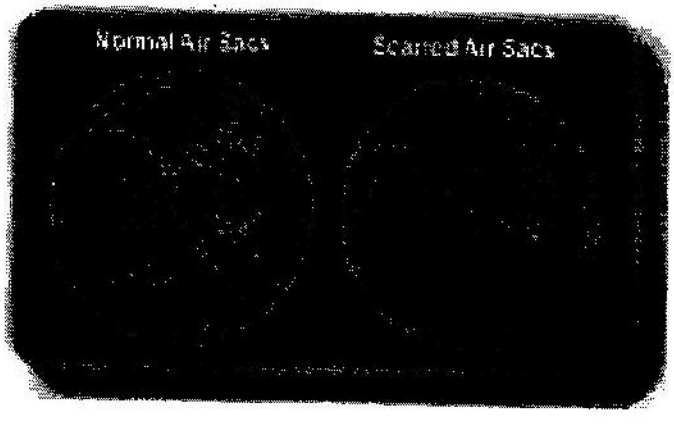

Fig.2 Normal and Scarred alveoli

They try to eat the particle and also fail, and this further damages the lungs. The scar tissue causes inflammation and thickening of the airways, which contributes to shortness of the breath. In reality, people who are exposed to asbestos inhale hundreds and thousands of asbestos fibres, which causes large-scale injury known as Asbestosis.

Fig.3 Appearance of Scarred Alveoli

The signs and symptoms of asbestosis can show up many years after the asbestos exposure has ended. Manifestations rarely occur less than 10 years following first exposure and are more common after 20 years or more. A patient with asbestosis will experience shortness of breath; persistent and productive cough, sometimes resulting in hemoptsis; shortness of breath often occurs with distressing spasms in acute state; chest tightness and chest pain; general ill feeling, fitful sleep and appetite loss.

Asbestos fibres which cause scarring of lung tissues may result in formation of tumours. Exposure of lungs further to cigarette smokes/carcinogenic gases and fumes leads to lung cancer. Mesothelioma is malignant tumour that can affect the lung, chest, or abdominal cavities. Often this disease is non-specific and can lead to delay in diagnosis. Sometimes, it resembles viral pneumonia. The latency period from the first asbestos exposure to onset of disease is generally 20-37 years or even more depending on the concentration of exposure and type of fibre. There are three types of mesothelioma. Pleural mesothelioma is a cancer of the lining of the lung (pleura), peritoneal mesothelioma is a cancer of the lining of the abdominal cavity (peritoneum), and pericardial mesothelioma is a cancer of the lining surrounding the heart (pericardium).

Pleural mesothelioma which affects the lining of the lungs, is the most common cancer. Its symptoms are breathing and swallowing difficulties, coughing, shortness of breath, fever and weight loss. The peritoneal mesothelioma which affects the abdomen is not as common as pleural mesothelioma. Its symptoms include nausea and vomiting, weight loss and loss of appetite, fever, bowel obstruction and pain or swelling of the stomach area. Pericardial mesothelioma which affects the heart and the tissue surrounding it is a rare one. Palpitations, breathing difficulties, and persistent coughing are some of its symptoms. The damage to the pleura in mesothelioma and lungs in cancer is shown in Fig. 4. The preceding figure shows healthy heart.

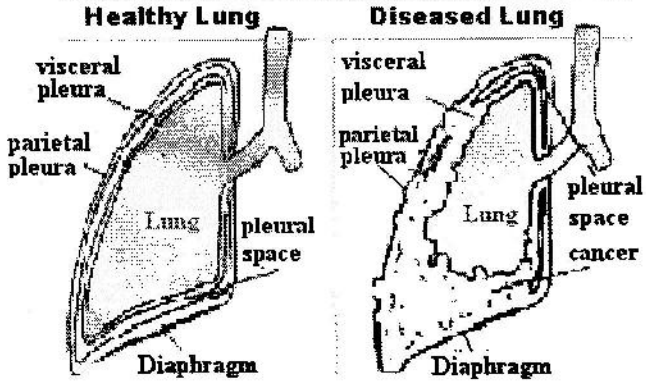

Fig.4 Mesothelioma and Lung Cancer

At this stage it is to be remembered that premium paid for insurance ensures financially better retired life whereas premium paid for exposure to asbestos leads to poor health in retired life. Thus, there is urgency in taking adequate precautions and medical care to overcome the unrestricted usage of asbestos friction material.

