

U. S. DEPARTMENT OF HEALTH, EDUCATION AND WELFARE  
CENTER FOR DISEASE CONTROL  
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH  
CINCINNATI, OHIO 45226

HEALTH HAZARD EVALUATION DETERMINATION  
REPORT NO. 77-67-499

ST. CLAIR RUBBER COMPANY  
MARYSVILLE, MICHIGAN

I. TOXICITY DETERMINATION

It has been determined on the basis of medical evidence collected October 26-27, 1977, that no hazard of clinical thyroid depression (hypothyroidism) existed for workers exposed to ethylene thiourea (ETU) at the St. Clair Rubber Company, Marysville, Michigan. There were, however, two statistical calculations of borderline significance found in the analysis of medical values obtained for the thyroid function laboratory tests ( $T_3$ ,  $T_4$  and  $T_7$ ).

Environmental sampling results did demonstrate that workers were exposed to trace amounts of ethylene thiourea as airborne dust or through direct contact of powdered ethylene thiourea (ETU). The use of a non-powdered dispersion form of ETU has reduced worker exposure significantly.

Recommendations to improve medical surveillance of workers and to reduce worker exposure to potentially toxic substances released in the compounding area have been made in this report.

II. DISTRIBUTION AND AVAILABILITY

Copies of this determination report are currently available upon request from The National Institute for Occupational Safety and Health, Division of Technical Services, Information Resources and Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days the report will be available through The National Technical Information Service (NTIS), Springfield, Virginia. Information regarding its availability through NTIS can be obtained from NIOSH, Publications Office at the Cincinnati address.

Copies of this report have been sent to:

- a) St. Clair Rubber Co., Marysville, Michigan
- b) Authorized Representative of Employees, United Rubber Workers, Local 47
- c) United Rubber Workers International
- d) U. S. Department of Labor - Region V
- e) NIOSH - Region V

For the purpose of informing the 175 affected employees, copies of the report shall be posted in a prominent place accessible to the employees for a period of 30 calendar days.

### III. INTRODUCTION

Section 20(a) (6) of the Occupational Safety and Health Act of 1970, 29 U. S. C. 669(a) (6), authorizes the Secretary of Health, Education, and Welfare, following a written request by any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The National Institute for Occupational Safety and Health received such a request from an authorized representative of employees, United Rubber Workers, Local 47, regarding a potential health hazard associated with production employees' exposure to ethylene thiourea (ETU). The URW International had notified its members that ETU had been shown to produce birth malformation and thyroid cancer in experimental animals. URW, Local 47, had asked that NIOSH investigate the use of ETU at the St. Clair Rubber Co., Marysville, Michigan, in order to determine what precautions would be necessary to protect the exposed workers.

### IV. HEALTH HAZARD EVALUATION

#### A. Description of Process - Conditions of Use

The St. Clair Rubber Company produces moulded rubber products, rubber coated fabric and liquid rubber adhesives. The company manufactures many types of bumper guards for the auto industries and under U. S. Government contract supplies special purpose rubber fabric for making raincoats, life rafts and numerous other rubber products used by the military. The St. Clair Rubber Company has been in business over 50 years and has been using ethylene thiourea (ETU) since 1949. ETU is used as an accelerator for curing neoprene rubber. Approximately 20% of the products manufactured by St. Clair Rubber are neoprene compounds. The Company estimated that it uses 450-500 pounds of ETU each month.

The areas of concern at St. Clair Rubber were those locations where ETU is handled; the compounding scales, the banbury mixer, the cloth room mixing area and the Adhesives Plant Churn Room.

At the time of the Initial Survey ETU was supplied to St. Clair Rubber from Du Pont under the trade name NA-22 and from The R. T Vanderbilt Company under the trade name Thiate N. Both products were shipped in large fiber drums, each containing 164 pounds of ETU in the form of a fine white powder. These shipping drums were also used as storage containers at the work areas where ETU was used. Workers would simply open the drum, reach in and scoop out the amount of ETU

required for curing a neoprene rubber batch. Employees had been directed to use dust masks and rubber gloves when handling ETU but no instruction had been provided regarding the proper use and maintenance of this equipment.

Approximately 300 pounds of powdered ETU were consumed each month in the compounding area. Although work practices were somewhat sloppy, ETU dust exposure was not prolonged or frequent. Compounders stated that normal mixing schedules required 30 batches per shift. Only 0.6 lbs. of ETU were needed for curing 1 batch and neoprene was not compounded during each shift. A set of 3 scales were used for weighing the rubber batch ingredients which were then placed on a conveyor and sent to the Banbury Operator for mixing at the proper time. The smallest of the 3 scales was used for weighing the ETU as it was poured into small paper sacks by one of the two compounders working in the area. The sacks were placed on the conveyor along with other needed ingredients. After mixing in the Banbury the batch was discharged, milled and rolled into slabs which were subsequently extruded or molded into final form.

