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Analyze the Level of Health Risks from Exposure to Toluene in Shoes Craftsman Workers

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Abstract

Craftsmen informal footwear industry was one commodity export labor-intensive. But rapid industrial shoes craftsman was less balanced with adequate worker protection system. Hazards resulting from this industry could be derived from elements of biological, chemical, psychological and physical. For example toluene chemicals had a high risk of harm, induce damage to major organs example the central nervous system, liver, kidneys, skin and others. Public Health Center Sememi in October 2013 reported at least 12 health complaints in the shoes craftsman at Oso Wilangun village Surabaya. This study was to analyze the level of health risks from exposure to toluene in workers craftsmen shoes. The population was 51 people by the sampling technique using total sampling. Data were collected using a questionnaires, checklist. While the research instruments using a vacuum pump combination glass tube containing activated carbon, bathroom scales, calculators and cameras. Data was analyzed descriptively with the results: 87.5% toluene concentrations below threshold limit values (<188 mg / m3), the smallest value of 0.80 mg / m3 and the highest concentration of 520.81 mg / m3, the level of health risk at the work site 1 (RQ = 5.25) and 3 (RQ = 1.06) was above the threshold value (in an unsafe condition), while the level of health risks in the workplace 2, 4, 5, 6, 7 and 8 was below a threshold value (RQ <1) and was in safe condition. There were 8 (17.0%) toluene concentrations below a threshold level of health risk, meaning that there were 8 people in an unsafe condition on exposure to toluene. So It was necessary to arrangements regarding the protection of workers' management through periodic examinations, the use of Personal Protective Equipment, setting hours of work, ventilate the room, as well as increased knowledge workers.

Keywords: Health Risks; Toluene; shoes craftsman Workers.

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1. Introduction

Industrial development in Indonesia is advancing in line with the demands of the various needs of products. To meet these needs, so many established a wide variety of industries both large and small scale, such as the Small and Medium Enterprises (SMEs) and home industries (home industry). Small and medium-sized businesses have a very important role in the growth of the national economy because it can create jobs, producing goods and services needed by many people. SMEs have proved themselves as a group that is powerful and flexible, and still survive and still accounts for the national economy significantly [1].

One of SMEs that meet the above description is an informal industry craftsmen footwear. The shoes industry is one of the commodities export labor-intensive. The success of the shoes craftsmen to maintain the existence of the resulting product is often not matched by adequate protection against the risk of their jobs which are associated with equipment and hazardous materials. Making shoes is one of the jobs that are vulnerable to danger. Long working hours but not supported with comfortable working conditions, often forcing producers to work with less ergonomic body position so prone to injury. Using a variety of dangerous equipment, such as scissors, cutting knives, nails, machine presses, stamp making machine, stove gas or electricity have contributed to a risk of workplace accidents.

Shoes-making consists of several stages of work process, starting from preparing uppers (making patterns, cutting patterns, outlining, decorating / dyeing, sewing), prepare the bottom of the shoes (gluing, sewing, coating), put the top and bottom (gluing , sewing, tacking), completion / finishing (cleaning, smoothing), packed to be sent to the consumer / market. The production process in the footwear industry working environment threatens the health, safety and welfare of the worker. They are particularly vulnerable to the dangers of the elements of biological, chemical, psychological and physical [2,3].

The many hazards that can occur in industrial craftsmen shoes, using chemicals is one of the high risk of danger. The use of chemicals can damage the health of the craftsmen shoes, among others, the use of glue, because in this process there is exposure to organic solvent vapors contained in the glue and it may have an impact on health if inhaled continuously for a long time [4]. The entry of organic solvent vapors into the body can cause a variety of reactions, ranging from mild irritation, addiction, kidney disorders, pulmonary edema reaction to central nervous system disorders [5].

Toluene is one of the aromatic hydrocarbon compounds that have many uses for human life, especially for the industrial sector. In 1994 is estimated at over 3 million tonnes of toluene is produced in the United States and around the world toluene production is estimated at 10 million tonnes. The use of toluene is quite extensive in the paint industry, rubber, cosmetics, adhesives and resins industry. Use paint and thinner, together with tobacco smoke represents a major source of toluene in indoor environments [6].

Although the compounds toluene less dangerous, but with the continuously exposure can cause health problems such as dizziness, vertigo, eye irritation, skin irritation, respiratory problems, impaired liver function, kidney function, impaired central nervous system (CNS) and the target This compound is the main organ of the central

nervous system (CNS) [7,8].

Toluene can enter the human body through three ways, namely through inhalation, ingestion and skin contact. Toluene is a volatile compound, toluene inhalation exposure is the most important exposure pathways to be considered. This happens because many of toluene released in the air with increasing temperature in the vicinity. In addition, exposure to toluene is more easily deposited and accumulated in the human vital organs such as the brain, liver, lungs, kidneys, and other organs [8].

