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W. O. Phoon and S. B. Tan

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SYNOPSIS

A total of 14 types of industries were surveyed. The total number of factories surveyed was 83, total number of workers in all the factories surveyed was 2,795. Average number of workers per factory was 33·7. 12 of the factories were found to be satisfactory. Of these 12 factories, three were undergoing maintenance servicing and hence were not in production at the time of the survey. The remaining 71 factories surveyed were unsatisfactory.

INTRODUCTION

Singapore has been undergoing the process of industrialization for over a decade. About ten years ago, Singapore depended largely upon her entrepot trade and her existence as a British naval base to sustain her economy. By 1973, however, there were more than 4,200 registered factories in Singapore, of which, 2,600 were in the manufacturing sector and accounted for more than 150,000 workers. In addition, there were about 25,000 workers in the construction industry and about 1,800 in stone quarrying.

Several industrial estates have been established. The largest is the Jurong Industrial Estate with more than four hundred factories. Other industrial estates are in the Kallang Basin, Redhill, Toa Payoh, Loyang, Sembawang, Kranji and elsewhere. Outside these industrial estates are other factories located all over Singapore.

Objective of the Survey

The factories in the Republic are of several types and sizes. Small factories, however, make up the vast majority. "The 1970 census of industrial production showed that out of a total of 1,747 manufacturing establishments (excluding rubber processing), 1534 belonged to the category of "small industries". This constitutes about 88% of the manufacturing firms." (Ong, P.B., 1972). It is, moreover, in small factories that conditions of hygiene and safety are the most unsatisfactory, as small factories do not usually have the financial resources to provide good hygiene and safety facilities.

For these reasons, it was felt that a survey of the health and safety conditions in small factories in Singapore could be extremely useful and interesting. For practical reasons and for convenience, a factory with a labour force of less than 100 workers was considered to fall into the category of "small factories". Apart from the factor of size, it is obvious that such "small factories" form a very heterogenous group. They would vary in type of activity as well as level of sophistication.

METHODS AND MATERIAL

The number of factories in each category of manufacturing industries, as registered with the Government, was ascertained.

From the Ministry of Labour, lists of factories with a labour force of more than ten but less than one hundred workers were obtained.

Random samples were drawn for each group of small factories engaged in a particular manufacturing process. A sample size of 80 or so was decided upon as this was the number of factories that we could complete within the two month period given to us, with the proviso that each category of industry should be represented by, preferably, at least three or four factories.

The ratio of the sample to the total number in each group was not based on any specific reason other than that each category should be represented by preferably at least three or four factories. Where the total number in a category was small, there was a tendency to take a pro-

Department of Social Medicine and Public Health, University of Singapore, Outram Hill, Singapore 3.

W. O. PHOON, M.B., B.S., F.R.C.P. (Glas. and Edin.), M.R.C.P., F.R.F.P.S. (Glas.), D.C.H., D.I.H., D.I.H.S.A., F.F.C.M., A.M., Professor and Head.

S. B. TAN, M.B., B.S., M.Sc. (P.H.) (S'pore). Lecturer.

portionately larger sample. As this survey is intended merely to acquire preliminary knowledge, it was decided that the exact size of the sample was not crucial.

The factories sampled were then contacted, and appointments for the visits were made. It is conceded that this could mean that the conditions found during the visits could have been rather different from those usually prevailing, as it was natural that factory owners and proprietors might have given their factory a special cleaning-up in anticipation of our visit. However, it was found impractical to make surprise visits as most of the factories were located in remote areas and were difficult to find without assistance from the factory occupiers themselves. In addition, access into the factories was often impossible without the prior authority of the owner or the manager, who is often not around in the factory but in the downtown administrative office or going about contacting prospective clients or suppliers of raw materials.

At each factory, a preliminary discussion was held with the factory manager or senior chargehand. Information about the history and general details about the factory and its employees were obtained and recorded on the spot by the field investigators.

Tests for environmental conditions, as described below, were made. A thorough inspection of the shop floor, stores, toilets and restrooms, canteens and compound was performed, usually in the company of a responsible staff-member of the factory. At the end of each visit, a final discussion was usually held between members of the team and senior staff of the factory concerned.

Most of the tests and observations were made during a single visit, but in a few cases, repeat visits were made for various reasons. Sometimes the factories were found not to be functional during the first visit. At other times the only person from whom reliable data could be obtained was absent from the premises. Doubtful test results had to be checked by repeating the tests.

Tests for Environmental Conditions

The factors investigated were the levels of lighting and sound, stresses due to heat, and concentrations of dust. Vapour concentrations were measured when potentially hazardous substances were used.

Lighting

Levels of light were measured by means of light meters. The worst and best situations in each factory were recorded. The results, obtained in lux, were then compared against the standards recommended by the Illumination Engineers Society (IES) of the United States of America. (IES, 1968).

Sound Levels

Sound levels were recorded by the Bruel and Kjaer precision sound level meter. Measurements were taken with the A network at operatives' stations. Results were then compared against the currently accepted standard of 90 dB(A) as the upper limit of safety for an eight hour working day. (ACGIH, 1973).

The threshold limit value (TLV) of 90 dB(A) refers to the sound pressure level that represents conditions under which it is believed that all workers may be repeatedly exposed without adverse effects on their hearing acuity. It is recognized that some authorities take 85 dB(A) instead of 90 dB(A) as the threshold limit value of noise, but we chose 90 dB(A) as the more generally accepted value.

