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BUSINESS CONFIDENTIAL PROJECT REPORT

DISPERSION OF ASBESTOS FOR USE AS A PIGMENT FOR PAPER COATING

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SUMMARY In a previous report (1), the use of 5 to 10 per cent asbestos based on clay in a coating was found to significantly increase the brightness and opacity of coatings on rough or low-brightness rawstocks. The bulk density of the pigment in the coating was also considerably reduced which is expected to lead to increased coverage in commercial practice, although the actual increase could not be measured in the laboratory coatings. It was subsequently found that the asbestos was not well dispersed as evidenced by the inability to filter clay-asbestos dispersion through a 100 mesh screen, and the presence of agglomerates on the surface of coated paper. A study of dispersants and dispersion techniques was initiated to develop good dispersions of clay-asbestos.

Such a procedure, based on the use of a Cowles Dissolver, has now been developed. For the preparation of asbestos dispersions, Tamol 731 is by far the best of the dispersants studied. Minimum viscosity in the asbestos-clay dispersions requires 8 to 10 per cent of a 25 per cent solution of Tamol 731 based on the weight of asbestos. Good dispersions of asbestos and clay may be prepared by first dispersing the asbestos with Tamol 731 in water at 8 per cent total solids in the Cowles Dissolver. When the asbestos is well dispersed, the clay is then dispersed in the asbestos dispersion. Using this technique, good dispersions at 62 per cent solids can be made with 5 per cent asbestos based on the clay. Fluid dispersions containing up to 10 per cent asbestos can also be prepared, but at lower total solids. Levels of asbestos higher than 10 per cent based on clay are impractical because of the low total solids required for fluidity. The dispersions prepared by this technique can be screened thru a 100 mesh screen, an important feature, as coating formulations are routinely screened in commercial practice. This indicates a high degree of dispersion of the asbestos, which had not been achieved in the previous work. The improvement in coating properties noted for asbestos in the previous work were checked and confirmed in this study.

RESEARCH AND DEVELOPMENT DEPARTMENT
CHEMICALS AND PLASTICS
UNION CARBIDE CORPORATION
SOUTH CHARLESTON, WEST VIRGINIA



A rough draft of a Technical Information Bulletin has been prepared and is currently being reviewed.

It is planned to cooperate with the asbestos business team in introducing asbestos to those paper and board manufacturers whose products might be expected to benefit from its use.

INTRODUCTION The use of asbestos as a pigment in paper coating has been investigated and reported previously (1). Because of the favorable effects on the brightness, opacity, and ink receptivity of paper coatings and in the coverage of rough, low brightness rawstock, it was decided that an attempt should be made to interest paper coaters in its use. However, before a technical information bulletin could be prepared, a more detailed investigation of the dispersants and dispersing methods was necessary to provide more reliable instructions for the preparation of the asbestos-clay dispersions.

This report covers the investigation of dispersants and dispersing methods for Asbestos HP and Asbestos T-135, and a check of the properties of these dispersions in coating colors and paper coatings to confirm the favorable results reported previously.

DISCUSSION In the previous work (1), it was found that asbestos could be dispersed with clay to give high-solids dispersions with up to 10 per cent asbestos based on the clay present. In that work the dispersant used was 1 per cent TSPP based on the weight of asbestos, plus about 0.3 per cent TSPP based on the weight of clay. It was realized at the time that this was probably not the optimum concentration of TSPP and that TSPP might not be the best dispersant, but these dispersions were used for a preliminary determination of the effect of the asbestos on rheology and coating properties.

Type of Dispersant for Asbestos-Clay Slurries

A series of dispersions of 5 per cent asbestos-95 per cent clay was made up at 67 per cent total solids with various dispersants to determine which were the most suitable for this application. In these dispersions, the asbestos, clay, and water were charged to a sigma blade mill and the dispersants added in small increments during the mixing. The Brookfield viscosity was measured 10 minutes after each addition to determine the minimum viscosity of the dispersion which would correspond to the optimum concentration of dispersant.

