



E. I. DU PONT DE NEMOURS & COMPANY
INCORPORATED

WILMINGTON, DELAWARE 19898

TEXTILE FIBERS DEPARTMENT

cc: C. B. Patterson - Emp. Relations
G. E. Lang - Louviers
J. F. Morgan - Haskell Lab.

March 2, 1971

O. WALDKIRCH	- CAPE FEAR	W. J. MANEY, JR.	- MARTINSVILLE
W. M. READING, JR.	- KINSTON	R. L. MYLES	- CAMDEN
M. E. BUCHANAN	- OLD HICKORY	J. C. JACKS	- WAYNESBORO
F. C. MINER	- SEAFORD	W. B. JONES	- SPRUANCE
W. D. RHODES, JR.	- CHATTANOOGA	G. R. COULTER	- CHESTNUT RUN

THERMAL INSULATION

Last year, a joint study was conducted between the Materials Engineering Group of the Engineering Service Division and Haskell Lab. to determine the comparative dustiness of several insulating materials and to appraise the relative health risk incurred while using these materials. Attached is a copy of Haskell's research project MR-1311, covering their responsibility in the program. Attached also, is a letter from G. E. Lang to the writer, giving supplemental information that should be of interest in your program to reduce health hazards from insulating materials.

In connection with asbestos dust control, there has long been a search for an acceptable disposable dust respirator. It has come to our attention that a new disposable dust-mist respirator has been developed by the Safety Products Division of the American Optical Corporation. This respirator has been approved by the U.S. Bureau of Mines under Schedule 21-B. A copy of an article appearing in the winter, 1970 issue of the Mt. Sinai School of Medicine Quarterly Journal is attached for your information.

Inquiries by our Purchasing Dept. indicate that the subject mask in question is called "Dust Demon" and can be ordered as Catalog #R-1040 from any American Optical distributor or agent. They are packed 24 to a carton and the prices quoted are as follows:

1 - 5 cartons	\$39.60/carton
6 - 11 cartons	\$36.00/carton
12 - or more	\$32.40/carton

RECEIVED

MAR 4 1971

HASKELL LABORATORY

RBH:jg
Attach.

MANUFACTURING DIVISIONS
J. A. Sigman
Division Engineer

Per
R. B. Hayden

BETTER THINGS FOR BETTER LIVING ... THROUGH CHEMISTRY

DUP 0901624

SC-DP-03395

EMPLOYEE RELATIONS DEPARTMENT
MEDICAL DIVISION
HASKELL LABORATORY FOR TOXICOLOGY AND INDUSTRIAL MEDICINE

DATE February 5, 1970

TO: GEORGE E. LANG, III
ENGINEERING SERVICES DEPARTMENT
ENGINEERING DEPARTMENT

MEDICAL RESEARCH PROJECT NR- 1311 PART 1

TITLE: DUSTINESS OF INSULATING MATERIALS

Authority is requested to undertake the investigation identified above and described as follows:

Haskell Laboratory proposes to participate with the Engineering Services Division in a study of the comparative dustiness of 8 or 10 commercial insulating materials. The Haskell Laboratory participation will consist of planning a study of the characteristics of these materials with respect to the dissemination of dust during their processing and handling. The tests will be carried-out at the Engineering Test Center using mainly the manpower of the Engineering Department. Haskell Laboratory will arrange for the necessary chemical and physical analyses of the dust obtained from these materials. Haskell Laboratory will participate in the analyses of results and the preparation of a final statement of conclusions.

If the results of this investigation indicate that additional studies should be included, a Part II will be submitted.

NOTE: The report should be addressed to G. E. Lang, ISD.

It is requested that the cover or first page of the report have a statement requested by the Materials Engineering Group of ISD as a part of the Company Thermal Insulation Program.

.....not to exceed.....
Amount requested \$ 2,000. Work to be started upon approval
Previously authorized - Request for study made by J. F. Morgan
Expended to date - as a result of discussions with G. E. Lang,
Account to be charged 260020-100

.....
If this request meets with your approval, please enter the account to be charged, have two copies authorized and return them to Employee Relations Department, Control Division, Accounting Section, Room N-12504. The additional copies may be retained for your information and distribution.

Proposed by _____
Assistant Director, Haskell Laboratory

Approved for Employee
Relations Department:

George E. Lang III Authorized April 12, 1970

DUP 0901625

Approved SAH

CARNEGIE-MELLON UNIVERSITY
MELLON INSTITUTE
RESEARCH SERVICES

X-Ray Diffraction Laboratory (7615-4)

Fellow Dr. James Morgan Account No. Hashell Lab Dupont Company
Investigation Analysis of Dust
Investigation No. IX NATURE OF REPORT Preliminary Progress XX
Date of Report July 9, 1970 Final

The four samples have been analyzed by means of the Debye-Scherrer x-ray diffraction technique. They appear to be 100% crystalline.

<u>Sample</u>	<u>Major Constituents</u>	<u>Minor Constituents</u>
I	Grunerite	
II	Grunerite	
III Tobermorite		Grunerite
IV Tobermorite		Grunerite

2. 117 Grunerite is a type of anthophyllite asbestos and has the approximate composition $(\text{Fe}0.9\text{Mg}0.1)\text{OH}_2\text{Si}_8\text{O}_{22}$. Tobermorite has the composition $\text{Ca}_5(\text{OH})_2\text{Si}_6\text{O}_{16} \cdot 4\text{H}_2\text{O}$.

Sidney S. Pollack
Sidney S. Pollack
Fellow
X-Ray Diffraction Laboratory

SSP:jdf
R&T: 7/9/70

HASKELL LABORATORY MEDICAL RESEARCH PROJECT MR-1311

Dustiness of Thermal Insulating Materials

Introduction

The study which is reported herein is part of a study initiated by the Thermal Insulation Group of the Engineering Services Division.

Purpose

The purpose of the study was to attempt to devise a means of measuring the comparative dustiness of several competitive insulating materials in relation to the risk of injury to health during their installation, use, removal, and disposal.

The health risk in working with thermal insulating materials consists of the danger of contracting lung disease from excessive inhalation of fine dust, including, in particular, asbestos fibers. The magnitude of the danger is dependent upon (a) the amount of dust inhaled, (b) its particle size, and (c) the composition of the crystalline particles or fibers. Glossy, non-crystalline particles and fibers have not been implicated in producing lung disease.

