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SUMMARY REPORT

HEALTH HAZARD OF INSULATION MATERIAL
DETERMINATION OF ALPHA-QUARTZ BY X-RAY DIFFRACTION

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SUMMARY Two materials being used for thermal insulation at the Institute Plant have been determined by X-ray diffraction to contain a considerable amount of asbestos and only a small amount of alpha-quartz. High concentrations of either alpha-quartz or asbestos in the dusts produced when handling these materials would constitute a health hazard to personnel applying them.

INTRODUCTION A request was made by Mr. R. E. Peele, the Industrial Hygienist for the Institute Plant, to investigate two insulation materials, Kaylo and Thermo-Bestos, in an effort to determine the amount of alpha-quartz in each. Kaylo is supplied by Owens Corning and Thermo-Bestos is supplied by Johns Manville, Inc. These two insulators produce dusting during cutting; hence, knowledge of the concentration level of alpha-quartz as well as asbestos in these two materials is required for health hazard classification. The following discussion presents data on the determination by X-ray diffraction of the concentration level of alpha-quartz.

DISCUSSION X-ray diffraction has been used to determine the approximate concentration of alpha-quartz in thermal insulation. The presence of alpha-quartz is determined by comparing the patterns of the materials in question with a reference pattern for alpha-quartz. A standard addition technique is used to obtain semi-quantitative data.

Qualitative Analysis

Diffraction data for both types of insulation material show that there is a small amount of alpha-quartz in each with the major observable component being some form of asbestos. These

data are given in Table 1. The presence of alpha-quartz has been established by an increase in the reflection corresponding to the 101 diffracting plane of alpha-quartz when a small amount of alpha-quartz is added to the Kaylo material. The remaining reflections in the two patterns are most certainly due to the asbestos. However, asbestos can exist in several different forms or can consist of a mixture of several components. Thus, it is difficult by X-ray diffraction to determine the exact composition of the asbestos or its concentration. Despite these difficulties, the relative intensities of the asbestos reflections as compared to those of alpha-quartz indicate that two to four times as much asbestos is present.

Quantitative Analysis

A sample of blasting sand was obtained and identified as better than ninety per cent alpha-quartz. The diffraction pattern of the blasting sand matched perfectly with the pattern for pure alpha-quartz, which is reported in the "X-Ray Powder Data File". Two standards were prepared by adding one and five per cent by weight of finely ground blasting sand to the Kaylo material and mixing thoroughly. A calibration curve, shown in Figure 1, was obtained by plotting the peak height of the reflection from the 101 diffracting plane of alpha-quartz against the per cent by weight of alpha-quartz added to the Kaylo material. The curve was extrapolated to zero per cent to complete the calibration.

From the calibration curve thus obtained the weight per cent alpha-quartz in the Kaylo and Thermo-Bestos materials is, respectively 5 and 2.5. The error of this determination may be as much as 10 to 20 per cent of the contained amount, due to orientation effects and diffraction variables that have not been corrected.

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Attachments:
1 Table
1 Figure

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TABLE I

ALPHA-QUARTZ IN INSULATION MATERIAL
QUALITATIVE DIFFRACTION DATA

Kaylo		Thermo-Bestos		Alpha-Quartz (a)	
d-spacing, Å	I/I_1	d-spacing, Å	I/I_1	d-spacing, Å	I/I_1
4.24	14			4.24	25
3.61*	19				
3.34	62	3.33	40	3.33	100
3.07*	81	3.20*	25		
3.05*	100 (b)	3.05*	100		
3.03*	100				
2.99*	52				
2.796*	33				
2.755*	29				
2.492*	29				
1.835	33	1.835	40	1.816	12.5