The effect of concentration on viscosity is similar for all dispersants, and is typified by Figure 1 which shows the effect of the concentration of Tamol 731 on the 95-5 clay-asbestos dispersion at 67 per cent solids. A list of the dispersants tested and the minimum viscosity obtained with each is shown in Table I.

Although TSPP had been used as the dispersant in previous work, the results shown in Table I indicated that an organic dispersant, Tamol 731 from Rohm and Haas was far superior to TSPP and also better than any of the other dispersants tested. Tamol 731 is supplied as a 25 per cent solution in water and is not an uncommon dispersant for use in paper coating formulations. The optimum concentration for dispersing asbestos was found to be about 9 per cent by wt. of the 25 per cent solution based on the weight of asbestos. It is possible that a more thorough search might uncover an even better dispersant than Tamol 731, but it is believed that the viscosity obtained with this dispersant (1220 cps.) is sufficiently low for practical use in paper coating.

The comparison of the dispersants was made in dispersions prepared in a sigma blade mixer, which, it was discovered later, did not completely disperse the asbestos. This does not affect the comparative rating of the dispersants, but complete dispersion of the asbestos would increase the viscosity so that somewhat lower total solids would be required for low viscosity dispersions.

The incomplete dispersion of the asbestos was uncovered when it was attempted to prepare coatings of heavier coat weight using a wire wound rod. These coatings were rough, and microscopic examination showed agglomerates of asbestos in the coating. Screening the coatings resulted in immediate blinding of a 100 mesh screen, and rapid blinding of a 60 mesh screen. The material on the screens also contained asbestos agglomerates.

Oddly, the rough coatings showed up only with a wire-wound rod to meter the coating on the paper. When the coatings were laid down with a blade, as had been done in the previous work, the coatings were smooth, presumably because the agglomerates were swept along with the blade and removed with the excess coating in hand drawdowns. Thus this problem was not recognized in the previous work, as all of the coatings in that study had been prepared with a blade, with no attempt at screening the coatings except with a coarse screen (to remove skins), which readily passed the small asbestos agglomerates.

It was postulated that a Cowles Dissolver might be more efficient in dispersing the asbestos than a sigma blade mixer, but attempts to disperse mixtures of clay and asbestos together showed such dilatancy that unreasonably low total solids were required to establish the flow necessary for dispersion in the Cowles. Similarly, attempts to add dry asbestos to a dilute clay slurry in the Cowles Dissolver caused gelation at very low levels of asbestos, and no usable dispersions were obtained.

It was discovered, however, that the asbestos could be dispersed alone in the Cowles Dissolver at about 8 per cent solids with 7 to 10 per cent Tamol 731 based on the weight of asbestos. This gave a quite viscous slurry but one that flowed adequately to give a moderate turnover and good agitation to the batch in the Dissolver. When the asbestos was well dispersed (about 20 minutes at 5000 RPM), dry clay could be added to the asbestos dispersion to bring the total solids up to 62 per cent with a 5 per cent asbestos-95 per cent clay mix. Surprisingly, the addition of clay to the asbestos suspension greatly reduced the viscosity, as evidenced by the increase in the speed of turnover in the Dissolver. The final dispersion of asbestos and clay was quite fluid, with a Brookfield viscosity of 1,460 cps at 10 rpm, and 396 cps at 100 ppm. The pH of the dispersion was 6.95. This dispersion could be suction filtered through a 100-mesh screen with no difficulty, and performed well in coating when applied with either a wire-wound rod or a blade, yielding smooth coatings. The dispersion displayed the same (30 per cent) increase in settled pigment volume with asbestos present that had been observed in the previous work. The dispersion procedure was repeated with similar results several times to assure its reproducibility. Thus a reliable method of producing good dispersions of asbestos in clay has been achieved.