In this study we attempted to compare the amounts of dust generated from each of the test materials when subjected to mechanical energy in a repeatable, reproducible manner, to examine the relative amounts of coarse and fine particles, (roughly the irrespirable and the respirable) and to examine the crystallinity of the fine dust by x-ray diffraction.

Methods

The tests were carried out at the Engineering Test Center by Engineering Department personnel jointly with Haskell Laboratory personnel. They were done in a small, closed room at the Center in which there was a minimum of air movement.

The thermal insulating materials that were chosen for entry into the comparative series were furnished by the Engineering Service Division. They were in the form of slabs, 2 inches thick. Mechanical energy was applied to the slab by making a series of 18-inch cuts with a circular table saw operating at a fixed speed. The cuts were timed and the times were held constant for all of the materials. The sequence that was followed in making the cuts

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and in collecting samples of airborne dust is presented in Appendix A.

Sampling Equipment.

Three series of samples of airborne dust were collected simultaneously during the sawing and another three series were collected after the dust had had time to settle out of the air. The first series consisted of a sample collected by drawing air through a millipore membrane filter (0.8 micron pore size) by means of a Unico[®] Telmatic Air Sampler; a second series was collected by drawing air through a similar filter by means of a small battery operated personal sampler of the type that has been in use in the construction division for the past couple of years. The third series of samples was collected by means of the Unico- 550 Turbinjet High Volume Air Sampler. It pulled the air first through a Model 240 Cyclone Separator. The fine fraction of dust passed through the cyclone and was deposited on Whatman No. 41 filter paper. In Appendix A, the high volume sampler is referred to as Hi-Vol and the millipore filter sampler is referred to as M. F.

Fiber Counts.

The millipore filters from both the Telmatic samplers and the construction division samplers were used for counting fibers according to the method currently in use by the U. S. Public Health Service. This is a count with a 430 x magnification, using phase contrast illumination and counting all fibers greater than 5 microns in length.

Weight Determinations.

The cyclone separators were each weighed before and after dust collection and the difference was recorded as the weight of coarse dust. Each of the Whatman filter papers was weighed before and after collection and the difference was recorded as fine dust.

X-Ray Diffraction.

The filter papers on which had been deposited the fine dust were submitted to the Chemical Physics Department, Carnegie-Mellon University, for identification of the minerals by means of x-ray diffraction.

Statement of Results

Fiber Counts.

The results of fiber counts are presented in Table 1. In this table the designation C after the Roman numeral identification of each material refers to the sample collected by the use of the

construction division sampling equipment. The fiber counts that were obtained from the millipore filter used with the Telmatic sampler during sawing are presented in Figure 1. Figure 2 gives the results obtained from the millipore filter samples collected with the Telmatic sampler after settling. Figures 3 and 4 present graphically the counts obtained from the millipore filter samples collected by use of the construction division sampling equipment during sawing and after settling respectively.

Weight Determinations.

In Table 2 are presented the results of the weighings of the cyclone separators and the filter papers with the calculated ratio of the coarse to the fine fractions. The ratios are plotted graphically in Figure 5 and Figure 6 representing the ratios during sawing and after settling respectively.

It will be noted that air volumes were not equal for all of the samples collected. It was satisfactory to calculate ratios of coarse to fine fractions with the weights that were actually obtained, but in order to make a meaningful comparison of the quantity of the fine dust generated by the sawing per unit volume of air, it became necessary to adjust the weights of the fine fractions to an equal air volume for all samples. The results are given in Tables 3 and 4 and they are plotted graphically in Figures 7 and 8.

Results of X-Ray Diffraction Analysis.

The fine fractions of dust that were deposited on Whatman 41 filter paper after passage thru the cyclone separator were submitted for analysis by means of the Debye-Scherrer technique. The results are presented in Appendix B.

It will be noted that with each material the composition as seen by x-ray diffraction remains the same for the fraction collected during sawing and that collected after settling. This rules out any selective settling of components of the mixture on a scale sufficient to influence the health effects of inhaled particles before and after settling.

The finding with respect to Unibestos is clear-cut. It consists of amosite asbestos.

In the group represented by Calsilite SS, Super-Caltomp, and Thermasil; and in the group consisting of Kaylo 20, the report states a possibility of the presence of either amosite or crocidolite. This question should be settled by reference to the suppliers because crocidolite would be less desirable from the health standpoint. There are reports of disease having occurred from relatively brief exposures in contrast to the slowly developing effects from long exposure in the case of the other asbestos forms.

If crocidolite is absent, the groups containing Calasilite SS, Super-Caltemp, Thermasil, and also Kaylo 10 STS and JM Silicated Thermobestos are about equal with respect to composition: they are all mainly a non-asbestos mineral (tobermorite) and about 10 per cent of an asbestos. Minerals like tobermorite are classed among the "inert" or nuisance particulates with respect to health effects, e.g., Portland Cement.

Kaylo 20 was found to contain a higher asbestos content, and also an unidentified crystalline material.

Comparison of Materials.

Table 5 presents a conditional ranking of the subject materials based strictly upon the numerical results of fiber counts, weights of fine fractions and the ratios of coarse to fine fractions for each material.

This classification, even when combined with the composition data, gives no clear-cut indication of superiority.

It may be reasoned that Kaylo 10 STS and JM Silicated Thermobestos, both of which have low asbestos content, performed remarkably well with respect to numbers of countable fibers and favorable weights of fines and ratios of coarse to fine.

The I&B Material and the Unibestos gave comparatively high fiber counts but were lowest in weight of fines and extremely favorable in ratio of coarse to fine fractions. It should be remembered that the fiber counts were made on whole airborne samples collected on membrane filters without prior size-separation. The I&B Material and Unibestos are apparently high in content of fibers that are countable by optics and by definition, but, when subjected to aerodynamic size separation, the dust cloud from both materials yielded extremely low weight of fines. Unibestos is less desirable on the basis of asbestos content.

Calasilite SS, Super-Caltemp, and Thermasil behaved in a similar range of performance with respect to fiber counts and weights of fine fractions. A strong point in their favor is the low asbestos content (unless it should be crocidolite).