Some cases of exposure to toluene recorded in [7]; including: Andersen reported the case of 16 volunteers who were exposed to toluene 6 hours / day for 4 days. The volunteers complained of irritation in the eyes and nose, headache, dizziness and feeling of intoxication. Furthermore, who studied the acute effects of exposure to toluene in 43 workers exposed printer parts toluene concentration of 100 ppm for 6.5 hours. The workers complained of irritation in the nose, a feeling of fatigue, drowsiness, headache and dizziness.

The study conducted by Hunnewell and Miller reported a case study of a person who exposed to toluene for 36 years showed behaviors such as slurred speech, progressive ataxia (loss of ability to control body movements), blurred vision, and oscillopsia (visual disturbances). Examination showed dysconjugate torsional nystagmus (eye movement involuntarily) and bilateral internuclear ophthalmoplegia (ocular motility disorders). The Result of MRI (Magnetic Resonance Imaging) visible abnormalities / abnormali atrophy (shrinkage or nerve tissue shrinkage) in the brain stem and cerebellum.

There are still numerous cases in health due to exposure to toluene in the airIn Indonesia. According to the ILO in 2004, nearly 70 percent of respiratory problems experienced by shoes workers in Tasikmalaya. They also often feel dizzy and sore waist. Research conducted by [9] against 48 workers in the shoes industry were chosen randomly in Iran, discovered the severity of exposure to toluene was significantly correlated with the number of shoes produced and the amount of glue used for the process. Meanwhile, according to [10] reported the an analysis results of 49 workers (38 men and 11 women) in Thailand petrol station workers exposed to toluene at risk of headache 61%, fatigue 29% and 11% throat irritation. Pearson statistical test showed a significant positive correlation between exposure to toluene and benzene to fatigue.

Other studies related to toluene done by [11] states that concentrations of toluene above the predetermined threshold can cause respiratory complaints. Workers exposed to toluene exceeding the TLV-TWA (> 20 ppm) in the workplace had 10.5 times the odds of respiratory complaints compared to workers exposed to toluene less than the TLV-TWA. Martha TH, et al reported to shoes workers in sole unit Cibaduyut Bandung, where the glue material most abundant compound is toluene, many respondents have health complaints identical to the symptoms of toluene exposure, including dizziness, nausea, weakness and shortness of breath. An urine analysis results of 72 working children in Ulil Albab Foundationshows all contain phenol (heart changing chemicals, such as benzene, toluene, xylene into phenol) [2].

As with any other shoes craftsman business, in the production process of shoes made by craftsman shoes at Tambak Oso Wilangun village also use chemicals, such as glue are known generally contain organic solvents

that are harmful to the health of workers. A number of medical cases in the village of Tambak Oso Wilangun, shown with health data obtained from Public Health Center Sememi. The data from Public Health Center Sememishown in Table 1:

Table 1: Health complaints in Sememi Public Health Center Surabaya, October 2013

No.	Type of complaints	Number	Percentage
1	Tingling	55	80,88
2	Headache	29	42,65
3	Skin hot, painful, dry, itchy, bloody	25	36,76
4	Burning sensation, stinging, watery eyes	17	25,00
5	Can not break (sleeplessness)	16	23,53
6	The pain, heat in the nose / throat Disorders balance (unsteady)	13	19,12
	Balance disorders		
7	Disorders pee: piss cloudy / red / dysuria	12	17,65
	Less hearing		
	Anoreksia		
8	Nausea, vomiting, dizziness	11	32,35
	weak limbs		
	Infertil		
9	Shortness of breath	10	14,70
	Hair loss, easily hurt mudah sakit		
	Forgetfulness		
10	yellowed skin, stomach obstruction, urinary such as tea, pain right upper abdomen	9	13,23
11	Movement disorders	3	8,82

(Source: Sememi PHC 2013)

The main problem in the shoes industry is a solvent used. Most of the solvent used is an organic solvent. Organic solvents are generally volatile liquid and was used as a diluent solvent or adhesive as well as the cleaning fluid. In the shoes industry, organic solvents contained in the adhesive material generally contains toluene. Toluene existence is a source of cumulative exposure can affect the stability and quality of the environment and cause health hazards.

In connection with his work activity system of shoes craftsmen worker in the Tambak Oso Wilangun Village become vulnerable groups at risk of exposure to toluene in the process of making shoes. Workers can be exposed glue, cleaning materials and paint, inhale the chemical vapors, absorbed by the skin because the glue is often added to with his bare hands, it could be ingested when eating, smoking or drinking in the workplace that

contains chemicals (toluene). In addition, the characteristics in the informal footwear industry related aspects of working hours, wages, technology used, health protection also affect the risk of health problems and is still less attention, has never been done measuring the concentration of toluene in the area of the working environment and lack of knowledge workers about the dangers of exposure to toluene. It is feared there will be health problems in workers in the shoes craftsman worker in Tambak Oso Wilangun village Surabaya later.