Both HP asbestos and asbestos T-135 could be made up into good dispersions with clay using the Cowles Dissolver and the above method. Viscosities obtained with the asbestos T-135 were somewhat lower than with HP asbestos, so that with T-135 the solids could be raised to about 67 per cent with the same viscosity as HP asbestos at 62 per cent total solids. This might be expected, as the T-135 contains 35 per cent TiO_2 and hence has less asbestos present for a given weight of additive in the clay suspension.

The asbestos T-135 dispersions at 67 per cent solids and the asbestos HP dispersions at 62 per cent solids were made up several times, and all were in the range of 1300-1700 cps at the 5 per cent level of pigment additive. All of these were made up with the open type of HP asbestos and asbestos T-135. However, a dispersion made up with pelleted HP asbestos also gave a similar viscosity at 62 per cent total solids, but required slightly longer dispersion of the asbestos in the Cowles Dissolver, (30 min. vs 20 min.) to get a good dispersion, as judged by the appearance of the asbestos slurry before adding the clay.

At 10 per cent asbestos based on clay, the viscosity was too high at 67 per cent solids, but good dispersions of low viscosity could be made at lower solids as shown in Figure 2. The data in Figure 2 were obtained with asbestos T-135, but the effect with HP asbestos would be similar. From the cure it is estimated that the use of T-135 at the 10 per cent level would be limited to dispersions at 58-62 per cent solids. Higher

solids levels gave dispersions which were difficult to handle and tended to gel on standing, although they could be restored to fluidity by jarring or agitation. Even the dispersions at 5 per cent asbestos HP and 62 per cent total solids tended to gel on long standing (several weeks) but were easily restored to fluidity by mild stirring or shaking.

The performance of the asbestos-clay dispersions was checked by making up starch- and latex-bound coating colors and observing their hiding power on unbleached Kraft paper with the results shown in Table II. Both the asbestos HP and asbestos T-135 gave significantly brighter coatings (better hiding power) than the control with no asbestos on this dark rawstock.

Interestingly, there was little or no difference in hiding power between asbestos T-135 or asbestos HP in coating formulations. Although asbestos is known to increase the efficiency of TiO_2 in paper, this effect was not observed in paper coatings. A comparison of the opacifying ability of asbestos HP, asbestos T-135, and TiO_2 at several levels in clay coatings on 50 lb. offset paper is shown in Figure 3. No difference in opacity was noted between asbestos HP and asbestos T-135 at the level of 5 per cent of the pigment in the clay coatings. The points lay along the same line. However, both the asbestos HP and T-135 substantially increased the level of opacity as compared with the all-clay formulation. In comparison with TiO_2 in coatings, the asbestos T-135 shows up very poorly. Even 10 per cent asbestos T-135 in the coating gave lower opacity than 5 per cent TiO_2 as shown in Figure 3.

It is probable that the dispersing effect of asbestos on TiO_2 which operates in paper is not needed in paper coating formulations because the TiO_2 is already efficiently dispersed in the clay pigment. Thus it appears that there is little incentive to use the more expensive T-135 rather than asbestos HP in paper coating.

CONCLUSIONS As a result of this work a practical method of preparing good dispersions of asbestos in clay for paper coating has been outlined. The dispersions are capable of being screened through 100 mesh screens, and can be prepared at up to 62 per cent solids at a level of 5 per cent HP asbestos in the clay pigment. Higher levels of asbestos in the pigment may be achieved, but these require lower total solids in the dispersion as indicated in previous work. About 10 per cent asbestos based on pigment is the upper limit for practical use in paper coating applications, but 5 per cent asbestos should be adequate to exhibit the favorable effects in most applications.

Union Carbide trial exhibit UC-1489: G. B. Kelly and G. W. Buttrick, Project Report on Dispersion of Asbestos for Us... Published by AsbestosClaims.Law
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The increase in brightness and opacity due to the presence of asbestos noted in previous work has been confirmed in these experiments. It is felt that there is now sufficient data and experience with asbestos on hand to prepare a Technical Information Bulletin and to attempt to interest customers in evaluating asbestos in selected coating applications. The most interesting applications are thought to be: 1) coating low brightness rawstock such as unbleached Kraft, 2) coating rough, low brightness rawstock such as cylinder board, and 3) coating lightweight publication papers. A rough draft of a Technical Information Bulletin has been prepared and is currently being reviewed.

