ARMSTRONG CORK COMPANY

FLOOR DIVISION

LANCASTER, PENNSYLVANIA

A study of this plant was conducted from March 17 to April 7, 1948 by the Industrial Health Section, Health and Welfare Division of the Metropolitan Life Insurance Company to determine the health hazards, if any, associated with the manufacturing operations. Previous studies were made in 1935, 1939 and 1943.

The results of the current study led to the following recommendations:

1. All exhaust systems should be kept properly repaired and maintained.

2. Lead free pigments should be used wherever possible. If pigments containing lead in any form must be used, the Medical and Safety Departments should be informed.

3. Exhaust ventilating systems at pigment or color scales should be re-designed to efficiently entrap and remove all dust produced by the operation.

4. Periodic samples of urine and/or blood should be collected from those employees who handle or are exposed to lead pigments or litharge and should be analyzed for lead to determine possible absorption. In collecting the samples, necessary precautions should be taken to prevent contamination from the hands or clothes of the employees and the samples should be analyzed by trained, experienced personnel.

5. Eating should be forbidden in locations where lead pigments are used. Employees who work in these areas should be cautioned to wash hands and face thoroughly before eating.

6. Employees handling lead pigments should be instructed as to the need for careful operating procedures to prevent dispersion of the dust into the atmosphere.

7. Building #59-A - Litharge should be weighed directly into the bucket to be used for charging, rather than being dumped into the charging bucket from a tared weighing bucket.

8. The exhaust system at the welding table in the Sheet Metal Shop should be re-designed to remove the welding fumes at their source. This may best be done by the use of a flexible, easily adjustable exhaust duct, or by lateral exhaust if the nature and size of the work will permit.

9. Lids should be provided for the charging chutes in the Asphalt Tile Building. These chutes should be kept covered except when charging is taking place.

10. Positive exhaust ventilation should be applied to the lead melting pot and at the pouring table in the Machine Shop, Building #30-N.

11. The present shot blasting equipment in Building #72 should be replaced with modern equipment that will provide a more efficient method of entrapping and collecting the dust.

12. The use of compressed air for floor cleaning should be discontinued, also dry sweeping - especially in departments where lead bearing dusts are encountered. Vacuum cleaning methods should be employed.

13. Approved type dust respirators should be used by yard men, and car unloaders in the Sundries Department, when unloading bulk or bagged raw materials - especially when handling asbestos or siliceous materials.

14. The general ventilation in Building #406 should be increased by the use of wall or ceiling ventilating fans, especially in the area of #3 Lacquer Machine, front end.

15. Operators at all hopper or mixer charging operations should be instructed to handle with reasonable care all bags of raw material and, after emptying, the bags should be shaken within the effective range of the exhaust hoods. A separate exhausted hood should be provided to take care of the shaking and stacking of empty bags where required.

16. The inlay backing-in operation should be studied to devise a method of ventilation to prevent the vapors of mineral spirits from accumulating at the rear of the machine close to the wall.

GOOD HYGIENE provided

Housekeeping and Personal Facilities

Housekeeping is generally good throughout the various departments. Aisles are well defined and free of obstructions.

Ample toilet, locker, and washing facilities are provided.

A hospital supervised by a full time physician and nurses is maintained.

Restaurant facilities are also available to all employees.

Methods of Sampling and Analyses

The samples were collected and analyzed by the method used and devised by the United States Public Health Service.[1]

The following tables show the dust, metal fume, and solvent vapor concentrations found at representative operations throughout the various departments, also chemical analyses of settled dust samples and of some of the most widely used raw materials for lead, total and free silica.

(1) United States Public Health Service, Public Health Bulletin No. 217, Determination and Control of Industrial Dust - J. J. Bloomfield and J. M. Dallavalle, 1935.

Processes

The processes are essentially the same as described in previous reports. The following changes were noted:

1. Cement is now prepared entirely by mechanical oxidation, eliminating the old air dry method.

2. Solutions of lead and manganese salts are used almost entirely in place of the dry oxides. This eliminates the exposure formerly caused by weighing and handling of the dry materials.

Conclusions

Inlay Department

Dust concentrations, in millions of particles under 10 microns in greatest diameter per cubic foot of air, were very low throughout the department. Although atmospheric dust conditions at some operations seemed higher than indicated by the findings, the appearance was evidently caused by the presence of particles over 10 microns - too large to enter the lungs and produce damage.

Only traces of lead could be determined in the atmosphere at representative operations. These are of no hygienic significance.