Kaylo 20 is a favorable material with respect to fiber counts and weights of fines. More information should be sought on its asbestos content before passing judgment.

litc.
msc

1

J. F. Morgan/bjd
Haskell Laboratory
December 14, 1970

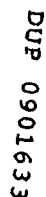
DUP 0901631

TABLE 1

RESULTS OF FIBER COUNTS

No.	Material	10 ⁶ Fibers > 5 μ per Filter	Air Volume (ml)	Fibers > 5 μ per ml
I	Unibestos	17.1	14,400	1180
I-C	Unibestos	11.8	10,400	1130
II	Unibestos	4.9	---	---
II-C	Unibestos	6.1	13,000	470
III	Thermasil	2.4	21,600	111
III-C	Thermasil	2.5	10,400	240
IV	Thermasil	2.5	24,000	104
IV-C	Thermasil	1.0	14,000	72
V	Kaylo 10 STS	1.1	22,400	49
V-C	Kaylo 10 STS	1.6	10,400	154
VIII	Kaylo 10 STS	1.0	28,000	36
VIII-C	Kaylo 10 STS	0.71	13,000	55
IX	Kaylo 20	9.5	22,400	424
IX-C	Kaylo 20	5.3	10,400	510
X	Kaylo 20	6.9	28,000	246
X-C	Kaylo 20	3.6	13,000	277
XI	JM Silicated Thermobestos	1.3	22,400	58
XI-C	JM Silicated Thermobestos	0.41	10,400	40
XII	JM Silicated Thermobestos	1.2	28,000	43
XII-C	JM Silicated Thermobestos	0.46	13,000	35
XIII	Calsilite SS	17.5	22,400	780

DUP 0901632



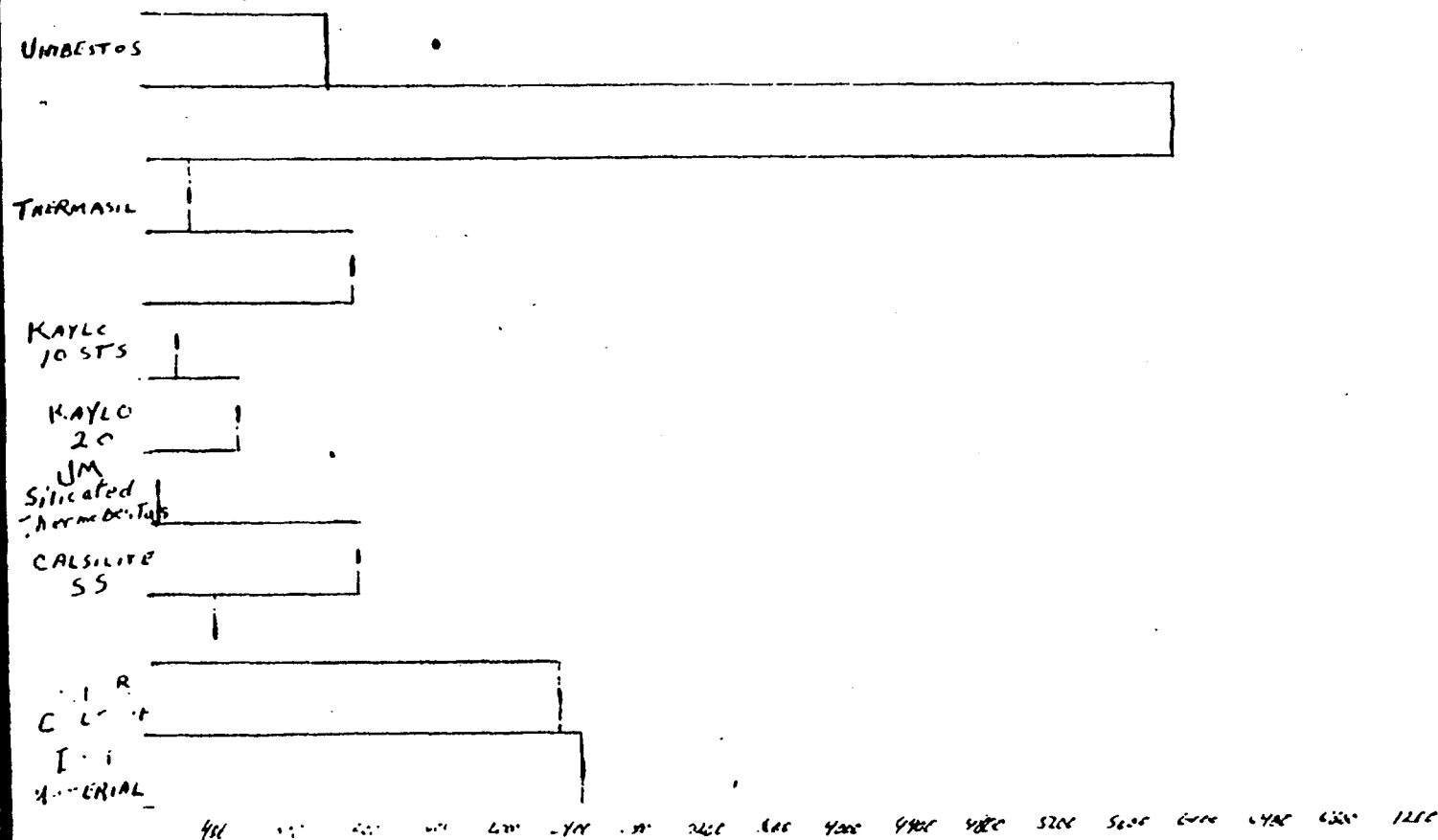
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250 251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275 276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300 301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325 326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375 376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400 401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416 417 418 419 420 421 422 423 424 425 426 427 428 429 430 431 432 433 434 435 436 437 438 439 440 441 442 443 444 445 446 447 448 449 450 451 452 453 454 455 456 457 458 459 460 461 462 463 464 465 466 467 468 469 470 471 472 473 474 475 476 477 478 479 480 481 482 483 484 485 486 487 488 489 490 491 492 493 494 495 496 497 498 499 500 501 502 503 504 505 506 507 508 509 510 511 512 513 514 515 516 517 518 519 520 521 522 523 524 525 526 527 528 529 530 531 532 533 534 535 536 537 538 539 540 541 542 543 544 545 546 547 548 549 550 551 552 553 554 555 556 557 558 559 560 561 562 563 564 565 566 567 568 569 570 571 572 573 574 575 576 577 578 579 580 581 582 583 584 585 586 587 588 589 590 591 592 593 594 595 596 597 598 599 600 601 602 603 604 605 606 607 608 609 610 611 612 613 614 615 616 617 618 619 620 621 622 623 624 625 626 627 628 629 630 631 632 633 634 635 636 637 638 639 640 641 642 643 644 645 646 647 648 649 650 651 652 653 654 655 656 657 658 659 660 661 662 663 664 665 666 667 668 669 670 671 672 673 674 675 676 677 678 679 680 681 682 683 684 685 686 687 688 689 690 691 692 693 694 695 696 697 698 699 700 701 702 703 704 705 706 707 708 709 710 711 712 713 714 715 716 717 718 719 720 721 722 723 724 725 726 727 728 729 730 731 732 733 734 735 736 737 738 739 740 741 742 743 744 745 746 747 748 749 750 751 752 753 754 755 756 757 758 759 760 761 762 763 764 765 766 767 768 769 770 771 772 773 774 775 776 777 778 779 780 781 782 783 784 785 786 787 788 789 790 791 792 793 794 795 796 797 798 799 800 801 802 803 804 805 806 807 808 809 810 811 812 813 814 815 816 817 818 819 820 821 822 823 824 825 826 827 828 829 830 831 832 833 834 835 836 837 838 839 840 841 842 843 844 845 846 847 848 849 850 851 852 853 854 855 856 857 858 859 860 861 862 863 864 865 866 867 868 869 870 871 872 873 874 875 876 877 878 879 880 881 882 883 884 885 886 887 888 889 890 891 892 893 894 895 896 897 898 899 900 901 902 903 904 905 906 907 908 909 910 911 912 913 914 915 916 917 918 919 920 921 922 923 924 925 926 927 928 929 930 931 932 933 934 935 936 937 938 939 940 941 942 943 944 945 946 947 948 949 950 951 952 953 954 955 956 957 958 959 960 961 962 963 964 965 966 967 968 969 970 971 972 973 974 975 976 977 978 979 980 981 982 983 984 985 986 987 988 989 990 991 992 993 994 995 996 997 998 999 1000 1001 1002 1003 1004 1005 1006 1007 1008 1009 1010 1011 1012 1013 1014 1015 1016 1017 1018 1019 1020 1021 1022 1023 1024 1025 1026 1027 1028 1029 1030 1031 1032 1033 1034 1035 1036 1037 1038 1039 1040 1