FUTURE ACTION It is planned to cooperate with the asbestos business team in introducing asbestos to those paper and board mills whose products might be expected to benefit from its use. These would be primarily cylinder board mills, mills producing lightweight publication papers, and mills coating unbleached kraft or other low brightness rawstocks. It is also planned to assist in my technical service problems dealing with asbestos in coatings.

EXPERIMENTAL The dispersions in the sigma blade mixer were prepared by placing 1500 g. of HT predispersed clay (dry) in the mixer with 79 g. of asbestos HP open (dry). These were well mixed and then 655 g. of distilled water was added together with about one half to two thirds of the estimated weight of dispersant required. The mixture was mixed for 15 min., then 60 ml of water was added. After an additional 15 minutes of mixing a final 60 ml portion of water was added. After 10 minutes mixing the viscosity of the dispersion was measured with a Brookfield Viscosimeter at room temperature. Additional dispersant was added in small increments, mixing for 10 minutes and measuring the viscosity after each addition. When the viscosity increased for two successive increments, the addition was stopped and the contents of the mixer were transferred to a 1-gallon jar, labelled, and sealed for future use in preparing coating colors. The dispersants used and the viscosities obtained are tabulated in Table I. A number of dispersions at 10 per cent asbestos T-135 were made up similarly with additional water to obtain fluid dispersions. The viscosities obtained at various total solids concentration are shown in Fig. 2. In each case 10 per cent Tamol 731, based on the weight of asbestos T-135 was used as the dispersant.

In the preparation of dispersions with the Cowles Dissolver, 158 g. of asbestos T-135 open, dry, was charged to the Dissolver with 1550 g. of distilled water and 14 g. of Tamol 731 solution (25 per cent solids). The dissolver was operated at

5000 rpm for 20 minutes at which time 3000 g. of dry HT predispersed clay was added. The mixture was further dispersed by continuing the agitation at 5000 rpm for 15 minutes. The viscosity of the dispersion was measured, and a 300 g. portion was filtered thru a 100 mesh screen with mild suction. There was no residue on the screen after filtration.

The dispersion in the Cowles Dissolver was repeated with the same weight of HP asbestos open, dry, (158 g.), 16 g. of Tamol 731, and 1550 g. of water. This suspension would not flow adequately to get a good dispersion, so it was necessary to add an additional 400 g. of water. The diluted suspension was agitated 20 minutes at 5000 rpm, and 3000 g. of dry HT predispersed clay was added. The mixture was agitated an additional 15 minutes. The viscosity of the mixture was measured and 300 g. was filtered thru a 100 mesh screen with mild suction--no residue was observed.

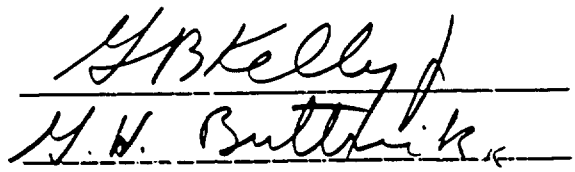
The dispersion in the Cowles Dissolver was repeated with 158 g. of HP asbestos pellets, 1950 g. of water, 16 g. of Tamol 731 solution (25 per cent), and 3000 g. of HT predispersed clay. The pellets water and Tamol 731 were dispersed at 5000 rpm for 30 minutes (until a smooth dispersion was obtained), the clay was added, and the mixture was further dispersed for 15 minutes. The viscosity was measured and a portion was filtered thru a 100 mesh screen--again no residue.