Approximately 150 pounds of powdered ETU per month were used in the cloth room. In this location the cloth room Serviceman mixed the ETU as a dispersion in toluene. An empty tin can was placed on a scale and 1 lb. of ETU was added. The can was then filled 3/4 full with toluene and placed under a small table mixer to disperse the ETU. This dispersion was then poured into a 55 gallon drum of liquid rubber "master batch" and blended with a large floor mixer for about 20 minutes. This drum was then sealed with a lid and rolled into position near the cloth room Spreader Operators. The Spreader Operator then tapped off small quantities of the liquid rubber and poured it onto a roller applicator which spread a thin rubber coating over nylon fabric as it was unrolled and fed through a long drying oven. The coated fabric was then rerolled at the opposite end of the oven. The fabric was fed through the spreader several times in order to apply the required number of rubber coatings to each side of the fabric.

On occasion ETU is added when a liquid rubber master batch is formulated. This is possible only when the batch is to be used within a few hours. Liquid rubber products and adhesives are formulated and mixed in large churns at the St. Clair Rubber Adhesives Plant located about 1 mile from the main plant.

ETU is added and mixed in the churns once a day on the average. Ten to 12 employees work in the adhesives plant, but only the Churn Loader is required to handle ETU. Eight to 9 pounds of ETU are used for each churn mix which is equivalent to 18 batches of finished product weighing approximately 100 pounds per batch.

Because of possible health risks associated with ETU, The St. Clair Rubber Company has discontinued use of this substance in its dry powder form. During August 1977, NA-22 and Thiate were substituted by Poly-Dispersion<sup>(R)</sup> END-75, supplied by Wyrrough and Loser, Inc. This is a white rubbery solid material containing a 75% dispersion of ETU in an ethylene propylene rubber binder. Conversion to this new form of ETU was relatively simple in that END 75 was a pound for pound replacement for NA-22 or Thiate N. The use of this material did not present a dust hazard to workers. The amount needed is trimmed from a slab in small strips, weighed and added to the neoprene compound as needed.

The medical program is provided by Surgical Associates, P.C. of Port Huron, Michigan. The physician retained by the company indicated, by letter, that the pre-placement evaluation included a medical history and physical examination. The physical included thyroid gland palpation. Laboratory tests included blood hemoglobin level and a urinalysis for sugar and albumin. There is no routine follow-up examination. The company did select a group of employees for periodic pulmonary function tests and CBC's and the results of the tests were reviewed by the company physician. The plant manager informed NIOSH that the employees were selected because of periodic exposure to toluene.

First aid facilities consisted of a room with a cot. There were some band-aids, cotton swabs, and an antiseptic solution present suitable for treating small lacerations. There was a small portable oxygen tank present which the safety committee member present was unable to operate. Immediate first-aid in case of emergency was reported to be given by trained supervisory personnel. Injured persons were to be transferred by local ambulance to the town hospital emergency room in the near vicinity.

Shower facilities were available at the plant. At the time of the follow up survey, the company did not provide protective clothing, but they indicated that overalls had been ordered and plans were to provide the workers with laundered overalls three times per week. A lunch room separate from the work area was provided.

## B. Evaluation Design and Study Progress

### 1. Initial Survey

On April 25 - 28, 1977, an initial environmental survey was conducted by NIOSH investigators. The production process and procedures for handling ETU were discussed with management and union representatives. NIOSH investigators provided research study

abstracts of experiments conducted with laboratory animals which reported that oral ingestion of ETU had caused thyroid carcinomas and birth defects in rats. The company was aware of these studies and was currently evaluating plans to substitute ETU powder with an ETU dispersion, in slab form, in order to eliminate the ETU dust exposure.

A walk-through tour of the production facilities was conducted in order to observe work practices, inspect ventilation systems and take photographs. Fifteen employees who were known to have handled ETU were given confidential non-directed interviews. The employees were asked if they had experienced health problems which in their opinion had been caused by or were related to conditions of their job assignments. Atmospheric samples for airborne ETU dust were collected in the compounding room, mill room, cloth room and Adhesives Plant. Seven personal and 2 area filter samples were analyzed for total weight in micrograms ( $\mu\text{g}$ ) of ETU per filter.

Product labels for Thiate N and NA-22 carry a recommendation that women of childbearing potential should not be exposed to the chemical. The labels also warned that based on animal studies ETU may cause birth defects and cancer. As a result of these warnings and the lack of available human exposure data, a follow-up environmental-medical investigation was considered necessary.

