REVIEW REPORT

Silica dust hazards in Vietnamese foundries

Current situation and countermeasures

Viet Nam General Confederation of Labour

National Institute of Labour Protection

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1. Introduction

The national strategy on prevention of silicosis aims to reduce exposure to silica dust among foundry workers and others. Effective measures presuppose an investigation of the current situation in industry.

Silicosis is a pulmonary disease caused by inhaling respirable silica dust. It is the leading occupational disease in Viet Nam. According to data provided by the Department of Preventive Medicine, foundries are among the five industrial sectors in which workers have the highest incidence of silicosis: 70.36 per cent (5).

This report aims to

- overview the current situation in Vietnamese foundries, introduce NILP research results for 1981-1985 and 1998;
- conduct pilot surveys of two foundries in Hanoi;
- suggest measures to reduce exposure to silica dust; and
- prepare a survey form for evaluating dust-prevention practices.

Methodology

- questionnaires and interview
- study of previous research and data
- field study
- expert counselling

Questionnaires

a) Form1: Primary Survey form (See Annex1)

The primary nation-wide survey seeks to clarify for each city, province, and industry the following issues:

- number of foundries
- capacity of each foundry
- number of male and female employees
- number of silicosis cases
- number of occupational accidents
- current situation of technology, dust-reduction measures, and plans for the future

Form 1 comes with two letters enclosed. One of them, from the standing vice-president of the VGCL requires the collaboration of trade unions in cities, provinces, and industries. The other letter, from the NILP, explains how to answer the questionnaire and provides a contact address.

b) Form2: Personal Questionnaire (see Annex 2)

Fifty of these questionnaires, designed to investigate working conditions, are distributed to each pilot foundry. The questionnaire aims to determine worker awareness of occupational safety and health (OSH), working conditions, silicosis, and preventive measures already in place.

Form 2 was distributed directly to employees in two workships in Hanoi. Respondents were selected in a way that cast light on the various stages in the foundry process.

Interview

The direct interview is intended for safety officers, health officers, production managers, and the company directorate.

Study of previous research and data

A study was carried out on the following research and data:

- results of the state level projects conducted on silicosis foundry workers by the NILP during 1981-1985
- data regarding health, X-rays, and silicosis cases at two pilot enterprises for the period 1995-1998
- company policies on OSH

Field studies

The following field studies were carried out:

- visual observation of technological processes and dust-prevention measures
- measurement of dust concentrations at various stages of production
- photographing specific operations
- laboratory analysis of dust samples

Expert consultations

Experts were consulted on the following issues:

- classifying degrees of severity in silicosis cases
- appropriate technology
- dust-prevention measures
- compiling survey forms

2. Overview: Current situation in Vietnamese foundries

2.1 Metal casting and its typical pollutants

Metal casting is a process in which molten metal is poured into heat-resistant moulds. The basic principles of foundry technology have changed little in thousands of years. However, in industrially developed countries, many stages of the process have been mechanized or automated. In Viet Nam, foundry technology is by those standards obsolescent. Manual labour is still the rule, except where mechanized equipment is necessary. In addition, lack of or ineffective dust-control systems makes the working environment more hazardous.

A brief description of the main foundry processes helps to establish the background to the current situation in Vietnamese foundries:

- Making a pattern of the desired article. Traditional wooden patterns remain the most common practice in Viet Nam. Pollutants include noise and wood dust from sawing and cutting machines.

- Making the mould and core and assembling the mould. There are two types of moulds: A "green" sand mould is made from silica sand, coal dust, clay, and organic binder. Green sand mould does not need drying. A dry mould, on the other hand, uses silica sand, clay, and water, painted with molasses and coal dust. The mould is then dried in an oven. Moulds are also distinguished by their form: on a sand floor or in a flask. Normally, casting on a sand floor is used for small articles, flasks for casting large ones. The danger of dust in the moulding process is minimal because the moulding sand is usually damp – except where sand mixer and muller, which are often significant sources of dust, are involved.

- Melting the metal. Iron melting is often done in a cupola. Scraps of iron, coke, and limestone, charged in layers, provide the raw material. A fan blows air into the cupola. Melting, at temperatures of 1200-1250^{0}C, requires 5 to 6 hours, depending on the capacity of the cupola. The molten iron is poured into ladles which, in turn, are used to pour the material into moulds. Pollutants include fumes, toxic gases, dust, and noise. Where induction furnaces are substituted for cupolas, there is less pollution. Steel melting furnaces employ an electric arc. Raw materials include steel bars, steel scrap, and additives. The temperature in the furnace can be adjusted by changing the elevation of the electrode. When steel is melted at temperatures of 1400-1450^{0}C, ingots are often added to adjust the carbon component in the steel. Aside from that, the process is similar to that of iron casting. Pollutants include fumes, toxic gases, dust, and noise. Less dust is generated in steel melting than in iron melting. Very often, however, melting furnaces without hoods emit dust and fumes inside the station, polluting upper zones such as that where crane cabins are located.

- Cooling the casting and removing the mould. After cooling, the casting is removed, or "shaken out" of, the mould either manually or using a vibrating grid. The sand is collected, treated, and either re-used or dumped. This workstation is especially hazardous because in contact with hot metal sand changes its crystal structure, becoming more toxic. Exposed to high levels of dust and work intensity, workers at this station are at high risk of silicosis.

- Cleaning the casting. After removal from the mould, the casting is cleaned. Cleaning includes removal of burnt-on moulding sand, cutting away surplus metal, and surface finishing. Cleaning tools include pneumatic hand chisels, grinders, and welding or cutting torches. This process is a major source of dust and noise. Advanced technology uses steel shot-blasting or, better, water or water and sand shot-blasting in an enclosed cabinet, eliminating exposure to hazardous silica dust.

2.2 NILP studies, 1981-1985.

From 1981 till 1985, Thai Quang Hoe and others from the NILP carried out State Research Project #58.01.02.02: "Study and application of technical measures to protect workers from silicosis in foundries in Viet Nam".

The project selected Tran Hung Dao, a manufacturer in Hanoi, together with eight other foundries throughout the country as pilot sites for study. Dust concentration measurements were conducted mainly at the Tran Hung Dao mechanical company. Silicosis and general health studies were carried out on a total 1,520 workers.

Some study results follow.

Environmental measurements

Table 1: Dust concentrations (mg/m3) in foundry work stations

Work station	Total dust concentration (mg/m^3)	Portion (%) of respiratory dust (2-5 μm)	Percentage (%) of free silica (SiO_2)
Materials mixing	14.8-41.1	1-8.6	80
Making moulds	7.8-27.8	25	24
Metal-melting furnace	1-7.9	14.3	24
Removing castings	7.4-14.8	25	64
Cleaning castings by hand	7.9	25.8	32
Crane cabin	5.3	-	40
Handling used sand	22-32	14.2	40

Source: NILP,1982

Comments

The percentage of free silica (SiO_2) in foundry dust fluctuates between 24 and 80 per cent, depending on the process stage. Average proportions of free silica are highest (80 per cent) at the materials-mixing stage, while they are lowest (24 per cent) in the mould-making and furnace stages. During removal of castings, it averages 64 per cent.

Dust concentrations are highest (22-32 mg/m3) during sand handling, while they are lowest (1-7.9 mg/m3) during the melting and pouring of iron into the mould. Dust concentrations (7.4-14.8mg/m3) are relatively moderate at the mould- and core-removing stages, but they are especially dangerous because they contain a high percentage of free silica. The average proportion of respiratory dust is highest (< 5 µm) during the cleaning of castings (25.8 per cent) and lowest (1-8.6 per cent) during materials mixing.

