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PLAINTIFF'S EXHIBIT

UC-3697

INDUSTRIAL HYGIENE SURVEY

BOUND BROOK PLANT

AUTHORS: R. W. Cope (2)

SUPERVISOR: N. H. Ketcham (2)

DATE: August 5, 1971

PROJECT NO.: 910E10

FILE NO.: 16037

SUMMARY The Bound Brook Plant was visited on June 23, 24, and 25, 1971 to continue the industrial hygiene surveillance program which is in effect in various areas of the plant. Operating conditions were somewhat abnormal because of the strike. This resulted in having to postpone sampling in some areas.

Dust samples were collected and analyzed in Buildings 3, 4, and 105. The results were all within the Threshold Limit Values (TLV's) proposed in the recent Occupational Safety and Health Standards.

Mercury in air samples were taken in Buildings 11 and 305. Building 11 meets the requirements of the Standards but the concentration in Building 305 exceeded the TLV of 0.1 mg/M^3 for mercury.

An outline of a complete industrial hygiene program for the plant is being prepared and will be mailed separately.

INTRODUCTION The author visited the Bound Brook Plant on June 23, 24, and 25, 1971 at the request of Dr. C. S. McKinley. This visit was made during the period of the strike when conditions were not normal. The purpose of the visit was to continue the industrial hygiene surveillance programs which are in effect in various areas of the plant.

DISCUSSION The plan for this visit was to collect samples for airborne dust in Buildings 3, 4, 101, and 105; sample for epichlorohydrin vapor in air in Building 21; determine the mercury vapor concentration in air in Building 11; and observe the effectiveness of the sound absorbing material that was to be installed on the resin dicer in Building 91. Due to the strike situation it was not possible to do all of those jobs planned because some of the equipment was down. The following discussion summarizes the observations made and the analyses of the samples taken.

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Building 3, Phenolic Resins, Unit C, Third Floor

Unit C was operating nearly full time. Although no asbestos was being added, two air samples were taken on 6-24-71 because of the dusty conditions that were observed. The dustiness was a result of having to add materials such as hydrated lime, stearic acid, calcium stearate, etc., by hand. This is not normally done but was necessary at this time because of equipment failure. One sample was taken on the south side of the unit near the loading hopper and operators desk. The dust in the area was 3 milligrams per cubic meter of air (mg/M^3). The second sample taken on the north side of the unit, in the aisle where the bulk of the material was added, gave a concentration of 13.6 mg/M^3. These are within the Threshold Limit Value (TLV) of 15 mg/M^3 for "nuisance" particulates.

Building 4, Pulverized Resins Area, First Floor

There was an operator bagging BRPA 5858 resin at the bagging machine. There was considerable dust on the floor but a sample taken at face level was only 0.4 millions of particles per cubic foot (mppcf). This is well under the TLV of 50 mppcf for "nuisance" particulates.

Samples were also taken at the drumming area before and during the drumming of resin. The sample taken before was on a black filter and counted at 0.06 mppcf. Two samples were taken during the drumming. One on a black filter was counted and had 0.56 mppcf and the other was weighed and contained 3.8 mg/M^3. These values are also well within the published TLV's of 50 mppcf and 15 mg/M^3, respectively.

Building 11, Maintenance Department, Instruments Shop

The air of the instruments shop was sampled for necessary vapor concentration. The only ventilation in the room was a window air conditioner in the south wall. The concentration found throughout the room was 0.04 milligrams per cubic meter. This is below the published TLV of 0.1 mg/M^3. This room had been given a thorough cleaning and additional spills kept cleaned up since my last visit.

Some mercury is handled in the main shop just outside the instruments shop. There was some spilled mercury on the floor under a bench which caused the concentration in air to be 0.05 mg/M^3 at face level. This was swept up after the readings were taken and later samples showed that the concentration was down to 0.02 mg/M^3.

Building 105, Fibers and Fabrics, Mezzanine Operating Area, Line 2000

Several additional samples were taken near line 2000 in the program of sampling initiated last October. Mr. R. C. McClintick had asked that the potential for hazardous exposure to toxic metals contained in colorants, stabilizers and flame retardants used be reviewed. The area was sampled during the preparation of colorant batches and the charging of line 2000. The highest dust concentration found was 7.3 mg/M^3.

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Analyses of the samples for metals was done by X-ray fluorescence. These analyses showed appreciable quantities of titanium present as titanium dioxide but only traces of some of the more toxic metals. From the colorants being added, the metal most likely to be present in any quantity was lead. The concentration of lead found was less than 0.002 mg/M^3. The current TLV is 0.2 mg/M^3.

Building 305, Phenol Plant

Building 305 is a small building about 10 x13 feet housing some equipment and a recorder. Mercury had been blown from the recorder into the insulation behind the recorder and onto the floor. The mercury concentration in air at face level in front of the recorder was 0.15 mg/M^3. The level near the open door on the west side was 0.08 mg/M^3. Operations personnel are seldom in this area but it should be cleaned up. Unit personnel were informed at the time of sampling.

