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Medical Health and Resources Division
Gulf Science and Technology Company
P. O. Box 2227
Houston, Texas 77001
September 28, 1976

*Enter into files
China Govt Plastics
3 separate documents*

Mr. B. H. Gambrill
P. O. Box 641
Singapore

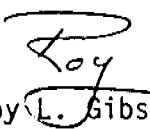
Dear Bryan:

Enclosed is my report on the medical survey of the CGPC operations in August. All of the observations and recommendations were discussed during the visit so there should be no surprises. I am sure you will let me know if there are any questions.

Attached is a memorandum to Bill Meador with our cost estimates. Assuming it is approved by Bill, and you have nothing to add, CGPC will be receiving a bill for \$3720.00.

Thanks again for your attention to our medical concerns and support with your management. I regret we hit you rather unexpectedly so recently after your arrival and at such a busy time, but everyone was most helpful, and I feel we got the job done. We will continue to keep you posted on events here. Let us know when we can be of help.

Regards,


Roy L. Gibson, M.D.

RLG:njf

cc: Mr. G. F. Huff
Mr. R. J. Comeaux
Dr. Wm. McClellan
Dr. Robert Cheng
Dr. F. D. Gassaway
Dr. T. Miller

CUSAROSS 00548

Occupational Health Survey
of
China Gulf Plastics Corporation

August 1976

by
Dr. Roy L. Gibson

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SUMMARY AND RECOMMENDATIONS

The occupational health program of CGPC is probably the best in Taiwan and the personnel involved in managing and implementing this program are enthusiastic, well-trained and now experienced individuals. CGPC management is again commended for its support of this effort to preserve the health of its workers. Medical examinations up to August were completed on over 800 workers and this number will continue to expand as now required by regulation. The environmental monitoring program continues to be accomplished with an expertise that is not available elsewhere in Taiwan. Engineering modifications have reduced exposures significantly. Current exposure levels to vinyl chloride and solvent mixtures do, however, indicate the need for a strategy aimed at compliance with U.S. standards. These standards are presently based on the best available evidence and are not likely to be revised upwards. Research studies now underway and recent reports involving neighborhood exposures to vinyl chloride are predicted eventually to lower the higher exposure limits now presently acceptable in other countries to U.S. levels.

There are other compelling reasons to reduce worker exposure to the lowest practicable levels. Liver cancer is the leading cause of death by cancer in Taiwan - 26 per 100,000 persons. The reason for this is unknown but one could speculate that susceptibility might be a factor. If this is so, is the Chinese liver also more susceptible to angiosarcomas? Hepatitis is also common in Taiwan as determined by serum antibody studies and this along with parasitism (liver flukes) could also play a role in carcinogenesis.

Management is also aware that CGPC workers are approaching the early latent period of liver angiosarcomas. Nearly all of the cases of angiosarcoma of the liver which have been identified were diagnosed in employees with more than 15 years of exposure. Considering that CGPC workers in the past commonly worked 8 to 10 hours or more a day, 6 to 7 days a week, their man-years of exposure have been reduced proportionately.

The recommendations which follow apply to the medical program of CGPC:

- (1) Medical examinations should be done on all workers at Toufen and Taoyuan.
- (2) "Exposed" and "non-exposed" groups should be defined, i.e. VCM and PVC workers, solvent workers, chlor-alkali workers, office workers, other groups.
- (3) Statistical comparison of the medical findings should be made between the groups of "exposed" workers and the "non-exposed" group. Gulf's medical staff will soon have an epidemiologist whose advise should be sought to select these groups and evaluate data.

- (4) The laboratory in the medical unit at Toufen is acceptable for standard laboratory procedures but it will be necessary to continue indefinitely a quality control check on the results by dividing blood samples and sending the duplicate sample to a reliable laboratory, preferably Veterans General Hospital (VGH), for analyses. It is also recommended that the number of tests be reduced and a GGTP enzyme test be added to the screening procedures.
- (5) Gulf's Medical Department should continue to provide a liaison service by keeping CGPC informed of clinical, industrial hygiene, environmental, educational and research activities and programs around the world.
- (6) Gulf's medical staff should continue to review medical records and statistical reports on request. All significant abnormalities and cancer cases should be reported to the medical staff for evaluation.
- (7) On-site visits by members of Gulf's medical staff should be made at periodic intervals in support of CGPC's efforts to reduce exposures and maintain a healthy workforce.
- (8) Most importantly a strategy to comply with U.S. exposure regulations on vinyl chloride should be planned as soon as possible and all current programs for engineering controls should be designed or modified to assure compliance as soon as possible.