Heat Stress

The Wet-Bulb Globe Thermometer Index was used to measure the environmental factors which might cause heat stress. The Wet-Bulb Globe Thermometer Index (WBGT) has been recommended by the American Conference of Governmental Hygienists (ACGIH) as the simplest and most suitable technique to measure the environmental factors relating to this problem. (ACGIH, 1972).

The determination of the WBGT requires the use of a black globe thermometer, a natural (static) thermometer and a dry-bulb thermometer. The range of dry and natural wet-bulb thermometers should be 5°C to 50°C with an accuracy of $\pm$ 0·5°C. The wick of the wet-bulb thermometer should be kept wet with distilled water at least half an hour before the reading is taken. The wick should be kept wet by a syringe. The globe thermometer (six inches in diameter) should have its thermometer bulb or sensor firmly fixed in the centre of the sphere. The globe thermometer should be exposed for at least 25 minutes before a reading is taken. A stand should be used to suspend the thermometers to avoid restriction of air flow around the bulbs.

The thermometers should be so placed to obtain as representative readings as possible of the conditions in which the workers operate.

Dust

The midget-impinger was employed to obtain samples of dust-laden air. 0·5 cubic feet of air was taken in each case. Distilled water was used as the medium. The suction pressure was maintained at 12 inches water guage during sampling. The dust samples were counted, using the standard light field technique. (ACGIH, 1969).

GENERAL OBSERVATIONS AND FINDINGS

Eighty-three factories altogether were visited. These factories employed a total of 2,795 workers. The categories of factories visited included Spinning, weaving, printing and finishing of yarn and fabric (3)*, Manufacture of bricks (4), Stone quarrying (6), Manufacture of asbestos products (1), Electro-plating, enamelling and polishing of metal products (8), Manufacture of basic industrial acids (3), Manufacture of basic industrial chemicals (2), Sawmilling (13), General engineering works (15), Commercial job printing (9), Manufacture of tiles, pipes (including earthen and glazed pipes) (3), Manufacture of cement (4), Iron foundry (10), Extraction of clay, sand and gravel (2).

Characteristics of the Workers

Age

114 (or 4·1%) of the workers were below eighteen years of age, while 446 (or 16·0%) were above forty-five years of age. Hence the vast majority of the workers were between eighteen and forty-five years old.

Sex

There were 433 (or 15·5%) female workers.

Length of Service

It is interesting to note that 606 (or 21·7%) of the workers had less than one year's service. This observation probably reflected the relatively high labour turnover in small factories, though in some instances it was due to a rapid expansion over the past twelve months which necessitated the recruitment of additional members of staff.

Structure of Factory Premises

Less than half of the total number of factories were constructed mostly of bricks. More than half were made from a combination of materials which included wood, brick and zinc.

More than half of the factories were housed in detached buildings. Less than one-fifth were housed in shophouses. Twelve factories were housed in impermanent buildings with atap roofs and walls of wooden planks.

Welfare and Toilet Facilities

The findings are summarized in Table I. By no means were all the factories provided with adequate washing facilities. Wash-basins were found in only 55 factories. Many of these basins were located in the office, and therefore were

*Nos. in brackets indicate total no. of factories visited.

TABLE I

WELFARE AND TOILET FACILITIES

Facilities Provided	Present	Absent	Total
Wash-basin	55	28	83
Toilets (Water-borne system 50) (Bucket System 27)	77	6	83
Shower	13	70	83
Changing room	17	66	83
Lockers	10	73	83
Lunch room or canteen	20	63	83

generally unavailable to the workers on the shopfloor who needed these facilities most.

Most of the factories had toilets. Most of the others which did not had access to toilets in adjoining premises or premises nearby.

Only 13 factories had shower facilities. The workers of most of the factories studied, therefore, were in a habit of returning home in soiled working clothes.

Changing rooms were present in only 17 factories. This posed less of a problem than basins and showers, as the workers could change their clothes in other parts of the factory or in the toilets if they wanted to.

Lockers were uncommon. Most of the workers kept few possessions on the premises of the factories.

Lunches were sometimes taken in the factories themselves, but only a minority of factories provided separate lunch rooms or canteens. In 26 factories a common area served a miscellany of uses as a lunch space, changing room and general store.

The condition of the facilities, when available, was subjectively assessed, and recorded as very dirty, fairly dirty or clean. The assessments can give a very rough guide only to the conditions seen. It is also very likely that the conditions varied a great deal throughout the day. Toilets assessed as clean could have been so merely because they were observed immediately after having been cleaned or before the peak period of usage.

In spite of the abovementioned limitations, it can be seen that the water-closet system was more frequently associated with cleanliness than the bucket system (15 in contrast to 1). In the small factories studied, most of the water-borne system toilets were of the squatting variety. This observation was gratifying, as it is not sensible to provide the Western or sitting type of toilet in the small factory, especially in Singapore or other parts of the East. There is greater danger of cross-infection in the usage of such toilets. Most Eastern users, moreover, would squat on the toilet seats, and dirty them with their shoes. It is also more difficult to clean such toilets if soiled. The squatting type of toilet, on the other hand, could be scrubbed or washed more easily.

The comparatively high frequency of clean wash-basins encountered is probably merely a reflection of the fact that they were mostly reserved for the use of managerial or clerical staff.