Based on these descriptions, is necessary to analysis of the level of health risks from exposure to toluene in shoes craftsman workersin the Tambak Oso Wilangun village Surabaya.

2. Methods

This research is a quantitative observational study conducted in the shoes industry at Tambak Oso Wilangun Surabaya as much as eight home industries. The research was held in June-July 2015. The population were 51 people working and use total sampling technique.

The variable in this study are the concentration of toluene and the level of health risk. While the data is identified common characteristics of workers, worker complaints and Anthropometric Workers (Weight), Pattern Worker Activities and Experiences.

Measurement of the tolueneconcentration in the work environment, carried out using the measurement method NIOSH 1501 with pipe material activated carbon adsorber (charcoal) using Gas Chromatography techniques (GC), while the level of workers' health risk is measured using observation and descriptive analysis. The research instruments used include bathroom scales to identify workersanthropometric, calculator to calculate the number of intake and level of health risks, as well as the questionnaire.

3. Discussion

1. Characteristics of Workers

Worker characteristics in this study involve Sex, Age, Marital Status, Education, Housing, Smoking Habit, Work Unit / section as described in Table 2 below.

Table 2 shows the majority of sex workers male that as many as 34 people (66.7%), the educational background of junior high school graduate as many as 19 people (37.3%). The age range of workers are in the range 17 to > 56 years, most workers (39.2%) of them were in the age range 46 - 55 years and the workers who are married as many as 43 people (84.3%).

Based on interviews and observations most of the workers live in locations that are 38 people (74.5%), these workers made up of the nuclear family and relatives. Smoking habits will increase the amount of toluene intake into the body of workers, which would exacerbate the health risks that it faces. Workers who have a habit of smoking as many as 24 people. From interviews found that workers who smoke more than 10 cigarettes a day amounted to 58.3%. Smoking habits at work is usually done at rest and at work. Workers at the shoes craftsman

is divided into two units, namely the glue unit by the duty (gluing work, sol, finishing) for about 56.9% and non-glue worker in charge of making patterns, sewing, packing amounted to 43.1%.

Table 2: Characteristics of shoes craftsmen worker in Tambak Oso Wilangun Village Surabaya, 2015

Worker characteristics		Total	
		n	%
Gender	Male	34	66,7
	Female	17	33,3
	Total	51	100,0
Age	17-25 th	6	11,8
	26-35 th	5	9,8
	36-45 th	14	27,5
	46-55 th	20	39,2
	> 56 th	6	11,8
	Total	51	100,0
Status	Not Married	8	15,7
	Married	43	84,3
	Total	51	100,0
Education	Elementary	16	31,4
	Junior High	19	37,3
	Senior High	14	27,5
	Diploma/Undergraduate	2	3,9
	Total	51	100,0
Domicile	In Location	38	74,5
	Outside location	13	25,5
	Total	51	100,0
Smoking habit	No Smoking	10	29,4
	Smoking	24	70,6
	Total	34	100,0
Work Unit	Glue Unit	29	56,9
	Non Glue Unit	22	43,1
	Total	51	100,0

2. Complaints Workers

Worker complaints include respiratory tract disorders and central nervous system. These results as described in Table 3 and 4.

2.1 Airway Disorders

Respiratory illness were found to include cough, cough with phlegm, shortness of breath / asthma and colds.

Table 3: Distribution of shoes craftsmen worker according to complaints of respiratory illness in the Tambak Oso Wilangun Village Surabaya, 2015

Airway Disease		Total	
		n	%
Cough	Yes	16	31,4
	No	35	68,6
	Total	51	100,0
Coughing up phlegm	Yes	5	9,8
	No	46	90,2
	Total	51	100,0
Shortness of breath / wheezing / asthma	Yes	16	31,4
	No	35	68,6
	Total	51	100,0
Common Cold	Yes	15	29,4
	No	36	70,6
	Total	51	100,0

Table 3 shows the distribution of respiratory tract disorder is one of the grievances felt by workers, this illustrates one of the few health problems caused by exposure to toluene felt by workers. Based on the results of interviews related complaints respiratory problems in workers, complaining that many workers are coughing and shortness of breath / wheezing as many as 16 people (31.4%), colds as many as 15 people (29.4%).

2.2 Central Nervous System Disorders (CNS)

Central nervous system disorders were found in the shoes craftsman workers are headache, tiredness / lethargy / fatigue in general, difficulty concentrating, drowsiness, impaired memory / forgetfulness, nausea or vomiting.

Table 4 shows the distribution of the central nervous system disorders(CNS) perceived by craftsmen shoes worker. The most common complaints felt by the workers are headache as many as 35 people (68.6%), fatigue in general 33 persons (64.7%) and drowsiness 30 people (58.8%). Based on the results of interviews related to the complaint of the central nervous system disorders (CNS) to headache most workers feel headaches 2-3 times a week, and during this time were done only taking a drug-free headache relief.