## 2. Follow-up Survey

A NIOSH physician, a physician's assistant and two industrial hygienists conducted the follow-up survey on October 26-27, 1977. An initial conference was conducted with company and union officials followed by a walk-through tour of the plant facility. During the walk-through the plant manager discussed the new work procedures that had been implemented for handling and using the Poly-Dispersion END-75 material. Additional environmental sampling for ETU was

conducted during 1st and 2nd shift operations. Also conducted in this follow up survey visit were medical evaluations involving employee physical examinations, blood tests and employee interviews using specially designed medical questionnaires.

### 3. Interim Status Report

A preliminary report summarizing the environmental findings from the initial and follow-up surveys was provided The St. Clair Rubber Company and to URW union representatives on January 24, 1978.

## C. Evaluation Methods

### 1. Environmental Sampling

As far as could be determined, atmospheric sampling and analysis for ETU dust had not been attempted prior to the conduct of this investigation. Personal and area dust samples were collected on 5 micron PVC filters and on 0.8 micron methyl cellulose ester filters mounted in 37 mm diameter 3 piece plastic cassettes which were attached to the worker's shirt collar. Workroom air was pulled through the filters using portable battery operated air sampling pumps operating with a flow rate of 2 liters of air per minute (1pm). Paper smear tabs were used to collect swipe samples from dusty work areas and from employee's hands, arms and clothing. Analysis of the samples for ETU content provided a rough determination of ETU dust fallout contamination and an evaluation of employee exposure to ETU through direct skin contact.

The analytical procedure for ETU determination involved preparation of an iron complexing reagent (pentacyanoammonioferrate) and derivatization of the ethylene thiourea with the iron complexing reagent to form a colored complex. Analyses were performed employing a recording U.V.-Visible spectrophotometer using the absorption maximum of the complex at 590 nm. To improve sensitivity, 5-cm sample cells were employed. Absorbance versus concentration plots of ethylene thiourea standard solutions were linear over the analytical range of 15-150 micrograms per filter with a linear correlation coefficient of 0.9999. Stability studies for the iron complex revealed a 1.5% degradation of the color in 3 hours and about 3% degradation in 4 hours. Therefore, analyses could be performed with small discrepancies within the first 4 hours. The percent recovery studies indicated that ethylene thiourea can be extracted from spiked PVC filters with 98.6% ( $\pm 3.2\%$ ) recovery efficiency and from methyl cellulose ester filters with 97.7 ( $\pm 1.7\%$ ) recovery efficiency. The air filter and smear tab field samples were similarly extracted, complexed and analyzed.

### 2. Medical

The NIOSH physician evaluated fifty-one employees of the St. Clair Rubber Company. The demographic breakdown is given in Table 1. Questionnaires and limited physical evaluations were administered by the NIOSH physician and blood was drawn by the NIOSH physician

assistant. Those St. Clair Rubber Company employees (management staff and office workers) who volunteered and had reported no previous exposure to ETU were used as controls. One "non-exposed" person had some ETU exposure but none for the past seven years.

The questionnaire included demographic data, work history, past medical history to elicit any history of thyroid disease, physical symptoms of thyroid disorder, and questions concerning on-the-job personal hygiene. The physical symptoms are listed in Table 2. The physical examination was an evaluation of facial features and palpation of the neck, thyroid, and supraclavicular areas.

The laboratory tests performed were  $T_3$  (triiodothyronine),  $T_4$  (thyroxine)  $T_7$ ; and if any abnormalities were discovered in the  $T_3$ ,  $T_4$ , or  $T_7$ , a TSH (thyroid stimulating hormone) level was determined. The blood was drawn by venipuncture. The blood was allowed to coagulate and the serum transferred to a second tube. The tubes were then transported to Medical Diagnostic Services - Ohio Valley in Cincinnati, Ohio for analysis. The analysis for  $T_3$  and  $T_4$  samples was by radioimmunoassay. Reagents were supplied in a kit from Bio-Rad Laboratories, Richmond, California. The  $T_7$  value is obtained by multiplying the  $T_3$  and  $T_4$  results. The TSH analysis was also by radioimmunoassay kit supplied by Bio-Rad Laboratories. Only one TSH analysis was performed.

#### D. Evaluation Criteria

Ethylenethiourea (ETU) is a white crystalline powder and is moderately soluble in organic solvents. It has been widely used since 1948 as an accelerator for neoprene rubber. No hazards to health had been recorded until 1969 when Innes<sup>1</sup> et al. reported absorption through

the skin of pregnant rats which produced fetal abnormalities at a dose level of 60 mg per kg. In 1973, Aylett<sup>2</sup> reported a high incidence of anencephaly and spinabifida and suggested an association with a local rubber manufacturing plant because 4 of 16 of the fathers had handled rubber. None of the mothers were exposed.