GENERAL

The survey of CGPC manufacturing operations at Toufen and Taoyuan and the TVCM plant in Kaohsiung was conducted in August, 1976. It is the third survey of these facilities by medical and industrial hygiene personnel of Gulf's Medical Department. The first visit was in March, 1974 following the public announcement by Goodrich earlier that year that vinyl chloride appeared to be a human carcinogen. All facilities were surveyed and interviews were held with CGPC management and personnel. Contacts were also established with local physicians, governmental health agencies and NAMRU-2 a U.S. Navy Medical Research Unit in Taipei. Detailed reports were prepared covering all aspects of the vinyl chloride situation as well as the findings of the survey. Many recommendations were made including the need for medical and environmental surveillance, a record-keeping system, industrial hygiene training, employee personal hygiene and health education and engineering controls to reduce exposures to both chemical and physical hazards. Management responded by holding meetings with supervisors and workers to advise them of the health risks and measures to reduce exposures. A medical examination program was started and engineering modifications were begun.

Following the survey CGPC management kept Gulf's medical staff closely advised of its plans and efforts to implement these recommendations. Concurrently, the medical staff advised GOACHEM and CGPC management of regulatory actions, medical and industrial hygiene practices and research efforts. This liaison activity has continued to the present. The medical staff also participated in an industrial hygiene training program for Mr. Edward Lu and arranged visits for Mr. Wilbur Shyeh to several vinyl chloride operations in the U.S.

The second medical survey was completed in October 1974 and consisted primarily of an on-site inspection of facilities, meetings with CGPC management, medical, industrial hygiene and safety personnel and the collection of blood samples for lead analysis. A report with recommendations also followed this visit. The principal objectives of this third visit were to (1) review the medical surveillance program, particularly the laboratory practices; (2) evaluate the effectiveness of environmental control measures and analytical procedures by conducting on-site sampling; and (3) inform CGPC management of current practices with respect to the occupational health aspects of vinyl chloride.

U.S. MEDICAL AND RESEARCH PROGRAMS

Medical surveillance programs in the U.S. vary to some extent but in general are comprehensive and in compliance with the requirements of the Occupational Safety and Health Act (OSHA) for Vinyl Chloride. These requirements have been distributed and need not be detailed again except to recall that they consist of a medical history, physical examination, total bilirubin, alkaline phosphatase, SGOT, SGPT, and GGTP. Of these the only procedure not being done by CGPC is the GGTP. The GGTP is a sensitive test for liver function and has not been available in Taiwan. Further investigation of hospital facilities might disclose a laboratory which is either now doing or would be able to perform this procedure. Details of the test have been requested and will follow. It is not a complicated procedure and could be done in the Toufen medical unit with spectrophotometric equipment. If possible this test should be added to the CGPC laboratory procedures as soon as practicable.

Ultrasonography is a relatively new procedure to diagnosis liver disease which is being studied in the U.S. and U.K. as a possible method for the early diagnosis of liver disease, including angiosarcomas, in vinyl chloride workers. The equipment is expensive and interpretation difficult, requiring extensive training and experience. At present it is still largely a research method which will require further evaluation. This is a hospital procedure and it is not proposed that CGPC use this technique in its program.

Outlines of the vinyl chloride and ethylene dichloride research programs being conducted by the Manufacturing Chemists Association (MCA) are attached (Appendix 1 and 2). These studies were recently reviewed for the Corporate Health Hazard Committee. Gulf is a participant, the costs for the vinyl chloride program being shared by GOACHEM and Gulf Oil Canada equally while GOACHEM pays for the eth-

ylene dichloride research project. I am still serving as both management and technical representative for vinyl chloride and Dr. Harold MacFarland, Manager of Toxicology, is the technical representative on ethylene dichloride. The next meeting on vinyl chloride is scheduled for October 13, 1976 in Washington, at which time all of the current research programs will be reviewed.