Figure 3

FIBER COUNTS, MILLIFORE FILTER

1 liter of air, 25.0

Countdown Division Sampler - During Drawing



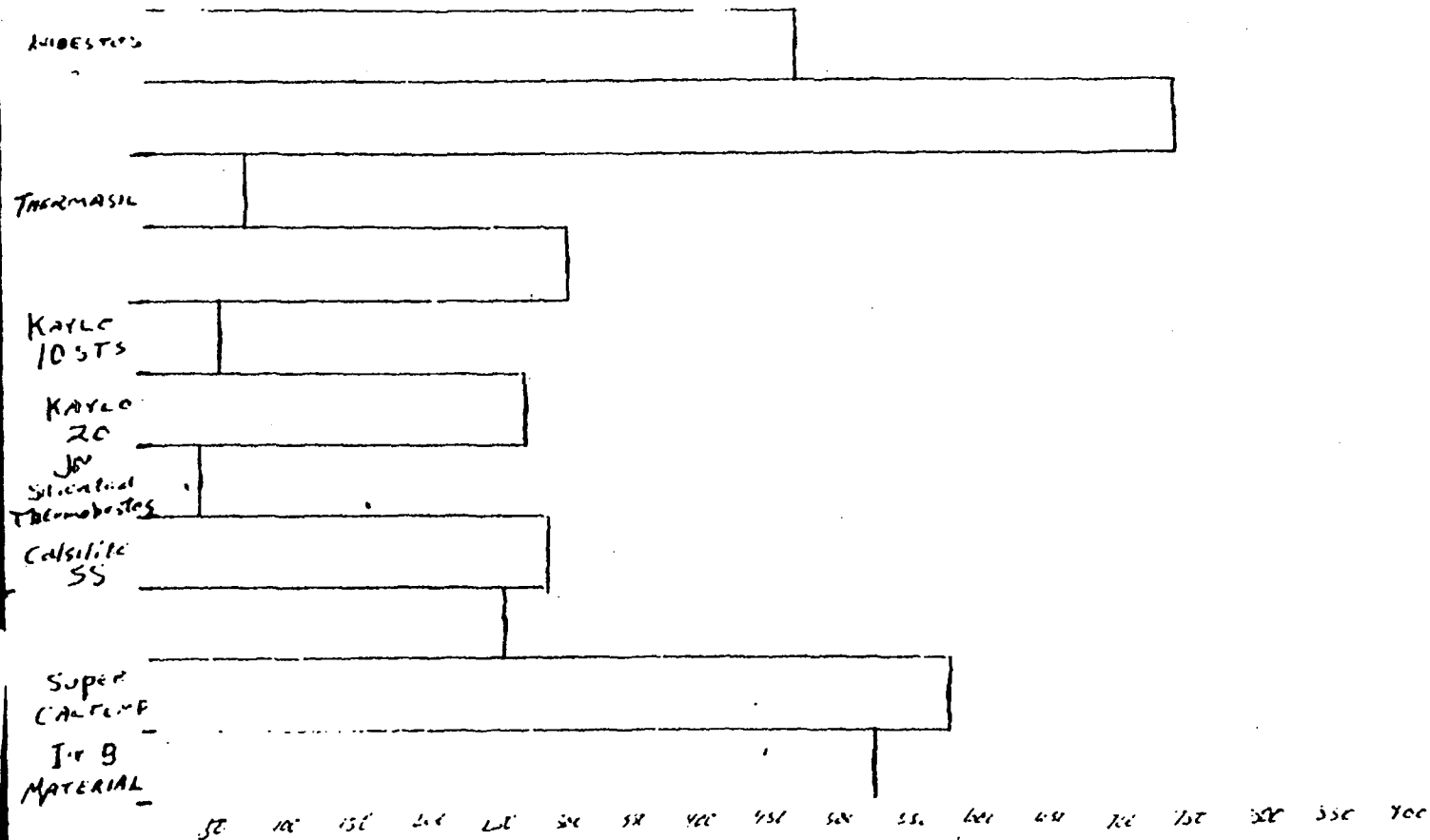
DUP 0901634

Figure 4

Index Curves, Milliken Filter

Fibers per ml, $> 5 \mu$

Construction Division Sampler - After Settling



DUP 0901635

Figure 5

VA



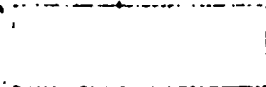
Therapy



1



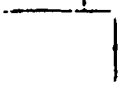
K-16040



U



CP



DUP 0901636

Figure 6

Thermal Insulation

8 inch section

UNIBESTOS

THERMASIL

KAYLO

10.575

KAYLO

2

Silicated
Thermasil

CALSILO

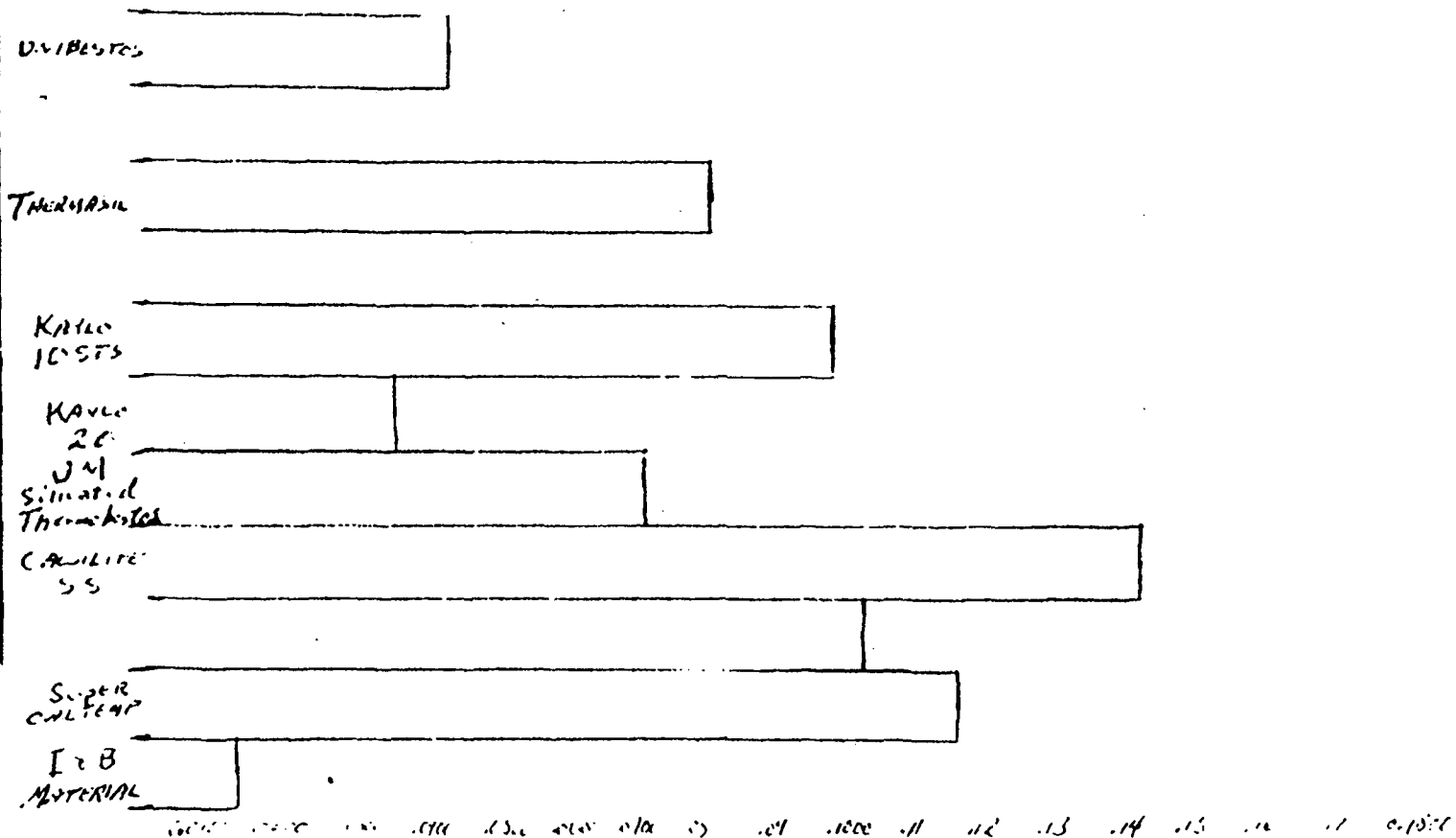
SS

CAL EM

DUP 0901637

Figure 1

DUST WEIGHTS, SIZE SEPARATED SAMPLES
 (Vibro Cyclone - WHATMAN 41 PAPER)
 WEIGHTS OF FINE FRACTIONS (grams).
 A - DUSTING SAMPLE



DUP 0901638

Figure 8

DUST WEIGHTS, SIZE SEPARATED SAMPLES

LINE CYCLOPS - WHATMAN 41 PAPER)

WEIGHTS OF FINE FRACTIONS (grams).

B. AFTER SETTLING

UNIFRST

THIRN

NOTE
11.5%

WVW

20

UM

THIRN

CALC

20

SUPER
CALC

I-B

INTERNAL

DUP 0901639

APPENDIX B

Sample	Composition
I, XIX,) II, XX) Unibestos	Amosite (grunerite)
XIII, XVII, XVIII, XXI, XXII, XXIII, XXIV, III, IV Super-Caltump Thermasil Calsilite SS	Major: Well crystallized Tobermorite, 11 Å hydrate. Probably less than about 10% amosite (grunerite) or crocidolite (riebeckite).
V, VIII, XI, XII Kaylo 10 STS JM Silicated Thermobestos	Major: Poorly crystallized 11 Å tobermorite or mix- ture of 11 Å and 14 Å hydrates of tobermorite. Possibly 10% or less of chrysotile or other serpentine mineral. (Based on presence of line at 7.3Å.)
IX, X Kaylo 20	Major: Poorly crystallized tobermorite as in V. Probably 10-20% of chrysotile or other serpentine mineral. Probably 10-20% of amosite (grunerite) or crocidolite (riebeckite). 10-20% unidentified crystalline material.
XXV I&B Material	Major: either clino-chrysotile or mixture of clino- and ortho- chrysotile. Probably 10-20% Mg(OH) ₂ . 10-20% unidentified crystalline material.
XXVI I&B Material	Sample too small for analysis.

