

Report to Client

**Sampling and Analysis of Crude Vermiculite Samples
For Possible Asbestiform Fibre and Quartz Content**

For

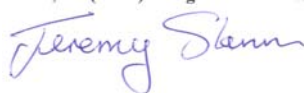
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1. INTRODUCTION

The Palabora Mining Company produces crude vermiculite from open cast mines at Phalaborwa, Limpopo Province, South Africa. The crude vermiculite is transported by rail from the mine to the port of Richards Bay on the Indian Ocean coastline of KwaZulu-Natal in South Africa. From this port it is shipped in bulk to a variety of destinations. Palabora Europe Limited stores Palabora vermiculite in both Rotterdam in the Netherlands and North Killingholme in the U.K.

In order to address concern on Health and Safety issues in the world-wide market for vermiculite, Palabora Europe have previously commissioned IOM Consulting to undertake a detailed analysis of vermiculite from the main PP & V ore body at Phalaborwa. This original study produced favourable results and has been followed up by routine screening of stocks.

The main aims were to collect representative samples from each grade of vermiculite as available in the European market, split them and analyse them at the IOM Consulting's Edinburgh headquarters for asbestiform minerals and crystalline silica. In conjunction with the usual analysis two additional samples (RSU and DDM) from South Africa were tested.

2. PROCEDURE

Mr Damien Eaves of IOM Consulting and Mr Mike Darling of Palabora Europe Limited visited the Palabora Europe Ltd vermiculite bulk store at North Killingholme Humberside, on Thursday 10th August 2006. All samples were collected by Damien Eaves of IOM Consulting. At the North Killingholme site, there are normally five different grades of vermiculite stored inside large silos of approximately 27 metres diameter and 9 metres high (Micron PP & V, Superfine PP & V, Fine PP & V, Medium PP & V and Large PP & V). At the time of this exercise there were five grades in stock and the approximate stocks at the time of sampling are summarised in Table 1.

Samples were collected from each grade as representatively as possible, by clearing away loose dust from the top of the material and digging into the stock as far as possible, avoiding any material falling in and re-mixing. A number of sub-samples per grade were extracted and mixed from each stockpile. Each sample was split on site with one sample being retained by Palabora Europe and the rest by IOM Consulting.

Table 1 Details of Crude Vermiculite Stocks at North Killingholme on 10th August 2006

Silo	Vermiculite Grade	Approx. Stock on 10 th August 2006 (tonnes)
906	Large (PP & V)	1126
915	Medium (PP & V)	106
907	Fine (PP & V)	1391
932	Superfine (PP & V)	1103
924	Micron (PP & V)	1356

3. METHODS OF ANALYSIS

3.1 Asbestos

The main objective was to identify any hazardous asbestos fibres present in the samples of vermiculite collected by IOM Consulting. This was achieved as follows:

- i) Initial examination by stereo-binocular microscopy and polarised light microscopy using methods described in HSE document HSG 248 (HSE, 2005a).

A portion of each sample was examined for the presence of fibrous asbestos minerals at X8 – X40 magnifications, using stereo-binocular microscopy. Any fibres detected, were mounted in appropriate refractive liquid and identified at 125X magnification using Polarised Light Microscopy (PLM) and dispersion staining microscopy.

This part of the analysis was carried out under IOM's external quality accreditation, awarded by the United Kingdom Accreditation Service (UKAS).

- ii) Quantitative assessment of amphibole asbestos by electron microscopy and X-ray diffractometry would normally then be carried out for samples in which asbestos fibres were detected in (i) above. In this instance, this was not done as there were no fibres identified.

3.2 Crystalline Silica

A portion of each August 2006 sample was ground up and analysed using X-ray diffraction techniques using modified versions of MDHS 101 (HSE, 2005b). Additional preparation of the 2006 Fine grade PP&V sample the Superfine, RSU and DDM were carried out to achieve a lower detection limit. Detailed method descriptions are shown in the certificates of analysis in Appendix 1.