CONCLUSIONS AND RECOMMENDATIONS

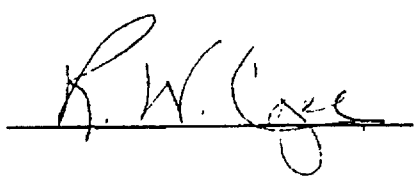
Conditions in the various operating areas of the Plant were not normal because of the strike. In some areas equipment was shut down completely and in others only part of the equipment was operating. The temporary abnormalities made conditions seem worse in some areas and better in others. Sample analyses were varied when compared to previous work done in the areas but were within allowable limits. Continued periodic sampling should be done in these areas when the strike ends.

Some areas which were not operating during this visit but which should be sampled periodically are those operations where carbon black is being added to the products such as in Bay 4 of Building 101 and two locations in Building 91.

I am currently outlining an industrial hygiene surveillance program for the Bound Brook Plant. This program will review recommendations that have been made in previous reports(1,2) and will update these as a result of more recent observations. A good part of the sampling and analytical work and much of the data collection and distribution can be done by plant personnel. The remainder of the program can be implemented by means of continued periodic visits of the writer and continued support from the Environmental Health Group of the Research and Development Department. This work should require the purchase by the Plant of only a minimal amount of additional sampling equipment. Recommendations concerning equipment will be included in the outline of the program being prepared.

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PROJECT REPORT

INDUSTRIAL HYGIENE SURVEY

TORRANCE PLANT

AUTHORS: R. W. Cope

SUPERVISOR: N. H. Ketcham

DATE: May 24, 1971

PROJECT NO.: 915L10

FILE NO.: 15749

SUMMARY A two-day environmental health survey was conducted in the Torrance Plant. This report records the author's observations and lists some recommendations which will be helpful to meet the requirements of the new Occupational Safety and Health Act.

There are a minimum number of environmental health problems in the Torrance Plant. This is testimony to their efforts in maintaining a good continuing health and safety program. External pressures are now emphasizing the need for increasing efforts "to assure so far as possible every working man and woman safe and healthful working conditions". Suggestions for additional effort in the Torrance Plant program are as follows:

1. Initiate a more formal program of periodic air sampling for solvent vapors in areas where potentially excessive concentration have been recognized or suspected.

2. Initiate periodic dust sampling in areas where asbestos and other dusts get into the air so that the problem can be properly evaluated and documented.

3. Continue to sample the air and observe good housekeeping practices in areas where mercury is handled.

4. Determine by air sampling whether there is a welding fume problem at welding operations in the plant.

5. Identify the areas of excessive noise exposure and introduce a program to reduce the noise in appropriate areas by engineering corrections as required by the Walsh-Healey and Occupational Safety and Health Acts.

6. Initiate the necessary work to correct the potentially hazardous condition in the analyzer house in Gas Separation.

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INTRODUCTION The author visited the Torrance Plant on April 6 and 7, 1971, at the request of the Manager's Office. The purpose of the visit was to conduct a survey to determine if there were any environmental health hazards that may need correction under the new Occupational Safety and Health Act. All areas of the plant were investigated in the two-day period.

DISCUSSION The discussion is divided into the following headings: chemical vapor, dust, mercury, radiation, ventilation, welding fumes and noise.

Chemical Vapor There aren't many areas in the plant where excessive exposure to organic vapor would normally occur. The dripolene odor from the clarifier and sludge cycling equipment is usually very noticeable in the Prestone Canning and Shipping area. The possible hazard is that aromatic hydrocarbon concentrations might become excessive in this area. Periodic checks should be made using the Kitigaw pump and the appropriate detector tubes that are available in the Plant. The results obtained using the detector tubes should be verified by subsequent analyses specific for benzene. There is a gas chromatographic method available which will determine benzene and dicyclopentadiene in air. It is sensitive to 0.1 ppm benzene.

There has also been considerable spillage of acrylates, vinyl acetate, etc. in the tank car-tank truck transfer area. One possible solution which is being considered after consultation with the Los Angeles County APCD is paving and draining the area.

There is an analyzer house in Gas Separation that contains continuous process instruments for analyzing the various gas streams. The concentration of gases in this building has gotten high enough to set off the alarm of a portable explosimeter. It is often necessary for an instrument man to spend considerable time in the building working on the analyzers. This situation should be corrected. Mr. P. F. Fisher, Engineering Department, has advised me that the recommended ventilation for installations such as this is as follows:

1. The cases of the analyzers should be purged with nitrogen from a system that has an alarm which will signal purge gas pressure failure.

2. The building should be ventilated to provide 0.1 inch of water pressure by air from a clean source. Since there is no air conditioning involved it should be relatively easy to provide 6 to 12 air changes per hour.

3. There should be a gas detector on the inlet air to the building and another detector at a low level near the analyzers. These detectors should be set to alarm at 20% of the lower explosive limit with the readout convenient to the operator in the control room.

There are a number of fork lifts operating in the distribution warehouses near the Polyethylene Unit. With as much traffic as there appeared to be, it would be wise to determine the carbon monoxide level in this area. There may be no problem.

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Dust There was asbestos insulating material being cut with a band saw in the Paint Shop of the Maintenance Building. There is no ventilation equipment on this saw. The hazard of asbestos is sufficient to take every possible precaution to avoid excessive exposure. Air samples should be taken in any area where asbestos insulation is being cut or handled regularly.