A second potential problem was reported by Ulland et al.<sup>3</sup> in 1972 when they induced follicular and papillary thyroid cancer with metastases in rats with exposure of 350 and 175 ppm in the diet during the 18-24 months of the study. No lesions were seen in the control animals. Hyperplastic and simple goiter were also induced at the same doses.

A third toxic effect was reported by Ruddick and Khera in 1975.<sup>4</sup> Pregnant rats were given a single dose of 40-240 mg ETU/kg during days 6-21 of gestation. Fetal abnormalities were observed at some dose, the toxic dose ranging with each lesion, for each day between days 10 and 21 of gestation.

In 1976, Smith<sup>5</sup> investigated both the problems of congenital abnormalities and thyroid cancer in workers exposed to ethylenethiourea in a rubber manufacturing plant in Birmingham, England. "The study investigated 699 female industrial users of rubber containing ethylenethiourea, and no excess of congenital abnormalities was found. As regards thyroid cancer, 1929 rubber workers were investigated, but no cancers were found.

There are no case reports describing acute toxicity in humans. This suggests a low acute toxicity as compared with the potential chronic toxicities. No threshold Limit Value or federal occupational health standard has been established for ethylenethiourea. The World Health Organization, an international agency for research, has evaluated the carcinogenic risk of ETU to man and found that ETU should be identified as an anti-thyroid substance. Substances of this type are believed to induce thyroid tumors through suppression of the rate of thyroxine synthesis leading to a hormonal imbalance. (ETU has a chemical structure closely related to propylthiouracil which is a drug used therapeutically for its thyroid depressive action.)

## E. Evaluation Results

### 1. Medical

The prevalence of symptomatic complaints are shown in Table 2. As noted, all complaints of hair distribution changes were by middle aged males complaining of thinning hairlines. They had no evidence of beard, body, or eyebrow hair changes.

The medical portion of the questionnaire elicited a history of hypothyroidism in two ETU exposed workers and one non-exposed worker. All three persons developed hypothyroidism prior to working at St. Clair Rubber Company and were removed from statistical analysis of the laboratory data. Also noted in questionnaires conducted by the industrial hygienist, during the initial survey, was a compounder who reported that he was under a doctor's care for a thyroid condition. His physician was alerted to the risk of occupational exposure to ETU. As a result, he was called in for reexamination. This person was one of the three with hypothyroidism described above. Following the initial survey, the industrial hygienist advised the company that those individuals with a known thyroid condition should not be permitted to handle ETU.



Other elicited medical illnesses were four histories of hypertension two of diabetes mellitus, one of chronic urticaria, one of asthma, one of Hodgkins disease, and one history of a treated facial skin cancer.

The laboratory results are listed in Tables 3, 4 and 5 with appropriate normal values. Table 3 lists ETU exposed workers and Table 4 lists non-ETU exposed workers. The two female participants and the three persons with known hypothyroidism prior to working at St. Clair Rubber Company are listed in Table 5. Laboratory results are also categorized by years of exposure in Tables 6, 7 and 8.

Each ETU-exposed male worker was asked the number of children fathered by him. The birth dates were not recorded; therefore, the number of children conceived while the father worked at St. Clair Rubber Company cannot be determined. Of the 42 ETU-exposed workers, 38 fathered a total of 136 children. The one exposed woman worker studied had three children with no birth defects. The only medical defects are one child with "pigeon toe" and one child with minimal brain dysfunction (hyperactive) as reported by the fathers.

There were few abnormal physical findings. Of the forty-three persons evaluated, six ETU exposed workers had small palpable anterior cervical lymph nodes. They were not considered abnormal in size or consistency by the NIOSH physician. Three ETU-exposed workers had slightly palpable thyroid glands. One of these three persons has had hypothyroidism since pre-St. Clair Rubber Company employment. None of the three thyroid glands were of abnormal consistency as determined by the NIOSH physician. None of the glands were nodular.

## 2. Environmental

The airborne ETU dust levels generated from use of powdered ETU (Thiate N or NA-22) and from use of the poly-Dispersion END-75 slabs are presented in Table 9 and 10 respectively. The results indicate that the amount of ETU dispersed into the air was reduced by switching to END-75. This reduction was especially significant for jobs involving direct handling of ETU as noted for the Churn Loader and Compounder #1. Only one job sampled (the Spreader Operator) showed an increase from no ETU detected during the initial survey on April 27, 1977, to 8 micro grams of ETU/M<sup>3</sup> during the follow-up survey on October 26, 1977.