Sources of asbestos pollution in friction material industry [5-7]

1. Storerooms: Even though the imported asbestos fibres come in closed polythene bags, rough handling can tear the bags and spilling of asbestos fibres can cause pollution.
2. The weighing and while shifting to transfer bin. The asbestos comes in well packed polythene bags and the fibre lengths are anywhere between 3 to 5 mm. while pouring the asbestos fibre size may get reduced due to attrition and there is likelihood of dust formation.
3. Open bins or receptacles used for transportation.
4. The mixing point where the material is transferred from the bins into huller and back into bin after mixing. Due to attrition in the huller, some fibres would have undergone size reduction and may cause dust pollution.
5. The presses where the powder compaction takes place, spillage and spewing occur which may cause dust pollution.
6. Grinding shops where the cured brake liner is finished to size gives rise to maximum dust.
7. Rivet hole drilling is another major source for asbestos dust formation and pollution.
8. Worker's clothes and body are the two major sources of attraction and propagation of asbestos dust.
9. Open dumping of the waste from the factory.
10. Sweeping of the factory floor is another unintended source giving rise air borne asbestos dust.

Sources of asbestos pollution in automobile repair shops/Garages [4-7]

1. During servicing of brakes, the drum is dismantled and the wear debris of the friction material collected in the drum is blown with air. During this process, the asbestos dust becomes airborne.
2. The brake shoes are normally polished with rough emery to dislodge the glazed worn-out and oxidized particles adhering to the surface and regain its effectiveness. This cleaning process generates asbestos dust and pollution.
3. The drum is also polished with emery to remove the adhering loose particles and obtain required roughness to ensure adequate friction. This process also generates asbestos dust and air blowing for cleaning purpose leads to asbestos pollution.
4. Sweeping of the dust from the floors can be the source of the airborne asbestos.
5. Dumping yard of worn out asbestos friction materials is another source of pollution.

Guidelines for reducing the asbestos pollution and hazards [5-22]

The asbestos hazard comes mainly from inhalation of the airborne dust. The pollution problem can be tackled by reduction, propagation, extraction and conversion methods (RPEC) and following some medical and exercise routine given below:

1. The asbestos bags should be handled gently so that bag tearing and spillage can be avoided.
2. Pouring/transfer of asbestos should be done with care to prevent any spillage.
3. Bags should never be whipped / stroked as it would result in floatation of the dust.
4. Every storage and transfer points of asbestos material should have proper hoods, exhausts, cyclone and electrostatic dust collectors.

5. Always transport asbestos in closed bins or receptacles.
6. Spilled asbestos on the floor should never be swept with broom as the tendency for floating of the dust is very high. Always use vacuum cleaner to reduce the tendency for propagation of the dust.
7. The asbestos dust collected should be treated and converted into non-toxic product before disposal. The used and waste asbestos friction liners should be buried at a sufficient depth below the ground.
8. The worker should use head cover and proper dress so that dust attraction can be reduced.
9. The dresses should be vacuum cleaned and laundered within the factory premises to prevent dust propagation.
10. The worker should return home with a bath at the factory premises to prevent asbestos dust propagation.
11. Usage of industrial fans should be avoided as they can cause the floatation of asbestos dust.
12. In the auto repair shops, the brake drum and liners should be cleaned with wet cloth and vacuum cleaner.
13. All the machineries, floors and walls should be frequently cleaned with wet methods.
14. The workers should wear the respirators or masks to prevent inhalation of the asbestos dust.
15. Every worker should undergo annual medical check up.
16. The workers exposed the asbestos dust should carry out deep breathing exercise, bhastrika pranayama and kapalabathi daily as it helps in expelling the inhaled dust.

Conclusion

A large number of plus points enumerated in this paper shows that the asbestos friction materials are ideal for brake-liners. However, the carcinogenic aspects of the material have made them foe of humanity. In India, the automobile boom and non-constrains have increased the usage of asbestos. In order to safe guard the health of the ignorant workers of the asbestos industry and auto repair shops, the hazards of the asbestos dust have been high lighted and guide lines have been given to contain the asbestos dust pollution and prevention of inhalation of the dust. Some tips given regarding the breathing exercise goes long way in maintaining good health

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