These minerals have varying degrees of isomorphous substitution of the elements so that the composition is not always the same. The approximate compositions are shown below:

DUP 0901640

APPENDIX B (CONT'D)

Anosite - Fibrous - $(\text{Fe}^{+2})_4\text{Fe}^{+2}, \text{Mg}_3[\text{Si}_8\text{O}_{22}](\text{OH})_2$

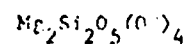
Gronerite - $(\text{Fe}^{+2})_4\text{Fe}^{+2}, \text{Mg}_3[\text{Si}_8\text{O}_{22}](\text{OH})_2$

Crocidolite - Fibrous - $\text{Na}_2\text{Fe}_3^{+2}\text{Fe}_2^{+3}\text{Si}_8\text{O}_{22}(\text{OH})_2$

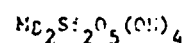
Riebeckite - $\text{Na}_2\text{Fe}_3^{+2}\text{Fe}_2^{+3}\text{Si}_8\text{O}_{22}(\text{OH})_2$

Serpentine Mineral

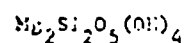
Chrysotile Fibrous



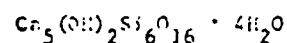
Antigorite Fibrous or Platy



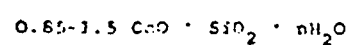
Lizardite Fibrous or Platy



Tobermorite 11 Å hydrate



Tobermorite 14 Å hydrate



(sometimes called plombicrite)

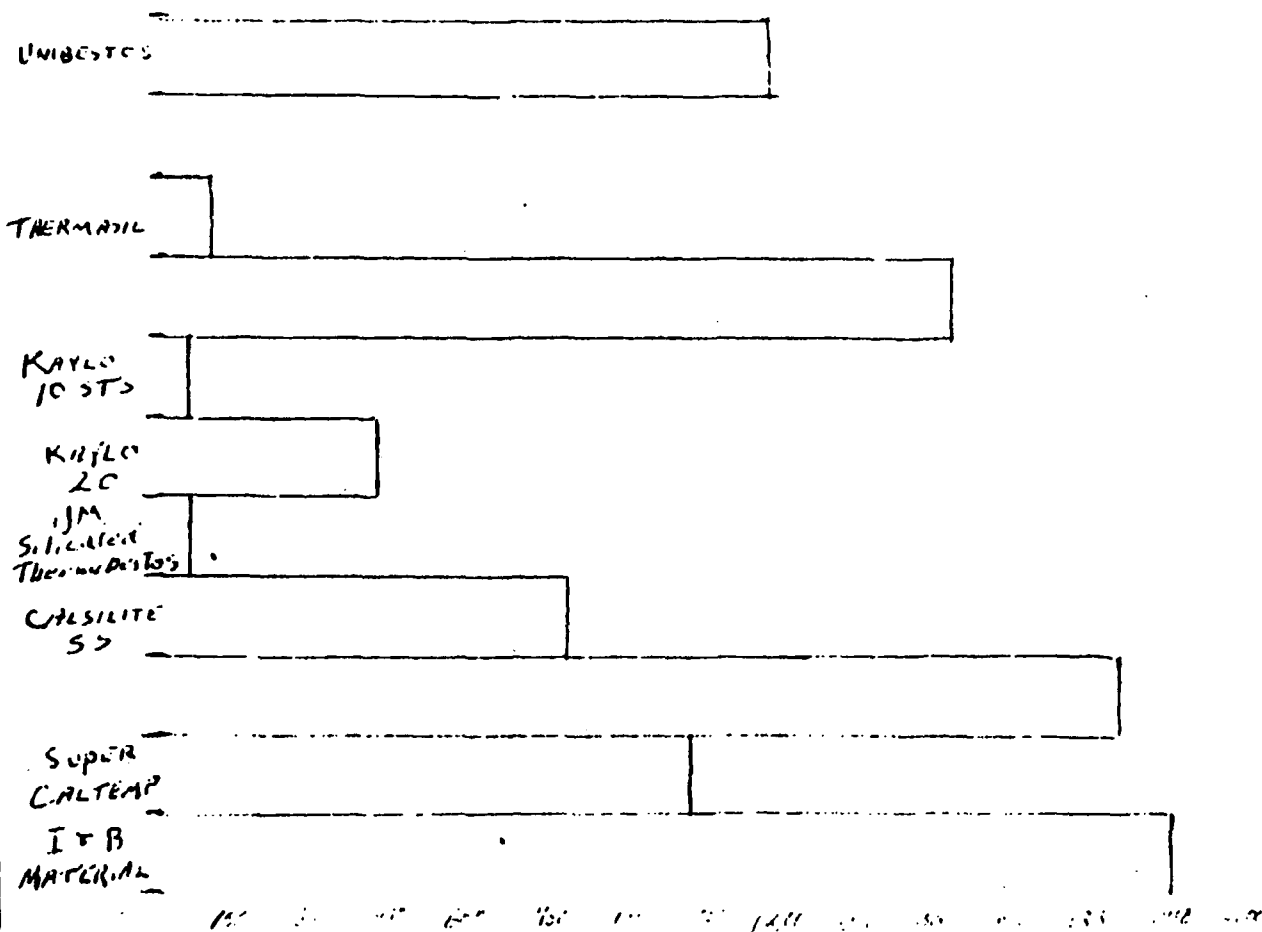
DUP 0901641

Figure 1

Fiber Counts, Millipore Filter

Fibers μ mly $> 5 \mu$

Titration Sample - During Salinity



DUP 0901642

Figure 2

1 inch (25.4 mm) diameter
 1 inch (25.4 mm) thick
 automatic sampler After Settling