It is somewhat surprising, however, that the majority of the lunch rooms or canteens were assessed as clean. This was probably because only the more welfare-conscious or affluent factories provided such facilities.

First Aid Facilities

It was observed that almost all the factories had first-aid boxes, as this is indeed a provision which the law requires. However, it can also be seen that in all the factories, except one, the boxes were unsatisfactory. Boxes were recorded as unsatisfactory either because they did not contain a quantity of all the following, or because they were kept in an untidy or dirty condition: Triangular bandages, Large, medium and small wound dressings, Safety pins, Absorbent cotton wool, Adhesive plaster.

This criterion is not stringent by generally accepted standards, yet only one of the boxes fulfilled it. It was also salutory to learn that the solitary satisfactory box was purchased just

TABLE II

CONDITION OF FACILITIES PROVIDED

Condition of Facilities	Very Dirty	Fairly Dirty	Clean	Total
Wash-basin	8	21	26	55
Toilet (Water-borne system)	7	28	15	50
Toilet (Bucket system)	15	11	1	27
Changing room	2	7	8	17
Lunch room/canteen	3	7	16	26

prior to and because of notice of our impending visit!

In the majority of boxes, not only were the materials they contained inadequate, but the state of cleanliness and maintenance was deplorable. Antiseptic bottles were found uncorked. Fungus was growing in some of them. Cotton wool was lying exposed. There was no pair of scissors or any other convenient means of cutting the dressings. Some boxes contained drinks, cigarettes, matches, etc.

The situation regarding first aiders was no better. Most factories had no trained first-aider on their work-force. By trained first-aider we mean someone who had undergone any formal course in first-aid, without necessarily having passed any examination therein.

Medical and Nursing Services

As could be expected, there was no doctor employed full-time by any of the factories. The employees of 45 factories (54·2%) had access to an individual general practitioner or a firm of general practitioners at these companies' expense. The general practitioners had clinics usually situated near the factories, but in some instances, these clinics were located some miles away. Employees seeking treatment travelled either by public transport or sometimes by transport of their companies to the clinics. The doctors never visited the factories on a routine basis, and very rarely did so even in medical emergencies. Most of the emergency cases, whether directly related to occupation or not, were sent directly to the government hospitals. Payments to the doctors were usually made on a per service basis. Very few doctors received a retainer fee. None of them was found to have been ever consulted on occupational health or safety problems by the management or workers of the factories.

There were no nurses, either on a part-time or full-time basis, in any of the factories.

Attitude Towards Health and Safety

It is not possible to give anything more than general impressions about the attitudes concerning health and safety on the part of the managements and the workers.

Most of the managements seemed to have very vague ideas about health and safety. A few managers assumed very defensive attitudes and claimed that their factories had no hazards. Only one manager had clear ideas about legislation in Singapore on health and safety. He was trained and spent several years in a developed country abroad. His superior knowledge, however, seemed only to make him more chary of us, and he declined to show us certain parts of his factory on the argument that he might be liable to litigation should any of us get hurt! The majority of the managers received our visits with courtesy and polite interest. Very few took advantage of the opportunity to ask for our advice, despite our repeated assurances that we were not coming to collect evidence to prosecute them.

Most of the workers took our visits placidly. Some others reacted with great curiosity. Most of them answered our questions very co-operatively. Very few of them, however, asked us questions about health and safety.

Spinning, Weaving, Printing and Finishing of Yarn and Fabric

(International Code No. 32111)

There were only three such registered factories with less than 100 workers in our country. All three were studied. One was engaged in making a cotton wiping cloth, used in cleaning operations in engineering industries. Another was concerned with the weaving of "batik" cloth and screen printing. A third printed cloth material. The processes in all three factories were quite straightforward, and did not involve major hazards.

Two out of these factories were regarded as having fairly satisfactory environmental conditions and housekeeping. One was noisy and dusty. (See Table III).

Manufacture of Tiles and Pipes

(International Code No. 36302)

Three out of four such factories were studied. The three factories visited only manufacture tiles. The white cement is mixed into a paste with the terrazo chips in water and then poured into moulds and dried. The slabs are then cut into the required size and brought to a grinder where the surface of the terrazo tiles is grounded. The polished tiles are then stacked in the storeroom.

The main problems in the factories were the rather excessive noise and dust. The workers handled the wet ingredients, which included lime powder, with their bare hands. No gloves or other protective equipment were used. The moving parts of many machines were not guard-

TABLE III

SPINNING, WEAVING, PRINTING AND FINISHING OF YARN AND FABRIC
ENVIRONMENTAL MEASUREMENTS

Measurements		Factory Number			Recommended standard for lighting	No. of factories below recom. std. (for lighting)	TLV	No. of factories above TLV
		1	2	3				
Lighting level in lux		300	85	110	150	2	NA	NA
Sound level in dB		86	72	89	NA	NA	90	0
Heat Stresses	Globe T° in °C	36	32·5	31·5	NA	NA	NA	NA
	W/B T° in °C	30	26	26	NA	NA	NA	NA
	WBGT in °C	31·8	28	27·7	NA	NA	30	1
Dust conc. (mppcf)		NM	NM	115	NA	NA	30	1

NM = not measured
NA = not applicable.