These studies indicate that air in foundries is polluted by dust with a high percentage of free silica and a very high portion of respiratory particles. Removal of castings from moulds and cores and cleaning of castings are particularly dangerous stages in the foundry process.

This is the main reason for the high rate of silicosis among foundry workers.

Results of silicosis studies

From 1982 till 1985, NILP researchers selected 1,520 workers for medical examinations, including chest X-rays, from the following factories: Hanoi Mechanical Company, Foundry Company Number 1 (Ho Chi Minh City), Ha Son Binh Mechanical Company (Hatay Province), Quang Trung Mechanical Company (Hanoi), Mai Dong Mechanical Company (Hanoi), Instrumental Company Number 1 (Hanoi), and Ha Nam Ninh Mechanical Company (Hanam Province).

Among the 1,520 workers examined (831 men and 689 women), 608 workers were found to be suffering from silicosis (370 men and 238 women). Percentage of silicosis cases is 40 per cent (608/1,520) of which men occupied 24.3 per cent (370/1,520) and women 15.7 per cent (238/1,520). Men suffered 60.8 per cent and women 39.2 per cent of the 608 silicosis cases.

Silicosis was distributed in terms of degree of severity as follows:

Table 2 Silicosis cases, distributed by degree of severity

Silicosis, degree of severity	Number of silicosis cases	Percentage (%)
1/Op	180	29.6
1p	150	24.4
1/2p	98	16.1
2p	86	14.2
2/3p	76	12.5
3p	14	2.3
1m	11	1.81
2m	12	1.97
A	4	0.16
Total	608	100.0

Note: These categories are based on ILO International Classification of Radiographs of Pneumoconioses (1980). Severity is described as profusion from 0/- to 3/+, based on assessment of the concentration opacities by comparison with the standard radiographs. P,m and A define the greatest diameter of the predominant opacities

Table 3 Silicosis cases, distributed by working history (in years)

Working years	Examined	Silicosis cases	Percentage %	
			Compared with examined	Compared with sufferers
< 5	286	44	15.4	7.2
6-10	453	113	24.9	18.6
11-15	430	240	55.8	39.5
16-20	187	95	50.8	15.6
21-25	82	55	67	9.0
26-30	53	40	75.5	6.6
>30	29	21	72.4	3.5
Total	1 520	608		100

Table 4 Silicosis cases, distributed by skill rank

Skill rank	Numbers of examined workers	Numbers of silicosis cases	Percentage %	
			Compared with numbers of silicosis cases	Compared with numbers of examined same skill
II	249	33	5.4	13.3
III	244	168	27.6	68.9
IV	713	263	43.3	36.9
V	206	94	15.5	45.6
VI	98	42	6.9	42.9
VII	10	8	1.3	80
Total	1 520	608	100	-

Note: Skill rank is a common occupational classification in Viet Nam. Ranks in the foundry vary according to the job performed. For example, in the moulding stage a worker of the 2nd rank can make simple moulds, while workers of higher make more complicated shapes.

Table 5 Development of silicosis among 122 cases observed from 1980 to 1984

Year	Number of silicosis cases	Silicosis degree						
		p				m		A
		1p	2p	3p	Total	1m	2m	A
1980	122	100	19	1	120	1	1	0
1984	122	90	13	0	103	11	7	1

Note: P, m, and n are abbreviations for Latin words. P stands for puntiformis; m stands for micro nodularis; and n stands for nodulavis. The figures indicate the degree of silicosis classified according to ILO/WHO Classification.

Comments

The studies involved a significant number of workers in various foundries ranging in size from medium to large scale, and the following remarks can be made with some confidence:

- A high proportion of foundry workers (40 per cent) suffer from silicosis. This represents a clear warning regarding employee health.

- Although the percentage of sufferers is high, the illness does not develop much from one degree to another. Few people suffered from silicosis of m and A degrees, and none were at the n, B, or C stages. This suggests worker health was generally bad because they had to stop working when the illness had not yet developed to a more severe stage. They were released from the production line because they were unable to work.

- The incidence of silicosis is related to skill ranking in the same way that it is to number of working years. That means the higher the skill rank, the higher the incidence of silicosis. And it means that very few skilled workers are found on the production line in foundries. Production-line workers are mainly of rank II, III, IV (see Table 4).

- Among 122 afflicted workers, after 3-4 years, only 18 per cent of the cases had developed a more severe form of the illness. This rate is not very high. Nevertheless, prevention measures should be considered.

2.3 Results of initial foundry investigations in 1998

Comprehensive statistic data about Vietnamese foundries has never before been available. This study means to provide, among other information, the following:

- number of foundries
- number of workers working in foundries
- number of workers suffering from silicosis
- number of work-related accidents in foundries
- technological state of foundries, including dust-abatement measures

In order to collect information, the Project has used as collaborators organizations such as the Trade Unions Net, which is active in provinces, industries, health departments, and health centres. However, given limited time and its wide range of concern, the Project has not received as many reports as expected. So far, only 20 provinces and 61 cities have reported, and 6 provinces reported not having a foundry. All relevant ministries – the Industry, Construction, Transport, Agriculture and Rural Development, and National Defense ministries – have submitted good reports.

Although only 30 per cent of provinces and cities and some ministries reported, it was in these areas that most foundries and foundry workers were concentrated. Therefore, the available data. presented in Table 6, can serve as the basis for analyzing foundries in Viet Nam.

Distribution of foundries and workforce by province and industry

The Agriculture and Rural Development Ministry led the list, with 15.7 per cent equals 13 of the 83 foundries. The National Defense and Industry ministries accounted for 12 out of 83, or 14.5 per cent. The Transport Ministry accounted for 8 of the total, or 9.6 per cent, while, with 6 out of 83, Hanoi accounted for 7.2 per cent. Provinces such as Can Tho, Nam Dinh, Son La, Nghe An and Thai Binh had only one foundry each, accounting for 1.2 per cent each.

However, simple foundry numbers did not accurately represent the magnitude of the industry in each case. Production capacity and worker numbers were also important. Among a total of 4,028 workers, the Industry Ministry stood at the top of the list, with 32 per cent. The Defense Ministry was next with 11.9 per cent, followed by Quang Ninh with 8.4 per cent, Dong Nai with 7.9 per cent, Hai Phong with 7.8 per cent, Hanoi with 6.6 per cent, and the remaining provinces and industries together accounting for 25.4 per cent.

No child labourers were found in state-owned foundries.

Incidence of silicosis

Statistic data indicate that, among a total of 4,028 workers, 383 (317 male and 66 female) suffered from silicosis. In other words, 9.5 per cent of the total were victims, 7.9 per cent of the total being male and 1.6 per cent female. Of the 383 actual sufferers, 82.8 per cent were male and 17.2 per cent were female.

