

PRELIMINARY PLANT VISIT
INDUSTRIAL HYGIENE REPORT

Georgia-Pacific Corporation
Chemical Division
Highway 28 West
Taylorsville, Mississippi

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1. INTRODUCTION

The following preliminary industrial hygiene survey report describes the Georgia-Pacific plant, which is located in Taylorsville, Mississippi. This Geogia-Pacific plant was selected for the survey because of its moderate formaldehyde production capacity (approximately 120 million pounds/year), its use of a metal oxide catalyst, and its southern location.

1.1 PLANT PERSONNEL CONTACTED

The plant visit described in this report was carried out by Glen Barrett (GEOMET Technologies, Inc.) and Dave Dunn (Monsanto Research Corporation) on October 13, 1981. Personnel contacted in connection with the visit were Mr. Ron Whobrey, plant manager; Mr. Richard Wise, plant superintendent; and Mr. Don Olsen, corporate manager-industrial hygiene.

1.2 SUMMARY OF ACTIVITY

The plant visit team met with plant personnel and held an extended conference during which the process, control technologies, and industrial hygiene programs described in this report were discussed. The group then walked through the formaldehyde production portion of the plant following the process flow. A closing conference was held during which information from the walk-through, plus more details concerning the safety and health program, were discussed.

2. BACKGROUND

The National Institute for Occupational Safety and Health (NIOSH) and the U.S. Environmental Protection Agency (EPA) have entered into an Interagency Agreement to perform a study that will determine the levels of pollutants to which workers in the formaldehyde production industry are exposed and that will evaluate the effectiveness of control technologies currently used to minimize exposures. A similar study of the semiconductor industry is being conducted simultaneously under the same agreement. The findings of both studies will be presented as reports summarizing the results of these assessments.

EPA has contracted with Monsanto Research Corporation (MRC) to perform the study on the formaldehyde production industry, under EPA Contract Number 68-03-3025, entitled "Technical and Engineering Services." MRC is being assisted in the study by personnel from GEOMET Technologies, Inc. (GTI).

The study of the formaldehyde industry is being directed toward a cross-section of production facilities. Of principal importance are the assessment of worker exposure to potentially hazardous agents in the workplace and an evaluation of control technologies applied to those agents. The worker exposure (industrial hygiene) study will examine all agents of concern, and the workforce exposed to such agents will be identified, concentrations evaluated, and the operations and process parameters of the work-site will be characterized.

A limited number of volunteers will be selected from the workers at a few selected sites for the determination of total (24-hour) exposure to air contaminants, including those found in the workplace, in transit, at home, and elsewhere. This portion of the study will be designed in such a way that it can be used to

- assess current formaldehyde production technology with respect to control of potential exposures of workers,
- identify the best available means to control emissions and potential exposures,
- evaluate the state-of-the-art of control technology in the formaldehyde production industry,
- assist the transfer of control technology inter- and intra-industry, and
- identify processes for which engineering controls are not available or are ineffective, where further research and development are needed, and to indicate priorities for application of control technology.

This segment is divided into two phases, preliminary surveys and detailed surveys. Objectives of these phases are presented below.

2.1.1 Objectives of the Preliminary Industrial Hygiene/Control Technology Survey Phase

The objectives of preliminary surveys are to:

- identify potential exposures to hazardous agents in formaldehyde processes and operations,
- identify control technology currently used by the formaldehyde industry to eliminate or control potential exposures,
- prepare a series of preliminary plant visit reports detailing findings from the first two objectives, and
- select 4-5 candidate plants from the original 12 plants for later detailed industrial hygiene surveys, based upon the findings from the first two objectives.

2.1.2 Objectives of The Detailed Industrial Hygiene/Control Technology Survey Phase

Detailed plant visits comprise the second phase of the industrial hygiene/control technology segment of the study. The objectives of these visits are to:

- observe operator work practices,
- conduct quantitative personal sampling,
- evaluate engineering control techniques used by the industry to reduce exposures, and
- prepare a series of detailed plant visit reports, detailing worker practices and evaluating the engineering controls used by the plant.

This part of the IH/CTA segment will be coordinated with the 24-hr exposure profile at four selected plants.

2.2 OBJECTIVES OF THE 24-HOUR EXPOSURE PROFILE SEGMENT

The objectives of the 24-hour exposure profile segment are to:

- determine the exposure of selected formaldehyde production and office workers to five selected pollutants on a 24-hour basis,
- evaluate these results and identify potential areas of concern due to high exposure, and
- determine the need for further indoor air studies.

3. DESCRIPTION OF PLANT

The Georgia-Pacific plant is located in an industrial park area approximately two miles from Taylorsville, Mississippi. Startup was in 1973. The plant produces 120×10^6 lb/yr of 37 to 50 percent formaldehyde solution with the use of an iron/molybdenum oxide catalyst. Forty to forty-five percent of the formaldehyde solution is used on site to manufacture phenol-formaldehyde and urea-formaldehyde resins. The remainder of the solution produced is shipped out by truck or rail to other customers, including other Georgia-Pacific resin plants.

The formaldehyde and resin production units are not enclosed in buildings. A plant site plan (Figure 1) shows the relationship of the formaldehyde production facility to the resin production facility. Open air construction, shown in Figure 2, provides for good natural dilution ventilation control of air contaminants. Enclosed within a single building structure are the control room for both formaldehyde and resin production, production-laboratory facility, quality control laboratory, employee locker room, management offices, and a warehouse.