Simple coating colors were made up with 20 per cent starch (Stayco M) binder and with 16 per cent latex (Dow 620) using the dispersions of asbestos HP and T-135. These were applied to unbleached Kraft rawstock and to publication grade paper (Oxford) with wire wound rods and with a blade by hand drawn downs. The coated papers were dried and evaluated with the results shown in Table II and Figure 3.

REFERENCES

(1) Kelly, G. B., and Buttrick, G. W., Project Report: Use of Asbestos as a Pigment in Paper Coatings, File Number 12808, Oct. 20, 1969.

Attachments:
2 Tables
3 Figures



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TABLE I

EFFECT OF DISPERSANTS ON VISCOSITY OF

95-5 CLAY-ASBESTOS DISPERSIONS AT 67% TOTAL SOLIDS

Dispersant	Dosage[1] %	Minimum Viscosity Brookfield, cps 10 RPM	Brookfield, cps 100 RPM	Hercules, cps 1100 RPM	Hercules, cps 2200 RPM
Tetrasodium Pyrophosphate	5.06	9,600	2,770	-	-
Potassium Tripolyphosphate	5.06	16,400	4,900	-	-
Calgon T[2]	6.96	10,900	3,040	-	-
Tamol 731, 25%[3] Solution	7.60	1,220	498	270	585
Tamol 850, 30%[3] Solution	33.5	7,700	1,910	-	-
GANTREZ AN 135, 6%[4] Solution	29.8	18,500	5,200	-	-
Starch, Stayco M,[5] 25% Solution	8.0	8,160	2,060	-	-

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(1) Dosage at minimum viscosity, % by wt. based on wt. of asbestos.

(2) Calgon Corp., Pittsburgh, Pa.

(3) Rohm and Haas, Philadelphia, Pa. 19105.

(4) GAF Corporation, 140 W. 51st St., N. Y., N. Y. 10020.

(5) A. E. Staley Mfg. Co., Decatur, Ill.

