



Occupational Hygiene Assessment Report

**M&V International Manufacturing Ltd.
Phum Trarpaing Cheksa
Khum Kongpong Chhnang
Srok Kompong Chhang
Kompong Chnang Province
Kingdom of Cambodia**

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Introduction

Sumerra was retained to conduct an occupational hygiene assessment at the M&V International Manufacturing Ltd. factory located in Kompong Chhnang Province, Cambodia. Sumerra staff conducted the assessment on September 6 & 7, 2011. Sumerra was assisted in the assessment by representatives of Better Factories Cambodia [International Labor Organization (ILO)] and Puls Trading Far East Limited (H&M).

The purpose of this investigation was to evaluate the environmental health conditions of the factory and identify the possible causes behind mass worker health symptoms (“fainting”) (see Case History below). The findings contained in this report are based on information gathered prior and during the assessment, the results of sample analysis and on-site observations from the assessment dates listed.

Case History

In recent years, outbreaks of mass fainting have been repeatedly reported in Cambodian garment and shoe factories. In the months preceding Sumerra’s evaluation, several occurrences were widely reported in both local and national media. There has been much speculation on the root causes of this phenomenon and reports have noted several environmental and social issues as potential factors such as: exposure to industrial chemicals, heat stress, overwork / excessive overtime, inadequate nutrition, noise exposure, and lack of ventilation.

The factory is a relative large garment factory consisting of several separate buildings (labeled alphabetically). The factory employs approximately 5,000 employees. In the case of the subject factory, according to a review of information gathered from various sources:

- Mass fainting occurred on two different occasions: August 23rd, 2011 and August 25th, 2011
- Following the initial fainting episode, the factory closed on August 24th 2011 and reopened on August 25th, 2011.
- In total, approximately 250 workers were reported as “fainting”.
- Symptoms began in the mornings (approximately 8AM to 9AM)

Methodology

The evaluation team conducted the following during the assessment:

- Visually assessed the factory areas for sources of health hazards that may offer explanation of worker health related symptoms such as fainting.
- Collected screening measurements in all areas of the factory for:
 - Temperature & Relative Humidity (RH)
 - Carbon Dioxide (CO₂)
 - Carbon Monoxide (CO)
 - Wet Bulb Globe Temperature (WBGT)
 - Total Particulates Mass (Dust) less than 10 μm in aerodynamic diameter (PM₁₀)
 - Levels of volatile organic compounds (VOC) using a photoionization detector (PID) calibrated to isobutylene
 - Noise
- Collected air samples for trichloroethylene (TCE) in the laundry and surround areas. TCE is a solvent used in some washes.
- Interviewed management and reviewed pertinent documents related to the events and general ESH
- Interviewed union representatives.

- Interviewed:
 - 52 workers from the group exhibiting symptoms described as fainting.
 - 14 workers from a control group (no symptoms reported)
- Interviewed the treating physician at the hospital where workers were treated.

Additional materials and methods descriptions can be found in Appendix A.

Results & Discussion

Interviews

Management

The following notable information was obtained in interview with factory management staff:

- The factory does not have a formal Environmental Safety and Health (ESH) committee constituted by management, line workers, and union representatives for the purpose of regularly reviewing ESH issues, conducting inspections, and investigating incidents.
- The factory does not have a formalized written grievance system. The factory provides a suggestion box; however, they report there have never been any suggestions. There is no feedback mechanism for response to potential complaints.
- The factory indicates that no direct complaints or grievances related to environmental conditions had been reported to the factory immediately prior to the mass fainting episodes on August 23rd and 25th.
- Management believes the cause of the fainting is that workers didn't get sufficient food (e.g. breakfast) before coming to work or workers were not feeling well (e.g. already ill) prior to coming to work.

Employees

Interviews were conducted with employees to quantify the various symptoms and conditions in the factory at the time of the fainting episodes. Employees were divided into two groups, the subject group who reported "fainting / feeling faint" and a control group who did not report this symptom.

Table 1 presents the reported symptoms and conditions rank-ordered in terms of incidence rate for the entire sample.

Symptoms such as chest tightness and shortness of breath were much more common in the fainting workers than the control workers. These symptoms are common in hyperventilation syndrome (breathing in excess of that required for normal intake of oxygen and carbon dioxide produced by increased frequency or depth of respiration) that is often caused by anxiety. This conclusion is supported by the commonly reported condition of becoming ill when seeing another worker become ill (reported as "Anxiety due to Seeing others Faint").