There are two sandblasting facilities in the rear of the Maintenance Building that are designed to protect employeees from dust exposure while cleaning equipment. The smaller of these, for use with very small items, has rubber gloves built into the hood, allowing access to the work and preventing exposure during the sandblasting. These gloves have rotted badly and need to be replaced. The larger facility is a walk-in booth with a ventilation hood for carrying away dust to the collector and individual air supplied hoods to protect the employee. This appeared to be operating efficiently.

There is another enclosed sandblasting hood with dust collection equipment in the Fluorocarbons Unit for cleaning cylinders before painting them. There is some dust accumulated in the immediate area of the blasting operation, indicating that it may be leaking. Air sampling during the sandblasting operation would indicate whether there is exposure to silica dust.

The upper levels of the Hot Processing area have an accumulation of dust on equipment and floors indicating there has been considerable fall-out. Whether this is Celite, Superfloss, Resin or a combination was not determined. It would be in order to periodically sample in this area to determine the dust concentration. From this data and the time the operators are required to be in the area, an evaluation of the potential hazard can be made.

Mercury Most of the mercury handling is done in the Instruments Shop. The shop had recently been cleaned up and the mercury vapor concentration checked by Laboratory personnel using a Kruger Mercury Vapor Detector. There was no visible mercury in the area and the Laboratory reported the mercury vapor level in the air was well under the TLV of 0.1 mg/M^3.

Radiation The radiation protection program is functioning well under the guidance of the radiation protection officer, Mr. W. E. Knight. The plant is in compliance with AEC and State requirements.

Ventilation Other than the specific instances mentioned under specific headings, ventilation systems in the Torrance Plant were operating efficiently. Periodic inspection and preventive maintenance will assure continued good operation.

Welding Fumes Much of the welding is done in a partitioned area of Building 211 off the Machine Shop. There are no local exhausts to individual welding stations. Periodic checks should be made, especially in the winter months, to assure that the men are not being excessively exposed.

Noise There are a number of areas where the noise is above the A-weighted sound level of 90 decibels. This does not mean that we are out of compliance with the regulation. The regulation states that protection against the effects of noise exposure shall be provided when the sound levels exceed those shown in the following table when measured on the A scale of a standard sound level meter at slow response.

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Permissible Noise Exposures	
Duration per day, hours	Sound Level dBA
8	90
6	92
4	95
3	97
2	100
1-1/2	102
1	105
1/2	110
1/4 or less	115

When employees are subjected to sound exceeding these limits feasible administrative or engineering controls shall be utilized. Areas where we are out of compliance with this regulation should be identified and measured so that the areas can be posted as to the maximum work time allowable without ear protection. The A-weighted measurements taken during this investigation were with the Torrance Plant General Radio Sound-Survey Meter which has been recently calibrated.

The major noise areas found were in the Polyethylene Unit. Areas which exceeded the 90 dBA limit were the Vickers compressor room; the intensifier area; and the product area around the extruders, make bins and shakers. It is possible that the DK resin transfer Unit is also excessively noisy. I was unable to measure it during this investigation.

Another area known to be very noisy is the Prestone Canning line. There was no canning scheduled for this time of year so measurements were impossible. Plant personnel have been studying the problem and are considering some possible solutions for lowering the noise level.

Other noise areas were located at the Oxide-Glycol Unit, Cracking Furnace Area, Steam Cycle Water Turbine, and the Steam Plant. These areas do not always have operators or other personnel in the vicinity of the noise sources. The main hazard may be to maintenance personnel making repairs in the area. Situations such as this should also be carefully evaluated to determine whether excessive exposures can occur.

CONCLUSIONS AND RECOMMENDATIONS There are a minimum of environmental health problems in the Torrance Plant. This is testimony to their efforts in maintaining a good continuing health and safety program. External pressures are now emphasizing the need for increasing efforts "to assure so far as possible every working man and woman safe and healthful working conditions". Suggestions for additional effort in the Torrance Plant environmental health program are as follows:

1. Initiate a more formal program of periodic air sampling for solvent vapors in areas where potentially excessive concentrations have been recognized or suspected.

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2. Initiate periodic dust sampling in areas where asbestos and other dusts get into the air so that the problem can be properly evaluated and documented.

3. Continue to sample the air and observe good housekeeping practices in areas where mercury is handled.

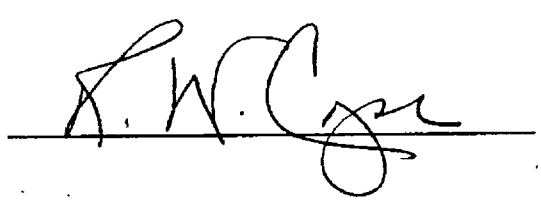
4. Determine by air sampling whether there is a welding fume problem at welding operations in the plant.

5. Identify the areas of excessive noise exposure and introduce a program to reduce the noise in appropriate areas by engineering corrections as required by the Walsh-Healey and Occupational Safety and Health Acts.

6. Initiate the necessary work to correct the potentially hazardous condition in the analyzer house in Gas Separation.

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Date of Manuscript: May 20, 1971
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PROJECT REPORT

INDUSTRIAL HYGIENE SURVEY
BOUND BROOK PLANT

AUTHORS: R. W. Cope (2)

SUPERVISOR: N. H. Ketcham (2)

DATE: February 11, 1971

PROJECT NO.: 910E10

FILE NO.: 15205

SUMMARY The author spent five days of the week ending 31 October 1970 in the Bound Brook Plant conducting an industrial hygiene survey. This report records the observations made and the results of air analyses taken.