TABLE IV

MANUFACTURE OF TILES AND PIPES
ENVIRONMENTAL MEASUREMENTS

Measurements		Factory Number			Recommended standard for lighting	No. of factories below recom. std. (for lighting)	TLV	No. of factories above TLV
		1	2	3				
Lighting level in lux		100	150	160	150	1	NA	NA
Sound level in dB		90	NM	84	NA	NA	90	0
Heat Stresses	Globe T° in °C	31	31	31	NA	NA	NA	NA
	W/B T° in °C	26·2	26·5	27	NA	NA	NA	NA
	WBGT in °C	27·7	27·9	28·2	NA	NA	28·0	1
Dust conc. (mppcf)		NM	760	NM	NA	NA	30·0	1

NM = not measured
NA = not applicable.

ed. Ventilation and toilet facilities were poor. (See Table IV).

Stone Quarrying

(International Code No. 21010)

All six quarries falling into this category were surveyed. All of these were located in remote areas of Singapore, and were involved in the quarrying and crushing of granite, used in the booming construction industry.

The processes start with the drilling of holes in granite rocks. Deep holes are first drilled into the granite rocks and explosives are implanted in them. The rocks are then blasted, forming large boulders. There is a secondary blasting process whereby the huge boulders are converted into smaller boulders. The boulders are loaded onto lorries which transport them to the primary crusher where the boulders are crushed. The granite is then subjected to a secondary crushing process where they are crushed into smaller pieces. They are then sieved and transported to their destination.

By the intrinsic nature of these processes, there are numerous dangers of physical trauma due to the dynamiting process, transportation and handling of the granite and the usage of heavy machinery, as well as a very serious risk of silicosis due to the inhalation of granite dust, which contains a high content of free silica.

Most of the workers were not wearing proper respirators nor appropriate safety equipment such as safety shoes or helmets. Some were

wearing handkerchiefs round their faces. In one of these quarries, there was an exhaust ventilation system, but the points at which exhaust ventilation were applied were very few and the exhaust pressure did not seem strong enough to reduce the dust significantly. In another quarry, water-jet nozzles had been fixed to the primary crushers, but the water was not turned on, although the crushing process was proceeding. After we arrived, the manager tried to turn on the water at our request, but failed as the nozzles were all clogged up, presumably because of infrequent usage. The managers of all the quarries visited expressed reservations about the use of wetting processes to reduce suspended dirt. They claimed that the water would combine with the gravel in the crushers, and this in turn would lead to clogging of the sieves used to sort out the granite chips by piece size.

Falling hazards were very common. For example, some of the primary crushers were placed in high towers to take advantage of greater force of gravity to move the granite pieces. There were many defective steps and some missing floor boards in those towers.

Table V shows the results of Environmental Tests in these factories. It should be noted that the dust concentrations in all the five factories which were measured were far in excess of permissible levels. The dust content in the sixth factory was not done as it was not in production during the visit. There was also infrequent usage of personal protective equipment.

Manufacture of Asbestos Products

(International Code No. 36920)

The single small factory falling within this category was visited. Unfortunately, the factory does not deal with asbestos at all. It uses gypsum and vermiculite instead.

This factory manufactures ceiling material. The gypsum is wetted and sprinkled on to fibreglass. The mixture is then placed in moulds and allowed to set and dry, after which it is removed from the moulds. The finished product is then brought to the construction site and fixed on to the ceiling, after which it is sprayed with vermiculite to protect from fire.

The environment was clean and tidy. There were adequate and well-maintained toilet facilities. However, it must be pointed out that the place was undergoing some repairs, and was therefore perhaps cleaner than usual.

As can be seen from Table VI, the dust level was still in excess of the permissible level.

The workers were not using respirators or gloves.

TABLE V

STONE QUARRYING

ENVIRONMENTAL MEASUREMENTS

Measurements		Factory Number						Rec. std. for lighting	No. of fac. below rec. std. (lighting)	TLV	No. of factories above TLV
		1	2	3	4	5	6				
Lighting level in lux		2500	2500	1000	2500	1000	2500	150	0	NA	NA
Sound level in dB		101	94	96	98	98	NM	NA	NA	90	5
Heat Stresses	Globe T° in °C	85	29·5	28·5	36	28·5	35	NA	NA	NA	NA
	W/B T° in °C	25·5	25·5	25·5	26·5	25	25·5	NA	NA	NA	NA
	WBGT in °C	28·3	26·6	26·4	29·3	26·1	28·3	NA	NA	28	3
Dust conc. (mppcf)		380	330	510	400	335	NM	NA	NA	5·5	5

NM=not measured
NA=not applicable.

TABLE VI

MANUFACTURE OF ASBESTOS PRODUCTS
ENVIRONMENTAL MEASUREMENTS

Measurements		Factory Number 1	Recommended standard for lighting	No. of factories below recom. std. (for lighting)	TLV	No. of factories above TLV
Lighting level in lux		120	150	1	NA	NA
Sound level in dB		70	NA	NA	90	0
Heat Stresses	Globe T° in °C	32	NA	NA	NA	NA
	W/B T° in °C	27·2	NA	NA	NA	NA
	WBGT in °C	28·6	NA	NA	30·6	0
Dust conc. (mppcf)		760	NA	NA	0·12	1

NA = not applicable.

Electroplating, Enamelling and Polishing of Metal Products

(International Code No. 38160)

The eight small factories in this category were studied. They were engaged in various processes such as chrome-plating, electroplating and galvanising. The articles to be electroplated are dipped into the tanks of chemicals in succession, e.g. water, sodium hydroxide, degreasers (solvents), solutions of copper sulphate or cyanide or chromates or nickel, etc., and the finished product is then taken out of the tanks and dried.