Odors (from various sources) were commonly reported by both groups. High temperature ("hot") conditions were reported by both groups as well as symptoms commonly related to heat strain such as intense sweating, rash, and muscle cramps.

Table 1. Summary of employee interviews

<i>Reported Symptoms</i>					
<u>Subject Group (Fainted)</u>			<u>Control Group (no fainting)</u>		
n = 52	Total # Workers	%	n = 14	Total # Workers	%
Headache	52	100.0%	Headache	13	92.9%
Chest Tightness	52	100.0%	Dizziness	12	85.7%
Shortness of Breath	50	96.2%	Severe Fatigue	11	78.6%
Dizziness	45	86.5%	Intense Sweating	9	64.3%
Severe Fatigue	28	53.8%	Eye / Skin Irritation	9	64.3%
Intense Sweating	28	53.8%	Shortness of Breath	7	50.0%
Rash	16	30.8%	Muscle Cramps	6	42.9%
Muscle Cramps	15	28.8%	Drowsiness	6	42.9%
Eye / Skin Irritation	12	23.1%	Chest Tightness	5	35.7%
Drowsiness	11	21.2%	Nausea	1	7.1%
Nausea	3	5.8%			

<i>Reported Conditions</i>					
<u>Subject Group (Fainted)</u>			<u>Control Group (no fainting)</u>		
n = 52	Total # Workers	%	n = 14	Total # Workers	%
Anxiety due to Seeing others Faint	37	71.2%	Odor from Fabrics	10	71.4%
Smoke Odor / Boiler	31	59.6%	Long Hours / Lack of Sleep	9	64.3%
Odor from Fabrics	31	59.6%	Odor from Bathroom	8	57.1%
Hot	26	50.0%	Smoke Odor / Boiler	5	35.7%
Stuffy / "No Air"	18	34.6%	Hot	4	28.6%
Odor from Bathroom	12	23.1%	Stuffy / "No Air"	4	28.6%
Odor from Cooling System	7	13.5%	Odor from Surrounding Neighborhood	4	28.6%
Poor General Health	6	11.5%	Hunger/Thirst	1	7.1%
Odor from Ironing Steam	3	5.8%			
Dusty	2	3.8%			
Odor from Laundry	1	1.9%			
Odor from Surrounding Neighborhood	1	1.9%			

Union

The union's report was consistent with the reports of symptoms and conditions made by individual employees. Additionally, the union reported that at the time of the fainting episode the cooling system was blocked by garbage and garment cartons as well as a lack of a sufficient place for the workers to rest during lunch/dinner/breaks.

Hospital Medical Staff

The following notable information was obtained in interview with the treating physician at the hospital:

- The most common symptoms reported to the physician were dizziness, feeling faint, and shortness of breath.
- Some workers self-reported that they felt they had not eaten enough food for the amount of work.
- With few exceptions, tests run on the workers did not indicate any specific abnormal conditions (e.g. elevated body temperature, elevated heart rate, and deficient blood oxygen levels). A few workers were found to be hypoglycemic (having low-blood sugar).
- The overall diagnosis (with the physician noting that he is not privy to environmental conditions in the factory) was generally lack of sufficient calories for the level of work and/or overwork resulting in excessive fatigue.

Environmental Conditions

General Indoor Environmental Quality (IEQ)

A table of IEQ monitoring results is provided in Appendix B.

Observations

The following notable observations were observed during the evaluation:

- Wood smoke odor was observed in the outdoor boiler area and in Building L (adjacent to the boiler area). Building L draws outdoor air for ventilation from the boiler area side.
- Some employees and union representatives reported that fabric and plastics have been burned in the boiler in the past resulting in strong disagreeable odors in the work areas (such as Building L). This was not observed during the evaluation.
- The metal fins of the water curtain cooling systems (air is drawn across metal fins that are cooled by pumping cool water over the surfaces) were dirty in some areas and had significant scaling (see Figure 1). Dirt and debris on wet cooling fin and coil surfaces can (and often does) result in microbial growth. Microbial growth often results in emission of microbial volatile organic compounds (MVOC) that are often odorous (musty, fishy odors)
- Some cooling units were not in operation in certain areas (e.g. packing) to keep relative humidity at a lower level.
- At least one truck was observed idling near the work buildings during delivery. The idling truck resulted in a strong odor of vehicle exhaust and resulted in a rise in carbon monoxide readings (see Carbon Monoxide section below). Measurement of carbon monoxide around another truck driving on-site indicated an increase in CO levels in the immediate area.