In this department, as well as in most other departments, hopper charging operations have been provided with exhaust ventilation to entrap and remove the generated dust. For the most part, the exhaust systems appeared to have been well designed, and if used efficiently, should control the dust. At several locations, there was evidence of lack of repair and maintenance which caused a decrease in the original efficiency.

Only a trace of formaldehyde could be determined beside the Accopac roll. An exhaust system is provided at the rolls and although it was in poor repair and its efficiency was low, it did remove most of the formaldehyde vapors.

No excessive acrolein concentrations were determined.

Rotary Department

With the exception of Sample #9, at pigment weighing, the dust concentrations in this department were very low.

At the pigment weighing operation, Building #31-7, a dust concentration of 30 million particles per cubic foot was determined and a lead concentration of 0.079 milligram per cubic meter was determined. This is about one half of the maximum allowable concentration. During this sampling period, the lead-free blue pigments were being weighed almost entirely. Employees handling lead pigments may be exposed to high lead concentrations from dust created during the weighing and dumping operations. Exhaust had been provided at the color scale, but air velocities produced were too low to measure and little, if any, protection was provided.

Exhaust booths, originally baffled with canvas curtains, had been provided at the charging hoppers. The canvas curtains have been removed and the resulting large face area has caused the air velocities into the booths to drop to a range of 50 to 75 lineal feet per minute, which is too low to control the dust.

Cork Mill

Samples #63 and #64, collected during stone dressing, show that there is a marked reduction in dust concentration when the exhaust hose is used. The operator at this operation was adequately protected by an air line respirator.

The balance of the dust concentrations found in the Cork Mill are comparatively low - far below those determined in previous surveys. Great improvement was observed in the housekeeping and in the maintenance of exhaust systems in

this building.

Sizing Department

Dust concentrations in this department were low and the free silica content of the dust was negligible. No potential health hazard was detected.

Bag Cleaning

This operation is done in a separate building. The bags are attached to an exhaust duct which draws the bag inside out and into the exhaust duct. That dust is dispersed into the atmosphere is produced by hand handling prior to cleaning.

At the time of sampling in this area, bags that had contained wood flour principally, and a very few with serpentine, were being cleaned. The dust concentration found, considering the comparatively non-toxic nature of the dust, does not indicate any health hazard. However, when cleaning bags that had contained more toxic substances, such as asbestos or highly siliceous material, a dust concentration in the same range would indicate a potential health hazard.

Linotile Department

Dust concentrations were low and no potential hazard was observed.

Callender Department

The only potential hazard detected in this department was at the operations involving the handling of lead pigments. A mixed sample of colors #35 and #38 was analyzed and found to contain 35.5 per cent lead. An air sample, #49, collected at the color weighing operation showed the presence of an average lead concentration of 3.71 milligrams of lead per cubic meter. Samples #46 and #48,

collected at the charging hoppers, showed 0.199 and 0.072 milligram of lead per cubic meter. An exhaust hood, located about five and one-half feet above the scales, was ineffective in controlling the dust produced in scooping, weighing and handling of the pigments. In order to be effective, the exhaust hood should create an air velocity of at least 150 lineal feet per minute past the location of dust generation and away from the breathing zone of the operator. This hood had a face velocity of 100 to 125 feet per minute, but was located so far above the floor that the air velocity at the pigment drums and scales was under 25 feet per minute. The charging hoppers were provided with exhaust creating an air velocity of 150 to 250 lineal feet per minute into the hopper. This is adequate to control dust produced during charging. The atmospheric lead determined in the vicinity of the hoppers was probably caused by careless handling of containers and by dust created during pigment weighing.

The batch weighing and charging operations vary from day to day, depending on the type material being made. The lead intake of the various workers will also vary, depending on the batch formula and the individual working habits. At operations of this type, air sampling does not always give a reliable indication of the degree of exposure. Routine urine and blood analyses should be performed on those operators who handle the lead pigments to determine the degree of lead absorption.

At the time of this survey, the Accofloor mixing was not in operation.

Mechanical Oxidation Department

During weighing of litharge, Building #59-A, the operator was exposed to 0.538 milligrams of lead per cubic meter of air. This was an intermittent operation, usually carried on about twice daily. An exhaust duct, located immediately behind the scales, produced an air velocity of 150 to 200 lineal feet per minute across the top of the bucket, which is adequate to control the dust produced at the scales. Even with careful handling, there was a small amount of spillage during transfer of the litharge from the drum to the weighing bucket. This spillage was removed by dry sweeping. Relocation of the supply drum nearer to the scale and nearer to the exhaust duct would help decrease the lead dust dissemination. It was noticed that the litharge was weighed into one bucket, which had evidently been tared, and then dumped into other buckets. This dumping created most of the dust at the weighing operation.