## F. Discussion

### 1. Environmental

NIOSH maintains that it is not currently possible to demonstrate safe levels of exposure to chemical carcinogens. Workplace carcinogen exposure levels which have been recommended by NIOSH were designed to restrict exposure to levels that can be reliably measured with current

state of the art sampling and analytical techniques. Although ETU is not currently classified as a known human carcinogen, any amount of ETU contaminating the work place should be considered unacceptable. The results presented in Table 11 demonstrate that reducing ETU to nondetectable levels is possible. Table 12 indicates the relative surface contamination level of ETU which more than likely had accumulated from previous use of powered ETU. Although sample T 2 on Table 12 would indicate that free ETU does not readily rub off the surface of END-75, handling the material with bare hand is not recommended.

## 2. Medical

On medical analysis of the questionnaire completed by ETU exposed groups, complaints of increased awareness of being cold, muscular weakness, and weight changes were noted. All these are symptoms of hypothyroidism, but laboratory testing did not support this diagnosis.

There are many reasons to prevent firm conclusions being drawn from the 136 children born with no structural birth defects. First, the number of children conceived when the father had been exposed is not known; and second, the total number of children is small. It does allow us to believe that no significant problem of teratogenesis exists via the male. This does not, however, allow us to ignore past studies indicating teratogenic and mutagenic effects in animals. Continued prudence at this time is justified in exposing women of reproductive age to this compound. This must be accomplished not only in the plant but also in educating the workers about personal hygiene to prevent contamination of their homes.

The laboratory values were only abnormal in one person. This worker was known to be hypothyroid prior to working at St. Clair Rubber Company. A statistical comparison of the ETU exposed workers and the non-exposed workers showed no significant difference for  $T_3$ ,  $T_4$ , or  $T_7$  at the  $P \leq .05$  level. When the total ETU-exposed group was divided into three groups by years of experience in an ETU exposed area, two calculations were of borderline significance when compared with non-exposed workers. The  $T_4$  values were significant ( $P=.05$ ) in the one year or less exposure group. The one to five year exposed group did not show these same results. The longest exposed group greater than 5 years exposure, was significant ( $P \leq .05$ ) for  $T_7$  values. Since these results do not correlate with length of exposure and are not associated with an increasing thyroid depression, and no findings were outside medical limits, findings are not an indication of a health hazard.

## G. Conclusions

There were no cases of hypothyroidism in workers exposed to ethylene thiourea at the St. Clair Rubber Company as found on October 26-27, 1977. There were indications that problems could arise in that borderline statistically significant differences were found in two exposed

groups (the 1 year or less exposure group and the greater than 5 year exposure group) as compared with non-ETU exposed workers. Because of this result, medical monitoring should be performed at regular intervals.

There were no reports of birth defects in children fathered by St. Clair Rubber Company employees. This does not mean that ethylene thiourea could not be a human teratogen at sufficient dose levels or periods of exposure on the basis of animal experiments. DuPont de Nemours and Company, Inc., continues to recommend that "women of child bearing potential should not be exposed to this chemical."<sup>6</sup>

The use of a non-powdered dispersion form of ETU greatly reduces the chance of worker exposure to airborne ETU dust. It would also appear less likely that ETU would be absorbed through the skin of workers handling ETU dispersions slab or solid material.

#### H. Recommendations

1. The medical program should be expanded to include laboratory monitoring of workers showing clinical signs of thyroid dysfunction in addition to thyroid palpation upon employment and at regular intervals.

2. Minimize employee exposure to ethylene thiourea as recommended by the NIOSH Current Intelligence Bulletin, #22, Ethylene Thiourea, April, 1978, DHEW (NIOSH) Publication 78-144.

3. Maintain the newly introduced solid form of ETU rather than the powdered form ETU.

4. First aid facilities should be inspected more frequently by the same individual who would be responsible for insuring adequate supplies, maintenance of equipment, and cleanliness.

5. Educate the workers on personal hygiene to prevent the exposure of themselves and their homes to dangerous chemicals. Relevant to this need are the 25 workers who reported smoking on breaks, but only eight admitted to hand washing prior to smoking.

6. The local exhaust ventilation systems for the compounding scales are inadequate and should be replaced with a system designed to effectively capture dust contaminants from all 3 scales. Although compounders are not likely exposed to excessive concentrations of any one compounding chemical, they are exposed to dust from many different chemicals. The combined effect of these chemicals on exposed workers is unknown.