At modest cost Gulf and CGPC have benefited from these extensive research efforts to define the vinyl chloride problem. The findings and conclusions to date have been distributed and are generally known to our management. Chronic exposure studies to low levels of vinyl chloride and mutagenic and teratogenic studies are now in progress. The latter studies are particularly important in view of the reports of the high incidence of abortions and birth defects of the central nervous system in persons not actively involved in vinyl chloride operations but living in the neighborhood of these facilities. The implications of these studies are pertinent to CGPC since many families of workers are living in company housing adjacent to the factories. Gulf medical staff will continue to monitor these research projects and keep CGPC informed.

TAIWAN MEDICAL REGULATIONS

In the past year the Taiwan government has issued occupational health regulations covering a wide variety of chemicals. These regulations were translated by Mr. Lu and Dr. Chung-Jee Yee at Toufen and a brief review of these new requirements along with the present CGPC medical procedures follows:

All Workers

Preemployment: medical history, physical examination, chest x-ray, hearing test, urine test (sugar, albumin)

Periodic: above procedures every 3 years if less than 29, every 2 years if 30 to 45, every year if over 45.

Vinyl Chloride Workers

Preplacement and Every Six Months: medical history, physical examination, blood tests (serum bilirubin, SGOT, SGPT, alkaline phosphatase, thymol turbidity, zinc turbidity, LDH. If abnormal, repeat tests and liver scan if abnormalities remain.

CGPC has been doing the following tests in addition to the above: complete blood count (hemoglobin, hematocrit, white cell count and differential), sedimentation rate, total protein (albumin, globulin), cholesterol, blood urea nitrogen, uric acid, creatinine, calcium and phosphorus. Reactor workers also receive hand x-rays every year and feet x-rays every two years.

Solvent Workers

Preplacement and Every Six Months: medical history, physical examination, urine (albumin), hematocrit, hemoglobin. Liver function tests are not defined but are recommended if findings are abnormal.

CGPC (solvent workers include those exposed to MEK, MIBK, Toluene, DOP, and other solvent vapors. Workers receive the same general examination as VC workers.

Chlor-Alkali Workers

Preplacement and Every Six Months: medical history, physical examination (only chest required); if abnormal findings then chest x-ray and pulmonary function tests should be done.

CGPC: Workers receive the same general examination as VC workers.

Mercury

Preplacement and Every Six Months: medical history, physical examination, urine (albumin, occult blood); if abnormal a microscopic urinalysis and psychiatric evaluation should be done.

CGPC: Workers now receive the same general examination as VC workers.

Lead

Preplacement and Every Six Months: medical history, physical examination, hematocrit, urine coproporphyrin; if abnormal, recheck above plus basophilic stippling, urine and blood lead analyses.

CGPC: Workers now receive the same general examination as VC workers.

Hydrogen Chloride and Ammonia

Preplacement and Every Year: medical history; if abnormal, chest x-ray and pulmonary function.

CGPC: Workers receive the same general examination as VC workers.

These medical requirements of the Taiwan government are more restrictive than those in the U.S. in so far as they require nearly all employees in the chemical trades to be examined. In some instances environmental monitoring is required but often only when abnormalities appear on the medical evaluations. Dependence

on the biologic system as indicator of exposure rather than direct environmental measurement is not an acceptable means of controlling a hazardous exposure; however, in the absence of regulated threshold limit values in Taiwan for many chemical substances, including vinyl chloride, the approach is not surprising.

CGPC MEDICAL PROGRAM EVALUATION

The medical procedures for workers at the Toufen and Taoyuan facilities have been defined. Prior to the government regulations only those workers in certain operations - VCM, PVC, leather, film sheet, print plant, floor tile, paint, R&D, chlor-alkali, and engraving - were included in the medical examination program.

The first two medical evaluations of these workers were conducted in June and December of 1974 on 171 and 133 workers, respectively. All blood studies were done by VGH in Taipei and the reports sent by CGPC to Gulf's Medical Department. An evaluation of 21 blood results on each employee was made and the conclusions, comparisons and recommendations reported by memoranda. Numerous follow-up studies were requested and further evaluated. While there were several interesting findings which appeared to be significant, none of the abnormalities could be related to specific occupational exposures and there were no angiosarcomas of the liver. In fact only one cancer has been diagnosed to date. One worker with a "lymphoma" was identified and has been under the care of physicians at VGH.

A control group of non-exposed people was not examined and is essential to evaluate the rather non-specific but possibly significant abnormalities which were observed. The recommendation to include a control group in the study was previously made and is now being implemented by virtue of the new regulations which will essentially include all workers at the factories in these medical examination programs. This internal control group which will consist principally of office workers will not, however represent a true "non-exposed" group since vinyl chloride levels in the office areas at Toufen exceed the U.S. standard of 1 ppm TWA and recently were measured at 7 ppm and 24 ppm.

