Paper Number: 3521

# Physical and mineralogical characterisation of asbestos mine sites in preparation for rehabilitation

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South Africa was one of the leading producers of all three principal varieties of asbestos: chrysotile (white asbestos), crocidolite (blue asbestos), and amosite (brown asbestos). Significant deposits containing the last two varieties of asbestos are almost unknown elsewhere in the world [1]. Asbestos mining was generally conducted on a small scale basis, and informally with low technology and minimal machinery. After the decommissioning of the asbestos mining activities, negative impacts of the residues and old facilities from these activities became evident in the lives of communities residing within the mining areas. The government therefore had to take action and rehabilitate these derelict and ownerless mines. The major component of the rehabilitation programmes should involve detailed physical and mineralogical investigation of abandoned asbestos mine sites. This forms the basic part of the mine rehabilitation costs, plan and design.

Physical investigation focuses on assessing the physical structures such as excavations, shafts, adits, tailing dumps and existing mine buildings that are suspected to be asbestos containing. These structures could potentially pose a danger to both humans and domestic animals. The aim is to determine the amount and type of asbestos fibres, the distance between the source of contamination and the surrounding communities, and the extent of contamination due to wind dispersions and water erosion. The topography of each site relative to the nearby communities, extent of vegetation cover, and water rivulets leading to main streams also form part of the physical characterisation. Samples suspected of contamination are collected for mineralogical analyses.

Mineralogical investigations place further emphasis on verifying the field observations using mineralogical tools and techniques such as X-ray diffraction (XRD), optical microscopy and scanning electron microscopy (SEM). X-ray diffraction is generally used to identify the types of asbestos constituting the samples, and their relative abundance. However, XRD does not determine crystal morphology. Therefore, in the case of asbestos, XRD does not differentiate between fibrous and non-fibrous types of the asbestos minerals. The SEM technique, used together with optical microscopy, is therefore used to classify if the mineral identified is asbestiform or not. This classification is based on the ratio of the length to breadth of an individual fibre. The material is considered asbestos free if the length to breadth ratio of a fibre is less than 3:1 [2]. If this ratio is greater than 3:1, the material is considered to be asbestos containing. Optical microscopy is used to search for asbestos fibres in the samples, since they are generally small and difficult to pick out visually. The presence of asbestos fibres in each site is considered to derive from a point source of pollution, e.g., a mine adit.

The mineralogical data and physical fibre distribution inform rehabilitation activities such as appropriate soil cover, and closure of adits to prevent erosion and further accessibility. Such investigations, therefore, should form the basis of planned rehabilitation programmes around abandoned asbestos mines.

*References:*

[1] Hart H.P. (1988). Asbestos in South Africa. Journal of the South African institute of mining and metallurgy. Vol. 88, no. 6. pp. 185-198.

[2] Policy on the handling and disposal of asbestos and asbestos containing waste in terms of section 20 of the Environment Conservation Act, 1989 (Act 73 of 1989).