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TABLE II

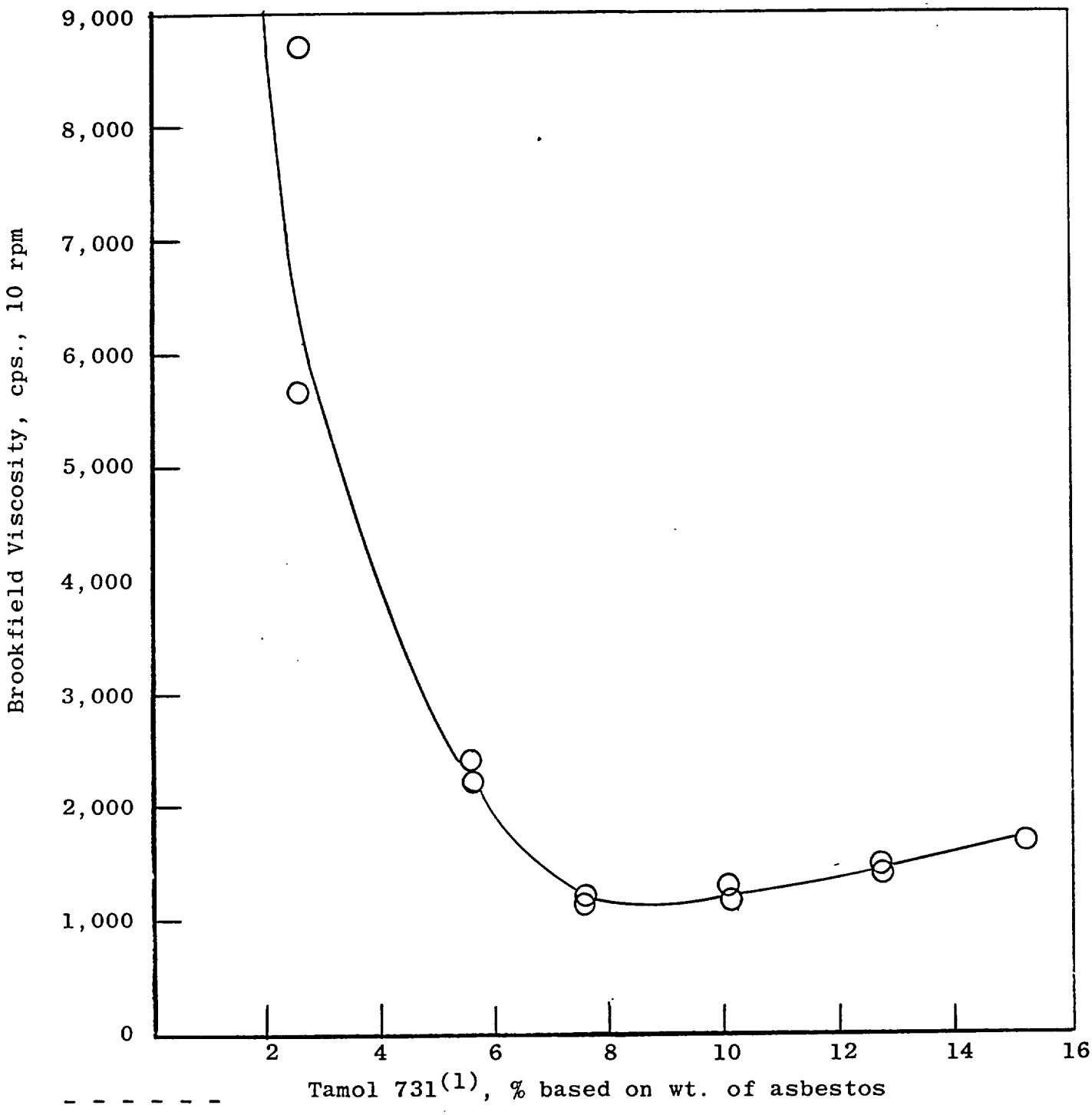
EFFECT OF ASBESTOS HP AND T-135 ON VISCOSITY AND COATING PROPERTIES

Pigment,	%	Binder, %	Total Solids %	Brookfield Viscosity, cps 10 RPM	Brookfield Viscosity, cps 100 RPM	Rawstock	Coat Wt. Lbs/ Ream	Brightness %	Gloss %	Opacity %	K and N Ink	IGT Pick, #4 Ink
Asbestos T-135 HT Clay	5 95	Starch, 20%	55	10,000	2,276	Unbleached kraft	10	66	-	-	33	-
Asbestos HP HT Clay	5 95	"	52	6,640	1,588	"	10	65			33	
Asbestos HT Clay	None 100	"	54	3,360	874	"	10	62			34	
Asbestos T-135 HT Clay	5 95	Latex, 16%	59	1,670	394	Unbleached kraft	12	59			36	
Asbestos HP	5 95	"	59	3,030	729	"	12	59			40	
Asbestos HT Clay	None 100	"	59	224	89.6	"	12	54			32.5	
Asbestos T-135 HT Clay	5 95	Starch, 20%	55	10,000	2,276	Oxford - Publication	12.5	79	12	91	48	250
Asbestos HP HT Clay	5 95	Starch, 20%	52	6,640	1,588	Oxford - Publication	12	79	11	90	46	250
Asbestos HT Clay	None 100	Starch, 20%	54	3,360	874	Oxford - Publication	12	78	13	88	49	325