Figure 1. Water Curtain Cooling System

General Ventilation

Ventilation is the term used to describe the amount of outdoor air provided in order to replace indoor air that has accumulated various contaminants (e.g. dust, chemicals) or bioeffluents (e.g. carbon dioxide produced from human respiration). Carbon dioxide levels were measured as an indicator of dilution ventilation. Carbon dioxide itself has no acute (short-term) health effects associated with low level exposure (below 5,000 ppm). Carbon dioxide levels significantly greater (e.g. 700 ppm) than the outdoor carbon dioxide levels (generally between 250 – 400 ppm) are indicative of poor dilution ventilation.

Results of the monitoring indicate that the rate of outdoor air ventilation in the factory was relatively high. Outdoor concentration on the day of the evaluation was an average of 345 ppm. Indoor carbon dioxide levels ranged from approximately 360 to 735 ppm with an average of 430 ppm (with only the auto knitting areas exceeding 550 ppm). Many workers and others have reported lack of “ventilation” in the workplace; however, one should not confuse ventilation with air flow / air speed. Air flow / air speed affects the perception of thermal comfort (see Thermal Comfort and Heat Stress sections below). Even when ventilation rates are high, it is possible to have low air flow / air speed that is not perceivable to human senses.

Carbon Monoxide

Carbon monoxide levels ranged from 0 to 2.5 ppm in indoor work areas with an average concentration of 1.4 ppm. Carbon monoxide levels were well within recommended occupational exposure limits (e.g. ACGIH TLV[®] is 25 ppm 8-hour TWA^a). However, the following conditions potentially resulting in abnormal exposure to carbon monoxide were observed:

- A truck was observed idling in a driveway area while receiving / delivering goods. Exhaust from idling vehicles can quickly result in elevated exposure to carbon monoxide (as well as general exhaust odors). Carbon monoxide levels around trucks in the area resulted in a rise in carbon monoxide levels (from 0 ppm to 5 ppm in areas around the vehicle).

Volatile Organic Compounds (General)

For monitoring of VOC's, a photoionization detector (PID) was used. For general screening of VOCs, the PID is calibrated to a single VOC (isobutylene) and results are used as a general estimate and for comparison of different areas. In cases where individual VOC's are known, a correction factor can be applied to calculate concentrations of that VOC.

Results of the screening of VOC's in the factory were generally unremarkable. With the exception of the laundry area and the auto-knitting areas, no responses above the baseline (0 ppm) were indicated.

In the laundry area, the PID indicated a response and a concentration of 0.100 ppm in one area of the washing room. Further investigation indicated that trichloroethylene (TCE) was used in certain wash cycles and may have been the cause of this response. Using a correction factor for TCE this would result in a concentration of TCE of 0.054 ppm, which is well below the ACGIH TLV[®] of 10 ppm 8-hour TWA and 25 ppm short term exposure limit (STEL). Regardless, due to the nature of the chemical (suspected human carcinogen) further investigation was conducted (see Chemical Exposures section below).

In the auto-knitting area the PID also indicated a response and a concentration of 0.100 ppm. The source of this low concentration of VOCs was unknown but would not be considered significant.

Particulates

Sources of particulates with specified occupational exposure limits (e.g. metals, silica, asbestos) were not identified. In general, particulate exposure would be related to airborne fabric fibers.

Concentrations of dust (measured as total mass of particles less than 10 μ m in aerodynamic diameter, PM₁₀) ranged from 0.03 to 0.6 mg/m³ in indoor work areas with an average concentration of 0.29 mg/m³. It is generally recommended to keep concentrations of inhalable particles at a concentration less than 10 mg/m³.

It should be noted that some persons may still find fabric fibers (even at low concentrations) irritating to the skin and upper airways (e.g. nose and mouth).

Thermal Comfort

Measurement of temperatures and relative humidity indicated several areas of high temperatures and high relative humidity. The majority of indoor temperatures exceeded 30°C with some areas exceeding 35°C (see Appendix B for details). In some areas relative humidity exceeded 80%.