3. Anthropometric (Weight), Pattern Worker Activities and Experiences.

3.2 Weight Distribution of Shoes Worker.

Weight loss is one of the important factors in the process of health risk analysis, this is due to weight loss is the denominator in the calculation of doses of an agent of pollutants that enter the body.

Table 4: Distribution of workers central nervous system disorder (CNS) in Tambak Oso Wilangun Village Surabaya, 2015

Central Nervous System Diseases		Total	
		n	%
Headache	Yes	35	68,6
	No	16	31,4
	Total	**51**	**100,0**
Fatigue / lethargy / fatigue in general	Yes	33	64,7
	No	18	35,3
	Total	**51**	**100,0**
Difficulty concentrating	Yes	8	15,7
	No	43	84,3
	Total	**51**	**100,0**
Experiencing a feeling of drowsiness	Yes	30	58,8
	No	21	41,2
	Total	**51**	**100,0**
Memory disorder / forgetful	Yes	10	19,6
	No	41	80,4
	Total	**51**	**100,0**
Nausea or vomiting	Yes	1	2,0
	No	50	98,0
	Total	**34**	**100,0**

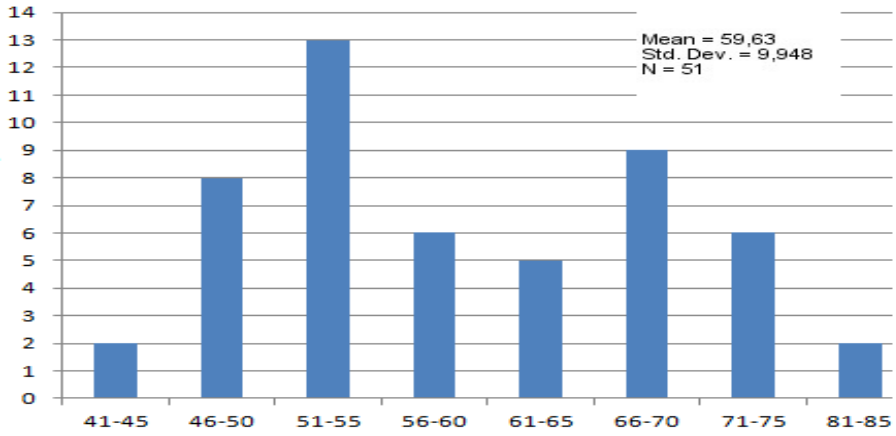

Figure 1: Weight Distribution of Shoes Worker in Tambak Oso Wilangun Village Surabaya, 2015

Figure 1 shows the majority of workers have between 51-55 kg body weight as many as 13 people (25.5%). While the average weight of 59.63 kg and a standard deviation of 9.95 kg.

3.2 Distribution of Pattern Worker Activity

Patterns of activity were includes the time of exposure, exposure frequency and duration of exposure. System work in eight locations was use a contract system, the workers receive income based on a number of a pair of shoes they had finished, so it can not be ascertained the working hours for all workers because the workers work as long as possible to produce pairs of shoes as much as possible. Number of working hours, which is a factor of exposure time (TE). In addition to the number of working hours / times of exposure, other variables that need to be taken into account is the number of working days per year. Because the contract work system, then a day off every worker also vary. Long working in the shoes industry also varies. For descriptive analysis of the number of working hours, the number of working days and long working obtained through a questionnaire.

Table 5: Distribution of Pattern Worker Activity in Tambak Oso Wilangun Village Surabaya 2015.

Description	Exposure Time (t_E) (hours/day)	Amount		Frequency of exposure (f_E) (days /year)	Amount		Duration Exposure (D_t)	Amount	
		n (people)	%		n (people)	%		n (people)	%
	≤ 8 hours	18	35,3	≤ 260 days	2	3,9	< 25 years	43	84,3
	> 8 hours	33	64,7	> 260 days	49	96,1	≥ 25 years	8	15,7
	Total	51	100	Total	51	100	Total	51	100
Average	Hours/day	8,9		Days/year	310,2		Years	15,2	
Std Deviation		2,2			25,0			9,0	
Median		10,0			33,0			14,0	
Minimum		2,0			248,0			1,0	
Maximum		12,0			351,0			35,0	
CoV		24,7			8,1			59,2	

Table 5 illustrates the distribution of exposure time (number of working hours per day), the number of working days in a year and long working and workers at the work site. Exposure time is categorized into 2 ≤ 8 hours / day and > 8 hours / day.

The results revealed 33 persons (64.7%) had exposure time > 8 hours / day, the average exposure time of workers is 8.9 hours / day with a range between 2-12 hours / day. It was show that each worksite has a tendency of exposure time are different from each other. Frequency of exposure are categorized into 2 ≤ 260 days and > 260 days. The results revealed as many as 49 people (96.1%) had a working time > 260 days / year, the average time spent working in 310.2 days a year with a standard deviation of 25.0 days / year. This indicates that each work site almost has the same frequency of exposure to each other.