The Bound Brook Plant is accomplishing significant improvement in their environmental health program. Progress was made in reducing solvent vapor exposures, identification and some correction of noise hazards, and improved ventilation. Suggestions for additional efforts in the continuing environmental health program are as follows:

1. Continue efforts to reduce noise by engineering corrections as required by the Walsh-Healey Act and the new Occupational Safety and Health Act.

2. Continue the program of periodic air sampling for solvent vapors in the areas where potentially excessive concentrations exist.

3. Renew efforts to clean up the floor area and cabinets in the instruments shop to reduce the possibility of high concentrations of mercury vapor. The shop should continue to be sampled at regular intervals to determine the mercury vapor concentration in air.

4. Periodic air sampling for asbestos dust concentration should be done in Building 3, and existing engineering studies continued to reduce possible exposures.

5. An air sampling program should be initiated to determine the dust hazard from carbon black in Bay 4 of Building 101. Steps should also be taken to replace or radically improve the ventilation and dust collection equipment for Bay 4.

6. Periodic air sampling should be done in Building 105 to determine the potential health hazard from metals in colorants used in lines 1000, 2000 and 3000.

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UCC 006075

INTRODUCTION This visit to the Bound Brook Plant was made at the request of Dr. C. S. McKinley. The visit was for five days ending on Friday, October 30, 1970. Nearly all areas of the plant were surveyed for possible environmental health hazards.

DISCUSSION The discussion is divided into the following headings: noise, mercury, solvent vapor, dust, welding fumes, radiation, and ventilation.

Noise - A great deal of progress was made during the past year to define the noise hazard in practically all areas of the Plant. Most of these areas were posted with signs advising employees concerning the amount of exposure time that is safe without ear protection. Sound absorbing material was received from the dicer manufacturer who claims it will attenuate the noise from the resin dicers in Building 91. This was to be installed. There was a bagging station in operation on the third floor of Building 91 that seemed noisy. No signs had been installed. Zolton Doktor will take some readings here to check it out.

In the Phenol Unit the noise level was significantly lowered near some steam turbines. This was accomplished by overhauling the turbine and realigning the impellers.

Mercury - Last year, during a similar visit to the Plant, mercury vapor was found in the air of the instruments shop. At that time the concentrations were from 0.2 to 0.4 mg/M^3 as compared to the threshold limit value (TLV) of 0.1 mg/M^3. There were changes made after that visit which improved the general ventilation in the room. Two fans were placed in an opening above the door to the Maintenance Shop. An exhaust was placed in the east wall and a louvered panel was placed in the door in the southwest corner of the room. In addition, the room was also given a general cleaning. This lowered the readings below the TLV. I did not expect concentrations of mercury to be above the TLV this time. However, as will be noted in Figure 1, it was again found that the mercury vapor concentration was nearly double the TLV. This room should be put on a routine schedule for periodic testing to see that the mercury vapor concentration is being maintained below the TLV. It would also be advisable to clean the floor area thoroughly to remove mercury deposits which are apparently ground into or under the floor tile. In addition, further effort should be made to provide and maintain adequate ventilation in this room.

Solvent Vapor - The solvent vapor problem in the old printing room of Building 105, Fibers and Fabrics, has been considerably improved. There were modifications made in the ventilation system which helped. The most significant difference was made by shutting down the printing machine on the south side of the room. It would be wise to continue monitoring this room from time to time to ensure that good housekeeping practices are being used to keep vapor concentrations under control.

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The hood in the ink room of Building 105 did not indicate any flow when checked with a velometer. This may be due to a broken fan belt but should be checked. I brought it to the attention of Mr. Morton. The exhaust vent in the northwest corner of this room was covered with 5-gallon cans. This essentially makes it ineffective, otherwise, the housekeeping was very good.

The new print room in Building 105 looks very good and seems to be well ventilated. Four of the meters for the explosimeters on the printing machine were "pegged" at the zero end during operation of the line. This would indicate they are out of calibration. Mr. Morton was going to check into this.

The color mixing room in Building 91 was very much improved since last years visit. The housekeeping was much improved, the vapor level was very low, and the ventilation systems were operating much better.

There have been complaints about epichlorohydrin vapor in Building 21 during the reaction and refining of epichlorohydrin. This system was not operating during this visit, so I was unable to obtain samples to estimate possible vapor concentrations in the air.

There were also complaints of solvent odors in Building 41. According to the foreman the problem was on the first floor in the east half of the building. A sample was taken in that location from 3:15 to 3:30 PM on 10-29-70. There was a definite odor in the area that smelled like an acrylate. The sample was analyzed for ethyl acrylate, acrylic acid, epichlorohydrin, and formaldehyde. We were unable to detect these chemicals in the sample. This would indicate that the concentration in air would be less than 0.2 parts per million (ppm) in air for any of these chemicals.

A second sample was taken in Building 41 in the same location between 10:15 and 10:30 AM on 10-30-70. An operator was discharging epoxy resin from Still No. 3. I experienced a slight burning sensation in the eyes while collecting the sample. The only thing detected in this sample was 0.04 ppm epichlorohydrin by colorimetric method 38C-K2C4-R2.1. The TLV is 5 ppm.

