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A PRELIMINARY EVALUATION OF AN ALTERNATE TEST  
TO DETERMINE THE SUITABILITY OF ASBESTOS FIBRE  
IN ASBESTOS CEMENT.

by

A. Winer

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Mines Branch Investigation Report IR 71-73

A PRELIMINARY EVALUATION OF AN ALTERNATE TEST TO DETERMINE  
THE SUITABILITY OF ASBESTOS FIBRE IN ASBESTOS CEMENT

by

A. Winer\*

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ABSTRACT

Loose-density test results, when adjusted, have been found by Lake Asbestos of Canada to correlate with results from the strength unit test but there are some discrepancies in this relationship. Since specific surface is related to the packing of the fibre and since this may be related to loose density, it seemed appropriate to investigate this relationship. Specific surface was measured by means of gas adsorption and permeability techniques.

There appears to be a relationship between specific surface, as measured by gas adsorption, and strength unit. This relationship is in two directions, i.e., between grades and groups. Also, this relationship appears to be strengthened when specific surface, derived from permeability measurements, are used.

Because of variations which are to be expected in sampling and strength-unit testing of asbestos, a much larger number of samples would have to be checked to verify the relation between strength units and specific surface. The number of samples required can be determined statistically from the data and from experience gained in the plant.

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Rapport d'investigations IR 71-73 de la Direction des mines

EVALUATION SOMMAIRE D'UN ESSAI ALTERNATIF POUR DETERMINER  
LA POSSIBILITE D'UTILIZATION D'UNE FIBRE D'AMIANTE DANS  
LA FABRICATION DE CIMENT D'AMIANTE

par

A. Winer\*

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RÉSUMÉ

Lake Asbestos of Canada a démontré qu'il existait une certaine corrélation entre les résultats ajustés d'essai de densité libre et ceux de résistance unitaire, mais cette relation présente toutefois quelques divergences. Puisque la surface spécifique est rattachée au tassement de la fibre et que ce dernier peut être rattaché à la densité libre, il a semblé approprié d'étudier cette relation. Les déterminations de surface spécifique ont été effectuées au moyen des techniques d'adsorption de gaz et de perméabilité.

Il semble y avoir une relation entre la surface spécifique mesurée par l'adsorption de gaz et la résistance unitaire. Cette relation est dans deux directions, i.e., entre les classes et les groupes. Cette même relation semble aussi renforcée lorsque les surfaces spécifiques sont déterminées au moyen de measurements de perméabilité.

Dû aux variations auxquelles on doit s'attendre dans l'échantillonnage et l'essai de résistance unitaire de l'asbeste, l'étude devrait porter sur un beaucoup plus grand nombre d'échantillons afin de vérifier la relation entre la résistance unitaire et la surface spécifique. Le nombre d'échantillons requis pourrait être déterminé statistiquement suivant l'expérience et les données obtenues à l'usine.

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## INTRODUCTION

A large proportion of milled asbestos ultimately enters asbestos cement products. A fibre strength-unit test\* , which determines the strength giving properties of specific grades of asbestos fibre in asbestos cement products, is now used by the asbestos industry but this test takes about five days to complete. The results from a loose-density test\*\* , (a form of bulk density) have been found, by Lake Asbestos of Canada, to correlate to some extent with the results from the strength-unit test. There are, however, some unexplained gaps in this relationship, consequently it is not completely satisfactory.

Since specific surface is related to packing of the fibre and since there is a test available which can measure this simply and quickly, it seemed appropriate to investigate this relationship with strength units.

## METHOD

Samples of fibre, from which portions had previously been evaluated by strength-unit and loose-density tests, were sent to the Mines Branch for investigation.

These samples were subjected to surface area measurements (gas adsorption and permeability) and the results compared.

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\* Test F-2, Asbestos Fibre Testing Procedures (1962), available from Q.A.M.A., Quebec, P.Q.

\*\* Test D-6, *ibid.*

RESULTS AND DISCUSSION

The results obtained by Lake Asbestos, from the loose-density and strength-unit tests, are summarized and shown in Table 1.