Two of these factories were generally clean and tidy. Of these, one factory was not in production at the time of the visit as it was undergoing maintenance servicing. Six were regarded as dirty and untidy. In these six factories, housekeeping was poor. Bits of metal of various sizes were found to be strewn around the floor. There was no proper place for storage. The floor was greasy or wet in many places. There were no proper alley-ways.

In most of the factories, no protective clothing or eqiupment was being used.

Table VII summarizes the results of the environment tests done. It can be observed that, in general, the factories are poorly illuminated and dusty. There was a general lack of usage of personal protective equipment.

Manufacture of Basic Industrial Acids

(International Code No. 35113)

The three small factories engaged in this activity were visited. They were mostly engaged in the manufacture of sulphuric acids.

The process starts with the sulphur being converted to sulphur dioxide by heating. A catalytic reaction then transforms the sulphur dioxide to sulphur trioxide which is then absorbed by dilute sulphuric acid to form concentrated sulphuric acid.

All were found to be unsatisfactory. In one, the floor was slippery, including the area next to the boilers. In another there were bits of articles everywhere on the floor.

From Table VIII, it can be observed that the lighting was generally very poor. Two factories had noise levels around the border-line of safe limits.

We also noted that all the workers observed used gloves, but most did not use either respiratory or eye protection. During the visits, at least one worker was seen working above a boiler without any facial protection from the fumes.

Manufacture of Basic Industrial Chemicals

(International Code No. 35119)

Both the small factories falling into this category were studied. One was not in production. The other was functional and generally quite neat and tidy. It manufactures adhesive glue for the plywood industry. The raw materials used include phenol, caustic soda, urea, etc., and these are reacted together in enclosed and automatic processes which are controlled by switches operated in the control room.

The changing rooms of the workers, however, were rather dirty. Helmets and boots were also strewn untidily on the floor. The re-

TABLE VII

ELECTROPLATING, ENAMELLING AND POLISHING OF METAL PRODUCTS

ENVIRONMENTAL MEASUREMENTS

Measurements		Factory Number								Rec. std. for lighting	No. of fac. below rec. std. (lighting)	TLV	No. of factories above TLV
		1	2	3	4	5	6	7	8				
Lighting level in lux		150	120	40	80	20	80	40	220	150	6	NA	NA
Sound level in dB		80	80	80	80	80	80	84	89	NA	NA	90	0
Heat Stresses	Globe T° in °C	30	31	29	32	33	31	35	32	NA	NA	NA	NA
	W/B T° in °C	26·7	26·1	25·6	27·2	28·9	27·2	27·2	27·8	NA	NA	NA	NA
	WBGT in °C	27·7	27·6	26·7	28·7	30·9	28·3	29·6	29·1	NA	NA	30·6	1
Dust conc. (mppcf)		NM	NM	NM	109	NM	188	NM	NM	NA	NA	30	2

NM = not measured
NA = not applicable.

sults of the environmental tests are given in Table IX.

Sawmilling

(International Code No. 33111)

A one-in-three sample of the small factories in this category was taken.

The logs are transported to the sawmills where they are cut into smaller pieces. The pieces of logs are then shaved and cut by a cutting machine into the planks of required size and thickness. These planks are then cured, dried, and stacked in the sawmills ready for transport.

Intrinsically, sawmills are associated with many hazards to health. The large logs can cause severe trauma if they are not handled or stacked properly. Fire is an ever-present danger. The circular saws and other machinery needed for the sawing processes pose serious hazards to body and limb, if not properly guarded or used with adequate precautions. In five out of the nine factories visited, guarding of machinery was considered to be inadequate. Only three factories were found to have satisfactory standards of housekeeping. In some factories, the circular saws were completely unguarded. Pieces of wood shavings and planks littered the premises. Dust abounded.

TABLE VIII

MANUFACTURE OF BASIC INDUSTRIAL ACIDS
ENVIRONMENTAL MEASUREMENTS

Measurements		Factory Number			Recommended standard for lighting	No. of factories below recom. std. (for lighting)	TLV	No. of factories above TLV
		1	2	3				
Lighting level in lux		40	60	125	150	3	NA	NA
Sound level in dB		93	80	90	NA	NA	90	1
Heat Stresses	Globe T° in °C	31·5	33	32	NA	NA	NA	NA
	W/B T° in °C	27·8	27·8	26·7	NA	NA	NA	NA
	WBGT in °C	29·2	29·4	28·3	NA	NA	28	3
Dust conc. (mppcf)		107	NM	186	NA	NA	30	3

NM = not measured
NA = not applicable.

TABLE IX

MANUFACTURE OF BASIC INDUSTRIAL CHEMICALS
ENVIRONMENTAL MEASUREMENTS

Measurements		Factory Number		Recommended standard for lighting	No. of factories below recom. std. (for lighting)	TLV	No. of factories above TLV
		1	2				
Lighting level in lux		220	100	150	1	NA	NA
Sound level in dB		83	NM	NA	NA	90	0
Heat Stresses	Globe T° in °C	32·5	33	NA	NA	NA	NA
	W/B T° in °C	26·7	28·3	NA	NA	NA	NA
	WBGT in °C	27·9	29·7	NA	NA	26·7*/31·4	1
Dust conc. (mppcf)		101	NM	NA	NA	30	1

NM = not measured
NA = not applicable
*Factory 1 does moderate work
Factory 2 does light work.