UNIGESTS

TERMOIL

KAYLO
 10 STS

KAYLO
 20

UM
 20 STS

UM
 55

SUPER
 CALTEMP

I & B
 MATERIAL

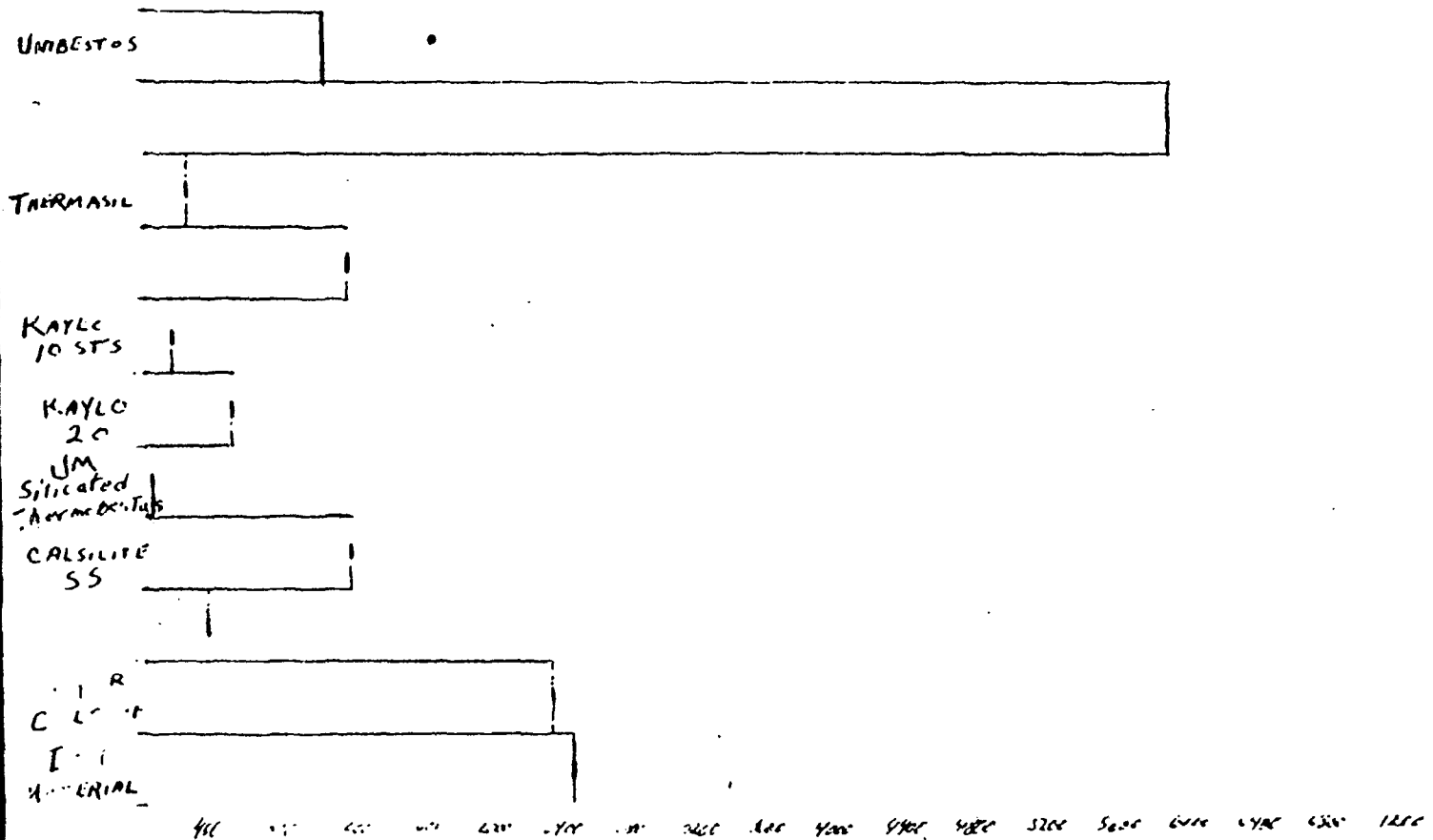
DUP 0901643

Figure 3

FIBER COUNTS, MILLIFORE FILTER

1 liter of air, 2.5 μ

Concentration Division Silmplot - During Drawing



DUP 0901644

Figure 4

Iron Chutes, Millstone Filter

Fibers per ml, $> 5^{\mu}$

Construction Division Sampler - After Settling

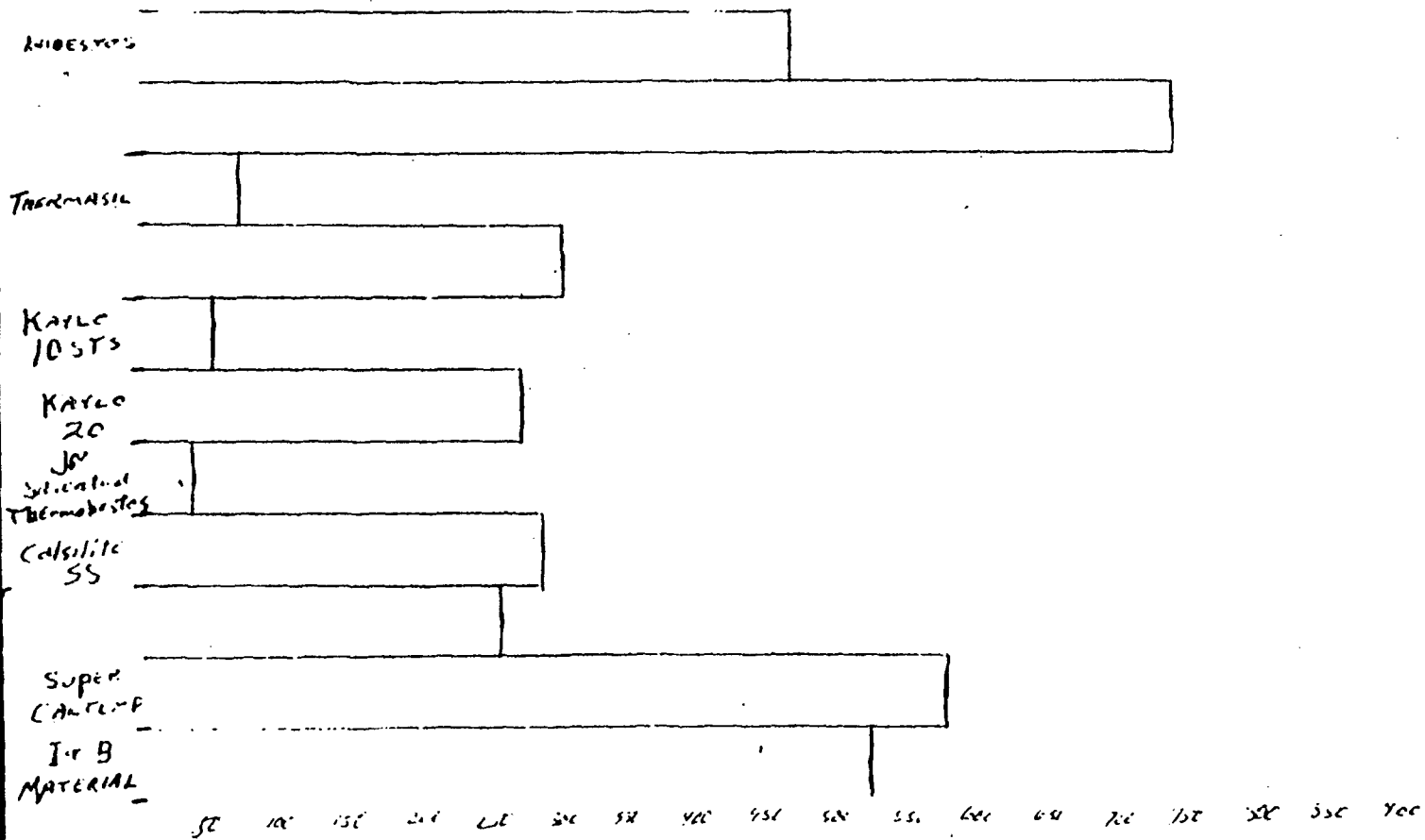


Figure 5

On 3-11-68



Thurs 3-14-68



K-120 20

U¹¹



CPM 1-1-70