Dust - Mr. R. C. McClintick specifically requested that the potential for hazardous exposure to toxic metals contained in colorants, stabilizers and flame retardants used in Building 105 be reviewed again. Several samples were taken in the vicinity of lines 1000, 2000, and 3000 during the weighing, mixing, and charging of colorants. We were unable to detect any of the suspect metals in these samples. However, it should be pointed out that there was very little variety in the products being made during the week of this visit. It would be a mistake to say that there is no hazard on this basis. To properly evaluate the potential for exposure, samples should be taken several times over a period of several months while different products are being produced. This would provide a much better evaluation of the total problem. I feel

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there is very little chance of excessive exposure to metals from this operation, if the operations I observed are representative of normal conditions.

Samples were taken in the vicinity of Unit C in Building 3, Phenol-Formaldehyde Resins. Asbestos is one of the additives manually charged to resin mixes produced in this unit. The samples were taken in the vicinity of the charging hopper on the third floor and beside the line on the first floor. The threshold limit value for asbestos fibers is 12 fibers per ml, greater than 5 microns in length, using phase contrast microscopy. The highest count, of 4 fibers per ml, was found near the rollers on the first floor. The maximum count near the loading hopper on the third floor was 3 fibers per ml while the operator was charging asbestos. Additional samples should be taken periodically to be certain that this operation is not exposing personnel to toxic concentrations of asbestos fibers.

Dust collection equipment was improved in Phenolic Resins, Building 4 at the drum and bag loading stations on the first floor. The major dust clouds now occur when the drums are lowered after loading and when weights of drums are adjusted by transferring resin from one drum to another, using a shovel. The samples were taken while drumming was being done at units 3 and 5. The dust level was 0.3 millions of particles per cubic foot (mppcf) of air as compared to a TLV of 50 mppcf.

Several complaints have been made concerning carbon dust in Bay 4 of Building 101. Carbon balck is added with polyethylene pellets into Banbury mixers. This operation is extremely dirty. The charging area is covered with carbon black. Primarily the problem is one of dust collection by the present ventilation system. This system does not adequately control the carbon black at the loading hoppers. There are also several leaks in the mixers. Flexible extensions from the ventilation system have been unsuccessful in capturing the dust from the leaks. An air sampling program needs to be initiated to determine whether the dust concentration exceeds the TLV of 3.5 milligrams per cubic meter under various operating conditions. Some trial samples indicate that the TLV is being exceeded.

Welding Fumes - The Machine Shop, Building 11, contains most of the welding operations. Local exhausts are available at all of the welding stations except one. The effectiveness of this system should be checked periodically.

Radiation - The radiation protection program is functioning well under the Plant Radiation Committee. There are some sources that are being removed from lines 1000, 2000, and 3000 in Building 105. This will be done under the jurisdiction of the committee in a manner consistent with AEC and State regulations.

Ventilation - As pointed out in the preceeding discussion the ventilation systems were in much better operating condition this year than last. Continued inspection and preventive maintenance will assure they remain in good condition.

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CONCLUSIONS AND RECOMMENDATIONS

The Bound Brook Plant is accomplishing significant improvement in their environmental health program. Progress was made in reducing solvent vapor exposures, identification and some correction of noise hazards, and improved ventilation. Suggestions for additional efforts in the continuing environmental health program are as follows:

1. Continue efforts to reduce noise by engineering corrections as required by the Walsh-Healey Act and the new Occupational Safety and Health Act.

2. Continue the program of periodic air sampling for solvent vapors in the areas where potentially excessive concentrations exist.

3. Renew efforts to clean up the floor area and cabinets in the instruments shop to reduce the possibility of high concentration of mercury vapor. The shop should continue to be sampled at regular intervals to determine the mercury vapor concentration in air.

4. Periodic air sampling for asbestos dust concentration should be done in Building 3, and existing engineering studies continued to reduce possible exposures.

5. An air sampling program should be initiated to determine the dust hazard from carbon black in Bay 4 of Building 101. Steps should also be taken to replace or radically improve the ventilation and dust collection equipment for Bay 4.

6. Periodic air sampling should be done in Building 105 to determine the potential health hazard from metals in colorants used in lines 1000, 2000, and 3000.