TABLE X

SAWMILLING

ENVIRONMENTAL MEASUREMENTS

Measurements		Factory Number													Rec. std. for lighting	No. of fac. below rec. std. (lighting)	TLV	No. of factories above TLV
		1	2	3	4	5	6	7	8	9	10	11	12	13				
Lighting level in lux		50	110	250	1750	1000	350	200	190	380	100	160	2500	600	150	3	NA	NA
Sound level in dB		86	92	92	95	104	93	96	98	95	97	104	91	104	NA	NA	90	12
Heat Stresses	Globe T° in °C	31·8	33	30	34·5	31·5	32·5	31	29·3	31	31·8	31·8	32	32·4	NA	NA	NA	NA
	W/B T° in °C	26	26·5	25·5	26	25·5	26·5	25·5	26	26	25·5	25	26	24·8	NA	NA	NA	NA
	WBGT in °C	27·8	28·5	26·8	28·5	26·8	28·3	27·1	27·1	27·5	28·2	27·1	27·8	27·1	NA	NA	28	4
Dust conc. (mppcf)		310	NM	NM	NM	400	NM	NM	NM	NM	NM	NM	NM	NM	NA	NA	30	2

NM = not measured
NA = not applicable.

TABLE XI

GENERAL ENGINEERING WORKS

ENVIRONMENTAL MEASUREMENTS

Measurements		Factory Number															Rec. std. for lighting	No. of fac. below rec. std. (lighting)	TLV	No. of factories above TLV
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15				
Lighting level in lux		80	260	60	300	220	30	120	20	80	60	40	100	140	100	180	150	11	NA	NA
Sound level in dB		80	80	80	70	80	80	70	80	80	80	80	80	80	80	80	NA	NA	90	0
Heat Stresses	Globe T° in °C	35	32·5	28	34·5	27	31·5	35	30·5	28·5	34·5	31	28	33	31	35·5	NA	NA	NA	NA
	W/B T° in °C	26·7	27·2	26·1	27·8	25·6	27·2	28·3	27·2	25·6	28·3	26·7	25·6	26·7	27·2	28·3	NA	NA	NA	NA
	WBGT in °C	29·2	28·6	26·7	29·8	26·6	28·5	30·3	28·2	26·6	30·2	28·0	26·4	28·6	28·4	30·5	NA	NA	30·6	0
Dust conc. (mppcf)		NM	112	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NA	NA	30	1

NM = not measured
NA = not applicable
No protective equipment used.

Table X shows the results of the environmental tests done. It can be seen that the environmental conditions in many such factories are unsatisfactory.

General Engineering Works

(International Code No. 38292)

A one-in-four sample of the establishments in this category was examined. A total of 15 factories were visited. Seven of these were situated in squatter areas. The activities included steel structure fabrication, manufacture of rubber mangles and rollers, repairs of different sorts of engines, manufacture of vehicle body parts, manufacture of metal products, and piling equipment.

The working environment in all of them was unsatisfactory. Housekeeping was poor. Many machines were unguarded. Many of the workers seemed to be exposed unduly without necessary precautions or personal protective devices, to large amounts of coolant oils. Protective equipment was generally not available or not used. Toilet facilities were inadequate or poorly maintained. Lighting was poor. First aid facilities and fire fighting equipment were inadequate. (See Table XI).

Commercial Job Printing

(International Code No. 34204)

Nine such factories were visited. These factories are actually printing presses. The papers are cut by a cutting machine into the required sizes and are then printed, using the various dyes.

The factories were, in general, grossly overcrowded and ventilation was poor. Most of them outgrew the space originally assigned to them when prosperity overtook them. (See Table XII).

Manufacture of Cement

(International Code No. 36400)

All the four cement manufacturing works in this category were inspected. By the very nature of the processes, which basically consist of grinding and mixing clinker with other substances, the industry is a very dusty one. Some of the grinding machines and escalator belts were also rather noisy. In only one factory were the workers wearing respirators; but in the others, some workers were using handkerchiefs over their faces. Dust counts confirmed the dustiness of the atmosphere. (See Table XIII).

TABLE XII

COMMERCIAL JOB PRINTING

ENVIRONMENTAL MEASUREMENTS

	Measurements	Factory Number									Rec. std. for lighting	No. of fac. below rec. std. (lighting)	TLV	No. of factories above TLV
		1	2	3	4	5	6	7	8	9				
	Lighting level in lux	100	30	200	240	200	200	200	100	180	450	9	NA	NA
	Sound level in dB	82	75	80	82	81	81	75	83	84	NA	NA	90	0
Heat Stresses	Globe T° in °C	28·5	31	28	29·2	31	31·5	28	28	28·5	NA	NA	NA	NA
	W/B T° in °C	26	26	19	24·5	25·8	25·5	23	26	25·5	NA	NA	NA	NA
	WBGT in °C	26·8	27·3	21·7	26·1	27·3	26·4	24·8	26·6	25·4	NA	NA	30	0

NA = not applicable.