The plant is nonunionized and operates through four shifts, 7 days/week. The total plant employs 38 employees, which includes 16 production workers (4 workers/shift) with the following breakdown:

- 4 shift leaders (supervisors),
- 4 operator technicians (operate formaldehyde production unit, formaldehyde loading, methanol unloading, can also operate the resin production unit),
- 4 operators (operate the resin production unit, unload raw feedstocks, load products),
- 4 utility men (loader, unloader, generally operate resin unit).

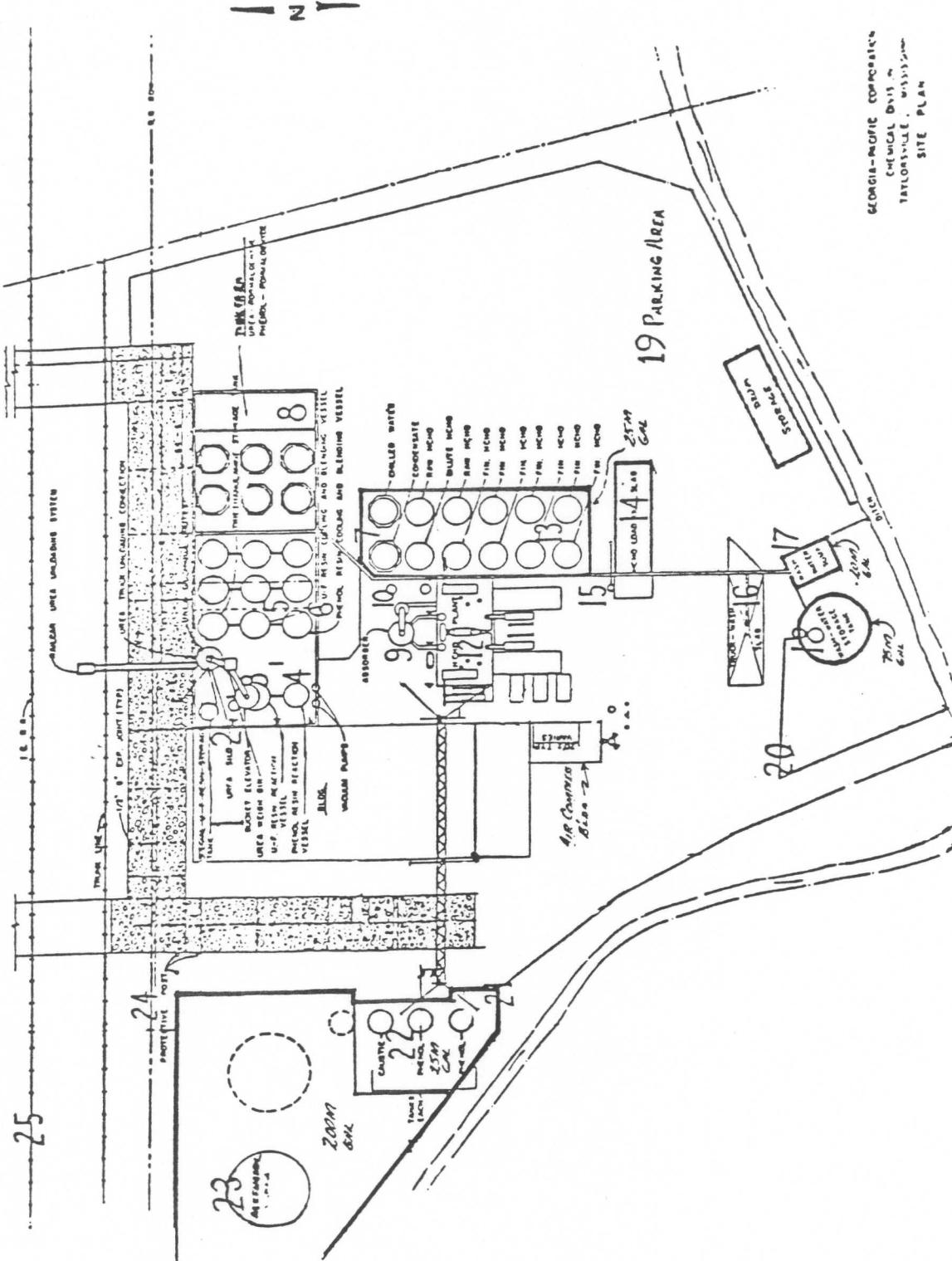


Figure 1. Plant Site Plan.

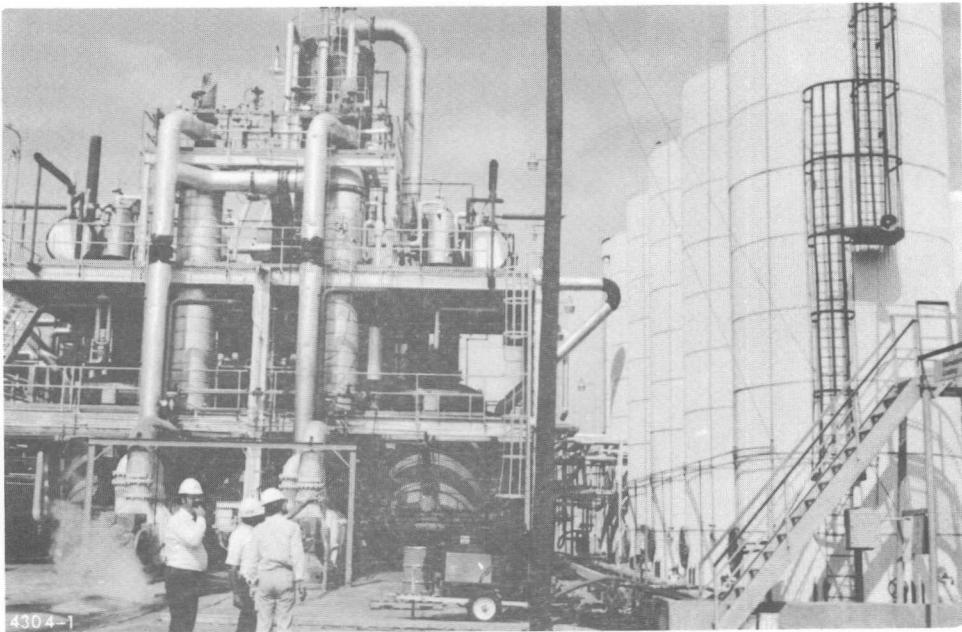


Figure 2. Production area. Note two converters in structure and single absorber behind structure.