After the weighing operation is completed, the air-borne litharge is either removed rapidly by the exhaust system, or settles to the floor. Another air sample taken a few minutes after weighing showed the presence of only a trace of lead.

Tests made during and after the charging of litharge into the kettles failed to show any atmospheric lead.

Other samples in this department failed to show significant concentrations of air-borne contaminants.

Paint and Backing Department

Only one sample collected in the Paint and Backing Section (Building #67B) showed significant dust concentrations. Sample #81, taken during the charging

of backing material, showed a concentration of 21.5 million particles per cubic foot of air. It was noticed that most of the dust here was produced by the handling of bags outside of the range of the exhaust system. Because of the short duration of this operation and the low free silica content of the dust, no health hazard is indicated here.

No high lead pigments were being used at the time of the survey and airborne lead concentrations are negligible. Exhaust has been provided at the charging hoppers which should control dust produced during dumping, provided care is exercised in handling the bags and material.

Maintenance Shops

Of the samples taken at representative operations in the Maintenance Shops, only sample #147 and sample #162, show any significant concentrations.

Sample #147 shows a lead concentration of .079 milligram per cubic meter of air - approximately one-half of the maximum allowable concentration. The lead melting pot is enclosed in a hood connected to a natural draft stack. No control measures are applied at the point of pouring, at which point probably most of this lead concentration is dispersed.

Sample #162, taken at the shot blast operator's position and at his breathing level, shows a high dust concentration. This dust contains a considerable amount of lead. The concentration of lead found exceeds the maximum allowable limit by five times. The present respiratory protection provided will not adequately protect against lead dust. The entire shot blast equipment and type of building housing this operation is antiquated. Under present methods of operation, complete control of the dust is not feasible.

Strong language

suggests given a free hand

Boxes used in the Inlay and Rotary Departments are brought into this shot blast room, coated with an accumulation of dusts. After placing the box in proper position for cleaning, the operator stands outside the actual blast room in front of glass panelled doors, directing the stream of steel shot propelled by air against the box. The building doors directly behind the operator are also closed during blasting. This confines the operator in an area approximately 50 square feet.

Some of the heavy dust concentration created in the blast room itself seeps through the doors of the blast room into the working area. In the blast room, a propeller fan on one side blows the dust towards an exhaust duct on the opposite side. This exhausts the dust to a point about one and one-half feet above the roof level on the outside of the building. No attempt is made to collect this dust.

Comparatively low concentrations of zinc, and no concentrations of lead, were determined at the galvanized sheet metal welding operation in the Sheet Metal Shop. An exhaust hood had been provided about four feet above the welding table. The hood was too far above the work to be efficient in removing the welding fumes and its principal effect, if any, would be to draw the fumes across the faces of the welders. In order to protect men welding on galvanized material from exposure to zinc fumes and to lead, which is frequently present as an impurity, local exhaust ventilation should be used. This would remove the fumes at the place of origin. If the nature and size of the work permits, this may be done efficiently by the use of lateral slot exhaust. If the work varies greatly in size or shape, an exhaust duct of flexible, easily adjustable, tubing is usually preferred.

In the Electrical Shop, carbon tetrachloride was occasionally used for cleaning motors. As the work was done in an exhausted booth, no health hazard was indicated.

Several potentially hazardous operations were not in progress during the survey and no evaluation could be made. These included degreasing in Building #30-N, metallizing in Building #30-A, and cleaning with carbon tetrachloride in the Meter and Instrument Section, Building #2.

Asphalt Tile Department

High dust concentrations were found at only two locations in the Asphalt Tile Department while grease-proof tile was being run. These were at the hopper loading operation, 3rd floor, and at the scrap receiving location under the scrap grinder. At both locations, the periods of high dust concentration were intermittent and of short duration. Exhaust ventilation was provided at each charging hopper and was used only during actual charging. When the charging of one hopper was completed, a damper in the exhaust duct was closed and the work proceeded to another hopper. The exhaust provided was adequate to control the dust produced during charging. However, it was customary to leave the lids to the charging chutes open at all times. As soon as the exhaust had been turned off, the dust and gases produced by the mixers were blown out of the chute and contaminated the immediate area.