TABLE XIII
MANUFACTURE OF CEMENT
ENVIRONMENTAL MEASUREMENTS

Measurements		Factory Number				Rec. std. for lighting	No. of fac. below rec. std. (lighting)	TLV	No. of factories above TLV
		1	2	3	4				
Lighting level in lux		200	150	50	150	150	1	NA	NA
Sound level in dB		88	92	76	93	NA	NA	90	2
Heat Stresses	Globe T° in °C	32	31·5	32·5	34	NA	NA	NA	NA
	W/B T° in °C	27	27	27·5	29	NA	NA	NA	NA
	WBGT in °C	28·5	28·4	28·9	30·4	NA	NA	29·4	1
Dust conc. (mppcf)		800	733	320	800	NA	NA	30	4

NA = not applicable.

TABLE XIV
IRON FOUNDRY
ENVIRONMENTAL MEASUREMENTS

Measurements		Factory Number										Rec. std. for lighting	No. of fac. below rec. std. (lighting)	TLV	No. of factories above TLV
		1	2	3	4	5	6	7	8	9	10				
Lighting level in lux		90	80	120	20	40	160	120	220	60	130	150	8	NA	NA
Sound level in dB		92	94	80	NM	NM	80	NM	80	80	80	NA	NA	90	2
Heat Stresses	Globe T° in °C	29·5	31	38	34·5	34	37	29	33	33	30	NA	NA	NA	NA
	W/B T° in °C	25·5	25·5	30·6	28·3	28·3	29·4	26·1	27·8	26·1	26·1	NA	NA	NA	NA
	WBGT in °C	26·7	27·2	32·8	30·1	30	31·7	26·4	29·4	28	27·3	NA	NA	28	5
Dust conc. (mppcf)		600	733	480	280	840	720	360	NM	480	NM	NA	NA	30	8

NM = not measured NA = not applicable.

TABLE XV
MANUFACTURE OF BRICKS
ENVIRONMENTAL MEASUREMENTS

Measurements		Factory Number				Recommended standard for lighting	No. of factories below recom. std. (for lighting)	TLV	No. of factories above TLV
		1	2	3	4				
Lighting level in lux		195	140	1000	700	150	1	NA	NA
Sound level in dB		83	98	75	75	NA	NA	90	1
Heat Stresses	Globe T° in °C	31·5	29·5	30	31·5	NA	NA	NA	NA
	W/B T° in °C	26·7	25·8	24	25·5	NA	NA	NA	NA
	WBGT in °C	28	26·8	25·8	27·2	NA	NA	30·6	0
Dust conc. (mppcf)		72·2	154	NM	NM	NA	NA	33	2

NM = not measured
NA = not applicable.

Iron Foundries

(International Code No. 37102)

Ten out of a total of 16 such foundries were studied. Many of these were situated in shophouses or squatter areas. Housekeeping was generally very poor, with one exception. Many places were cluttered with raw materials, finished products or tools. Despite handling hot castings, in only one of the ten foundries were protective gloves used. No other protective clothing was in evidence in all the foundries.

Heat stress is a big problem in these foundries. As can be seen from Table XIV, in five of these foundries the heat stress was above tolerable limits. The dust concentrations in eight foundries were also in excess of limit values. In two foundries the noise levels exceeded 90 dB.

Manufacture of Bricks

(International Code No. 36301)

A one-in-three sample was taken, consisting of four factories. Three factories used the wet process, and as a consequence less dust was produced. One factory used the dry process.

Clay is first dug from the surrounding hills and is then grounded up, after which it is sieved. The dry clay is then wetted and pressed, after which it is extruded into columns. The columns of wet clay are then cut into the size of bricks and dried, after which they undergo firing in ovens. The bricks are then cooled and stored.

As all the four factories were situated amidst large compounds, and many of the processes took place in the open, no great problems occurred regarding overcrowding or underventilation. In one factory, a battery-operated saw used to cut wood to fire the furnace was found to be noisy and unguarded. (See Table XV).

DISCUSSION

Following our criteria abovementioned, we found that 12 or 14·4% of all the factories visited were satisfactory. Notwithstanding the subjective nature of some of the observations, this is still a disappointing result.

The small factories start off with several inherent disadvantages. Very often they have extremely limited financial resources, and are therefore unable to spend much money on provisions for health and safety. There is usually less job security and poorer remuneration in the small factories than in the large ones, and as a result the calibre of worker is generally lower in terms of education, as workers compete to secure jobs in the large factories and often the small factories get only those rejected for similar posts in the large factories. The large factories including those owned by multi-national enterprises, are generally very sensitive about their public image and often spend money on health and safety to improve such an image. The small factories are less exposed to public scrutiny. Moreover, in small factories workers have sometimes to undertake a miscellany of tasks and operate a motley collection of machines. As a result they may be less familiar with the working and the danger of each particular machine. In large factories, on the contrary, there is usually less interchangeability of workers connected with different processes.

Even in affluent countries, such as U.S.A., there are similar problems in small factories. "With relatively few exceptions, workers in these so-called small plants do not have the benefit of in-plant health services. Far too many of them receive only emergency care for accidents, and this service is often inadequate. The many problems, economic and otherwise, that small businessmen face daily leave them little time for considering the advantages of protective services other than those required by law. They may recognize the value of occupational health services but find that individual programs are expensive and that other employers are hesistant to engage in co-operative projects. However, there are enough small-plant health programs in operation to show that nursing and other health services can be provided successfully and at a price small businessmen can afford." (Nursing Part-time in Industry, 1965).

This opinion is supported by many occupational health authorities. In an International Labour Organisation publication are these words,

"Much has been said about the problems of safety and health peculiar to small undertakings which represent between one half and four-fifths of all industrial undertakings and employ between one-fifth and one-half of the economically active population, depending on the country. These undertakings face great difficulties in financing and organizing accident prevention and cannot afford to call in safety specialists." (ILO, 1969).