The Industry Ministry had the greatest number of sufferers, with 171 out of the total 383, or 44.6 per cent. The National Defense Ministry was next, with 62, or 16.2 per cent; followed by Hanoi with 47, or 12.3 per cent; Quang Ninh with 29, or 7.6 per cent; the Construction Ministry with 22, or 5.7 per cent; the Transport Ministry with 17, or 4.4 per cent; Hai Phong with 13, or 3.4 per cent; and the remaining provinces and industries with only an insignificant portion. (Figure 1)

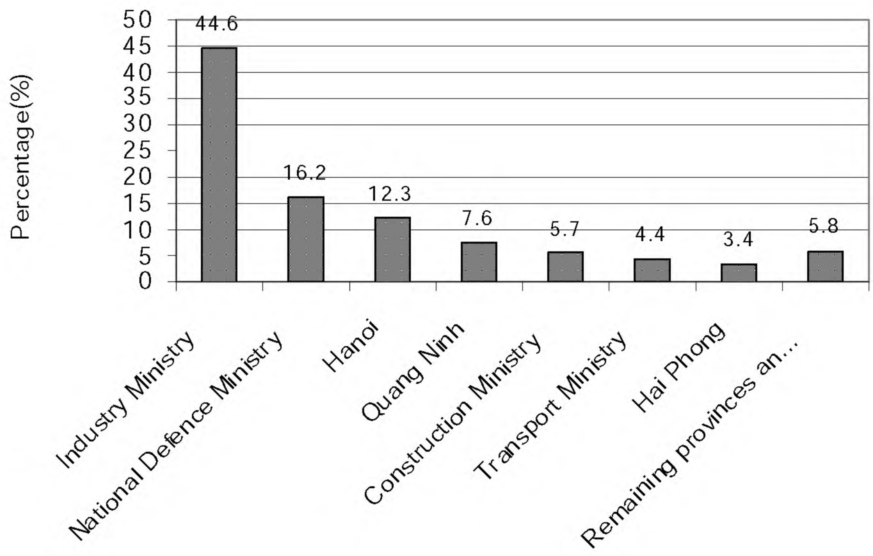

Figure 1. Percentage of silicosis-sufferers distributed by provinces and industries

Some provinces with large numbers of foundry workers have yet to identify silicosis victims. But any conclusions regarding incidence of silicosis, in these cases, must await investigation of local examination and X-ray procedures. For example, the 1998 figures are only about one-quarter those reported in 1985, with reported female victims 9.8 times fewer. (See Table 2.)

The following factors may be responsible for the apparent change in the incidence of silicosis:

- The 1985 data came from high-capacity foundries employing significant numbers of workers. These workers had all received medical examinations including chest X-rays. Where silicosis existed in this sample population, it was identified. The 1998 data, on the other hand, are merely statistics reported by provinces and industries. In many cases, workers exposed to silica dust had not been given medical exams and chest X-rays.
- Some technological improvements have been made, however, and dust concentrations at the mould-making stage, for example, have been much reduced. This would also help to explain the figures concerning females, since a disproportionate number of women are employed in mould making.

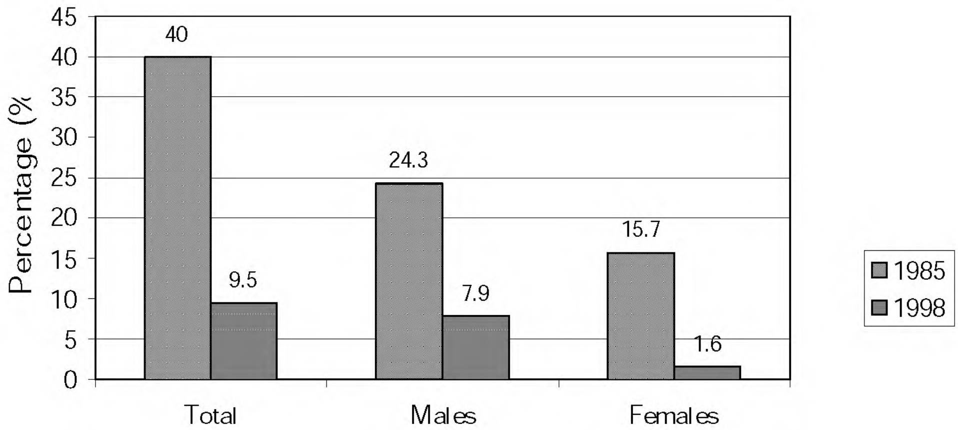

Figure 2. Comparison of silicosis-suffering percentages in 1985 and 1998

Work-related accidents

Given insufficient statistic data, it is difficult to evaluate work-related accidents. However, it is obvious that accident rates remain high in provinces such as Da Nang (19), Can Tho (16), and Cao Bang (12). Common foundry accidents include burns from hot metal and pinching from crane chains.

Recommendations: Methods of information collection and assessment

- The collection of information on foundries should continue, using Form 3 (See Annex 3) to update the existing data.
- The Presidium of the VGCL requires that trade unions in cities, provinces and industries with foundries be given the responsibility for administering Form 3 and sending the collected data to the NILP every year before the end of November.
- The NILP needs financial support from the VGCL, with about 20 million VND required to pay those who fill in Form 3 and send the data to the NILP for assessment.
- The results of data collection and assessment should be disseminated to national taskforces on the elimination of silicosis.

Table 6. Statistics on Vietnamese foundries (1998)

N^0	Provinces, cities, and industries	Number of foundries	Capacity in tonnes/ year	Workforce			Number of silicosis cases			Number of compensa-ted cases	Number of work-related accidents
				Total	Male	Female	Total	Male	Female		
1	Hanoi	6	3 978	266	175	91	47	37	10	9	9
2	Quang Ninh	4	4 050	340	232	108	29	28	1	29	5
3	Can Tho	1	60 000	111	110	01	0	0	0	0	16
4	Ho Chi Minh City	4	505	42	40	02	9	9	0	0	NR
5	Cao Bang	3	14 100	244	179	65	0	0	0	0	12
6	Dong Nai	5	91 068	317	278	39	6	4	2	1	8
7	Da Nang	2	8 048	124	124	0	3	3	0	3	19
8	Namdinh	1	300	34	20	14	2	2	0	2	NR
9	Son La	1	30	6	5	1	2	2	0	0	NR
10	Hai Phong	3	12 982	313	251	62	13	7	6	6	6
11	Nghe An	1	80	38	33	5	0	0	0	0	3
12	Thai Binh	1	500	20	17	3	0	0	0	0	NR
	Ministries:										
13	Agriculture	13		42	36	6	0	0	0	0	NR
14	Industry	12	187 105	1 290	1087	203	171	142	29	42	68
15	Construction	6		226	166	60	22	22	0	1	NR
16	Transport	8		135	87	48	17	13	4	8	NR
17	National Defence	12	4 539	480	335	145	62	48	14	14	6
	Total	83		4 028	3 175	853	383	317	66	115	

Note: NR = not reported

- Provinces: Ph∟ y∟n, H∟ nam, L∟o cai, V∟nh ph∟c, Long an, Ti∟n giang: foundries do not exist
- 6 foundries in Thainguyen, but listed under the Ministry of Industry

3. Pilot survey in two Hanoi foundries

3.1 Hanoi Mechanical Company (HAMECO)

HAMECO, established in 1958, is situated in Nguyen Trai Road, Thanh Xuan District, Hanoi City. The first objective in constructing this factory was to establish a modern mechanical plant as the flagship of the machine tool industry. At the time, the factory was the largest in Southeast Asia.

Company products include machines tool such as cutting, planing, and drilling equipment. Currently, HAMECO ranks first in manufacturing equipment for the sugar industry. The foundry, with a designed capacity of 8,000 tonnes of cast-iron and steel per year, is the most important part of the production process. Now, because of a slump in the manufacturing sector, foundry capacity has been reduced to 4,000 tonnes/year.