An irritating gas or vapor is produced during the mixing of the ingredients for the grease-proof tile. It was not possible to identify the vapor, although the odor was strongly suggestive of the petroleum distillates. It is probable

that the vapor was produced by the heating of the various oils added to the mix. The irritating condition was noticed principally during unloading of the B & K Mixer on the 4th floor, and at the hopper charging area on the 3rd floor. A man cooler fan is located at the B & K hopper on the 4th floor. The vapors on the 3rd floor can be controlled by keeping the loading chutes closed.

Yard Department

Exceedingly high dust concentrations were found at wood flour, asbestos and whiting car unloading operations. Samples #132 and #133, taken while unloading and stacking bags of Super-fine fir wood flour, and Sample #37, taken while unloading whiting, show concentrations exceeding 50 million dust particles per cubic foot of air - a standard now being suggested for non-toxic and non-siliceous dusts. No respirators are worn by the men while unloading.

Samples #134 and #135 show very high dust concentrations for asbestos, exceeding the maximum allowable limit of 5 million particles per cubic foot of air. Although the exposure to the asbestos dust is not constant, it is, however, frequent enough to warrant dust control measures either by exhaust control equipment or by the use of personal respiratory protective devices. The same crews of men are used daily for unloading various raw materials. This means that their exposure to high dust concentrations of one kind or another is quite frequent.

Cut Order Department, Building #150 - Inspection and Trimming Building. #155, Crate Shop Dept., Building #435.

No excessive or toxic concentrations of dust or solvent vapors were found in these departments.

Tube Winding Department, Building #158

Sample #138, taken while cleaning up, is the only sample to show a dust

concentration exceeding 50 million particles per cubic foot of air, the suggested standard for this type of dust, which is principally paper. The exposure to this high dust concentration is, however, limited to approximately fifteen minutes per day - the length of time it takes to blow off the dust from machines and floor. During this cleaning period, operators other than the cleaner leave the department. Substitution of vacuum cleaning for the blowing off would eliminate the unsightly condition created and the necessity for having the workmen leave the department.

Lacquer Department - Building #406

No excessive or toxic dust concentrations were found in this department. However, high and irritating concentrations of acetate vapors were found at the front end near #3 lacquer machine guide. The need for better general ventilation in this area is indicated.

Adhesives Department, Building #405

The highest dust concentrations found in this department were on the 2nd floor (Samples #143 and #145) and at the unloading of bulk clay from freight cars (Sample 144).

At the cement mixer (Sample #143) the dust is dispersed chiefly from the handling of bags of raw materials out of range of the exhaust hood.

Sample #145 was taken at the Fuller-Eaton Unit while the hopper was being charged with clay. Some leakage of fine dust was noted.

Sample #144 shows a high dust concentration. The exposure, however, is not daily but often enough to warrant the use of an approved dust respirator by the workmen considering the free silica content of the dust.

Saturation Department - Building #90

In this Department, the only high and excessive dust concentrations found (Samples #153 and #155) were at the charging hoppers of the coating paint mixers and in the area near the top of the dry paper festoons.

The exhaust ventilation applied at the charging hoppers is adequate to remove the dust when dumping. However, as in the case of similar operations in other departments, dust is dispersed by the shaking and stacking of empty bags out of the range of the exhaust hood. Considering the free silica content of the dust and in view of the fact that this is a somewhat constant operation, approved respirators should be supplied and used until a method of handling empty bags under exhaust ventilation is devised.

Considering the type of dust, Sample #155 does not indicate a health hazard. However, there is a nuisance factor to be considered. The present practice of enclosing the festoons should prevent the spread of this dust.

Felt Coating Mixing and Print Coating Departments - Building #92

No excessive or toxic dust concentrations were found in these departments. The concentrations of ammonia found are low and do not indicate any health hazard.

Display Department

The dust concentration found in this Department (Sample #160) is of no hygienic significance. However, it does create a nuisance. The present bag collector located adjacent to the wood saw requires frequent shaking down. This is done by hitting the bag with a board and considerable fine dust is dispersed in the process.

Print Department, Building #23
Shoe Filler Department, Building #78

The concentrations of solvent vapors found at the breathing level of men in these departments are low and do not indicate any health hazard.