The remaining employee job classifications are as follows:

- 1 quality control laboratory supervisor,
- 1 quality control chemist
- 1 lead maintenance technician (manages 3 maintenance workers)
- 3 maintenance workers
- 11 truckers (unload formaldehyde and resin at customer facility)
- 5 management and clerical personnel

The maintenance workers are assigned to day shifts, Monday through Friday, and are on-call at other times. Operators prepare maintenance work orders, and maintenance workers keep work logs to assure equipment repair. Maintenance workers have been called in during night shifts to repair a failing pump seal, although normally a standby pump is available and used to replace a failing operating pump.

4. PROCESS DESCRIPTION

Formaldehyde is manufactured by oxidation of methanol using an iron/molybdenum oxide catalyst. (See process flow diagram in Attachment A). The production process takes place in two identical parallel trains.

Methanol is unloaded from a rail car or tank truck to a bulk storage tank from which it is pumped to the vaporizer. Air is simultaneously drawn through a primary filter and combined with vaporized methanol in the vaporizer. The vaporized methanol-air mixture is fed to the converter, which consists of vertical catalyst-filled tubes. Dowtherm A[®], a coolant, is pumped through the outside of the converter and removes the heat of reaction. Dowtherm vapor is condensed and recirculated to the converter.

Hot formaldehyde gas, produced in each converter tube, is fed to the aftercooler. Cooled gas from the two parallel aftercoolers is united at the base of a single atmospheric absorber column. Liquid effluent from the absorber, containing 50-51 percent formaldehyde by weight, is fed to a resin bead ion exchanger to remove any formic acid and stored in storage tanks. Gas emitted from the top of the absorber column, consisting of mostly nitrogen and oxygen, is recycled to the process through the compressor. An oxygen analyzer is used in-line to control the oxygen content of the air feeding the vaporizer to reduce explosion hazard. The entire process has not been modified since initial startup in 1973.

5. DESCRIPTION OF PROGRAMS

5.1 INDUSTRIAL HYGIENE AND SAFETY

The corporate office provides safety and health program guidelines to the plant. These guidelines can be modified by individual plants to meet specific needs. Each plant employee receives a Chemical Division safety manual which contains sections dealing directly with an industrial hygiene program. These are "Chemical Substances," "Laboratory Safety," and "Medical and First Aid." The safety manual provides procedural guidelines for the division, but the exact administration of the safety and health program is left up to the discretion of each plant. If accident and illness experience is kept within acceptable guidelines, the corporate and division offices will let the plant operate its own program. If plant experience creates questions, the corporate and division offices will provide more direct guidance to assist the plant in reducing accident frequency and severity rates.

Georgia-Pacific employs an industrial hygienist at the corporate level, Mr. D. Olsen, who provides industrial hygiene service for all the plants. Plant personnel assist with sampling programs recommended by Mr. Olsen. Formaldehyde sampling results and noise level readings are reported in Section 6.

The plant holds one general meeting per month, with management and supervisory personnel attending. Safety is specifically included as a topic. Specific safety topics discussed are accidents and their prevention, unsafe practices, etc. The plant recently conducted a plantwide safety meeting with the objective of upgrading the plant safety program.

Plant safety inspections are conducted once per week by the Sunday day shift crew, utilizing a checklist form supplied by the Chemical

Division. The plant superintendent follows up on needed controls the following Monday. Both the plant manager and the plant superintendent conduct routine walk-through safety inspections.

Contingency plans for emergencies are well defined. The plant has a fire emergency plan. The Taylorsville volunteer fire department has visited the plant to determine fire fighting methods needed for particular fires that could occur. The emergency spill cleanup plan is now in the process of being updated.

The plant has had two lost-time accidents in the last 4 years. No accidents occurred in 1979 and 1980. Five accidents occurred in 1981, with two of the accidents involving chemical exposures. One accident resulted in a phenol burn at the resin manufacturing facility. The other accident resulted in eye irritation due to spraying of formaldehyde solution in the face and eyes of an operator when a sample valve on the absorber broke. The operator was wearing safety glasses. No employee has reported an illness due to inhalation of a hazardous airborne material during the plant's existence.

5.2 OCCUPATIONAL SAFETY AND HEALTH (OSH) TRAINING

All newly hired employees are taken through a 60-90 day probationary training period. The plant superintendent reviews the division safety manual with each new employee during this period. The employee is under direct supervision by an experienced operator or lead operator technician during the probationary period. The employee then generally advances from the lowest level of responsibility at the utility level (loader, cleanup, etc.) at the resin manufacturing facility, to a resin operator, to a formaldehyde production operator with responsibilities of loading and unloading, to a formaldehyde production unit operator. Generally it takes 3-4 years to be promoted from the utility level to a formaldehyde production unit operator. Employees are

under supervision as they advance to each level. Formaldehyde and resin operators are transferred back and forth between positions approximately every 6 months to ensure good operation of the resin unit.

The employment turnover rate is not precisely known but is considered generally low. Ten of the 16 production workers have more than 7 years of employment. In the past 5 years, the plant manager has hired one or two employees per year to fill plant positions.