Duration Exposure describe the length of stay in a location exposure, also categorized into 2 is < 25 years and ≥ 25 years. The results revealed as many as 43 people (84.3%) had a duration of exposure < 25 years, average 15.2 years old work. Long working varies between 1 year to 35 years time. This shows that each worksite has a tendency duration of exposure differ from one another.

Based on interviews of working experience shows that workers are workers who have worked a long time, and

therefore needs to consider the working time of worker in the manufacture of shoes before they work in the industry that exposured toluene.

4.3 Distribution of Workers Experience

Picture variety of work experience in the shoes craftsman worker is as shown below:

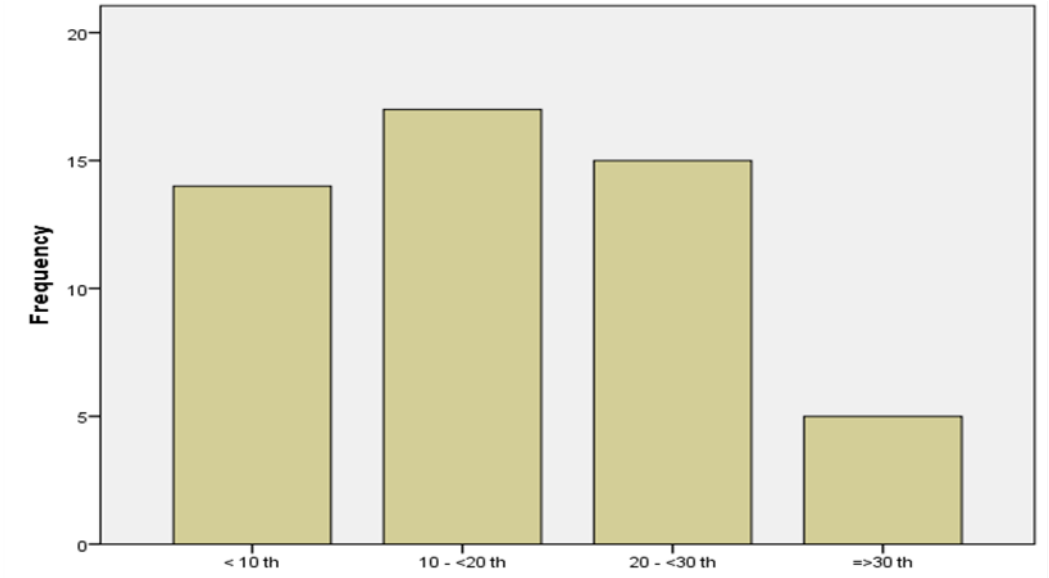

Figure 2: show that workers with tenure of less than 10 years as many as 14 people (27.5%), working period < 10 - < 20 years as many as 17 people (33.3%), working period 20 - 30 years as many as 15 people (29.4%) and work period of more than 30 years is 5 people (9.8%).

4. The concentration of toluene

The concentration of toluene at shoes worker describe on table 6.

Tabel 6 shows that concentrations of toluene in eight points at seven work locations were reach of 88.9 %. This concentration were below the threshold limit value (at 50 ppm or 188 mg / m3). Obtained an average toluene concentration of 71.8 mg / m3, with a standard deviation was 169.1 mg / m3. It shows that each worksite has a tendency different from each other. The lowest level of toluene concentration is 0.80 mg / m3 and the highest concentration of 520.81 mg / m3. While the distribution of toluene exposure on workers as depicted in Figure 3.

The results show that levels of toluene exposure on workers craftsmen mostly located below a threshold value that is as much (92.2%) and 7.8% had levels of toluene exposure more than the exposure limit values (188 mg / m3).

Different toluene concentrations at each observation point. High concentrations are at an observation point that is caused by several factors, namely the number of shoes produced very much, the lack of using existing natural ventilation, indoor temperature hot, bad habits are workers sticking the residual glue from the fingers in any

place, the amount of adhesive that is used quite a lot, using glue directly from the container that open continuously, the storage location of the material and disposable waste materials are not well ordered, many containers of glue is in a state not sealed , the use of glue was poured into a bottle with a clipped position so that the residual glue in the open state, the number of workers who have a habit of smoking. While the observation point having a low toluene concentrations (below threshold value) because this room has a large enough natural ventilation (4 pieces of window size 1.25mx 0,45m), the door is always open and the fan is always on when the working. Wide enough ventilation so that air exchange is progressing well. The use of glue to put in little bottles former aqua and closed position can affect the results when measuring the concentration of toluene.