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FIGURE 1

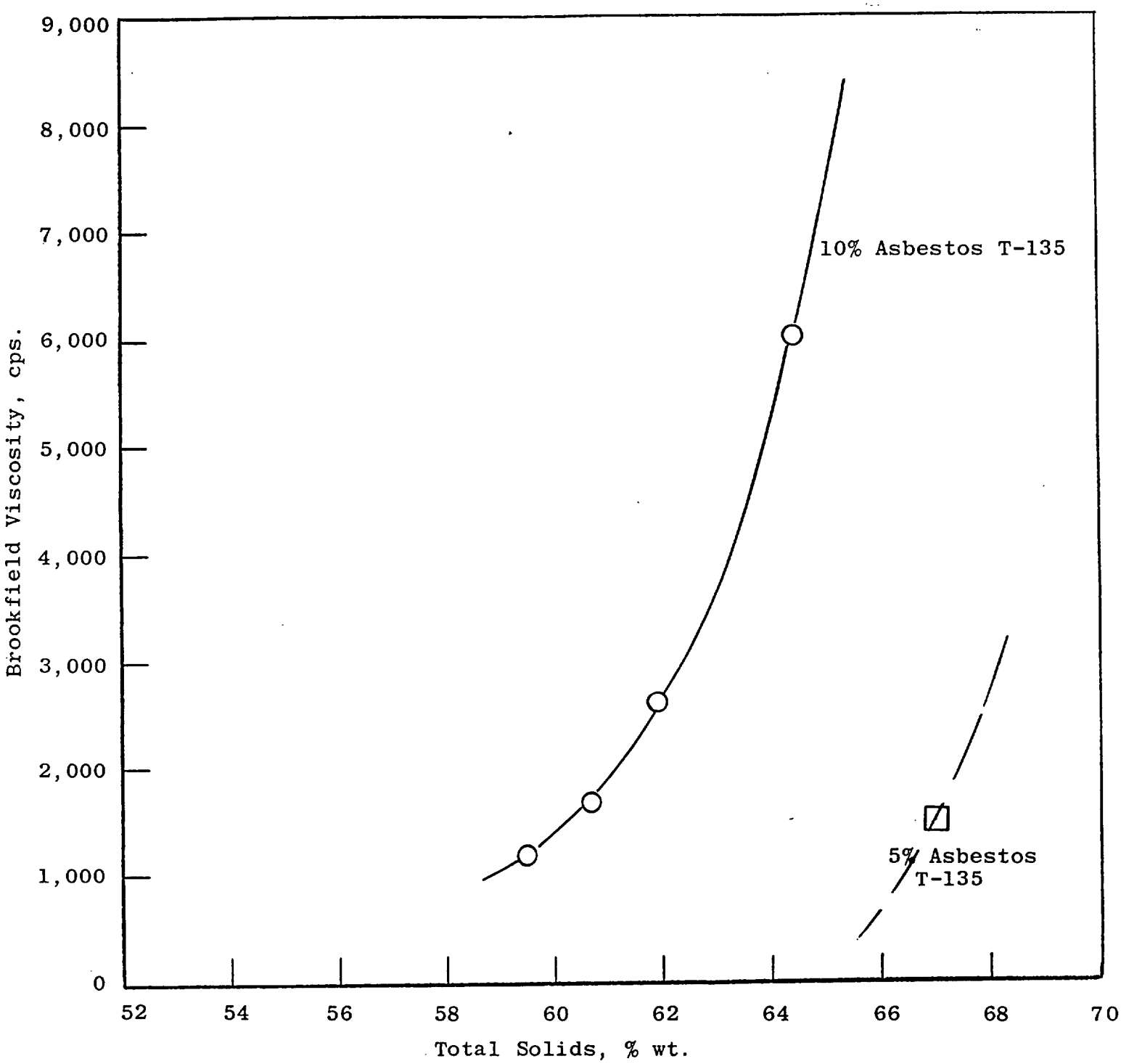
EFFECT OF CONCENTRATION OF TAMOL 731 ON VISCOSITY
OF 95-5 CLAY ASBESTOS DISPERSIONS AT 67 PER CENT SOLIDS



(1) 25% Solution, as is.