Inlay Backing-In

The concentration of mineral spirits found around the Inlay Backing-In machine, although below the toxic limits, is nevertheless irritating. The heaviest concentration was found at the rear end of the backing-in machine. Due to the irritating effect of these fumes, the need for more general ventilation on this floor is advisable.

ARMSTRONG CORK COMPANY

FLOOR DIVISION

Health Hazards

Asbestos

Asbestosis is a pneumoconiosis caused by the inhalation of asbestos dust. It is distinct from silicosis in its pathology and clinical course. As long as asbestos fibers continue to be inhaled, scar tissue develops as a gradually thickening sleeve about the respiratory bronchioles. The stimulus from inhaled asbestos may be mechanical rather than chemical. Asbestosis is a disease which must always be watched for where asbestos dust is present. With respect to tuberculosis and asbestosis, the two diseases may coexist, but there does not appear to be a predisposition to tuberculosis as is the case with silicosis. The Threshold limit for asbestos dust adopted by the American Conference of Governmental Hygienists at their 1948 meeting is 5 million particles of asbestos per cubic foot of air.

up to date

Wood Dust

Wood dust has possibly a tendency to irritate the upper respiratory tract and, in hypersensitive individuals, may cause asthma and the like. Very rarely fungous disease is reported as occurring due to the inhalation of wood dust on which molds have grown. Ordinarily, wood dust is not hazardous to the lungs.

Whiting

The dust of whiting, which is understood to be calcium carbonate, would not be expected to cause any lung trouble even in fairly high concentrations.

Silica Dust

The hazards of silica dust with special reference to the lungs has long been appreciated. It has been firmly established that the inhalation of this dust results in a fibrosis of the lungs which disease is known as "silicosis" and its presence, for some reason yet ill-defined, results in extraordinary predisposition to pulmonary tuberculosis. It should be borne in mind that silicosis develops very slowly, taking from five to fifteen and even twenty to twenty-five years to become established. This rate of progress is influenced mainly by the dosage of silica which the lungs receive and this dosage, in turn, depends upon three variables; the amount of free silica in the dust, the quantity and particle size of dust in the air, and the extent of exposure. Individual idiosyncrasy might be included as a fourth variable. However, little is known of the variation in susceptibility in those exposed to dust.

The threshold limits adopted by the American Conference of Governmental Hygienists at their 1948 meeting were as follows:

Silica	Million particles per cubic foot
high (above 50% free SiO_2)	5
medium (5 to 50% free SiO_2)	20
low (below 5% free SiO_2)	50

The toxicity of clay and slate depends upon their free silica content. The threshold limit for slate adopted by the Governmental Industrial Hygienists is 50 million particles per cubic foot of air having a free silica content below 5%.

Sodium Carbonate

Sodium carbonate, sometimes called sal soda or washing soda, is a white, finely crystallized powder. It has no marked action on the flesh, clothing, or

on metals. It is slightly caustic if swallowed or if the dust is breathed into the lungs.

Zinc

Zinc and other metal oxide fumes may produce zinc "chills" or "metal fume fever", but, as a rule, though uncomfortable and sometimes briefly disabling, they are not dangerous unless combined with lead, arsenic, cadmium, or other toxic fumes. However, arsenic and lead are very often present as impurities in zinc. Zinc fumes are not, strictly speaking, poisonous and do not have any detectable after effects. Much of the injury attributed to them is probably due to other metals with which they are so often contaminated. It is estimated that chills will not occur if the air breathed does not contain more than 15 milligrams of zinc per cubic meter of air. This is the threshold limit adopted by the Governmental Industrial Hygienists.

Acetates

For the acetates, experience seems to show that methyl acetate is the least narcotic but somewhat more irritating to the eyes and the upper air passages than the higher members of the group. It has been known to cause a tight feeling in the chest and breathlessness. Ethyl acetate is more narcotic than methyl, although Zangger regards it as the safest of all the organic solvents. Normal butyl and amyl acetates are about the same in irritating and narcotic properties, but butyl is 25 per cent more volatile than amyl. Both are more active than the lower acetates and may cause burning of eyes, nose, throat, cough tightness in the chest, bronchial catarrh, headache and indigestion, as has been known for years. Many men and women can use it without even discomfort, and both

German and British factory inspectors, after careful study, could find no constitutional disturbance traceable to butyl or amyl acetates, although one fatal case in 1930 was claimed following the use of a mixed solvent containing amyl acetate.(2) The threshold limits adopted by the Governmental Hygienists are as follows:

	Parts per Million
Amyl acetate	200
Butyl acetate	200
Ethyl acetate	400
Methyl acetate	200

Sulfuric Acid

This acid has a local caustic action on the skin and mucous membranes of the eyes, throat, and upper respiratory tract. Except for accidents with concentrated acid, this is not usually a serious hazard in industry. Exposure to dilute sulphuric acid mist or spray may cause irritation of the upper respiratory tract and eyes and may discolor the front teeth of those exposed.