The third medical evaluation program was conducted in January-February, 1976 and the results of the blood studies on 136 employees were sent to the Medical Department in May. The blood samples were divided into two parts, one sample being analyzed by VGH and the other by the laboratory technician in the medical unit at Toufen. A statistical comparison of the duplicate samples was done by Mr. Hsuing-Shon Kao, an industrial engineer at Toufen. Each employee again had approximately 20 blood tests. These reports were reviewed prior to the survey and again in detail at Toufen. Conclusions and recommendations were discussed with management and medical personnel. The remarks which follow will summarize these discussions.

Each worker is identified by his name, written in Chinese characters, and by a number; however, the numbers assigned on the third sample program were not the same as the first two samples. Consequently, it was not possible on our review to observe trends in individual workers. This was done by the plant physician,

however, who knows the workers and uses an excellent form to record these periodic medical findings. The translated version of the Gulf Medical Examination Form is also being used for preemployment examinations.

Routine blood tests were done on 136 workers at Toufen and Taoyuan. The following procedures were done in the Toufen medical laboratory:

January-February 1976

	<u>Number Abnormal</u>	<u>% Abnormal</u>
Sedimentation Rate	31	23
Hemoglobin	84	62
WBC	3	2
Neutrophils	1	0
Lymphocytes	0	0
Monocytes	0	0
Eosinophils	2	1
Basophils	0	0

The blood chemistry tests were done on divided samples by the laboratories at Toufen and VGH but not all of the workers received each test and the results which follow reflect these variations:

January-February 1976

	<u>Toufen</u>		<u>VGH</u>		<u>Total Examined</u>
	<u>Number Abnormal</u>	<u>% Abnormal</u>	<u>Number Abnormal</u>	<u>% Abnormal</u>	
Total protein	48	44	69	51	108/135
Albumin	3	3	0	0	108/135
Calcium	Not done		19	14	0/135
Phosphorus	40	42	25	19	95/135
Cholesterol	23	22	10	7	106/135
Urea	0	0	6	4	18/135
Uric acid	0	0	9	7	68/135
Creatinine	0	0	0	0	68/135
Total bilirubin	0	0	7	5	95/136
Alkaline phosphatase	5	5	2	2	97/136
LDH	Not done		0	0	0/136
SGOT	19	15	56	43	0/136
TTT	13	11	Not done		117/0
CCF	0	0	Not done		48/0
SGPT	4	3	Not done		131/0

Comparison of the VGH results with the 1974 findings without definitive statistical evaluation reveals probable significant increases in the percentages of abnormal total protein and SGOT results and significant decreases in abnormal cholesterol and phosphorus values. The phosphorus result at Toufen is comparable to previous VGH test results. Other differences are small and are most likely insignificant.

The blood count at Toufen again reveals a high percentage of abnormal sedimentation rates similar to previous results. Abnormal hemoglobin values, however, are 2 to 3 times higher than on the earlier samples and the eosinophil counts are now within normal limits. Without exception the liver function abnormalities were borderline -- SGOT ranges up to 65 units, SGPT to 52 units and total protein to 9.5 grams and are of questionable significance. They could represent minor liver irritation from any cause but do not appear to be job related. The high percentage of abnormal hemoglobin values could be related to the test procedure using a hemoglobinometer. A more accurate colorimetric method is recommended to evaluate this finding.

All medical results were reviewed and workers with significant variations were identified for retesting. Several of those with abnormalities had already been reexamined with essentially normal results. Eight workers with SGOT or SGPT elevations exceeding 50 were selected for retesting and presumably this has now been accomplished.

The statistical comparison of the Toufen and VGH blood chemistry findings was reviewed at Toufen with Mr. Kao. Significant differences were reported for the following tests; total bilirubin, SGOT, cholesterol, uric acid and phosphorus. It was pointed out that most of those tests are indicators of liver function, an important consideration in screening both vinyl chloride and solvent workers. It is necessary that the differences be explained and consequently the practice of duplicating samples should be continued. This will also provide a quality control check for the Toufen medical laboratory. Results might be expected to vary considering the newness of the Toufen laboratory and equipment and the relative inexperience of the technician. On the other hand, I was told that the laboratory equipment at the VGH at times malfunctioned with varying test results. The Toufen laboratory technician was not available for interview and no tests were being done during the survey.