4. RESULTS

- 4.1 Polarised Light Microscopy examinations did not detect any amphibole or chrysotile asbestos fibres present in any of the samples of vermiculite. As there were no amphibole or chrysotile asbestos fibres detected in any of the samples of vermiculite collected, quantitative analysis of the vermiculite materials was not undertaken.
- 4.2. X-ray diffractometry of the August 2006 bulk materials detected no concentrations of crystalline silica present in the samples of vermiculite.
- 4.3. For the sample subjected to chemical digestion prior to analysis by XRD, concentrations recorded were below the limit of detection for the methodology adopted.
- 4.3 A summary of results is given in Tables 2a, 2b and 2c below. Certificates of Analysis are attached (Appendix 1).

Table 2a Summary of Results August 2006 sampling exercise.

Silo Number	Vermiculite Grade	Asbestos	Crystalline Silica
906	Large (PP & V)	None Detected	None Detected
915	Medium (PP & V)	None Detected	None Detected
907	Fine (PP & V)	None Detected	None Detected
932	Superfine (PP & V)	None Detected	None Detected
924	Micron (PP & V)	None Detected	None Detected
N/A	RSU Grade	None Detected	None Detected
N/A	DDM Grade	None Detected	None Detected

Table 2b Crystalline Silica Results.

Silo Number	Vermiculite Grade	Cristobalite %	Quartz %
906	Large (PP & V)	None Detected (<0.3)	None Detected (<0.3)
915	Medium (PP & V)	None Detected (<0.3)	None Detected (<0.3)
907	Fine (PP & V)	None Detected (<0.3)	None Detected (<0.3)
932	Superfine (PP & V)	None Detected (<0.3)	None Detected (<0.3)
924	Micron (PP & V)	None Detected (<0.3)	None Detected (<0.3)
N/A	RSU Grade	None Detected (<0.3)	None Detected (<0.3)
N/A	DDM Grade	None Detected (<0.3)	None Detected (<0.3)

Table 2c Crystalline silica content of Fine grade PP&V, Superfine, RSU and DDM, after chemical digestion.

Sample	Original weight (g)	Weight after digestion (g)	Percentage Cristobalite	Percentage Quartz
Fine PP&V	1.14392	0.07831 (6.8%)	None detected <0.03*	0.05
Superfine	1.00442	0.08484 (8.4%)	None detected <0.04*	Non detected (<0.04)
RSU	1.00252	0.06925 (6.9%)	None detected <0.05*	Non detected (<0.03)
DDM	1.00451	0.2183 (21.7%)	None detected <0.09*	None detected <0.09*

* Refer to Certificate of Analysis for explanation of detection limit.

5. CONCLUSIONS

- 5.1 The vermiculite materials tested comply with the 0.1% European packaging and labelling of carcinogen (asbestos) requirements (HSE, 2002) and the 0.1% trigger value for asbestos required for labelling of hazardous materials in the UK.

The levels are also lower than the 0.001% for asbestos in loose aggregates proposed by Addison *et al* (1988) based on work at the IOM using asbestos and soil mixtures. Therefore, it is concluded that these materials or products containing them should not present a significant asbestos-related health hazard when used in controlled occupational environment.

- 5.2. Similarly with there being no crystalline silica (<0.3%) detected in six of the bulk samples, there should not be any health hazard, specifically related to crystalline silica, when the materials are used in a controlled environment.

REFERENCES:

Addison J, Davies LST. (1990). Analysis of amphibole asbestos in chrysotile and other minerals. *Ann.Occ.hyg.*; 34: 159-175.

Health and Safety Executive (2005a). *Workplace Exposure Limits 2005*. EH40/05. HSE Books, Sudbury.

Chung (1974). *Quantitative Interpretation of X-ray Diffraction patterns of Mixtures. Simultaneous Determination of a set of Reference Intensities*. Sherwin-Williams Research Centre, Chicago, Illinois.

Health and Safety Executive (2002). *Approved Supply List. Information approved for the classification and labelling of substances and preparations dangerous for supply (seventh edition)* L129 HSE Books, Sudbury.

Health and Safety Executive (2005b). "Crystalline Silica in respirable airborne dusts". Laboratory method using x-ray diffraction (direct method). *Methods for the Determination of Hazardous Substances No. 101*. HMSO, London.

Health and Safety Executive (2005). HSG 248 "Asbestos: The analyst's guide for sampling, analysis and clearance procedures." HMSO, London

Appendix 1

Certificates of Analysis