Toluol

Toluol has an anesthetic effect and the symptoms of poisoning are: headache, dizziness, anemia, muscular tremor, scarlet lips, spots of extravasated blood on skin, possibly cough. Animal experiments reported in the literature indicate that toluol is more irritant than benzol and with lower concentrations has a somewhat stronger narcotic action, but its effect on the blood picture and the blood-forming organs is considerably less severe and of a different type. The diminishing solubility on ascent in the series would, on the other hand, tend to

2. Industrial Toxicology, Alice Hamilton and Rutherford T. Johnstone, Oxford Medical Publications - 1945.

counterbalance an increasing physiological activity if the comparison were made on the basis of concentration in the air. Toluol is less volatile than benzol. Regarding the toxicity of toluol for men, an exact appraisal of its hazards is difficult because only exceptionally is there an exclusive exposure to toluol, since in most industries it is frequently mixed with xylol and benzol. Two hundred parts per million has been adopted as the threshold limit by the Governmental Industrial Hygienists.

Shellac Solution

The shellac is a skin irritant and may cause a dermatitis in susceptible individuals.

Ammonium Hydroxide

Since ammonia has a penetrating, intensely pungent, suffocating odor, and is strongly irritant, there is little likelihood that one will remain dangerously long in an atmosphere seriously contaminated with ammonia if one is conscious and able to escape. However, serious injury may result if escape from the vapor or gas is impossible, or if one is subjected to the action of the aqueous solution (ammonia water or ammonium hydroxide.) Aqueous ammonia exerts a local irritant action; strong solutions cause tissue destruction on contact, whether acting on eyes, skin, mucous membrane, gastro-intestinal mucosa, or pulmonary tissue.

Concentrated solutions of ammonia remaining in contact with the eye for even a short time may cause serious ocular damage, which may result in prolonged severe visual disturbances or permanent scarring of the cornea. The consequences of skin contact with ammonia water vary from a relatively mild dermatitis to

severe burns, depending upon the strength of the solution, length of contact, and individual skin sensitivity.

Ammonia gas, readily given off by aqueous solutions of ammonia, may cause severe irritation of the skin, eyes and respiratory mucosa.

The threshold limit for ammonia adopted by the Governmental Industrial Hygienists is 100 parts per million.

Kerosene

The toxicity of kerosene is similar to other aliphatic hydrocarbons - naphtha, gasoline and benzene. Kerosene being less volatile than the others would be less active. The most pronounced effect of these hydrocarbons is on the nervous system, for instance "naphtha" jags and possibly some chronic effects. However, these substances may exert some irritant action on the respiratory tract. The Governmental Industrial Hygienists have adopted a threshold limit for gasoline of 500 parts per million.

Triethanolamine

The literature on triethanolamine is chiefly concerned with its chemistry and uses; only a few studies concerning its physiological action are available and these are on experimental animals. Victor H. Kindsvatter of the University of Pennsylvania reported in the Journal of Industrial Hygiene and Toxicology, June 1940, that the pathology of the liver, kidney, spleen, adrenal, heart, lung, optic and peripheral nerves of the animals exposed to varying concentrations over a period of several months indicated only slight reversible effects on liver and kidney, and that restitution to normal readily took place as demonstrated by animals with normal livers and nearly normal kidneys after maximum exposure

followed by a rest period of two to three months. Toxic absorption of large doses of the free base through the skin is indicated in the pathology of the liver, kidney, lung, and by skin inflammation. The recommendation is made that all precautions ordinarily employed when handling any non-volatile alkali should be observed when handling the free base to avoid local irritation.

Rosin

Rosin may cause an allergic dermatitis.

Titanium Dioxide

Although most references in the literature describe titanium as harmless, a study made in Italy among experimental animals disclosed that titanium oxide caused an inflammatory reaction of the lung tissue resembling that caused by exposure to pneumoconiosis-producing dusts.(3)

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(3) Pneumoconiosis Caused by Titanium - L. Lenzi, Asso. de med. appl lavoro indust, Volume 7, Pages 301-318, October 1936.