R. W. Cope

Attachment: 1 Figure

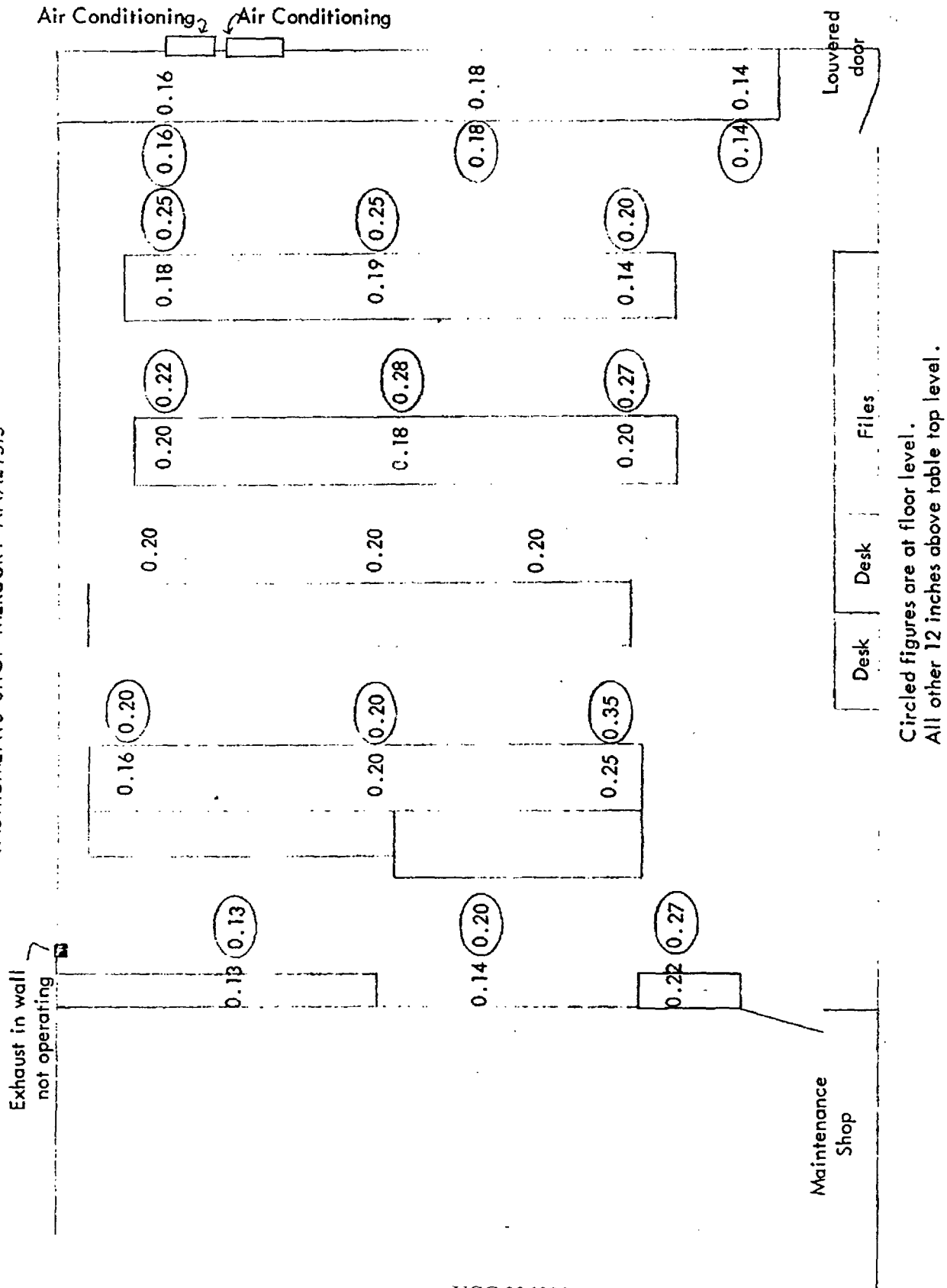
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910C10

FIGURE 1

INSTRUMENTS SHOP MERCURY ANALYSIS



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BUSINESS CONFIDENTIAL PROJECT REPORT

DISPERSION OF ASBESTOS FOR USE AS A PIGMENT FOR PAPER COATING

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SUPERVISOR: F. J. Welch

DATE: August 3, 1970

PROJECT NO.: 915L10

FILE NO.: 14217

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

UCC 006082

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.

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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.

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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

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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.

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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

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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

Manuscript date: July 14, 1970
Date typed: July 15, 1970
GBK/GWB/lja

G B Kelly
G. W. Buttrick

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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	-	-