Table 6: Distribution of toluene concentration in the work environment of shoes worker in Tambak Oso Wilangun Village Surabaya 2015

Consentration Of Toluena (NAB = 188 mg/m^3)	**Total**	
	n	**%**
< NAB	8	88,9
≥ NAB	1	11,1
Total	9	100,0
Average	71,8 mg/m^3	
Standart Deviation	169,1 mg/m^3	
Median	15,92 mg/m^3	
Min-Max	0,8 - 520,8 mg/m^3	
Coeff.Of Variation	235,58 %	

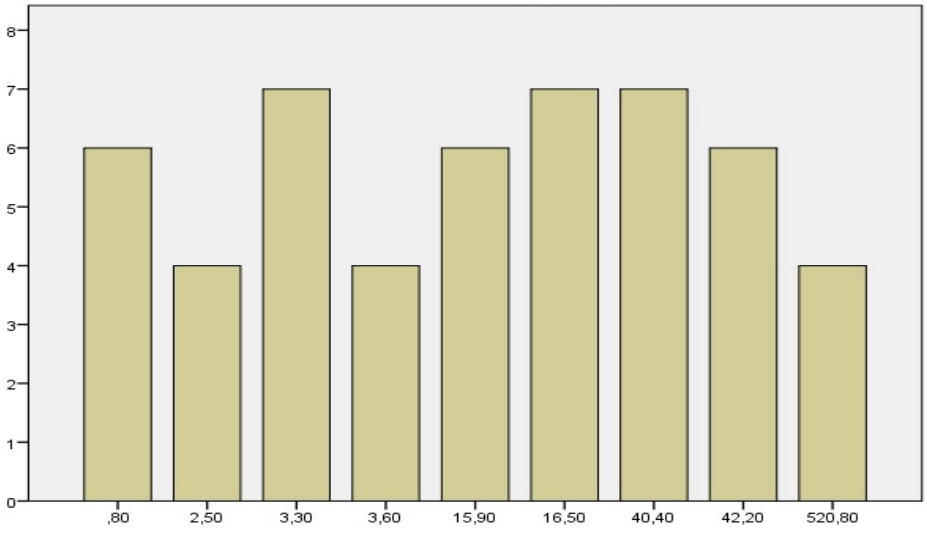

Figure 3: Distribution of toluene exposure levels in workers

Based on field observations nearly all work locations lack of air exchange. This can be seen many natural ventilation (windows) in a closed position. Air exchange only rely on the fan that is placed in front of the workers and working near the entrance of the room. To decrease the concentration of toluene in the room in addition to optimizing the existing ventilation, if possible to the gluing process is done in an open area like a veranda / porch, fitted Local Exhaust Ventilation can also be used or activated carbon. [12] explained that the waste can be used as a hazelnut shell. The manufacture of activated charcoal may be used to remove toluene in an enclosed space.

The observation of current research around the work site is obtained most of the workers smoked (70.6%), both at work and outside work hours. In addition to coming from the adhesive / glue, which is another source of toluene is cigarette smoke [13]. Someone who smokes one pack per day, then the intake of toluene in a body of 1,000 mg / day [8].

Exposure to toluene was 50% -80% absorbed by humans through respiratory / inhalation [14]. The symptoms caused by inhalation exposure of toluene was accordance to concentration of toluene [15]. Exposure to toluene can also cause excitement, euphoria, hallucinations, fatigue in general, drowsiness, dizziness, headache and sinkope. [16]. describes relationship Organic Solvents with neurotoxic symptoms at worker in Industry Informal Ciomas Bogor, it is known there is a relationship between the concentration toulena disorders neurotoxic symptoms (OR = 6.235; p = 0.000), it relevan with health problems experienced by workers in craftsman shoes where most workers have experienced headaches (68.6%), fatigue (64.7%) and drowsiness (58.8%), which can disrupt productivity.

Based on [17] describes the relationship of Exposure Steam organic solvents with the emergence of conjunctivitis / complaints irritation Eye (Research on Labor Male Informal Sector in the Industry Footwear, District Ciomas, Bogor) it can be seen that the group of respondents were exposed to toluene high had a 4.6 times greater risk for the occurrence of eye irritation complaints compared to the low exposure group (OR = 4.6; p = 0.004; CI = 1.65 to 12.84), it accordingly with the complaints of the workers where 7,8% have experienced eye irritation while doing activities. Toluene may worsen hearing loss in noisy work environments, with a major impact is hearing loss at lower frequencies [18]. Research [9]. in Iran is known that there was a significant positive correlation between the amount of glue with the concentration of toluene, was also a significant positive correlation was found between the level of production and the level of toluene exposure.

5. Risk Level Health Workers

5.1 Risk Level Health Workers Job location

Table 7 shows the health risk level in eight locations craftsmen work shoes as follows: Calculation of the level of health risk to workers at the work place 1 gained an average value of RQ = 5.25, meaning that the health risks for workers at work place 1 is currently in an unsafe condition. RQ values ≥ 1 on the work place is toluene concentrations above the threshold value. Although environmental conditions is unsafe but it found the workers with RQ values < 1, because the workers only work for 2-3 hours / day and working life < 3 years. Calculation

of the level of health risk to workers in the workplace 2 gained an average value of RQ = 0.65, means that the health risks for workers at work place 2 is in a safe condition.