Production process

HAMECO operates two foundries:

Steel foundry

Steel scraps and ingots are melted in two electric-arc furnaces with capacities of 1.5 tonnes and 3 tonnes per batch, respectively. The molten steel is poured into ladles, which are then transported by crane to "green sand" moulds, where the molten metal is poured. Castings may be as large as 4,000 kilograms. Cooling time before removing the moulds is four days for large articles and one day for small ones. Mould removal employs vibrating grids, while casts are cleaned by hand.

Cast-iron foundry

The cast-iron is melted in 250-kilogram batches in induction-type furnaces. With castings weighing more than 250 kilograms, the iron is melted in an electric-arc furnace and transported by crane from the steel workshop. Both green sand and dry moulds are used. Moulds are shaken out and casts are cleaned by hand. The used sand is screened and reused.

Working environment

All foundry processes – mould making, metal melting, mould removal, cast cleaning, mould drying, etc. – generate dust. Most of the equipment was provided by the former Soviet Union, and, after 40 years of use (1958-1998), much of it is in poor repair, especially the ventilation and exhaust systems. Obsolete technology together with ailing dust and fume control systems exacerbate any hazardous conditions.

Given the nature of foundry production, all processes are on line and unpartitioned one from the other (excluding a drum-shaped cleaning machine situated in a separate room), so dust spreads easily from one work area to another. Consequently all areas of the foundry, including the manager's office, are polluted.

Table 7: Silica dust concentrations in different sampling places.

N^0	Sampling place	Total dust < 50µm mg/m3	Respiratory dust < 5µm mg/m3	SiO2 %
1	Melting steel furnace:			
	- 4 m from furnace door (fixed sample)	22.4	10.7	7.9
	- Personal sampling	-	7.6	8.3
2	In crane cabin	17.8	14.6	12.7
3	Mould-removing (personal sample carrying during clean-up and preliminary cleaning of casting)	-	8.6	16.1
4	Cleaning by pneumatic machine	57.4	23.9	29.6
5	Cleaning by chisel	-	19.5	18.3
6	Surroundings	4.64	2.49	18.7

Source: NILP, 30 October, 1998.

As seen in Table 7, all dust samples exceeded the standards by a minimum of 1.3 times (in the area near the steel-melting furnace) and by a maximum of 14.3 times (where cleaning casts with a pneumatic machine). The percentage of free silica fluctuated between 8 and 30 per cent, especially in the mould-removal and cast-cleaning areas, which were considered the most dangerous because of their high dust concentrations and close exposure.

Workforce

According to statistical data for 1995-1998, foundry worker numbers tended to decrease, from 157 people in 1995 to 121 in 1998. (See Table 8.)

Table 8: Number of foundry workes in 1995 - 1998

Working year	1995			1996			1997			1998		
	male	female	total	male	female	total	male	female	total	male	female	total
<5	13	0	13	5	0	5	10	0	10	10	0	10
6-10	15	5	20	13	5	18	5	2	7	5	2	7
11-15	43	3	46	40	3	43	31	1	32	31	1	a
16-20	41	13	53	35	10	45	34	7	41	34	7	41
21-25	13	2	15	10	2	12	11	7	18	11	7	18
26-30	7	2	9	5	1	6	10	1	11	10	1	11
> 30	1	0	1	0	0	0	2	0	2	2	0	2
Total	133	24	157	114	21	135	103	18	121	103	18	121

The data in Table 9 shows changes in the number of foundry workers with the same work history (in percentages).

Table 9: Percentage of foundry workers divided by the working year

Working year	1995 (%)	1998 (%)
< 5	8.3	8.3
6 – 10	5.8	12.7
11-15	26.4	29.3
16-20	33.9	33.8
21-25	14.9	9.6
26-30	9.0	5.7
> 30	1.7	0.6

The number of workers with a work history of fewer than 20 years tended to remain unchanged or increase slightly, but those with more than 20 years tended to decrease. The latter had retired or transferred to other work.

The number of female workers had changed very little, with 15 per cent in 1995 as opposed to 14.8 per cent in 1998. (See Table 8.) This was probably because most of them were working in the mould-making area, where work intensity was less and dust concentrations were low, so they were able to work more years than their male counterparts.

Health evaluation

Table 10: State of health of foundry workers in 1995 - 1998

Health category	1995		1996		1997		1998	
	N^0	%	N^0	%	N^0	%	N^0	%
Excellent	2	2.4	8	9	5	5.4	4	3.7
Good	4	4.8	36	36	19	20.4	8	7.5
Normal	72	88	38	43	57	61.3	77	72
Poor	4	4.8	4	5	12	12.9	18	16.8
Very poor	-	-	-	-	-	-	-	-
Number of examined workers	82	100	88	100	93	100	107	100

According to statistical data regarding worker health for 1995-1998, the percentage of those in "excellent" health was low (2-9 per cent), while those in the "normal" category was highest. This was a disadvantage for workers who enjoyed normal health and worked in hazardous environments, since the possibility of contracting silicosis was higher than it was among the workers in "good" health.

Incidence of silicosis

HAMECO conducts good health care and occupational disease examinations. Examination results for silicosis follow:

Table 11. Suspected cases of silicosis (0/1P degree), cumulative data

Working year	1995			1996			1997			1998		
	male	female	total	male	female	total	male	female	total	male	female	total
<5	0	0	0	0	0	0	0	0	0	0	0	0
6-10	0	0	0	0	0	0	0	0	0	0	0	0
11-15	5	1	6	5	1	6	4	0	4	7	0	4
16-20	7	2	9	7	3	10	8	1	8	4	1	8
21-25	2	0	2	3	0	3	6	3	6	4	3	7
26-30	0	0	0	0	0	0	2	0	2	3	0	3
> 30	0	0	0	0	0	0	0	0	0	0	0	0
Total	14	3	17	15	4	19	16	4	20	18	4	22

Source: HAMECO.

Table 12. Compensated cases of silicosis (cumulative data)

Working year	1995			1996			1997			1998		
	male	female	total	male	female	total	male	female	total	male	female	total
< 5	0	0	0	0	0	0	0	0	0	0	0	0
6-10	1	0	1	1	0	1	1	0	1	1	0	1
11-15	2	1	3	2	0	2	2	0	2	2	0	2
16-20	5	1	6	4	2	6	4	5	6	2	2	4
21-25	4	0	4	3	0	3	2	0	2	4	0	4
26-30	1	0	1	1	0	1	2	0	2	3	0	3
> 30	0	0	0	1	0	1	1	0	1	1	0	1
Total	13	2	15	12	02	14	12	2	14	13	2	15

Comments

1. The percentage of silicosis cases (cases/total worker number) was relatively high.

Table 13: Percentages of silicosis cases and compensated cases in 1995 -1998

	1995	1996	1997	1998
Total worker numbers	157	135	121	121
cases	32	33	34	37
% cases	20.3	17.8	20.7	22.3
Compensated cases	15	14	14	15
% compensated cases	9.6	10.4	11.6	12.4

2. Silicosis cases in the steel foundry were higher than they were in the cast-iron foundry

Table 14: Silicosis cases in the steel and cast-iron foundries

Workshop	1995			1996			1997			1998		
	Worker numbers	Case	%	Worker numbers	Case	%	Worker numbers	Case	%	Worker numbers	Case	%
Steel foundry	74	21	28.3	56	16	28.6	56	17	30.3	56	18	32.1
Cast-iron foundry	62	11	17.7	50	8	16	50	8	16	50	9	18

3. The percentage of silicosis cases among crane drivers was very high.

Table 15: Silicosis cases among crane drivers

	1995			1998		
	Number of workers	Case	%	Number of workers	Case	%
Cranes	13	7	53.8	6	3	50
Total workers	157	7	4.5	121	3	2.5

4. The percentage of silicosis cases among female workers was lower, but remained alarmingly high.

Table 16: Silicosis cases among women workers

	1995			1998		
	Worker numbers	Case	%	Worker numbers	Case	%
Female workers	24	5	20.8	18	6	33.3
Total workers	157	5	3.2	121	6	5

5. Some confirmed silicosis cases were transferred to other jobs, some to other enterprises or retired, and two cases died. The majority remained in the foundry.