- - - - - - - - - -

(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

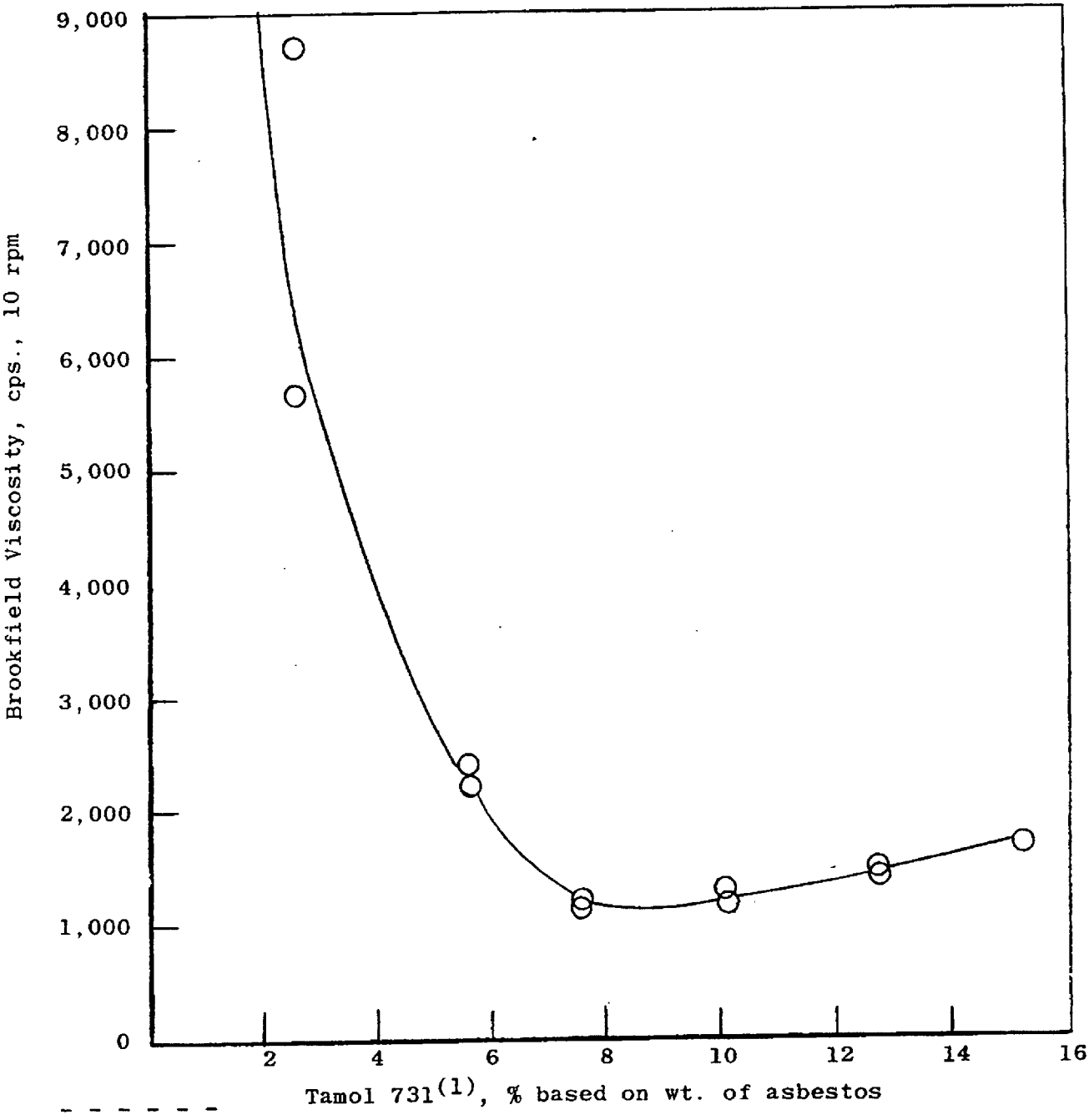
Pigment,	%	Binder, %	Total Solids %	Brookfield Viscosity, cps 10 RPM	Brookfield Viscosity, cps 100 RPM	Rawstock	Coat Wt. Lbs/ Ream	Brightness %	Gloss %	Opacity %	K and N Ink	IGT Pick, #4 Ink
Asbestos T-135 HT Clay	5 95	Starch, 20%	55	10,000	2,276	Unbleached kraft	10	66	-	-	33	-
Asbestos HP HT Clay	5 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



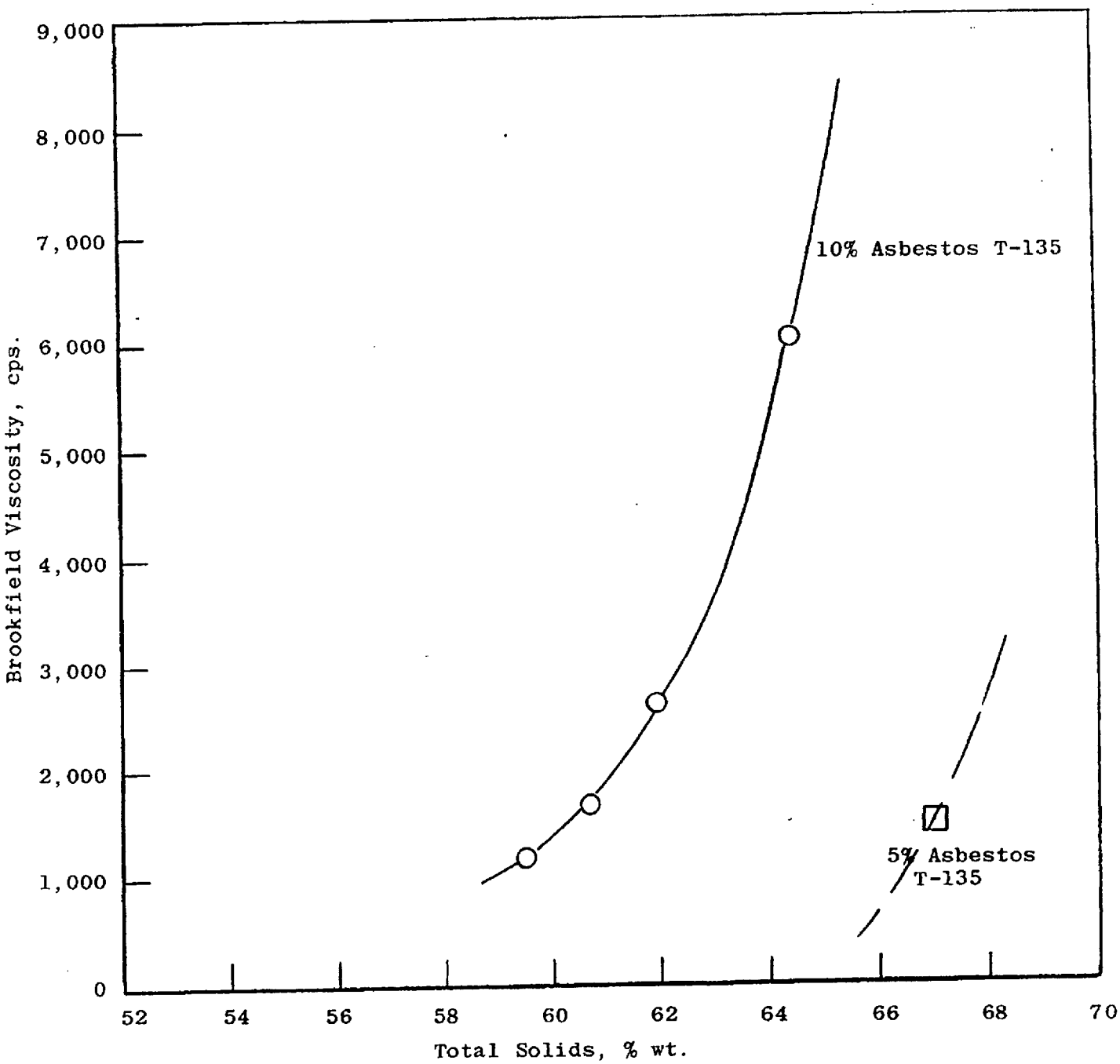
(1) 25% Solution, as is.