Two employees on each shift are trained in cardiopulmonary resuscitation. All employees are trained in first aid.

5.3 PERSONAL PROTECTIVE EQUIPMENT (PPE) AND SAFETY EQUIPMENT

An emergency eye wash and shower is located in each of the following areas:

- Rail car methanol receiving,
- Truck methanol receiving,
- Rail car formaldehyde loading,
- Truck formaldehyde loading,
- Formaldehyde production unit.

All employees are required to wear a hard hat and safety glasses with side shields while working in production areas. Additional PPE is required for the following specific operations:

Formaldehyde Loading

Full-face organic vapor cartridge respirator
Rubber gloves

Formaldehyde Solution Sample Withdrawal

Rubber gloves

Catalyst Removal from the Converter

Half-face respirator approved for nontoxic dust

Sample Removal of Gas from the Line Leading from
a Converter to the Aftercooler

Full-face organic vapor cartridge respirator
Gloves

Formaldehyde Storage Tank Entry

Full protective suit
Boots
Gloves
Air-supplied respirator

The plant has a brief written respiratory protection program in the division safety manual.

5.4 MEDICAL PROGRAM

All employees are given a pre-employment physical examination by a Taylorsville medical clinic. The examination includes a back X-ray, urinalysis, and a medical history questionnaire. Employees are also given a baseline audiometric test at the nearby Taylorsville Crossett Division plant. Because the plant does not employ a nurse or physician, all accidents or illnesses are treated at the local medical clinic. Employees are not given periodic physical examinations or specialty examinations for specific hazardous exposures.

6. SAMPLE DATA

Short-term formaldehyde samples were taken with a direct reading instrument on March 3, 1980 by a division chemist. The results are shown on the attached plant "Ambient Air Survey" form (Attachment B). None of the results exceed the Occupational Safety and Health Act (OSHA) ceiling limit of 3 ppm. Additional sampling of this kind will be done on an as-needed basis or when process changes are made.

The quality control supervisor and quality control chemist had monitored the formaldehyde exposure of four employees with passive dosimeter badges 3 weeks prior to the preliminary industrial hygiene survey. The exposure for two formaldehyde and two resin production unit operators was monitored for an 8-hour shift. The sample results for the formaldehyde operators were higher than those for the resin operators; results ranged from 0.9 to 2.4 ppm. The 2.4 ppm measurement was obtained for a formaldehyde operator who had loaded five trucks with formaldehyde during the sample period. No air sampling has been performed for methanol. Operators generally work an average of 4 hours in the control room, which is away from areas where most exposures would be expected to occur.

It should be noted that Georgia-Pacific has conducted side-by-side tests of the formaldehyde badge and double impinger method and has found large discrepancies between the two methods. In general, the badge method yields much higher levels of formaldehyde detected. Georgia-Pacific is currently evaluating the accuracy of both the DuPont and 3M badges.

Another Georgia-Pacific division personnel manager has taken noise level readings with a sound level meter. Two types of noise sources

identified at the formaldehyde production unit were the air filter and compressors. Employees are not exposed to excessive noise due to these sources since they do not work in the vicinity of the sources for most of a shift.

7. CONTROL STRATEGY

Several areas of the formaldehyde operation that present exposure potential are discussed below with respect to the control technology applied. Exposure reduction is primarily achieved by using a continuous closed process. An exception is the initial open entry point of methanol into the process and the formaldehyde loading.

Leaks and spills of the process vapors and solutions can occur from mechanical equipment used. Leaks were smelled during the walk-through, but no samples were taken during the survey.

7.1 METHANOL UNLOADING AND HANDLING

Methanol is received and unloaded either from rail cars or trucks to the same diked methanol storage tank. The level of methanol in the tank can be read in the control room with the use of a diaphragm-operated gauge. Most unloading is done during the day. Two to three rail cars can be unloaded in a day, Figure 3, but generally two cars are unloaded, usually simultaneously. Trucks are unloaded at a separate area, Figure 4. Both rail cars and trucks are unloaded from the bottom using an adapter shown in Figure 5, with displaced methanol causing air to be drawn into the top of the rail car or tanker. The pump used to feed methanol to the storage tank is equipped with a mechanical seal and is preceded by a surge tank. The lines are pumped dry when rail car unloading is finished. Once truck tanker unloading is finished, the unloading tube is placed in the separate diked sump; and residual methanol is washed down into the sump. During the survey, the unloading tube line had residual methanol dripping out of it into the sump which resulted in methanol vapors that were smelled.