TABLE 1

Summary of Results (Lake Asbestos)  
Loose Density Vs Strength Units

Identification	Grade	Strength Indicated by:	
		S.U. Test strength units	Loose-Density Test lb /ft <sup>3</sup> **
Sample 1	6D-3	70.8	69.9
" 2	5R-3	91.9	89.4
" 3	5D-3	96.2	90.3
" 4	4T-3	104.0	99.0
" 5*	4T-3	112.1	106.3
" 6*	4T-3	110.9	106.3
" 7	4T-3	121.4	118.7
" 8	5K-4	89.4	86.4
" 9	4T-3	119.9	110.9
" 10	6D-4	62.9	58.2
" 11	5R-3	94.4	87.2
" 12	6D-3	74.5	71.3
" 13	5R-3	91.1	85.7
" 14	5R-3	95.4	90.3
" 15	4T-3	114.6	104.0

\*Samples 5 and 6 are identical, except that the fibre was processed with 7-mm openings in Sample 5 and with 10-mm openings in Sample 6.

\*\*Adjusted results by Lake Asbestos of Canada.

A scatter diagram, based on the results in Table 1, is shown in Figure 1. The relationship, as shown by the curve, is relatively good although the loose-density results, obtained from adjusted results, contain many unexplained discrepancies.