Table 17: Occupational situation of workers having confirmed silicosis

Work place	1995	1996	1997	1998
Still working in foundry	32	33	34	36
Transferred to other job	3	5	9	-
Transferred to other enterprises	-	1	1	-
On pension	1	2	1	-
Died	-	1	1	-

Dust control measures

Wetting down

This technique was applied to the mould-making and mould shakeout areas. Dust emission was much reduced.

Isolation

Some drum-type cleaning machines were placed in isolated rooms. Although noise and dust emission levels were high, the workers were not directly exposed. These kind of hazards pollute the surrounding environment only by infiltration (through doors and window, for example).

Ventilation

The present ventilation systems were in poor repair. In order to reduce workers' exposure to dust, one pedestal fan had been installed to blow the dust away while the worker was standing upwind. This method, although it reduces dust exposure where it is installed, pollutes other areas.

Personal protective equipment (PPE)

Cotton respirators were the only PPE used. Many kinds of cotton respirators were available, but those with eight cotton layers were the most widely used in the foundry. According to questionnaire responses from 100 workers, all workers used respirators for dust prevention, while 50 per cent also humidified their respirators before use to increase their efficiency.

Management measures

- providing facilities for washing face and hands and changing clothes
- scheduling steel melting on the night-shift, aiming to reduce fumes and dust for the majority of workers
- assessing income based on a marking system (See below, Article 4.)

Article 4: Coefficients for production units

Determination of points

Evaluation criteria		Points
Volume of work done		Up to 30
Progress of work		to 20
Quality of work		to 10
Occupational safety		to 10
House-keeping		to 10
Work discipline		to 10
Collaboration		to 10
	Total:	Up to 100

Classification and determination of factor

Total points	Class	Factor
100	A	1.2
95	A1	1.1
85	B	1.05
70	B1	1
50	C	0.9
30-49	C1	0.85
< 30	D	0.8

The manager regularly audits the workplace to check whether workers are respecting regulations, and awards marks for each component of the point system. So the workers' income depends on how well they respect regulations in the course of all work activities. This method contributes to raising worker awareness of OSH matters in general, and silicosis prevention in particular.

Promotion and training

HAMECO organizes an annual training course for its own workers, aiming to raise awareness of OSH issues. However, there has never been a training course specializing in the topic of silica dust prevention. This has instead been incorporated into the course of OSH.

Future methods of dust control

In order to increase product quality and market competitiveness, HAMECO has borrowed 160 billion VND from the Government, including 60 billion VND for new foundry technology, including measures to ameliorate areas and processes wherein workers are most exposed to silica dust:

- Mould-making. Furan (an organic by-product of oil refining) will be substituted for water and glass liquid, and a mix of Furan and diluted acid will be used to make moulds that are easily broken and which therefore emit less dust.
- Steel and cast-iron melting furnaces. Steel and cast iron will be melted in high-capacity, induction-type furnaces that emit less dust and fumes.
- Mould removal and cast cleaning. These processes will automated and contained in rooms with fume- and dust-control systems.

The project to improve the foundry technology began at the end of 1998 and is going to finish in 2000.

3.2 The Electrical Engineering Company

The Electrical Engineering Company (Ministry of Industry) specializes in the production of three-phase and single-phase electric motors. Production capacity is 26,000 pieces a year. The company has two production units: the assembly line is situated in Cau Dien, 10 kilometres north of the centre, and the foundry is in Chem, 7 kilometres from the assembly unit.

Technical processes at the Hanoi Mechanical Company and the Electrical Engineering Company are similar in many ways. We discuss only those features that are different, in the section below.

Technology

Only cast iron is produced with capacity of 1,200 tonnes a year. Cast iron is melted in cupolas. Other processes are similar to that of in HAMECO.

Dust pollution

Table 18: Silica dust concentration in different work stations.

N^0	Sampling place	Percentage particle of diameter<5µm (%)	Percentage of free silica (%)	Total dust concentration (mg/m3)	Compared to standard (times)
1	Manual mould breaking	80	44	6.6	1.6
2	Small-piece cleaning	55	40	3.3	-
3	Castings cleaned by hand grinder	90	32	6.5	1.6

Source: 1998 survey, Occupational Health Centre, Ministry of Industry.

According to these measurements, dust pollution levels in this foundry are not high.

Workforce

Table 19: Number of foundry workers in 1995 - 1998

Working year	1995			1996			1997			1998		
	male	female	total	male	female	total	male	female	total	male	female	total
<5	10	1	11	4	0	4	10	1	11	10	1	11
6-10	3	3	6	2	2	4	2	1	3	2	1	3
11-15	14	12	26	9	2	11	7	6	13	6	6	12
16-20	16	2	18	18	10	28	17	10	27	18	10	28
21-25	3	1	4	2	4	6	5	2	7	5	3	8
26-30	2	1	3	0	1	1	1	2	3	0	1	1
> 30	0	0	0	0	0	0	0	0	0	0	1	1
Total	48	20	68	35	19	54	42	22	64	41	23	64

In the period 1995-1998, the number of workers remained relatively stable. Workers with 11-20 years of experience were in the majority with 64.7 per cent (1995), 72.2 per cent (1996), and 62.5 per cent (1997-1998). The percentage of female workers was relatively high: 29.4 per cent (1995), 35.18 per cent (1996), and 34.4 per cent (1997-1998). As in HAMECO, most female workers worked in the mould-making process, where working conditions were less harmful and the work was relatively light.

Health evaluation

Table 20: State of health of foundry workers in 1995 - 1998

Health category	1995		1996		1997		1998	
	N.	%	N.	%	N.	%	N.	%
Excellent	24	35.3	9	16.7	2	3.1	1	1.55
Good	27	39.7	26	48.1	25	39.1	19	29.7
Normal	16	23.5	18	33.3	35	54.7	34	53.1
Poor	1	1.5	1	1.9	2	3.1	9	14.1
Very poor	-	-	-	-	-	-	1	1.55
Number of examined workers	68		54		64		64	

Comments

Workers' health has worsened year by year.