FIGURE 2

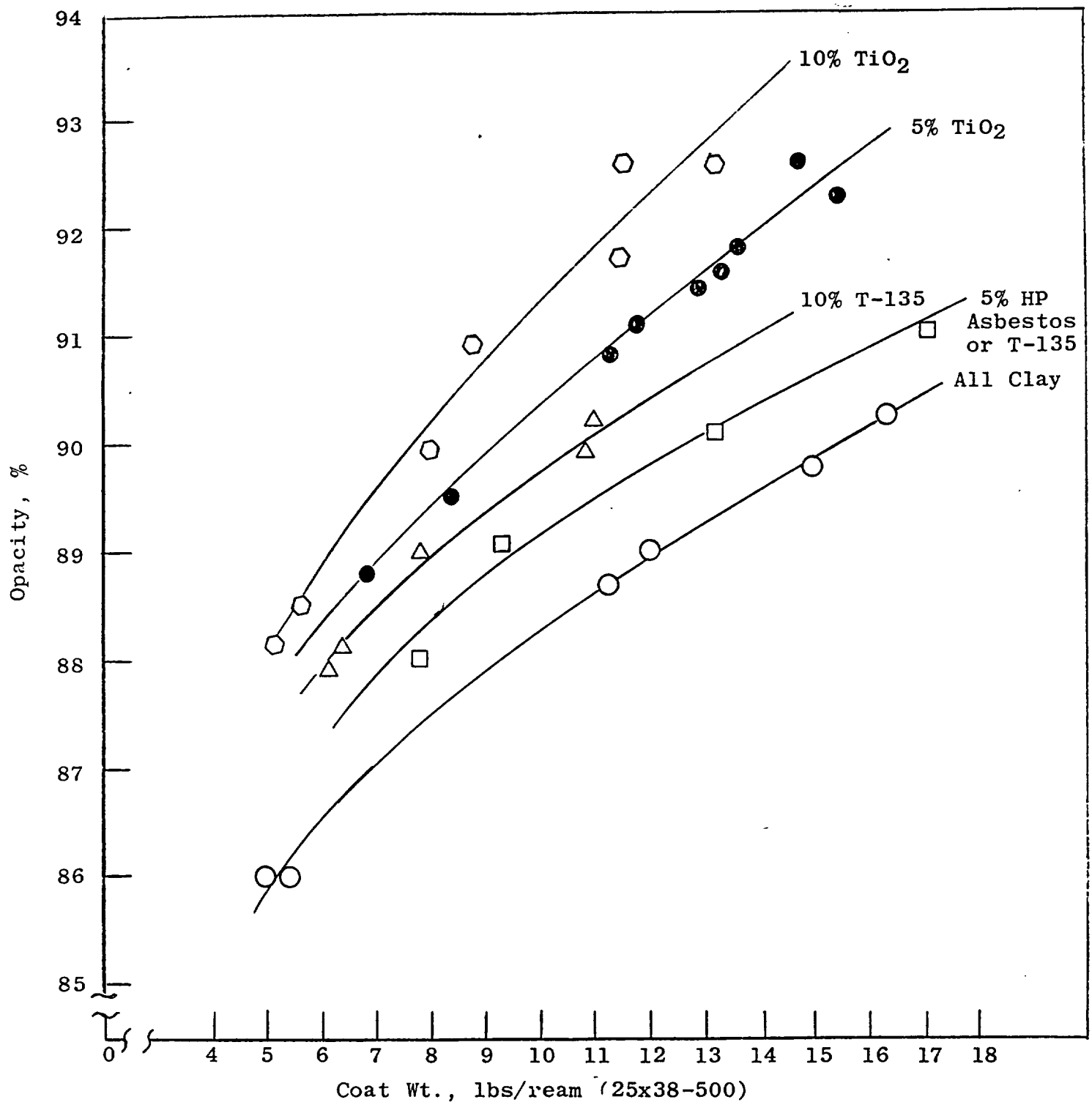
EFFECT OF TOTAL SOLIDS ON VISCOSITY WITH
10 PER CENT ASBESTOS T-135/90 PER CENT #2 CLAY DISPERSION
TAMOL 731 DISPERSANT



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FIGURE 3

COMPARISON OF ASBESTOS T-135 WITH TiO_2
IN CLAY COATINGS ON PAPER
EFFECT ON OPACITY AT VARIOUS COAT WEIGHTS



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