7. Workers should use gloves when handling Poly-Dispersion END-75 (containing 75% ETU).

V. References

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Table 1

St. Clair Rubber Company  
HHE 77-67  
October 26-27, 1977

## Demographic Data

	<u>Males</u>	<u>Females</u>	<u>Mean Age</u>
1) All studied persons	49	2	41.6
2) All persons studied minus persons with known hypothyroidism or female employees	46	0	40.7
3) Of line 2, Not ETU Exposed Controls (Table 3)	8	0	35.4
4) Of line 2, ETU Exposed Workers (Table 3)	38	0	42.1
5) Of line 4, a) 1 yr or less exposure (Table 6)	5	0	28.4
b) 1-5 years exposure (Table 7)	6	0	35.0
c) > 5 years exposure (Table 8)	27	0	46.1

Table 2

St. Clair Rubber Company  
 HHE 77-67  
 October 26-27, 1977

Prevalence of Symptomatic Complaints

Symptoms	ETU Exposed Worker N=42		Not ETU Exposed Controls N=7	
	<u># of complaints</u>	<u>Percent</u>	<u># of complaints</u>	<u>Percent</u>
weight change	5	11.9	0	0
decrease temperature tolerance				
Cold	6	14.3	0	0
Warm	6	14.3	2	28.6
hoarseness	1	2.4	1	14.3
lethargy	1	2.4	0	0
change hair distribution	5*	11.9	0	0
weakness	4	9.5	0	0
difficult swallowing	1	2.4	0	0

\*all complaints of hair distribution changes were complaints of elevating scalp hairline and thinning scalp hair.

Table 3

St. Clair Rubber Company  
HHE 77-67  
October 26-27, 1977

## Laboratory Results of ETU-Exposed Workers

<u>Number</u>	<u>T<sub>3</sub></u> (% 25-35)	<u>T<sub>4</sub></u> (mcg/dl 15-12)	<u>T<sub>7</sub></u> (1.3-4.2)
Normal			
101	28.4	7.1	2.01
103	27.7	9.8	2.71
104	26.1	9.0	2.6
105	28.2	8.2	2.3
106	27.4	9.2	2.52
107	26.8	7.0	1.9
108	29.7	7.3	2.16
109	27.4	9.7	2.65
110	29.8	8.6	2.56
112	30.7	7.8	2.4
115	26.8	5.7	1.5
116	28.1	9.2	2.58
117	29.5	9.3	2.74
118	27.6	11.2	3.1
119	28.4	8.9	2.52
121	28.3	7.1	2.0
122	31.5	9.3	2.9
123	28.7	8.3	2.38
124	29.4	6.6	1.9
125	30.6	7.3	2.2

NOTE: T<sub>7</sub> Values obtained by multiplying the T<sub>3</sub> and T<sub>4</sub> results.



Table 3 (con't)

St. Clair Rubber Company  
 HHE 77-67  
 October 26-27, 1977

## Laboratory Result of ETU-Exposed Workers

<u>Number</u>	<u>T<sub>3</sub></u> (% 25-35)	<u>T<sub>4</sub></u> (mcg/dl 15-12)	<u>T<sub>7</sub></u> (1.3-4.2)
127	33.6	7.0	2.4
128	27.5	9.3	2.5
129	32.5	5.9	1.9
130	30.7	7.4	2.3
131	26.5	9.3	2.5
132	28.4	9.0	2.6
134	29.8	9.0	2.68
135	30.6	7.4	2.26
136	29.2	10.2	2.97
137	29.0	7.6	2.20
139	28.4	8.0	2.3
142	29.6	8.8	2.6
143	30.7	7.0	2.14
144	30.8	9.5	2.9
146	27.7	7.7	2.1
149	24.1	8.1	2.76
150	29.7	7.7	2.3
151	30.9	7.8	2.4
Mean	28.97	8.24	2.41
S.D.	1.86	1.21	0.34

Table 4

St. Clair Rubber Company  
HHE 77-67  
October 26-27, 1977

Laboratory Results of Females Workers and Persons with Previous Diagnosed Hypothyroidism

<u>Number</u>	<u>T<sub>3</sub></u> (% 25-35)	<u>T<sub>4</sub></u> (mcg/dl 15-12)	<u>T<sub>7</sub></u> (1.3-4.2)
120	26.4	4.4	1.2
126	29.2	8.6	2.5
138	26.0	11.9	3.09
145	30.1	5.2	1.6
147	28.7	8.6	2.5

Note: T<sub>7</sub> values obtained by multiplying the T<sub>3</sub> and T<sub>4</sub> results.