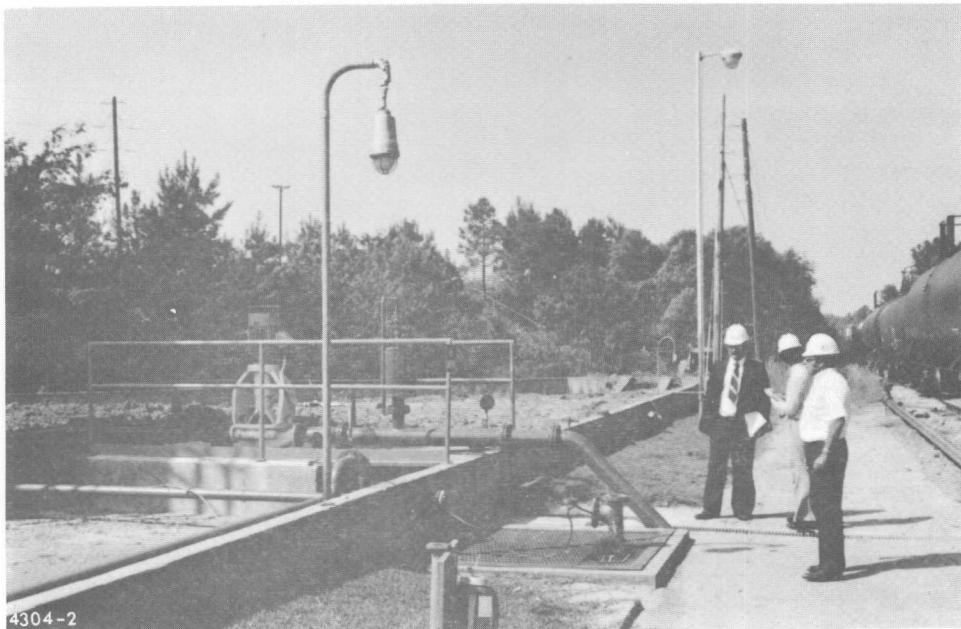


Figure 3. Rail methanol unloading area.

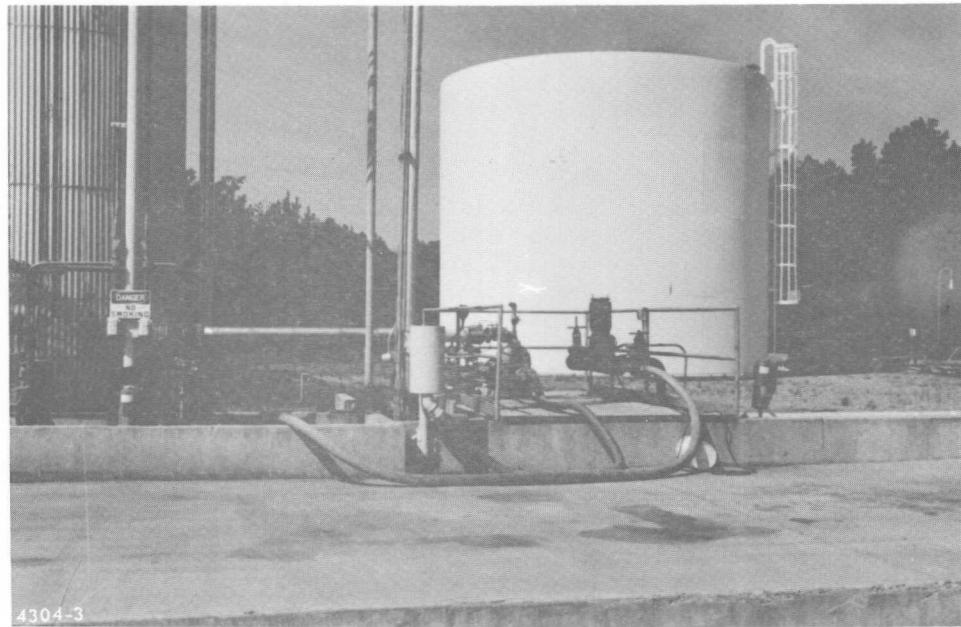


Figure 4. Truck MeOH unloading area. Rail unloading on right. White tank is MeOH bulk storage.

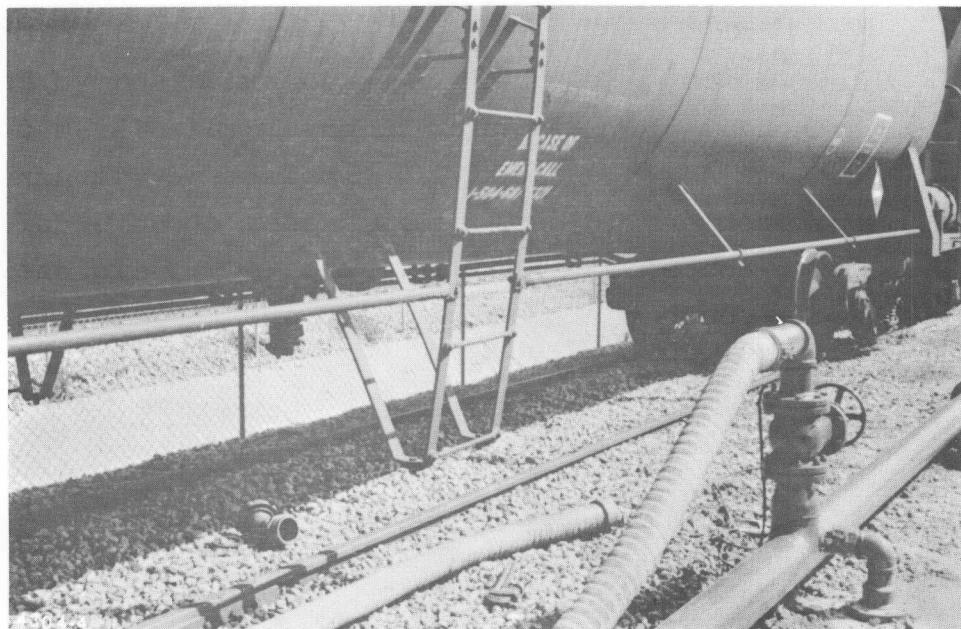


Figure 5. Adapter and flexible hose used for rail car unloading.

7.2 CONTROL ROOM

The control room contains the control panel for both the formaldehyde and resin production units. The control panels are equipped with audiovisual alarms. Formaldehyde solution samples are also titrated by the operators in this room. Samples are collected in open 250 mL flasks, weighed, and titrated without the use of a local exhaust ventilated laboratory hood. A small makeshift hood is available but a recent remodeling of the control room makes its use infeasible. The formaldehyde exposure could be greater during analysis without the use of a laboratory hood. The control room is provided with conditioned air. The percentage of recirculated air is not known.