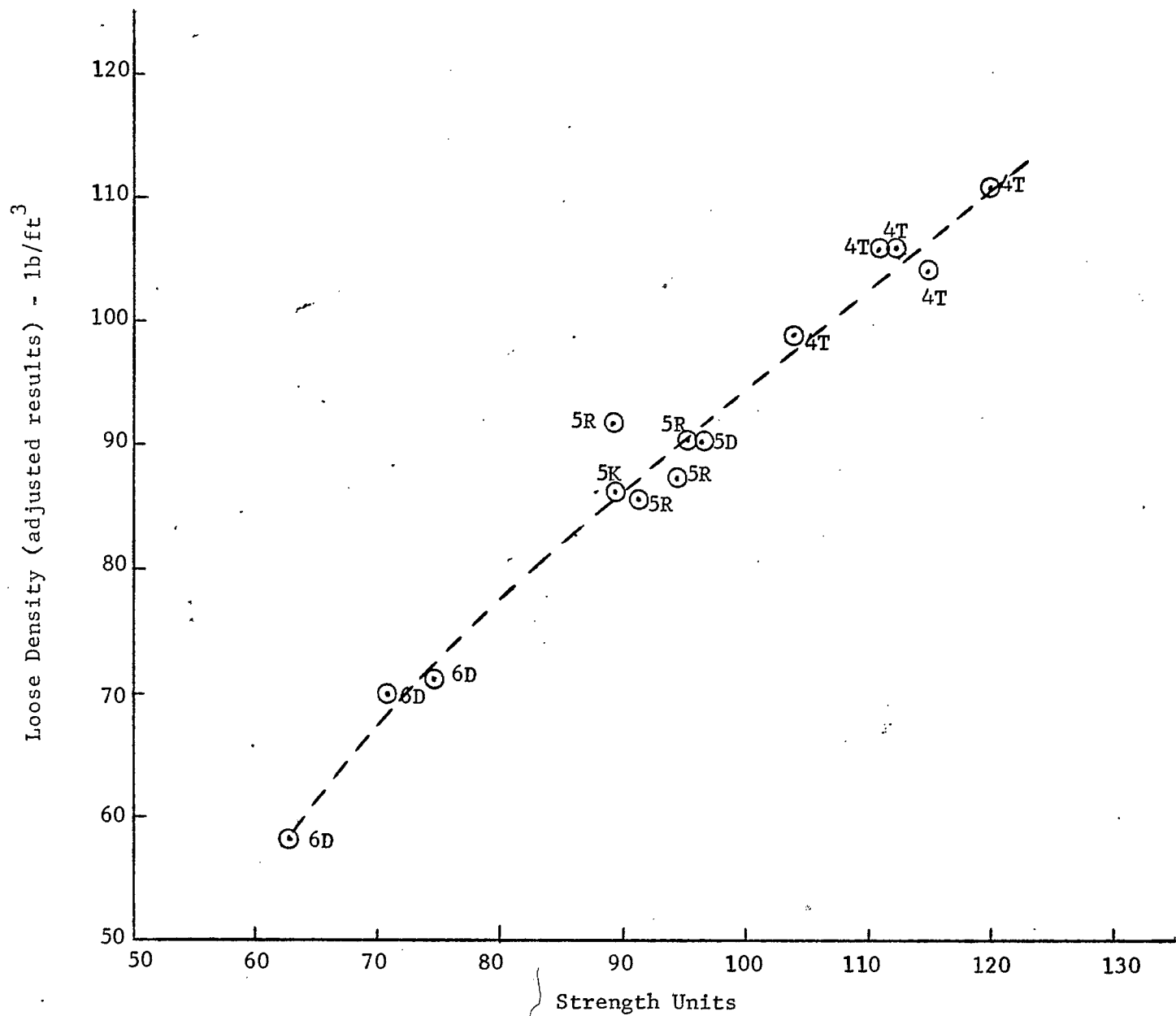


FIGURE 1 - STRENGTH UNITS vs LOOSE DENSITY  
(after Lake Asbestos of Canada)

The specific surfaces derived from gas adsorption measurements are shown in Table 2.

TABLE 2

Summary of Results  
Specific Surface Derived from Gas Adsorption Measurements

Sample No.	Specific Surface* m <sup>2</sup> /g	Sample No.	Specific Surface* m <sup>2</sup> /g
1	18.76	9	16.08
2	18.22	10	18.05
3	14.73	11	19.71
4	16.58	12	19.75
5	17.46	13	18.46
6	16.45	14	18.98
7	16.35	15	19.11
8	16.92		

\* Average of three results.

A graph of specific surface versus strength units from Table 1 is shown in Figure 2.

Although the small number of results did not warrant a statistical analysis and no definite conclusion can be made, a number of trends appear to be developing, if it be assumed that the specific surface determinations are accurate to within 0.5 m<sup>2</sup>/g. This assumption is based on many years of experience and is presumed to be valid. From Figure 2, it is evident that samples of similar grades show a relatively large deviation (approximately 2 to 3 m<sup>2</sup>/g). However, a straight line may reasonably be drawn through the results of any one grade, e.g., b-b, c-c, d-d. Samples of Grade 4T show the largest deviation. It also appears that a straight line may be drawn through the centres of the different grades, i.e., A<sub>1</sub>-A<sub>2</sub>. Thus groups and grades appear to be differentiated.

The results of specific surface determinations based on a permeability technique (Lee and Nurse) are shown in Table 3 and a graph of these results is shown in Figure 3. Table 3 also includes, for comparison, the specific surface derived from gas adsorption measurements.

