

Short Communication

Visual Disturbances among Workers Exposed to Triethylamine in a Foundry in Japan

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Triethylamine (TEA), an aliphatic amine, has been used widely as a catalyst in foundries and polyurethane foam production. TEA has irritating effects on the skin, eyes, trachea and bronchi¹. Main symptoms in workers exposed to TEA are foggy and/or halo vision when looking at a light^{2–4}, that would be related to corneal edema or microcysts caused by TEA⁵.

Visual disturbances in workers handling TEA have not been reported in Japan so far as references from MEDLINE or TOXLINE retrieved up to November in 2000 are concerned.

Our study aims to find if there are any workers complaining of visual disturbances among those who exposed to TEA in foundries in Japan.

Subjects and Methods

All twelve male workers engaging in producing cores by the cold box method in a foundry were studied with a questionnaire made for determining visual and general symptoms⁶ during the previous six months. Three workers (group A) were engaged in picking up molded cores and arranging them on shelves near a molding machine, which used TEA as mist. Nine workers (group B) engaged in the same work near three molding machines, which used TEA as gas.

TEA was measured three times in the breathing zone of each workers with an amine detector tube (No.180, GASTEC) and a gas pump (GV100S, GASTEC) between 15:00 and 16:00 on one Thursday in September. The highest value is shown (Table 2).

A Passive Dosimeter (3D, GASTEC) was fixed to the neck of the working clothes of each workers before

starting work, and the value indicated by the Passive Dosimeter at the completion of work was divided by the number of working hours per day for workers to calculate the time weighted average (TWA) of TEA.

Results

TEA exposure hours in a day were about 8.5–10 h in all twelve workers. Foggy vision was reported in three workers (100%) and halo vision in two (67%) among workers in Group A. Among those in Group B, six (67%) workers complained of foggy vision and one (11%) of halo vision (Table 1). All of the three workers experienced foggy vision once or twice a week in Group A. All of the workers had foggy vision about once a month in Group B. Foggy and halo vision developed several hours after the start of their work and disappeared two or three hours after completion of their work in all the workers with those visual symptoms.

Among the three workers complaining of halo vision, two workers complained of difficulty in discriminating traffic signals when they were driving a car.

In Group A, all of the three workers noticed an unpleasant odor like ammonia in the workplace. Seven (78%) workers also noticed the unpleasant odor and one worker in Group B complained of headache.

The TEA level in the breathing zone of a worker was 50 ppm where molded cores were picked up and 60 ppm where cores were arranged on shelves in Group A. In Group B, The TEA level in the breathing zone of three workers was 3–4 ppm where cores were picked up and 4–6 ppm where cores were arranged. The TWA level was 6.8 ppm in Group A and 0.8–2.2 ppm in Group B (Table 2).

Discussion

We found complaints of visual disturbance prevalent among workers exposed to TEA in a foundry.

Åkesson *et al.*³, have reported that foggy vision and objective corneal edema were found at a TEA level of 10–15 mg/m³ (2.4–3.7 ppm) in terms of TWA with exposure for 4 to 8 h, but that no visual disturbance occurred with exposure for 2 h even at this exposure level. In our study, the TWA concentration in Group A was 6.8 ppm, which is higher than the TEA level reported by Åkesson *et al.*³ Visual disturbances occurred once or twice a week in Group A.

Järvinen⁵ has reported that blurred vision and a decrease in contrast sensitivity were observed with exposure to 6.5 mg/m³ (1.6 ppm, for 4 h) of TEA, but that such an effect was absent with exposure to 3.0 mg/m³ (0.7 ppm). This suggests that the level of TEA at which visual disturbances develop is 0.7 ppm to 1.6 ppm in terms of TWA. In our study, the TWA concentration in Group B was 0.8–2.2 ppm, which is close to the range of 0.7–1.6 ppm reported by Järvinen⁵. Nevertheless six

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Table 1. Visual and general symptoms in foundry workers

Group	n	Age	Duration of employment (months)	Symptoms			
				Foggy vision	Halo vision	Headache	Unpleasant odor
A	3	54 ± 36* (31–62)#	161 ± 145 (10–300)	3 (100%)	2 (67%)	0 (0%)	3 (100%)
B	9	30 ± 13 (20–58)	54 ± 36 (5–112)	6 (67%)	1 (11%)	1 (11%)	7 (78%)
Total	12	34 ± 14 (20–62)	81 ± 85 (5–300)	9 (75%)	3 (25%)	1 (8%)	10 (83%)

*: mean ± SD. #: range (min.–max.)

Table 2. TEA levels in air at sand core machine*

Group	Breathing zone		TWA
	Core removing	Core arranging	
A	50 ppm	60 ppm	6.8 ppm
	3 ppm	6 ppm	2.2 ppm
B	3 ppm	4 ppm	0.8 ppm
	4 ppm	5 ppm	1.4 ppm

*: TLV-TWA and TLV-STEL/C by ACGIH are 1 ppm and 3 ppm, respectively (1999).

(67%) workers in Group B complained of visual disturbances about once a month. This suggested that visual disturbances could develop even at about 1 ppm. As TEA levels at the workplace may vary with the temperature, air current and the shape of cores, there might be some measurement errors unknown to us, so that further studies of the association between the work environment and health problems are needed.

As for the prognosis of visual disturbances due to TEA, all the workers complaining of visual disturbance in our survey replied that these symptoms were transient and improved within several hours after discontinuation of work exposed to TEA. Results of studies by means of a slit lamp, ultrasonic pachymeter and ocular microscopy have indicated that sequelae of the visual disturbances do not remain even after long-term exposure⁴. As the present survey was a cross-sectional, a longitudinal study on the sequelae would be necessary in the future.

Not much attention has been paid to visual disturbances due to TEA in Japan even though it has been widely used in industry. For example, we checked the material safety data sheets (MSDS) on TEA used in this foundry and found no mention of visual disturbance other than irritating effects of TEA on the mucosae and eyes. In this situation, a worker with foggy or halo vision driving a car may cause a traffic accident. It is therefore considered to be important to establish regulations and take countermeasures against harmful effects of TEA in Japan.

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