- "excellent" health category: declined rapidly from 35 per cent (1995) to 1.5 per cent (1998)
- "normal": increased from 23 per cent (1995) to 53.8 per cent (1998)
- "poor" increased from 2 per cent (1995) to 14.6 per cent (1998)
- "very poor": 0.8 per cent in 1998; not applicable before 1997

Incidence of silicosis

Table 21: Suspected silicosis cases (0/1P degree), cumulative data

Working year	1995			1996			1997			1998		
	male	female	total	male	female	total	male	female	total	male	female	total
< 5	-	-	-	-	-	-	-	-	-	-	-	-
6-10	-	-	-	-	-	-	-	-	-	-	-	-
11-15	3	0	2	2	0	2	2	0	2	1	0	1
16-20	2	1	4	3	0	3	1	0	1	5	0	5
21-25	-	-	-	0	1	1	2	1	3	3	0	3
26-30	1	0	1	1	0	1	-	-	-	0	1	1
> 30	-	-	-	-	-	-	1	1	2	1	1	2
Total	6	1	7	6	1	7	6	2	8	10	2	12

Table 22: Compensated silicosis cases (Cumulative data)

Working year	1995			1996			1997			1998		
	male	female	total	male	female	total	male	female	total	male	female	total
<5	-	-	-	-	-	-	-	-	-	-	-	-
6-10	-	-	-	-	-	-	-	-	-	-	-	-
11-15	-	-	-	-	-	-	-	-	-	-	-	-
16-20	1	1	-	1	1	2	1	1	2	3	1	4
21-25	1	-	-	-	-	-	-	-	-	-	-	-
26-30	-	-	-	1	0	1	1	0	1	1	0	1
> 30	-	-	-	-	-	-	-	-	-	-	-	-
Total	2	1	3	2	1	3	2	1	3	6	1	7

Source: Electrical Engineering Company.

Comments

1. The incidence of silicosis was on the rise from 1995 to 1998, with an especially sharp increase in 1998. (See Table 23.)

Table 23: Percentage of silicosis cases in 1995 - 1998

Year	1995	1996	1997	1998
Total workers	68	54	64	64
Silicosis cases	10	10	11	19
% suffered	14.7	18.5	17.2	29.7
Compensated cases	3	3	3	7
% compensated cases	4.4	5.6	4.7	10.9

2. The percentage of silicosis cases among female workers is low (tab.24)

Table 24 : Percentage of silicosis cases among women

Year	1995	1996	1997	1998
Total workers	68	54	64	64
Silicosis cases	2	2	3	3
Percentage (%)	3	3.7	4.7	4.7

3. Work activities with the highest percentage of silicosis cases appear in Table 25

Table 25: Silicosis cases in some work activities

	Number of workers	Silicosis cases	Percentage (%)
Cast iron grinding	19	5	26.3
Cupola	19	4	21
Moulding	19	3	15.8

Dust-control measures already implemented

Besides the classic methods applied in other enterprises, some improvements are evident in the foundry cleaning process:

- Cleaning of castings is restricted to an isolated room, far from the main production building.
- Sand and water shot-blasting is used to clean castings. This equipment is compact, easy to use, efficient, and inexpensive (about 20 million VND per unit).

3.3 NILP recommendations

Dust-control measures

- Nowadays, electric-arc furnaces are a popular means of melting steel in Vietnamese foundries. To control emission of fumes, it is necessary to deal with two issues:

    - As much of the pollutant emissions as possible must be collected.

    - The collected air must be cleaned before being discharged into the atmosphere.

  Collection of gases is difficult and complicated, and the most costly part of the system is the cleaning device.

  In order to trap fumes effectively, foundries have to install hoods both above the furnace and again in the upper zones under the roof. However, installing a hood directly above the furnace obstructs furnace operations. Thus, the hood is often installed only higher, under the roof. This option is not very effective. It requires much more exhaust air, for one thing, and wind blows the fumes away from the hood opening, further reducing its effectiveness.

  Among other things, appropriate cleaning devices also have to be highly efficient at collecting gases and resistant to high temperatures. To meet these requirements, imported technology often uses a baghouse as a gas filter. Such filters, with an air-flow rate of 100,000 cubic metres per hour, were installed in Viet Thanh and VICASA steel mills at an investment of US$550,000 each. Not only are the capital investment costs beyond the means of many companies, operation costs (power consumption, maintenance, etc.) also present big problems.

  The NILP suggests using scrubbers for collecting dust instead of baghouses. These devices have been applied at the Duyen Hai Mechanical Company (Hai Phong City) and the Hai Phong steel mill. Their effectiveness of trapping fumes at the hood is about 70 per cent, and their dust-cleaning efficiency is about 85 per cent. In combination with its high rate of discharge, this kind of system can maintain concentrations of dust at ground level within permissible limits. Total costs for such a fume- and dust-control system run about 600 million VND.

- For other dust sources such as material belt conveyers, stone-crushing machines, and grinding machines, the NILP proposes the popular cyclone with spiral vane guide dust-control method. This device has been used with success in many factories throughout the country. It collects soil, stone, and cement dust with an efficiency of 80 per cent. Among its advantages are simplicity of manufacture, low costs of capital investment and maintenance, moderate dust-trapping efficiency, and stability of operation. With an estimated cost of 200 million VND for a complete dust exhaust system of 30,000 cubic metres per hour, this is an appropriate means of control for most dusty processes.

Enclosing hood for belt conveyor…

- For dust sources where it is impossible to install exhaust ventilation system, various kinds of water suppression systems may be applied. The NILP has produced a good axial ventilator which can operate as mist equipment. This fan performs two functions: while it suppresses dust it also cools. The NILP has also studied a method that uses spray nozzles with good effect.

In conclusion, depending on specific conditions, various dust-control measures may be appropriate:

  - dust collection and cleaning by scrubber;
  - dust collection and cleaning by cyclone with spiral vane guide; or
  - dust suppression by axial mist fans or spray nozzles.

Personal protective equipment.

Interviews and direct observation shows that most workers wear respirators comprising 6, 8, or 12 layers of cotton. However, not all respirators are designed for silicosis prevention.

- Most of these respirators are not checked for quality, especially regarding their capacity to protect the wearer from respiratory dust. Therefore, even crane operators, who usually wear respirators, have suffered a high incidence of silicosis (more than 50 per cent of examined crane operators). Respirator quality clearly represents a problem.

- Some workers usually take respirators off when engaged in removing moulds. In interviews, workers said that they felt it was too difficult to breathe when wearing the respirators, especially after working for some time. This is not surprising, since a layer of dust collects on the surface of the respirator during use. The high work intensity in this activity already tires the workers, and they need more air to breathe; therefore they tend to take respirators off. But this behaviour can be dangerous, since dust in this area is more harmful than in the other stages due to its relatively small particle size, high concentrations, and high toxicity.

- A special type of respirator is needed for workers exposed to silica dust. Currently, only one type of respirator is used for workers engaged in all jobs.

The NILP has produced respirators that are appropriate for protection against silica dust. Their use should be promoted.

Promotion and training

Interviews with workers as well as managers at two pilot foundries revealed that none of the companies had organized training courses on prevention of silicosis. Nevertheless, top management at these companies understood to some extent the danger of silicosis, and had implemented measures such as the following:

- annual health checks, including chest X-rays
- rehabilitation for workers with poor health
- OSH regulations
- rescheduling hazardous processes, which can sometimes be operated at night to limit the number of people exposed to risk
- improved technology where possible

Such managers were in the minority, however. Junior officers such as safety officers and production managers and, even more, workers have a very limited understanding of silicosis. Very few of them understand the mechanism underlying silicosis – for example, they do not know that only particles of less than 5µm can go deep into the alveoli and cause the disease, while larger particles can be retained in upper respiratory path or captured by common respirators. Neither do they realize that those areas where dust concentrations are not very high, but where there is a small particle size or a high proportion of free silica, are more dangerous than areas where dust concentrations are high but there are larger particles and less free silica. Many do not understand that silicosis is incurable.