7.3 ABSORBER

The absorber is equipped with pumps that transfer the absorber solution to the storage tank farm. The off-gas from the top of the absorber is combined with fresh, filtered air prior to the methanol vaporizer.

A small paraformaldehyde formation on a seal indicated a formaldehyde leak on an absorber pump , Figure 6. There was no formaldehyde odor. The absorber is equipped with a spare pump to be used if the original pump fails. The pumps are equipped with mechanical seals. All pumps at the plant are equipped with this type of seal.

7.4 FORMALDEHYDE STORAGE AND LOADING

Formaldehyde is stored in five 25,000 gallon and five 30,000 gallon capacity tanks at 55-60°C. The level of the tanks can be read in the control room. All of the tanks are diked by an 18" wall. The tanks are vented directly to the atmosphere. Some tanks are equipped with agitators, Figure 7, to reduce paraformaldehyde buildup. The remaining tanks are to be equipped with agitators.

The tanks are cleaned annually by pumping a solution of hot water, formaldehyde, sodium hydroxide, and steam into the tanks. If the inside of the tanks have to be visually inspected, PPE is required as stated in Section 5.3.

Most tanks contain a 50 percent solution. If a 37 percent solution is needed prior to loading, 50 percent solution is transferred to an empty tank and diluted with water to 37 percent. Solution samples are not drawn from a rail car or truck tanker during loading to ensure proper concentration. Instead, samples are drawn from the tank supplying formaldehyde prior to loading via a sample port. This reduces the exposure potential for the loader since he does not perform this sampling task.

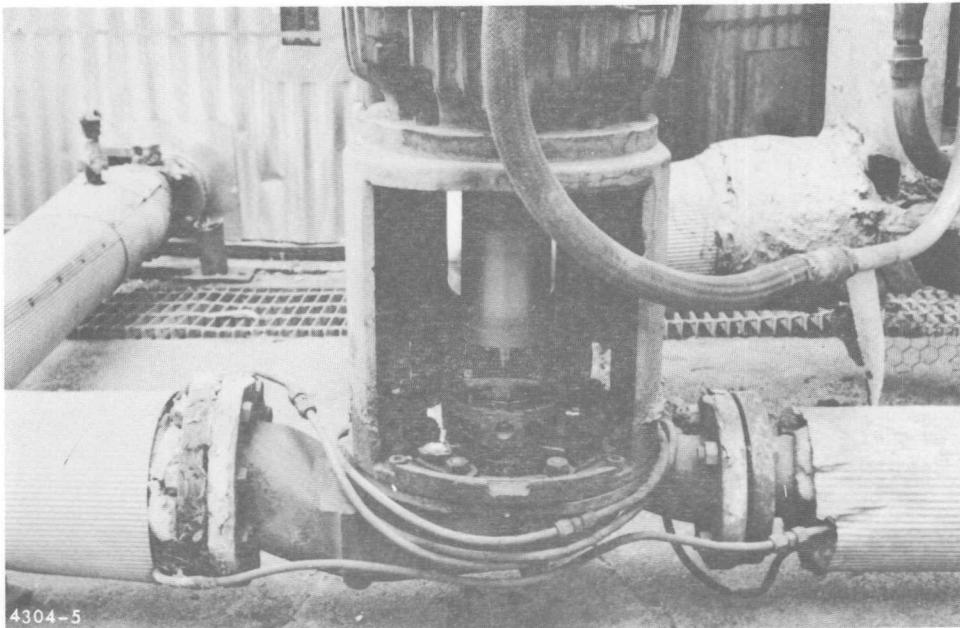


Figure 6. Absorber transfer pump. Note small paraformaldehyde on left side of pump.

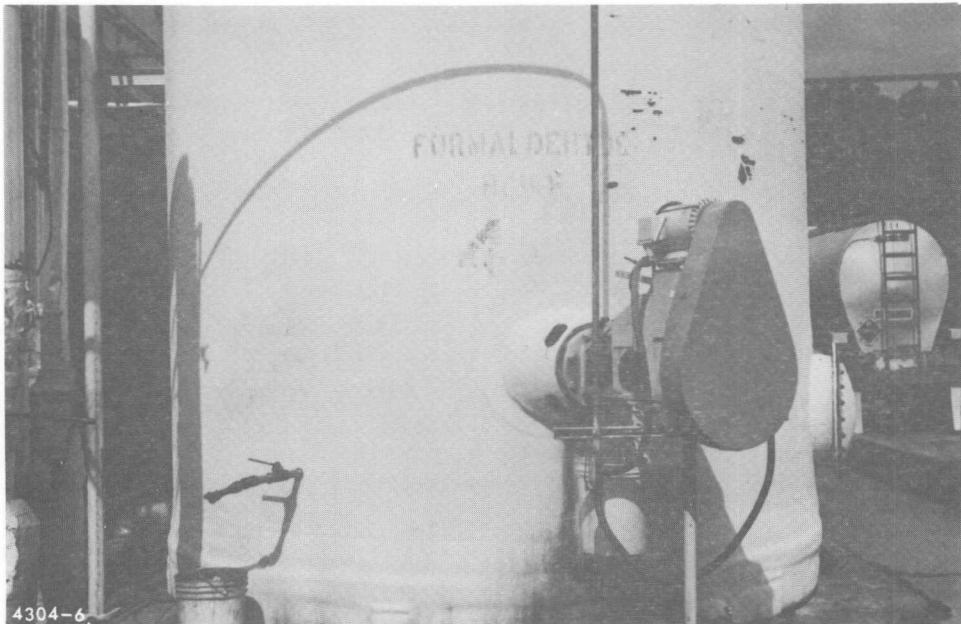


Figure 7. Side agitator used to mix the formaldehyde storage tank. Note bucket that collects leaking solution.