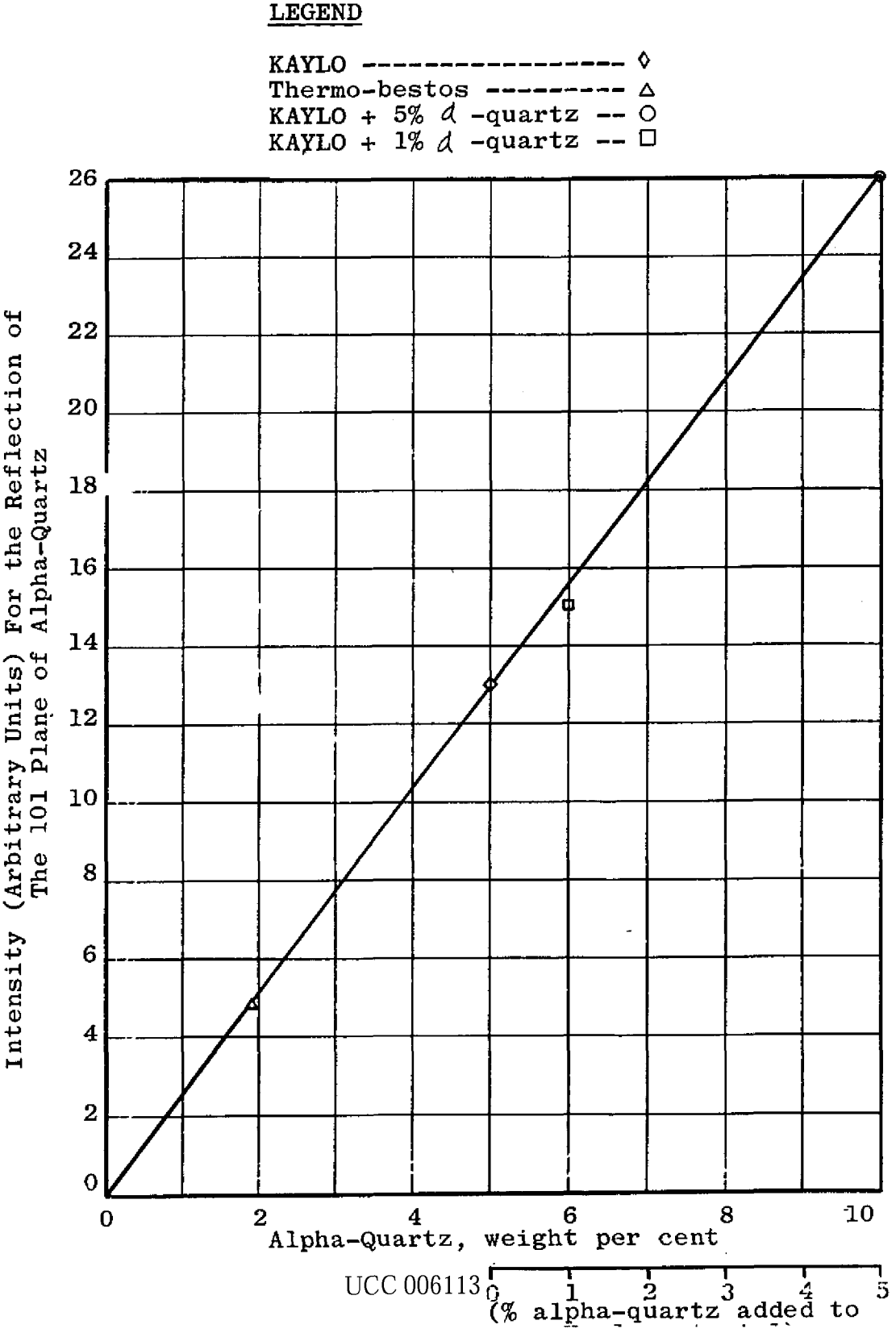
(a) There are several more spacings for alpha-quartz that have not been listed. These reflections are too weak to be detected except for material containing about 75 per cent or more alpha-quartz.

(b) Probably represents one diffuse reflection.

* These reflections are due to the components that are generally found in asbestos, i.e. various forms of calcium-magnesium,-aluminum, -etc., silicates.

ALPHA-QUARTZ IN INSULATION MATERIAL

STANDARD-ADDITION CURVE



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