Table 7: Level of health risks in workers based on the workplace

Description	Level of health risks in the workplace							
	LK-1	LK-2	LK-3	LK-4	LK-5	LK-6	LK-7	LK-8
Mean	5,25	0,65	1,06	0,67	0,21	0,10	0,12	0,04
Std. Deviation	5,57	0,23	0,55	0,45	0,03	0,05	0,07	0,01
Median	4,86	0,66	1,11	0,58	0,21	0,11	0,10	0,04
Minimum	0,29	0,41	0,08	0,16	0,16	0,02	0,05	0,03
Maximum	10,99	1,03	1,75	1,33	0,25	0,15	0,22	0,05

Calculation of the level of health risk to workers at the work place 3 obtained an average value of RQ = 1.06, means that the health risks for workers at the work place 3 is currently in an unsafe condition. RQ values ≥1 suspected causes by exposure frequency and duration of exposure. Calculation of the level of health risk to workers at the work place 4 gained an average value of RQ = 0.67, meaning that the health risks for workers at work place 4 is in a safe condition. Calculation of the level of health risk to workers at the work place 5 obtained an average value of RQ = 0.21, meaning that the health risks for workers at the work place 5 is in a safe condition. Calculation of the level of health risk to workers at the work place 6 obtained an average value of RQ = 0.11, means that the health risks for workers at the work place 6 is currently in a safe condition.

Statistical data indicate that the average period of employment at this location range of 15.3 years. Toluene concentration were below the value RFC is suspected that causes RQ <1. The calculation of the level of health risk to workers at the work place 7 obtained an average value of values RQ = 0.12, means that the health risks to workers at work place 7 is in a safe condition. Statistical data indicate that the average period of employment at this location range of 20.9 years. The calculation of the level of health risk to workers at the work place 8 obtained an average value of RQ = 0.04, means that the health risks to workers at work place 8 is currently in a safe condition. Statistical data indicate that the average period of employment at this location range of 22.2 years. Toluene concentration under risk Level 1 ppm (ATSDR, 2000) suspected that causes RQ <1.

5.2 Level of Individual Health Risk

Each worker has the anthropometric characteristics and different patterns of exposure, therefore it need to calculate the level of individual health risk of workers at all work place. The calculation of the level of health risk to individuals with real time exposure duration obtained RQ ≥ 1 by the value of 19.6% (10 people). RQ values ≥ 1 was in work place 1 as much as 2 people. Because the concentration of toluene above the threshold value of 188 mg / m3 and workers already employed more than 10 years with working time between 8-10 hours / day. The value of RQ ≥ 1 is also found in individuals at work place 2 (1 people), work place 3 (5 people), and

work place 4 (2 people), this is due to the concentration of toluene in that location above the value of the dose responses at 5 mg / m3 (IRIS 2005), workers are already working of 10-35 years, with working time between 7-11 hours / day.

Nearly all ventilation natural that there are not functioning optimally, evidenced many windows in a closed state, the working position near the door and the direction of the fan is wrong (facing workers) as well as during the day when the air temperature increased allowing the toluene to evaporate easily, this causes toluene vapor circulating in the room and can be inhaled by workers, this condition may cause the worker complaints of cough and shortness of breath experienced by workers amount (31.4%).

In addition, almost all workers no use of personal protective equipment, especially masks, except at the work place 1 (using masks) so that steam pungent-smelling glue was directly inhaled. When asked if they were dizziness or headache, several worker were answering that of the week 3 times a headache and usually take free medication headache. From observations at the work place indicates that the worker uses his finger to perform glueing with more reason average and nothing is wasted (economical), but found there were some workers with long fingernails. This can cause the residual of the glue is absorbed in the skin. In addition it was found there was a worker whose skin is dry and cracked and felt numbness.

Habits that worse the health risks is smoking in the workplace, it was already filled with toluene vapor. The workers smoked average > 10 cigarettes / day. Cigarettes are basically known to contain harmful chemicals harmful to the health of users, including a small amount of toluene [8]. Moreover, the habit of not wearing clothes at work, this happens because the temperature of the working environment tends to heat, causing workers feel the heat so choose shirtless while working.Toluene can enter the human body when breathing, eating contaminated food or drinking contaminated water. Another bad habit are the workers put food and drinks in the work area. No doubt sometimes eat or drink while working without washing hands with water. Exposure to toluene was 50-80% absorbed by humans through respiratory or inhalation [14], after going through breathing or swallowing toluene was very quickly absorbed by lungs or gastrointestinal tract into the blood stream where the toluene vapor is inhaled can reach the brain before detoxified in the liver, it cause toluene have lipophilic properties so easily distributed to the lipid-rich tissues such as the brain, kidneys, and liver and accumulates in adipose tissue.