Clearly, these people should be trained and provided with at least a minimum knowledge of silicosis and methods of prevention. The NILP has organized many training workshops on OSH which include discussion of silicosis. More of these workshops are needed, as are training programmes for trainers.

4. Conclusions

Based on reported materials and pilot surveys of the Hanoi Mechanical Company and Electrical Engineering Company, the following conclusions and suggestions can be offered:

1. Vietnamese foundry technology is obsolescent, with many processes being performed by hand. Over the last few years, especially since 1996, many foundries have had to close for lack of orders. The survivors are operating at less than full capacity (maximum 50 per cent of designed capacity). Given production problems and limited investment capital, most foundries cannot upgrade to advanced technology. Whatever can be done to improve the working environment has already been done (for example using green sand, wetting down, etc.), but improvements are limited and inadequate. In addition, a lack of dust exhaust systems results in dust concentrations exceeding permissible limits in most foundry workstations.

2. In consequence, worker health has worsened. Few fall into the health categories of "excellent" or "good"; the majority are classified as "normal". Only 40 per cent of foundries have workers chest X-rayed and examined for silicosis. Foundry workers are concentrated in provinces such as Hanoi, Quang Ninh, Thai Nguyen, and Can Tho and in the ministerial sectors of Heavy Industry and Transport. The percentage of silicosis victims in Viet Nam is 9.5 per cent (among these, 2.5 per cent are compensated). Female workers often perform light jobs such as making moulds, and fewer than 2 per cent suffer from silicosis.

There are no child workers in state-owned foundries.

The figures indicate that the current incidence of silicosis is much lower than it was in 1985. Possible explanations include these:

- The 1985 data were collected from factories with high-capacity foundries and large number of workers, where all the sample population had been given medical exams and chest X-rays. The 1998 data are simply statistics reported by provinces and industries. In many cases, these sources had not organized medical examinations or chest X-rays for workers exposed to silica dust.

- Recent technology improvements in processes such as mould-making have much reduced dust concentrations.

- Work intensity has declined due to lack of orders, with many foundries working only two or three days a week. Therefore, exposure to dust has decreased.

The pilot survey of two Hanoi foundries shows that the incidence of silicosis victims, which was 20 per cent in average 1995-1998, was twice as high as that found nationwide. Female victims among the foundry workers account for fewer than 5 per cent. The number of silicosis cases in the steel foundry was 1.5 times higher than that in the iron foundry. More than 50 per cent of crane operators were found to have silicosis. Therefore, attention should be given to these work places when considering methods of silica dust control. For example, the crane cabin should be enclosed and provided with filtered or bottled air.

3. To improve the working environment and, ultimately, to satisfy national standards, the basic measure is change in technological processes. Only by applying advanced technology can foundries eliminate the causes of silicosis. While the Vietnamese economy is in recession, such changes should be taken step by step. Priority should be given to the following processes:

- mould-making;
- cleaning of castings; and
- melting.

4. If technological changes are not practicable, the following improvements can in the meantime reduce exposure to silica dust:

- Isolate or enclose dust sources such as sand mixers, vibrating grids, and drum cleaners.
- Wet down floors and mould surfaces before removing castings; axial mist fans and water spray nozzles are among the appropriate equipment;
- Local dust exhaust ventilation systems play an important role in dust control for dusty processes such as mould removal, sand mixing, and steel melting. The NILP has designed hundreds of dust-control systems for industrial enterprises throughout the country. For steel processing, in particular, fume exhaust systems have been installed and operated successfully in the Duyen Hai Mechanical Company and Hai Phong Steel Mill. Scrubbers have been used as dust- and smoke-cleaning devices. This model could be widely applied for steel-melting furnaces in foundries.
- Employ an OSH point system in calculating workers' income. Income will depend how well they respect working regulations, including OSH regulations. This method also improves worker awareness of OSH issues.
- Use high-quality respirators. The NILP is producing a respirator that is very effective for foundry workers. Humidifying cotton respirators, meanwhile, does help to reduce the amount of dust inhaled.
- Organize training courses on silicosis and countermeasures. Priority should be given to training trainers.

5. Recommendations regarding systematic foundry reports:

- Collection of foundry information using Form 3 should continue so that data can be updated.
- The Presidium of the VGCL invests trade unions in cities, provinces, and industries where there are foundries with the responsibility for collecting Form 3 data and sending to the NILP. This should be done annually, with reports being sent by the end of November.
- The NILP needs financial support from the VGCL, with a total of about 20 million VND for remuneration of those who fill in Form 3 and send to the NILP and for the assessment of data.

- The collected data then will be disseminated to all members of the national taskforces on the elimination of silicosis.

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7. Reports on foundries from 20 provinces and cities and 5 industries.

Annex 1

FORM I Primary survey form

Nº	Com-pany	City (Province)	Year of Establish-ment	Capacity (Tonnes/year)	Number of workers			Silicosis cases			Number of compensated workers	Accidents
					Total	Male	Female	Total	Male	Female		

Other information.

1. Comment on current state of technological processes in the foundry
2. Measures already implemented for reduction of silica dust exposure
3. Plans to improve technology and working conditions

Information to be sent to this address:

Mr. Pham Van Hai

1. Yet Kieu, Hanoi

National Institute of Labour Protection.

Annex 2

FORM 2

Personal questionnaire

To help researchers and policy-makers form a basis for proposing scientific and technical measures and policies on improvement of working conditions, would you please to answer the following questions by marking an "x" in the appropriate blank squares? Thank you.

1. Sex:

Male ❑ Female ❑

2. Date of birth: . . . .

3. Education: . . . / 10 Profession: . . . .

. . . / 12

4. Name of job: . . . . Workplace: . . . .

5. Number of working years: . . . . Number of years for present job: . . . .

6. Level of skill:

7. Does present job satisfy you?

Yes ❑ No ❑ No idea ❑

8. How are present working conditions in comparison to previous?

Better ❑ The same ❑ Worse ❑ No idea ❑

9. Which hazards are you exposed to?

Heat ❑ Cold ❑ Wet ❑ Dust ❑

Noise ❑ Vibration ❑ Radiation ❑ Chemicals ❑

Toxic gases ❑ Shortage of light ❑ Nothing ❑

10. Do the following dangers exist in your workplace?

Moving or sharp parts that are not covered ❑

Potential for electric shock ❑ Falling or flying objects ❑

Heat source/potential burns ❑ Erosion substances ❑

Potential for collapse ❑ Slipping ❑

Risk of falls❑ Explosion potential ❑

11. Which tools do you work with?

Manual ❑ Machine ❑ Modern ❑ Simple ❑

New imported ❑ Very old ❑

How many years have you worked with the machine? . . . , years

In what condition are the instruments, tools or machines with which you work?

Good, convenient❑ Good, inconvenient❑ Normal ❑ Bad, inconvenient❑

Safe ❑ Unsafe ❑

12. What do you think about your work load?

Heavy ❑ Medium ❑ Light ❑

13. In your opinion, are working conditions improving?

Yes ❑ No ❑ Difficult to answer ❑

14. How many training courses on labour protection have you attended? . . . . courses

15. Do you have any understanding of silicosis?

Yes ❑ No ❑ Little ❑

16. Is personal protective equipment provided?

Yes ❑ No ❑

Provided by money ❑ Not provided ❑

17. Did you have any work-related accidents last year?

Yes ❑ No ❑

If yes, which part of body was injured? . . . .