TABLE 5

St. Clair Rubber Company  
HHE 77-67  
October 26-27, 1977

## Laboratory Results of Non-ETU Exposed Controls

<u>Number</u>	<u>T<sub>3</sub></u>	<u>T<sub>4</sub></u>	<u>T<sub>7</sub></u>
102	27.7	9.8	2.71
111	30.8	8.7	2.7
113	28.9	9.6	2.8
114	27.0	11.1	3.0
133	28.0	8.8	2.46
140	26.5	8.1	2.1
141	28.0	10.7	2.99
148	34.3	7.2	2.46
Mean	28.9	9.25	2.65
S.D.	2.54	1.31	0.30
Var.	5.65	1.50	0.08

NORMAL (% 25-35) (mcg/dl 15-12) (1.3-4.2)

Non-ETU Exposed group (Management staff and Office Workers)

Table 6

St. Clair Rubber Company  
HHE 77-67  
October 26-27, 1977

ETU-Exposed Workers with up to 1 year in Exposure Area

<u>Number</u>	<u>T<sub>3</sub></u>	<u>T<sub>4</sub></u>	<u>T<sub>7</sub></u>
122	31.5	9.3	2.9
127	33.6	7.0	2.4
129	32.5	5.9	1.9
137	29.0	7.6	2.20
123	28.7	8.3	2.38
Mean	31.06	7.62	2.36
S.D.	2.15	1.29	0.36
Var.	3.41	1.33	0.11
NORMAL	(%25-35)	(mcg/dl 15-12)	(1.3-4.2)

Table 7

St. Clair Rubber Company  
 IHHE 77-67  
 October 26-27, 1977

ETU-Exposed Workers with 1 to 5 years in Exposure Area

<u>Number</u>	<u>T<sub>3</sub></u>	<u>T<sub>4</sub></u>	<u>T<sub>7</sub></u>
116	28.1	9.2	2.58
119	28.4	8.9	2.52
124	29.4	6.6	1.9
135	30.6	7.4	2.26
144	30.8	9.5	2.9
149	34.1	8.1	2.76
Mean	30.23	8.28	2.49
S.D.	2.19	1.13	.36
Var.	4.00	1.05	.11
NORMAL	(% 25-35)	(mcg/dl 15-12)	(1.3-4.2)

Table 8

St. Clair Rubber Company  
HHE 77-67  
October 26-27, 1977

ETU-Exposed Workers with Greater than 5 years in Exposure Area

<u>Number</u>	<u>T<sub>3</sub></u>	<u>T<sub>4</sub></u>	<u>T<sub>7</sub></u>
101	28.4	7.1	2.01
103	28.4	8.2	2.3
104	26.1	9.0	2.6
105	28.2	8.2	2.3
106	27.4	9.2	2.52
107	26.8	7.0	1.9
108	29.7	7.3	2.16
109	27.4	9.7	2.65
110	29.8	8.6	2.56
112	30.7	7.8	2.4
115	26.8	5.7	1.4
117	29.5	9.3	2.74
118	27.6	11.2	3.1
121	28.3	7.1	2.0
125	30.6	7.3	2.2
128	27.5	9.3	2.5
130	30.7	7.4	2.3
131	26.5	9.3	2.5
132	28.4	9.0	2.6
134	29.8	9.0	2.68

Table 8 (con't)

St. Clair Rubber Company  
HHE 77-67  
October 26-27, 1977

ETU-Exposed Workers with Greater than 5 years in Exposure Area

<u>Number</u>	<u>T<sub>3</sub></u>	<u>T<sub>4</sub></u>	<u>T<sub>7</sub></u>
136	29.2	10.2	2.97
139	28.4	8.0	2.3
142	29.6	8.8	2.6
143	30.7	7.0	2.14
146	27.7	7.7	2.1
150	29.7	7.7	2.3
151	30.9	7.8	2.4
Mean	28.70	8.29	2.38
S.D.	1.43	1.19	.34
Var.	1.97	1.36	.11
NORMAL	(%25-35)	(mcg/dl 15-12)	(1.3-4.2)

Table 9

St. Clair Rubber Company  
Marysville, Michigan  
April 27, 1977

<u>Sample Number</u>	<u>Type Sample</u>	<u>Job Location</u>	ETU Atmospheric Sampling Results				
			<u>Sampling Period</u>	<u>ETU</u> ug/sample	<u>ETU</u> Less Blanks	<u>Sample Volume</u> Liters	<u>ETU</u> Ug/M <sup>3</sup>
P1	Blank	-	-	5.6	-	-	-
P2	Blank	-	-	4.8	-	-	-
P3	Personal	Compounder #1	0830-1416	55.9	50.7	657.4	77
P4	Personal	Compounder #2	0838-1417	4.8	-	667.8	ND
P5	Personal	Banbury Operator	0841-1418	6.6	1.4	653.8	2
P6	Personal	Blending Mill Opr.	0846-1419	7.6	2.4	672.7	4
P7	Personal	Spreader Opr.	0848-1424	4.9	-	658.6	ND
P8	Personal	Cloth Room Service Man	0850-1425	11.6	6.4	649.9	10
P9	Personal	Churn Room Loader	0929-0934	16.1	10.9	9.9	1100
*P10	Area	Compounding Scales	0835-1429	-	-	700.9	-
P11	Area	Cloth Room Mixing	0852-1426	10.6	5.4	651.3	8

ug/M<sup>3</sup> = micro grams ETU per cubic meter of air

ND = Not Detected (ETU on filter equal or less than blank filter samples)