A similar study of small factories carried out in Korea showed that, of 3,600 workers in 60 factories studied, the number of those who were exposed to harmful elements exceeding the maximum allowable concentration was as follows:—

870 persons (24·2%) to noise, 427 persons (11·9%) to dust, 268 persons (7·4%) to lead, 563 persons (15·6%) to organic solvents, and 297 persons (8·3%) to harmful chemical substances such as chlorine, carbon dioxide, sulfur dioxide, etc. (Cho *et al*, 1969).

It is not very useful to compare those findings with the findings in our survey, as the types of processes carried out in Singapore differ from those in Korea, hence also the hazards. However, the Korean study does point out the very great health problems posed by small factories in that country.

The availability of access to a doctor, who was appointed by the factory, was present in only 45 (54·1%) of the factories surveyed. This is about the same proportion as found in a similar survey in the developing world, in which 152 out of 338 small plants surveyed (45%) had access to a physician in his clinic. (El Samra, G.H., 1972).

It must be pointed out, however, that in Singapore, government outpatient clinics are located all over the Republic. Charges for consultation and medicines are low.

The low percentages (19·2%) of the factories surveyed which had proper sanitary facilities reflects the general non-observance of many of the provisions about health, safety and welfare laid down by the law (The Factories Act, Part IV, 1973). Even in those factories which were considered to have such facilities, the majority (See Table II) did not keep them in clean condition.

First aid boxes are required to be available in all factories, yet even then three factories did not have them (The Factories Act, Part VI, 1973). Moreover, only one out of the 80 factories which had such boxes was deemed to have contents up to the required standard.

We do not have the data about the occupational diseases or injuries which have actually occurred in the factories or industries surveyed. However, surveys of morbidity have been carried out in granite quarries in Singapore. A recent radiological survey of 1230 workers in 23 granite quarries in Singapore showed that 15% had a definite and another 17% had suspected pneumoconiosis. This is not surprising in view of the very unsatisfactory conditions found during the present survey. A similar study in 1965 of granite quarry workers gave a prevalence of eight percent only, suggesting an increase of prevalence after five years. (Supramaniam *et al*, 1962).

Occupational dermatitis in engineering works has been reported in Singapore. Subsequent to the present survey, a study of this problem was conducted in an engineering establishment. Five out of a total of 59 workers studied had dermatitis due to the coolant oils they were exposed to. (Phoon & Bong 1974).

In the manufacture of rubber footwear, we have mentioned that rubber is milled with chemical powder into sheets. Silicosis had been detected in workers making this "rubber powder". (Poh *et al*, 1972). However, no study has yet

been made into the question of silicosis of workers handling this "rubber powder" while making footwear. It is likely that there is such a risk.

After having presented the findings and discussed the problems, great difficulties are also encountered in discussing possible solutions.

As we have pointed out, proper legislation about minimum health and safety standards do exist in countries such as Singapore. The problem is effective enforcement of such legislation. There is little doubt that more effective enforcement of such legislation, especially in small factories, will not be possible without an increase of manpower in the Factory Inspectorate of the Ministry of Labour or similar bodies.

Mere enforcement of laws, however, is not by any means the sole solution to these problems. Many new small factories are being set up with financial support and technical advice by governments or international agencies. Advice relating to health and safety should be provided, as well as that about economic or processing matters.

"In several developing countries, small factories are being erected either by the energies of an Economic Development Board or as a result of assistance by the United Nations. It is important that the senior members of such Boards appreciate the role of occupational health and that those giving "assistance" should regard safety and health as an integral part of technical instruction." (Bell, A., 1968).

It will not be realistic to expect that the small factories could afford, by themselves, to pay for the occupational health services which are necessary to control the hazards in the working environment, nor indeed, that they will take the initiative to set up such services. In 1969, one of the authors of this paper urged, "after a central Industrial Health Unit has been properly set up by the government to provide general supervision and co-ordination, firms and factories should also invest in the well-being of their workers. Perhaps a form of contributory health insurance is best. It must be emphasized that the money should not be solely used to pay doctors for the treatment of coughs and colds and other ordinary diseases. Some funds should be channelled into the establishment and support of several Industrial Health Service Units which can each look after many small factories or a few large ones—such Industrial Health Units can be set up either by the government itself or private enterprise with the encouragement of the government. (Phoon, W.O., 1969). We still believe that such Units should be set up.

Health education of both proprietors, supervisors and workers in small factories is also most important. Unfortunately, in most safety campaigns, the messages reach mostly those who are already "converted" to safety, that is, those in the large factories. This also applies to seminars conducted by National Safety First Councils and similar voluntary bodies. The people managing or working in small factories seem to be either not contacted, not interested or unable to attend. Perhaps one way of overcoming these difficulties is the more frequent usage of mobile exhibitions or health teams to go round the small factories.

We will conclude with the words of Dr. M.A. El Batawi, the present chief of Occupational Health, World Health Organization,

"There are unique problems in small scale industries in the field of occupational health and safety that actually require solution and probably also require special approach, because these problems stand from the economic situation of small scale industries, the technical disadvantage of employers and workers working in small scale industries. Small scale factories are not a problem only in developing countries but also a problem in developed nations." (El Batawi, M.A., 1969).

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