

EXPOSURE TO METHANOL

from spirit duplicating machines

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AIR SAMPLES for methanol vapors, collected in a small room in which spirit duplicating machines were operated, gave high results. Because this type of duplicating machine is in common use in schools and business offices, we became interested. Doubtless many of the rooms in which the spirit duplicators are located are no larger than the room tested. Such being the case, there is good reason to believe that an appreciable number of workers are exposed to excessive methanol concentrations.

Subsequent samplings in a large, fairly well ventilated office showed much lower concentrations but still above the permissible level at the breathing zones of the operators.

Description of Equipment

THERE ARE several different makes of spirit duplicating machines commercially available but they are all essentially the same, with only minor mechanical differences, and all operate on the same general principles. The material to be re-produced is drawn, typed, or written on the master sheet which has been placed on a "carbon" paper so that the ink is transferred from the "carbon" to the back of the master sheet. The ink used in the carbon is concentrated crystal violet or mixtures of this with other dyes. The master sheet ready for the duplicating machine has the copy to be re-produced outlined in reverse in the concentrated dye. The master sheet is then placed on a rotating drum in the machine with the concentrated dye side outward.

The copy sheet is fed between two rollers. One of the rollers is kept covered with solvent (spirit fluid) fed to the roller by a felt

pad from a reservoir. As the copy sheet passes between these rollers it is completely covered with solvent. The moistened copy sheet passes between another roller and the rotating drum, and as it comes in contact with the reverse image on the master sheet it will pick up a small amount of the concentrated dye and the final printed copy will be a purple re-production.

The amount of dye picked up from a master will depend on the pressure between the roller and the rotating drum, and therefore the depth of color will depend on the pressure. Since the amount of dye on the master is fixed, the number of reproductions obtainable will depend on the amount of dye removed by each copy. An average is about 300 copies per master.

Duplicating Fluid

THE SPIRIT duplicating fluids are a mixture of methanol, ethanol, and cellosolve. The methanol content of the commercially used fluids can vary from 40% to 100%. Insofar as it is known, none of the duplicating fluids are without methanol. One gallon of the fluid can do from 8,000 to 12,000 copies, with wide variations between machines and in different runs on the same machine. The methanol content of the duplicating fluid used when air samples were collected in the small test room was 70%, and 65% when later sampling was done in the large office.

Sampling Method and Method of Analysis

FILTERED-GLASS bubblers were used with distilled water as the collecting medium. The rate of air flow through the collecting device was from five to eight liters per minute.

The method of analysis was to oxidize the

methanol to formaldehyde and test with Schiff's reagent. The results were compared to standards and read colorimetrically by eye.

Results of Sampling

DISREGARDING the ethanol and cellosolve in the duplicating fluids, samples for methanol were collected during runs of from 300 to 500 sheets on four different makes of duplicators. Breathing zone concentrations ranged from 400 to 800 PPM and general room air concentrations went as high as 1000 PPM. The high general room atmosphere concentration can be explained by the fact that the sheets of paper were moist with duplicating fluid when fed into the receiving tray of the machine and as they were handled or riffled large volumes of methanol vapor rapidly evaporated.

Leaving the door to the room open during a run decreased the methanol concentrations but they were still above the allowable limit.

Subsequent sampling at a battery of four machines, of which a maximum of three were in operation at any one time, showed methanol vapor concentrations ranging from 155 to 420 PPM in the operators' breathing zones. The machines were located in a large office with about 5000 sq. ft. of unpartitioned floor area and a 10 ft. high ceiling. General room air concentrations in the area were lower, dropping down to 65 PPM 10 ft. away from the machines.

In the Literature

INsofar as is known, the only report in the literature of exposure to methanol vapors from operating spirit duplicating machines is an article in the September, 1948 issue of the "Industrial Hygiene Newsletter" in which an investigation made by the Connecticut State Department of Health is reported. They found high concentrations of methanol at all machines in steady use.

In one plant about one gallon of fluid was used per day and they found from 286 to 430 PPM with an average of 367 PPM. Fluid contained 50% methanol. In a second plant only two quarts of fluid (50% methanol) was used per week and only 40 to 50 PPM with an average of 40 PPM was found. In a third plant, a consumption of fluid was 10 gallons per week (75% methanol) and they found from 510 to 635 PPM with an

average of 572 PPM. They also sampled in two other plants. The article concluded, "The use of these . . . for two or three hours per day maximum, with a daily consumption of less than one pint of fluid per day, should not present a health hazard, particularly if the fluid used contains less than 50% methanol."

Toxicity of Methanol

METHYL ALCOHOL poisoning results most frequently from ingestion and the severity of the results are well known. Baskerville¹ collected, up to 1913, 720 cases of methyl alcohol poisoning, 390 of which ended fatally, 90 of which developed blindness, and 85 of which suffered impaired vision. He collected from the literature 64 cases of industrial poisonings caused by vapor inhalation, of which six ended fatally, 19 suffered permanent blindness, and 33 had impaired vision.

Maximum Allowable Concentration

THE AMERICAN STANDARDS ASSOCIATION has adopted 200 PPM as the MAC for methyl alcohol on the basis of eight hours per day exposure.

PATY² reports STERNER as having found, in connection with film manufacture, methanol vapor concentrations ranging from 200 to several thousand PPM, the latter values occurring for only short periods of time. The daily average of the concentrations to which operators were exposed was probably between 400 and 500 PPM. STERNER believes these latter values would not ordinarily result in any serious effect or even moderate discomfort, since numbers of men known to him have been exposed to such conditions while handling millions of gallons of this solvent failed to show any evidence of methyl alcohol intoxication. STERNER'S experience indicates some margin of safety in the 200 PPM MAC for Methanol but, if the more susceptible individuals are to be protected the MAC should not be exceeded.

Conclusions

1. The spirit duplicators should not be used in confined areas such as small offices without exhaust ventilation. An air-conditioning system would help to dilute the solvent vapor concentrations but with steady operation of the duplicators the air supply

would be insufficient to dilute the vapors to safe levels.

2. Machines operated steadily in small rooms should be provided with an enclosing hood over the receiving basket, with an air flow sufficient to give at least 100 l.f.m. in-flow through the working openings of the hood. A canopy type hood is suggested for the receiving tray, completely enclosing it except for openings to allow the paper to be fed into the tray and the finished work removed. A two and a half inch diameter exhaust duct would suffice to carry the re-

quired air flow and a small centrifugal type fan would satisfactorily move the required volume of air.

3. Intermittent operation with a total time of only two or three hours per day would need no more than good general room ventilation.

References

1. VON OETTINGEN, W. E.: The Aliphatic Alcohols: Their Toxicity and Potential Dangers in Relation to Their Chemical Constitution and Their Fate in Metabolism, pp. 20-21.
 2. PATTY, FRANK A., EDITOR: Industrial Hygiene and Toxicology, Vol. II.
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