\*Sample not analyzed - filter cassette tampered with during sampling



Table 10

St. Clair Rubber Company  
 Marysville, Michigan  
 October 26, 1977

<u>Sample Number</u>	<u>Type Sample</u>	<u>Job/Location</u>	<u>Sampling Period</u>	ETU Atmospheric Sampling Results			<u>ETU</u>
				<u>ETU</u>	<u>ETU</u>	<u>Sample Volume</u>	
				ug/sample	Less Blanks	Liters	ug/M <sup>3</sup>
A1	Personal	Spreader Operator	1328-1449	8	-	162	ND
A2	Area	Cloth Room Mixing	1324-2210	8	-	1024	ND
A3	Blank		-	8	-	-	ND
A4	Personal	Serviceman/Duster Opr.	1331-1440	8	-	138	ND
A5	Personal	Churn Room Loader	1355-1412	8	-	34	ND
A6	Area	Churn Room Tumbler	1355-1412	9	1	34	29
A7	Personal	Cloth Room Serviceman	1501-2046	11	3	690	4
A8	Personal	Spreader Operator	1503-2210	13	5	614	8
A9	Personal	Compounder #1	2016-2226	9	1	260	4
A10	Personal	Compounder #2	2024-2228	8	-	248	ND
A11	Personal	Blender Mill Opr.	2034-2231	8	-	234	ND
A12	Personal	Banbury Opr.	2029-2230	9	1	242	4
A13	Area	Compounding Scale #3	2026-2228	10	2	244	8
A14	Area	Mill Room	2032-2230	8	-	236	ND

ug/M<sup>3</sup> = micro grams ETU per cubic meter of air

ND = Not Detected (ETU on filter equal to or less than blank filter samples)

Table 11

St. Clair Rubber Company  
Marysville, Michigan

Sampling Results Comparison  
April 27, 1977 - October 26, 1977

<u>Job/Location</u>	<u>April 27</u> Sample Number	<u>ETU*</u> Ug/Sample	<u>October 26</u> Sample Number	<u>ETU*</u> Ug/Sample
Compounder #1	P3	50.7	A9	1
Compounder #2	P4	ND	A10	ND
Banbury Opr.	P5	1.4	A12	1
Blending Mill Opr.	P6	2.4	A11	ND
Cloth Room Serviceman	P8	6.4	A7	3
Spreader Operator	P7	ND	A8	5
Churn Room Loader	P9	10.9	A5	ND
Compounding Scales	P10	Not Analyzed	A13	2
Cloth Room Mixing Area	P11	5.4	A2	ND
Serviceman/Duster Opr.	-	-	A4	ND
Mill Room	-	-	A14	ND
Churn Room Tumbler	-	-	A6	1
Spreader Operator	-	-	A1	ND

\*ETU in micro grams per sample less blanks values.

ND = Not Detected (ETU on filter equal to or less than blank filter samples).

Table 12

St. Clair Rubber Company  
 Marysville, Michigan  
 October 26, 1977  
 ETU Smear Tab Sample Results

<u>Sample Number</u>	<u>Location</u>	<u>ETU</u>	
		<u>Ug/sample</u>	<u>- Blank</u>
T1	Top of Churn Room Mixer	41	34
T2	END-75 Slab Surface	9	2
T3	Churn Room Office window	9	2
T4	Churn loader, palm of hand	7	-
T5	" , back of hand	8	1
T6	" , shirt shoulder	8	1
T7	Churn Room, Column next to mixer	11	4
T8	Churn Room, Elect. Box. old ETU storage	47	40
T9	" , Light Switch, near old ETU storage	7	-
T10	Blank	7	-
T11	Serviceman, Palm of hand	7	-
T12	" , Shirt shoulder	7	-
T13	Cloth Room Serviceman, gloves	8	1
T14	Cloth Room Mixing Can, On outside	23	16
T15	Curing Compound (20780) cap handle	11	4
T16	Banbury Opr., palm of gloves	7	-
T17	Compounder #2, palm of gloves	7	-
T18	" #1, palm of shoulder	7	-
T19	" #1, palm of gloves	7	-
T20	Top of Compounding Scale #5	10	3
T21	Top of Banbury Exhaust Hood	12	5
T22	Serviceman, Skin on arm	7	-
T23	Spreader #8, top of oven	7	-
T24	" #8, roller	7	-