Number of days off: . . . . Number of accidents . . . .

18. How often do you have a medical examination?

Periodically ❑ Not periodically ❑ Never ❑

19. Do you have occupational examinations for silicosis?

Yes ❑ No ❑

If yes, how severely have you suffered?:

Not severe enough to be compensated ❑ Compensated ❑

20. What have you done to reduce exposure to silica dust? Write down the measures implemented:

. . . .

. . . .

. . . .

. . . .

. . . .

. . . .

. . . .

. . . .

. . .

Annex 3

FORM 3

Vietnam General Confederation of Labour
National Institute of Labour Protection

Survey for evaluating dust-prevention practices in Vietnamese foundries

This survey supports the National Action Programme on the Prevention of Silicosis. The purpose of the survey is to (1) review current dust management practices; (2) identify needed improvements – especially low-cost dust-prevention practices that employers could implement immediately; and (3) assist the Government of Viet Nam as well as the Viet Nam General Confederation of Labour in future dust-management planning, for example, establishing new policies, legislation, and projects to improve working conditions and prevent silicosis.

Please answer the questions or mark (X) in an appropriate blank square. Thank you.

Company: . . . .
Year of establishment: . . . .
Province (City): . . . .
Industry: . . . .
Address: . . . . Tel.: . . . .

1. Foundry description

Designed capacity: . . . .
Actual capacity (at present): . . . .
Main products: . . . .

1.1. Draw a simple flowchart of your foundry:

1.2. List main equipment and machines used in all workstations.

Equipment (machines)	Quantity	Capacity	Type	Year commenced operation

2. The state of technological processes.

(Please mark (x) or fill in appropriate spaces).

2.1. Steel-melting furnace.

Number of furnaces: . . . .

Type of furnace:

+ Electrode ...
+ Induction ...

Dust/fume exhaust system? Yes ... No ...
If yes, how does it work? Good ... No good ...

2.2. Iron-melting furnace.

Number of furnaces: . . . .

Type of furnace:

+ Cupola ...
+ Induction ...

Dust/fume exhaust system? Yes ... No ...
If yes, how does it work? Good ... No good ...

2.3. Moulding.

Type of moulding

	Yes	No
+ Dry	...	...
+ Green	...	...
+ Self dry	...	...
+ Moulding on sand floor	...	...
+ Moulding in flask	...	...

+ Other (list type). . . . .

Type of dry

	Yes	No
+ Dry in reflection furnace powered by coal	...	...
+ Dry in reflection furnace powered by oil	...	...
+ Dry in reflection furnace powered by gas	...	...
+ Dry by blowing Co_2 gas	...	...
+ Self dry by mixing special chemical in mould	...	...

2.4. Shakeout of mould.

Manual ...
Vibrating grid ...
Others: . . . .
. . . .

Dust exhaust system? Yes ... No ...
If yes, how does it work? Good ... No good ...

2.5. Cleaning of castings.

Manual ...
Pneumatic tool ...
Steel shot ...
Sand-blasting ...
Water shot-blasting ...
Sand and water shot-blasting ...
Dust exhaust system? Yes ... No ...
If yes, how does it work? Good ... No good ...

2.6. Is sand recycled?

Yes ...
No ...
If yes, is there a dust exhaust system?
Yes ... No ...
If yes, how does it work? Good ... No good ...

3. Health Category

Health category	1995		1996		1997		1998	
	Number	%	Number	%	Number	%	Number	%
Excellent								
Good								
Normal								
Poor								
Very poor								
Total of health examined workers								

Workforce

Working history (working years)	1995			1996			1997			1998			1999		
	male	female	total	male	female	total	male	female	total	male	female	total	male	female	total
0-5															
6-10															
11-15															
16-20															
21-25															
26-30															
>30															
Total															

X-rays

Working history (working years)	1995			1996			1997			1998			1999		
	male	female	total	male	female	total	male	female	total	male	female	total	male	female	total
0-5															
6-10															
11-15															
16-20															
21-25															
26-30															
>30															
Total															

Suspected cases of silicosis

Working history (working years)	1995			1996			1997			1998			1999		
	male	female	total	male	female	total	male	female	total	male	female	total	male	female	total
0-5															
6-10															
11-15															
16-20															
21-25															
26-30															
>30															
Total															

Confirmed or compensated cases of silicosis

Working history (working years)	1995			1996			1997			1998			1999		
	male	female	total	male	female	total	male	female	total	male	female	total	male	female	total
0-5															
6-10															
11-15															
16-20															
21-25															
26-30															
>30															
Total															

5. Methods of controlling exposure to silica dust

5.1. Which measures of dust control have been used for each dust source?

Workstation	Dust source	Respirable or total dust concent'n (mg/m^3)	SiO_2 concent'n (%)	Compared with standard	Current methods of dust control
Preparation of moulding sand					
Mould making					
Melting					
Shakeout of mould					
Cleaning of casting					
Sand Recycling					

Vietnamese standard

Maximum permissible concentration of silica dust in ambient air at workplace

Silica content (%)	Total dust concentration (mg/m^3)		Respirable concentration (mg/m^3)	
	Average over 8 hrs	Short-time sampling	Average over 8 hrs	Short-time sampling
100	0.3	0.5	0.1	0.3
50 up to 100	1.0	2.0	0.5	1.0
20 up to 50	2.0	4.0	1.0	2.0
5 up to 20	4.0	8.0	2.0	4.0
1 up to 5	6.0	12.0	3.0	6.0
<1	8.0	16.0	4.0	8.0

5.2. Personal Protective Equipment (PPE).

What kind of PPE is used?

+ Respirator (cotton)
  - 6 layers ...
  - 8 layers ...
  - 12 layers ...

+ Half-mask ...
+ Other: . . . .

Who supplies PPE to your company?

+ State- owned company ...
+ Private ...
+ Both ...

How often is the PPE changed?

+ Weekly ...
+ Monthly ...
+ 3 mouths ...
+ > 3 mouths ...

5.3. Hygiene practices.

Are there places for workers to wash hands and face before eat during break times?

Yes ... No ...

Are there bathrooms for showering and change of clothes?

Yes ... No ...

5.4. How often is the working environment monitored?

	1995	1996	1997	1998
Frequency of monitoring				

5.5. Company's OSH policy and health-care programme.

There has been any training course on silicosis?

Yes ... No ...

If yes,

+ When the last one took place?

. . . .

+ Who provides the training service?

. . . .

+ How long does the course last?

. . . .

+ How many workers attend the course? . . . .

In what way do you warn workers about the dangers of silicosis?

+ By posters ...
+ By giving bad points in competition ...
+ By cutting incentives ...

How do you check worker awareness of the danger of silicosis?

+ By seeing workers wearing respirators ...
+ By receiving complaints about dust and suggestions for the improvement of workplaces. ...
+ Others

5.6. Measures need to be implemented in the future.

Does company have any plan to:

+ Change the technological processes in foundry?

  Yes ... No ...

If yes,

- For which workstation?

  . . . .
  . . . .
  . . . .

- Time of commencement and completion.

  . . . .
  . . . .
  . . . .

+ Install exhaust system for dusty processes?

  Yes ... No ...

If yes

- For which dust source?

  . . . .
  . . . .
  . . . .

- Time of commencement and completion.

  . . . .
  . . . .
  . . . .

+ Others: . . . .
. . . .