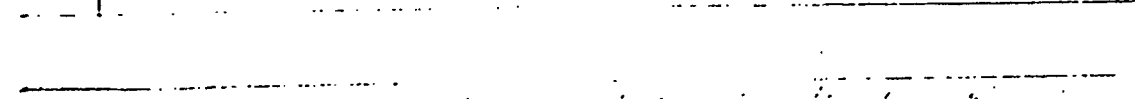
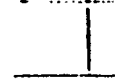


Figure 6

1. 100% ...
B ...

UNIBESTOS

THERMASIL

KAYLO
IC-575

KAYLO
2

Silicated
Thermosil

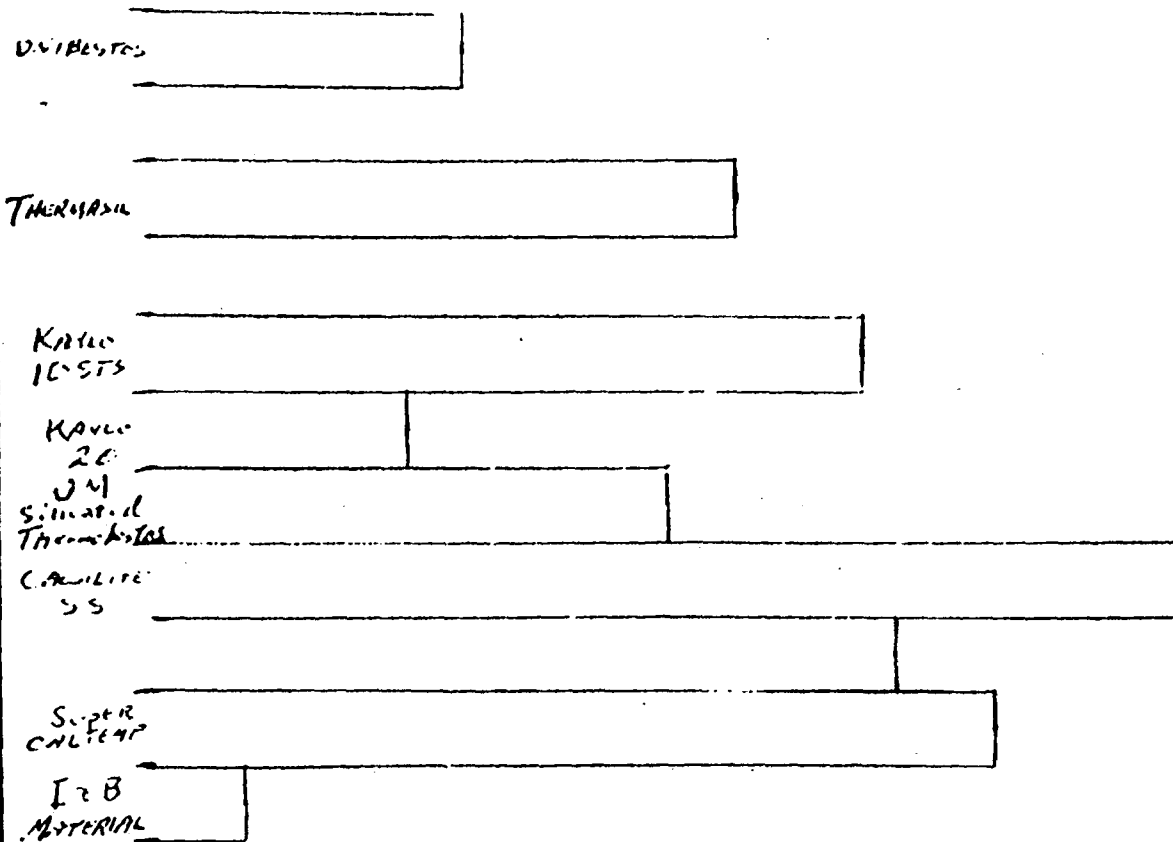
CELSITE
SS

CAL^R
EM

DUP 0901647

Figure 1

DUST WEIGHTS, SIZE SEPARATED SAMPLES
 (Using Cyclone - standard 41 paper)
 WEIGHTS OF FIVE FRACTIONS (grams).
 A - During Operation



DUP 0901648

Figure 8

DUST WEIGHTS, SIZE SEPARATED SAMPLES
FINE CYCLOPS - WHATMAN 41 PAPER)
WEIGHTS OF FINE FRACTIONS (grams).
B. AFTER SETTLING