Displaced air when loading trucks or rail cars is vented to the atmosphere. Since the displaced air is not scrubbed, an airborne formaldehyde exposure could be present for operators or any nearby employees. Figure 8 shows the truck loading area.

7.5 SAMPLING POINTS

To ensure product quality, formaldehyde solution samples are taken from the absorber, Figure 9, and formaldehyde storage tanks, Figure 10. Samples are taken by opening a ball valve and filling a 250 mL Erlenmeyer flask. Specific PPE required is described in Section 5.3.

A gas sample is drawn from the line from the converter to the after-cooler by a laboratory technician wearing PPE (see Section 5.3). A rubber hose is attached to the sample port, the line purged, and a syringe is used to withdraw gas from the rubber hose. The gas is then injected into the gas chromatograph in the quality control laboratory for methanol analysis.

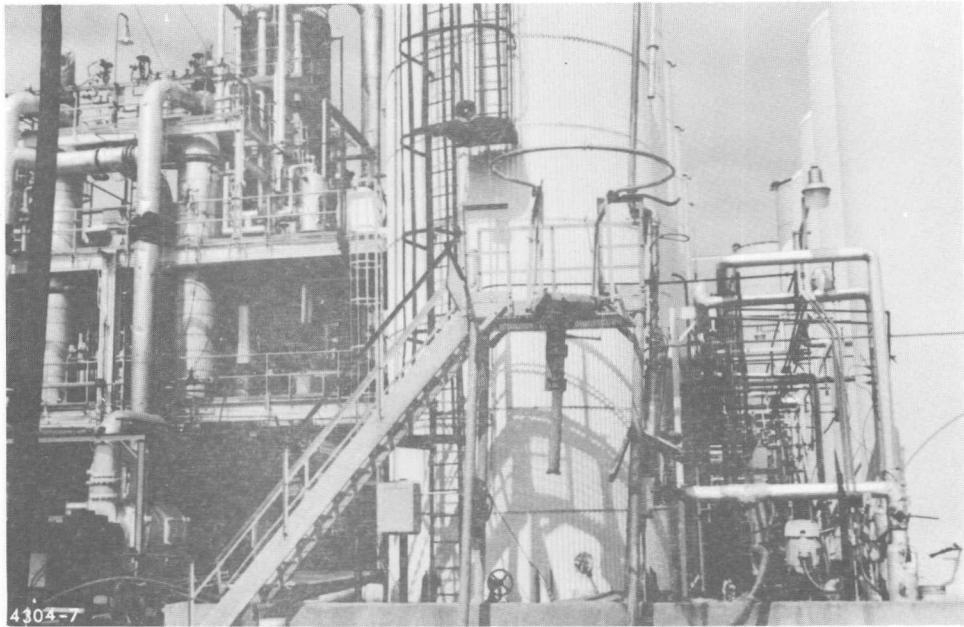


Figure 8. Truck loading area and formaldehyde storage tanks.



Figure 9. Absorber sampling point. Note purge collection bucket.