As of August over 800 workers had received medical examinations in the medical unit at Toufen and this program will continue on an annual or semi-annual basis in compliance with regulations. The number of workers examined is now large enough to make valid statistical comparisons of various groups of workers. It was proposed that at least four "exposed" groups and one "non-exposed" group of workers be selected for statistical comparison of certain blood studies. The "exposed" groups would include: (1) VCM and PVC workers; (2) solvent workers; (3) chlor-alkali workers and; (4) all other factory workers. The "non-exposed" group would be made up of office workers and might also include some family members living in company housing. Each group should be large enough to support valid statistical analysis.

Further, it was recommended that fewer blood studies be performed by the medical unit at Toufen. In my opinion, the following tests should be continued: sedimentation rate, hemoglobin, white cell count and differential, cholesterol, creatinine, total bilirubin, alkaline phosphatase, SGOT and SGPT. As previously mentioned the GGTP test should be added to these procedures. The regulation also requires certain liver function tests, the thymol and zinc turbidity tests, which are commonly done in Taiwan. The total protein, calcium, phosphorus, urea, LDH and uric acid studies should be discontinued. The laboratory technician could then concentrate on fewer tests with perhaps less chance of error and better quality control. The statistician could then evaluate only those test procedures which are of most importance in screening the CGPC groups of workers. We are now seeking a full-time epidemiologist for our medical staff which will enable us to improve our epidemiological investigations and provide detailed statistical analyses. This person should work closely with the CGPC statistician in the selection of his study groups and the statistical evaluations which will follow.

TVCM MEDICAL PROGRAM

The TVCM facility in Kaohsiung was visited and the medical program briefly reviewed. All workers receive medical examinations which are done by a government physician in a nearby medical facility in accordance with government requirements. I was told that the findings were generally normal. Unfortunately, it was not possible on short notice to arrange a meeting with the physician or review the medical records. It appeared to be a sensitive issue since our ownership in this facility is relatively small and shared with several companies, including Formosa Plastics.

VINYL CHLORIDE

● FACILITIES

TAIWAN
ECUADOR
~~CANADA~~

● REGULATIONS

YES
NO
~~YES~~

● TLV (US 1 ppm)

NONE
NONE
~~10 ppm~~

MCA RESEARCH PROGRAMS

● ANIMAL EXPOSURE STUDY (BIOTEST)	\$180,000
EPIDEMIOLOGICAL STUDY (T/C)	93,000
METABOLIC STUDIES (DOW)	114,000
CHRONIC INHALATION STUDIES (DOW)	220,000
● SINGLE ACUTE EXPOSURE	80,000
MUTAGENIC AND TERATOGENIC STUDIES (DOW)	115,000
● DIAGNOSTIC STUDIES (U. LOUISVILLE)	<u>200,000</u>
● TOTAL COST	\$1,022,000
● GULF COST TO DATE	\$6,582 (LIMIT 10,000-1974)

RESULTS

ANIMAL TUMORS

- HUMAN LIVER ANGIOSARCOMAS, LIVER FIBROSIS, OTHER SUSPECT HEALTH PROBLEMS
- COMMUNITY STUDIES UNDERWAY SUGGEST GENETIC PROBLEM

CHRONIC STUDIES AND DIAGNOSTIC STUDIES IN PROGRESS

ETHYLENE DICHLORIDE

CUSAROSS 00561

● FACILITIES

TAIWAN
~~CANADA~~

● REGULATIONS

YES
~~YES~~

● TLV (50 ppm ⁵→~~2~~ ppm)

NONE
~~+~~

MCA RESEARCH PROGRAMS

● CHRONIC INHALATION STUDIES*(MALTONI)

\$220,000-\$270,000 (\$142,500)

METABOLIC STUDIES *(MARIO NEGRI INSTITUTE)

65,000- 115,000 (54,000)

REPRODUCTION AND TERATOLOGY STUDIES (DOW)

20,000- 35,000 (76,000)

● TOTAL COST

\$305,000-\$420,000 (\$272,000)

● GULF COST TO DATE

\$5,120

RESULTS

● NONE - ALL STUDIES IN PROGRESS

●*JOINT SUPPORT WITH EUROPEAN GROUP