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FIGURE 2

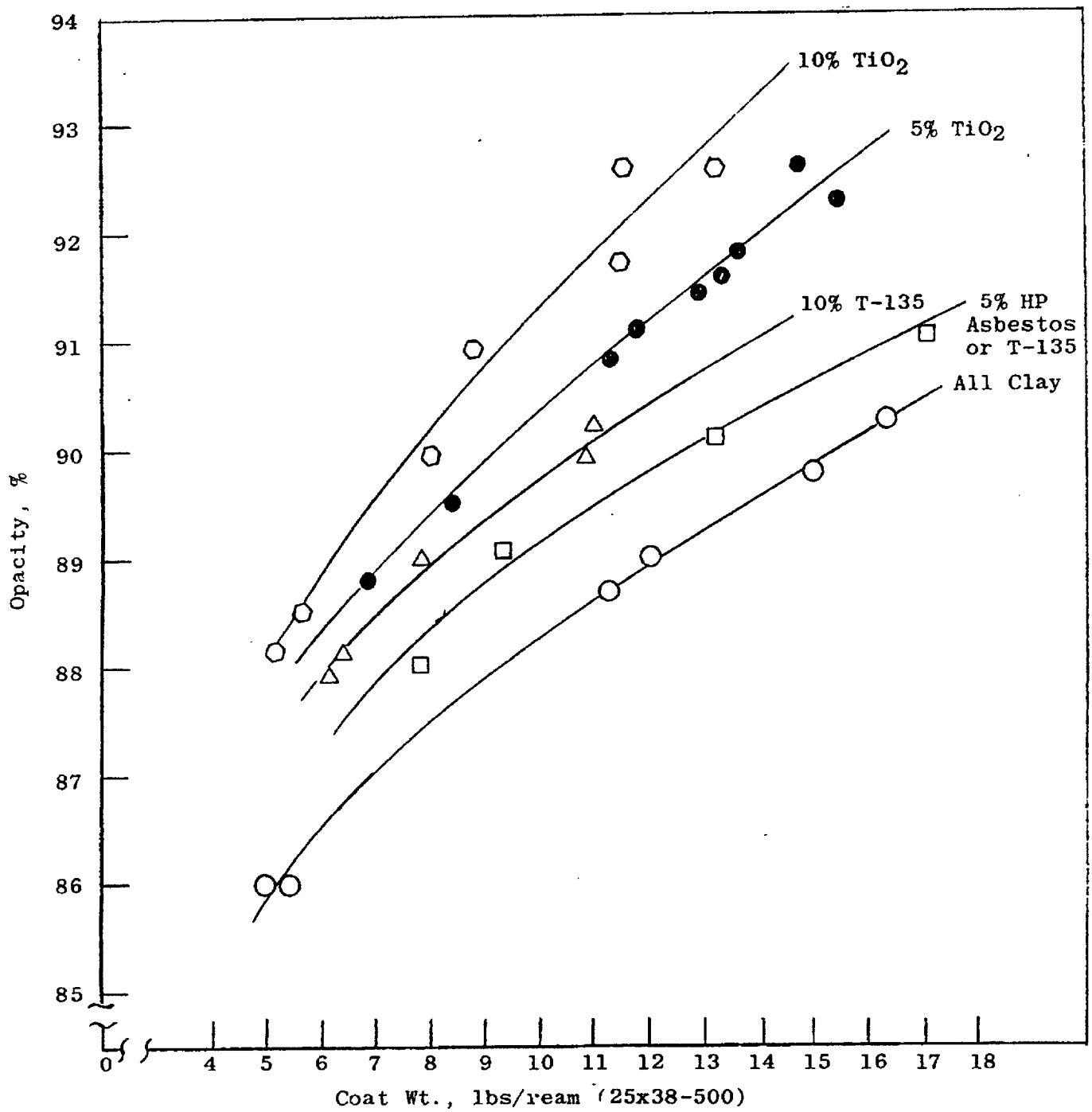
EFFECT OF TOTAL SOLIDS ON VISCOSITY WITH
10 PER CENT ASBESTOS T-135/90 PER CENT #2 CLAY DISPERSION
TAMOL 731 DISPERSANT



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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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