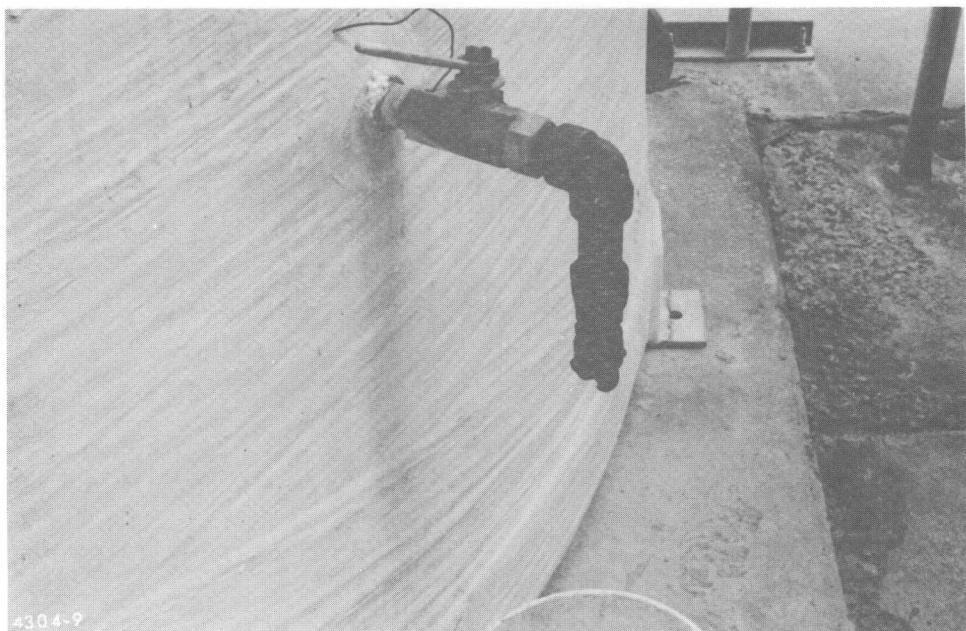
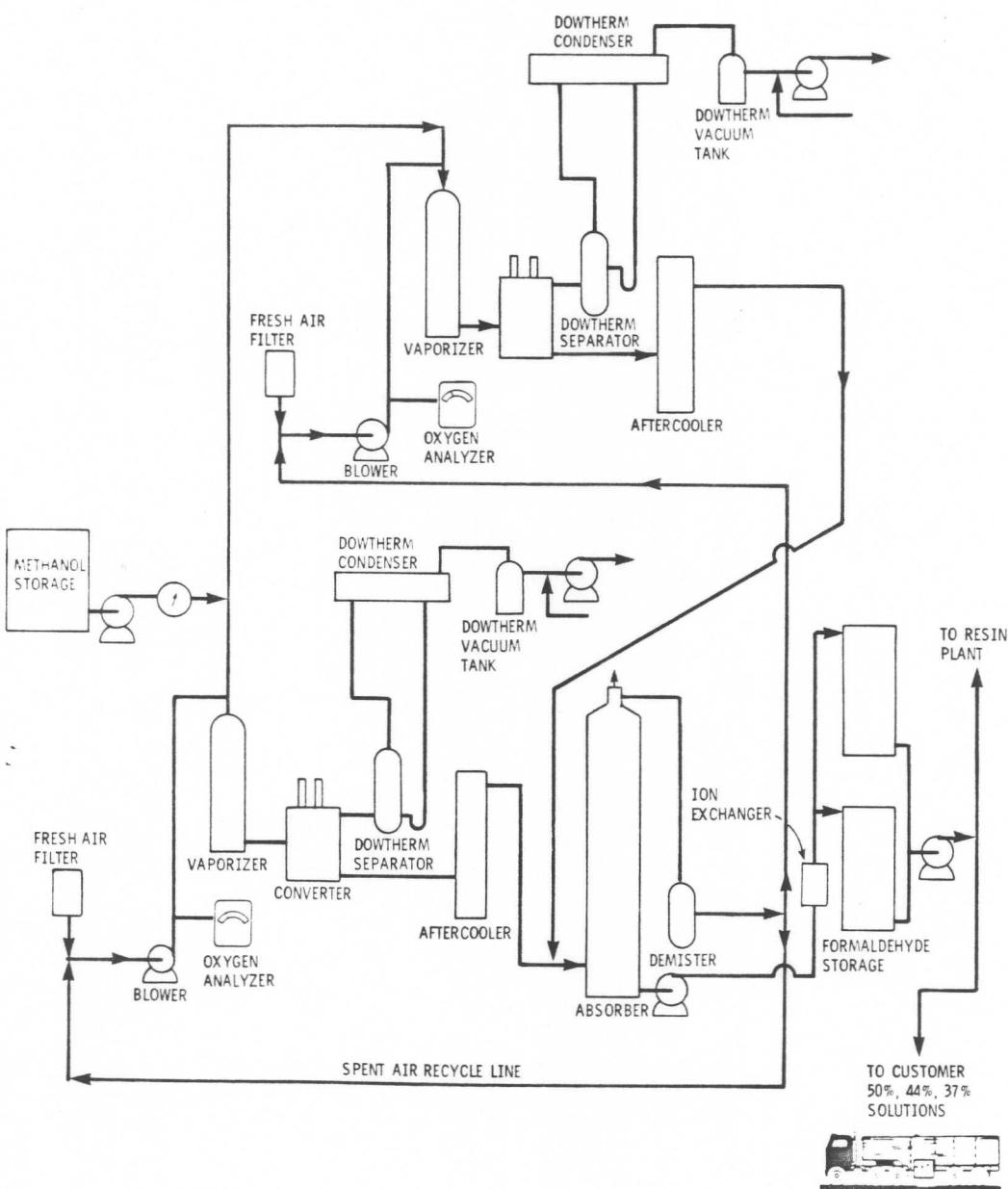


Figure 10. Storage tank sample point.

8. CONCLUSIONS AND RECOMMENDATIONS

The plant appears to have an effective engineering control program. Although small formaldehyde leaks were detected, all were minor and did not appear to be excessive exposure sources. The absence of major leaks demonstrates an effective maintenance program. Also, the operation of a safety and health program, including the training program, indicate corporate awareness and concern for the employees' health and well-being.

Chemical goggles, a face shield, or a full-face cartridge respirator should be required to protect the eyes when working directly with a liquid formaldehyde solution.



Attachment A. Formaldehyde Plant Flow Diagram

Facility: Chemical Resin Plant Date: 3/6/80
 Location: P.O. Box 556 Taylorsville, Miss. 39168
 Sampling Method: CEA 555 Air Monitor
 Instrument Serial No.: _____ Calibration Date: 3/6/80 By: L.R. Newton
 Sampled By: L.R. Newton Facility Supervisor: Ron Whobrey
 Outside Weather: Clear - 75°F Area Ventilated: Adequate

O.S.H.A. Specification for HCHO: 3 ppm Max. t.w.a.

Test No.	Location	Time On	Time Off	Conc. PPM(HCHO)	Temp. °F	% R.H. Humidity	Remarks
1	Q.C. Laboratory	5:00	- 5:15	0.95	80.5°	44%	Nozzle placed on work bench near door entrance. Some ventilation needed.
2	Control Room	5:16	- 5:30	0.25	81°	42%	Monitor placed hand high on work bench about 3' from control panel
3	Reactor #1 Sample Spout	5:31	- 5:43	0.60	73°	48%	Nozzle placed 3' from sample spout. Phenol/Formaldehyde charge
4	R.C.I. Formaldehyde Photocatalyst Absorber	5:45	- 5:56	0.30	75 1/2°	45%	Nozzle taped to ladder going up absorber. Before #1+2 converter.
5	Formaldehyde Storage Tanks	5:58	- 6:14	0.25	73°F	48%	Monitor between tanks $\approx 45 + \approx 46$.
6	UF Storage tanks Farm	6:15	- 6:30	0.10	68°F	58%	Nozzle waist high between tanks $\approx 20 + 21$

Comments: All areas evaluated are within/below the O.S.H.A. 3 PPM Max. Possible area which might need additional ventilation would be the laboratory.

Attachment B. Ambient Air Survey