Cross Tabulation between Toluene Concentration and The Level of Health Risk.

The level of health risk for all workers described in Table 8 below.

Table 8 shows that concentration of toluene below the threshold limit values (<188 mg / m3) with the level of health risk (RQ ≥ 1) as much as 8 (17.0%), meaning that there are 8 peoples in an unsafe condition on exposure to toluene. Based on the results of crosstabulation indicate a health risk level (RQ ≥ 1) below the threshold value are at work place 2 as much as 1 person, work place 3 by 5 peoples, work place 4 as much as 2 people, while the health risk level (RQ ≥ 1) above the threshold values occur in a single location. Another cause which led RQ ≥ 1 is the exposure time of more than 8 hours / day and frequency of exposure of more than 260 days / year. It was

found that the health risk level is not safe (RQ ≥ 1) during the study as many as 10 people (19.6%).

Table 8: Cross Tabulation measurement of the toluene concentration and level of health risks on shoes craftsmen worker in Tambak Oso Wilangun Village Surabaya 2015

Concentration Of Toluene (NAB = 188 mg/m^3)			RQ1		Total
			< 1,0	≥ 1,0	
Konst Toluena	< 188 mg/m^3	n	39	8	47
		%	83,0%	17,0%	100,0%
	≥188 mg/m^3	n	2	2	4
		%	50,0%	50,0%	100,0%
Total		n	41	10	51
		%	80,4%	19,6%	100,0%

6. Conclusions

Based on the results of research and discussion, it can be concluded that:

a. Most workers (66.7%) were male, 37.5% of junior high education, 74.5 % live in production location. 70.6% smoked, 56.9% worked in the glue unit. Anthropometric (Weight data) showed an average worker weight were 59.63 kg. Number of hours worked 8.9 hours / day, the number of working days in a year 310.2 days. Early work recorded 15.2 years, the majority of toluene exposure time more than 8 hours (64.7%), the frequency of exposure more than 260 days (96.1%), duration of exposure < 25 years (84.3%).
b. The most respiratory problems that happen were coughing and shortness of breath or asthma (31.4%), the most common central nervous system disorders were headache (68.6%), fatigue (64.7%), difficulty concentrating (15.7%) , somnolence (58.8%), forgetfulness (19.6%), nausea and vomiting (2%).
c. The majority (87.5%) of toluene concentrations below the threshold value, the smallest value of 0.80 mg / m3 and the highest concentration of 520.81 mg / m3. The highest concentrations of toluene at the work place 1, in the amount of 520.81 mg / m3.
d. The level of health risk to workers who have RQ ≥ 1 value as much as 19.6% (10 people) in an unsafe condition for exposure to toluene, are at the work place1 (2 peoples), work place 2 (1 people), work place 3 (5 peoples) and work place 4 (2 peoples).
e. The level of health risk in the workplace1 (RQ = 5.25) and 3 (RQ = 1.06) in an unsafe condition (RQ ≥ 1), while the level of health risks in the work place 2 (RQ = 0.65), the Work place 4 (RQ = 0.67), work place 5 (RQ = 0.21), work place 6 (RQ = 0.11), work place 7 (RQ = 0.12), work place 8 (RQ <0.04), it shown that still in safe condition (RQ <1).
f. The concentration of toluene was 18.03 mg / m3 is a safe concentration for people whose weight 59.63 kg and exposed 8 hours / day for 260 days a year according to the minister's decision No. 13 / MEN / X / 2011 for a period of 25 years into the future.

7. Suggestion

These suggestion can be given to the craftsman and workers are as follows:

1. For business owners:

   a. Reorganize the work location, a ventilation system, if possible to the gluing process is done in an open area like a veranda / patio home and need to install Local Exhaust Ventilation primarily on the work location in order to meet the requirements of health and safety in the work environment.
   b. Appealed to the workers as good as possible not to smoke, eat and drink in the work place.
   c. Set the number of working hours, time off for workers and allows restrictions the working period.
   d. Applying simple technology such as using a brush for gluing, utilizing plant neutralizing toluenes toxin such as Sansevieria trifasciata, Tradescantia pallida, and if allow to replace water-based glue.

2. For workers:

   a. Raise awareness to stop smoking and also implement good personal hygiene such as not eating and drinking in the work area, and wear dress while working.
   b. Using personal protective equipment, such as masks which can prevent the entry of toluene into the body in conducting its work, use the tool when gluing, example using a brush and gluing by hand directly.
   c. Doing labeling of chemicals used correctly, study the safety data sheet that available on chemicals and glue shut down as soon as possible after each use.

3. For the Department of Labor and Department of Health:

   a. Inform the results of this study to the owner of shoes craftsman about the concentration of toluene.
   b. Giving notification related the health risks that will occur in the future, especially workers who have value RQ≥1.
   c. Conduct regular monitoring of toluene concentration in the workplace, particularly in the informal sector.

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