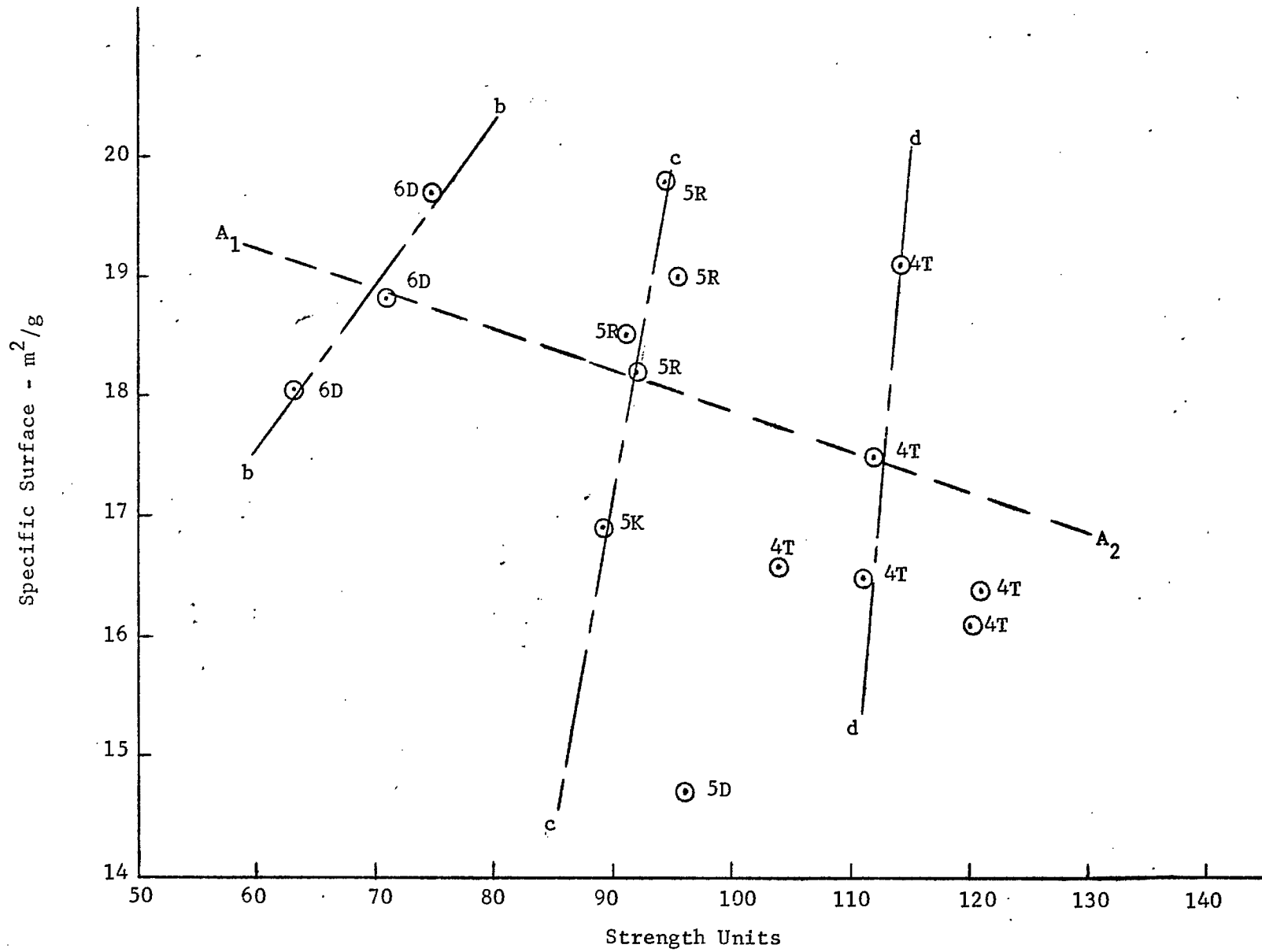


FIGURE 2 - STRENGTH UNITS vs SPECIFIC SURFACE (Gas Adsorption)



TABLE 3

Summary of Specific Surface (m<sup>2</sup>/g) Determinations  
(Permeability and Gas Adsorption)

Sample No.	Sorptometer (Gas Adsorption)	Lee & Nurse (Permeability)
1	18.76	1.69
2	18.22	1.62
3	14.73	1.57
4	16.58	1.37
5	17.46	1.35
6	16.45	1.39
7	16.35	1.42
8	16.92	1.54
9	16.08	1.37
10	18.05	1.55
11	19.75	1.62
12	19.71	1.85
13	18.46	1.58
14	18.98	1.62
15	19.11	1.35

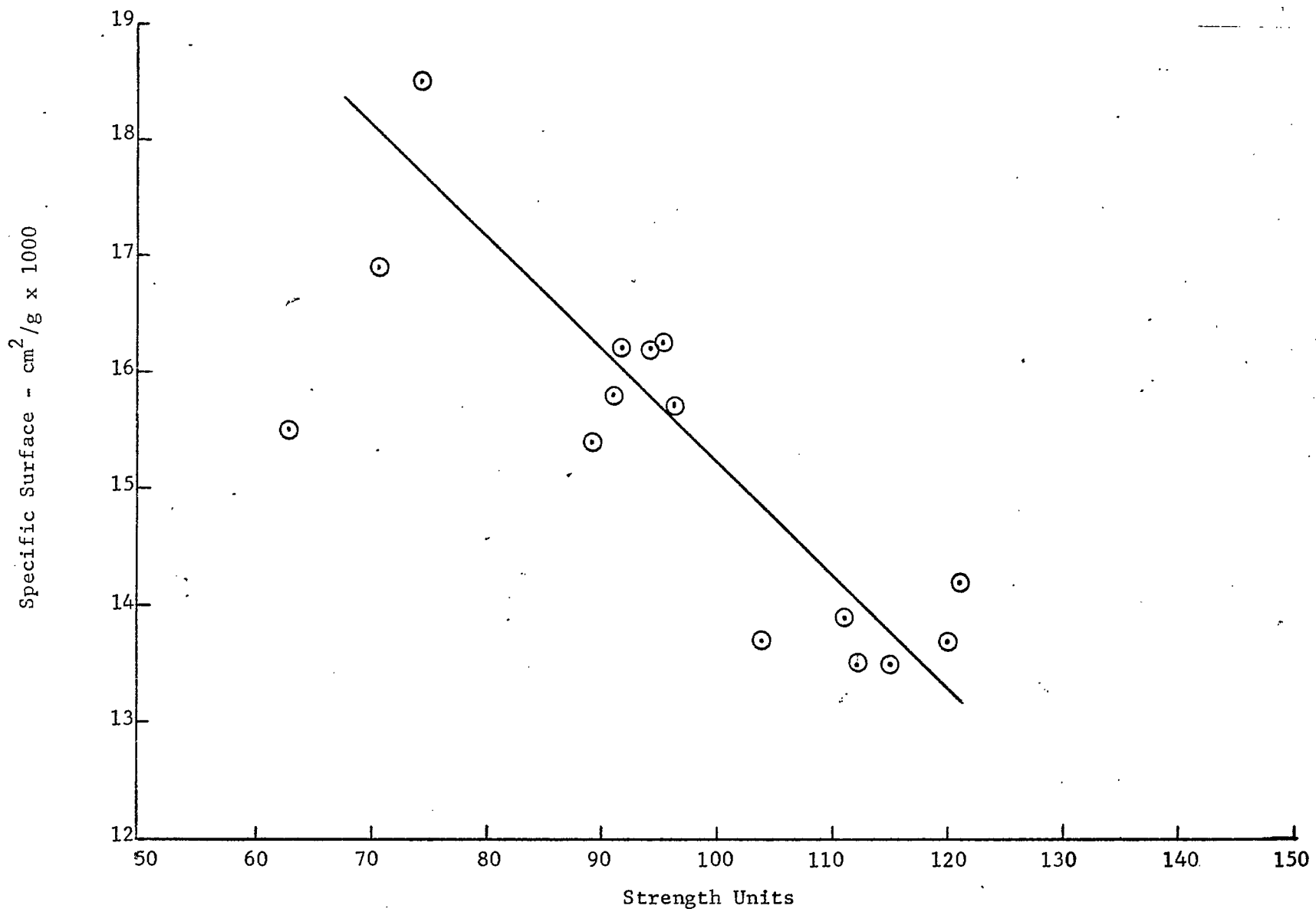


FIGURE 3 - STRENGTH UNITS vs SPECIFIC SURFACE (Lee Nurse Permeability)

Since permeability results are known to relate to the degree of separation of the fibre, one would expect that loose density would also be related to permeability. The curve in Figure 3 derived from the permeability data in Table 3, shows this assumption to be valid, although there are not enough results to make a valid statistical analysis. Furthermore, the deviation of results are less than those in Table 2. It is possible that the scatter of results may be partially due to sampling and to deviations of the results in strength-unit testing.

Definite conclusions cannot, of course, be made because the samples were too few for this study. However, we believe it would be worthwhile to record and statistically analyze the results obtained from strength-unit testing and permeability (e.g., rapid surface area test\*) as well as loose density. Since these results are recorded as a matter of course in plant quality control, more valid conclusions might be based upon the statistical analysis of say 200 to 300 results.

#### SUMMARY AND RECOMMENDATIONS

There appears to be a relationship between specific surface, as measured by gas adsorption, and strength units. This relationship is in two directions, i.e., between grades and groups. Also, this relationship appears to be strengthened when specific surface, derived from permeability measurements, are used.

Because of variations which are to be expected in sampling and strength-unit testing of asbestos, a much larger number of samples would have to be checked to verify the relation between strength units and specific surface. The number of samples required can be determined statistically from the data and from experience gained in the plant. Since there is now much data available in the files of Lake Asbestos of Canada, additional testing may not be necessary, and the data recorded over, say, one or two years could be assembled and statistically analyzed. This analysis could be performed at the Mines Branch.

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\* Test D-3. Asbestos Fibre Testing Procedure (see page 1).