^a American Conference of Government Industrial Hygienist (ACGIH). TLV[®]s[®] and BEIs[®] Based on the Documentation of the Threshold Limit Values and Physical Agents & Biological Exposure Indices. 2011

Additionally, in the larger building areas, air flow / air speed was not perceived by investigators. The lack of air flow is often perceived as a lack of “ventilation” and “stuffiness”, though as noted above in the Ventilation section; this is often incorrectly identified as such. However, lack of perceived air flow can result in thermal discomfort.

High temperatures, high relative humidity, and lack of air flow can contribute to heat stress and discomfort and is further evaluated below using another measure. This discomfort can lead to additional work related stress and potentially result in heat related illness (addressed below).

Heat Stress

In order to screen for heat stress exposure, the evaluator measured Wet Bulb Globe Temperature (WBGT). WBGT is a composite measure used to estimate the effect of temperature, humidity, air speed and solar radiation (outdoors). The ACGIH has published screening criteria to assist in judging heat stress exposure (see Table 2 below).

Measured WBGT can be compared to these limits to determine potential risk of heat related illness. The allocation of work is the amount of time expected to be spend in the high heat conditions. “Light” & “Moderate” refer to the level of work performed (e.g. Light = Sitting with light manual work with hands or hands and arms, and driving. Standing with some light arm work and occasional walking; Moderate = Sustained moderate hand and arm work, moderate arm and leg work, moderate arm and truck work, or light pushing or pulling. Normal walking.) The action limit represents conditions for which a heat stress management program should be considered and the threshold limit value (TLV) is the limit under which it is believed by ACGIH that nearly all heat acclimated, hydrated, un-medicated, healthy workers may be repeatedly exposed without adverse health effects.

Table 2. Screening Criteria for ACGIH TLV® and Action Limit for Heat Stress Exposure^b

Allocation of Work	TLV® (WBGT in °C)		Action Limit (WBGT in °C)	
	Light	Moderate	Light	Moderate
75 to 100%	31.0	28.0	28.0	25.0
50 to 75%	31.0	29.0	28.5	26.0

Results of monitoring indicate that the majority of work areas (the exception being the air conditioned work spaces for administration and auto-knitting) of the factory exceed the ACGIH action limits for light and moderate work (see Table 2 above and Appendix B). In other words, there is a risk of heat related illness and a heat stress management program should be considered. Additionally, some of the work areas would exceed the TLV® for moderate work (e.g. Building J, sewing, south end) and therefore are at risk of adverse health effects related to heat stress.

Other factors must be taken into account such as work hours, clothing, and nutritional & hydration status. In this case, it was common to observe workers wearing double layers of clothing, including cotton sweatshirts (see Figure 2). Double layers of clothing such as this may add up to 3^o to the measured WBGT for the worker.

ACGIH TLVs® are determined based on a normal 8 hour per day, 5 day work week. Reportedly, at M&V work hours sometimes exceeded 12 hours per day, 6 days per week putting further stress on workers bodies that could make them more susceptible to heat illness.



Figure 2. Worker in Sweatshirt

In summary, based on these results and observations, heat related illnesses would be a potential risk to workers in this factory.

^b American Conference of Government Industrial Hygienist (ACGIH). TLV®s and BEIs® Based on the Documentation of the Threshold Limit Values and Physical Agents & Biological Exposure Indices. 2011

Chemical Exposures

As noted above, employees reported disagreeable odors as conditions in the factory and reportedly were concerned with chemical exposures. An investigation was conducted into the claims regarding chemical exposures from the laundry area and from certain fabrics as noted below.

Laundry

Review of the material safety data sheets (MSDS) of chemicals stored and used in the laundry indicate mostly low volatility washing detergents and softeners that are unlikely to present a significant hazard to those outside the laundry area (no laundry workers were reported to have fainted and wear respiratory protection while working). However, as noted above in the VOC section, the PID indicated a response and a concentration of 0.100 ppm in one area of the washing room. It was discovered that the laundry uses a degreaser in some washes that contains TCE. Therefore, Sumerra measured the VOC response to opening the degreaser container and the result is found in Table 3 below. The calculated concentration of TCE was well below the ACGIH STEL of 25 ppm.

Table 3. VOC Measurement Results in Chemical Storage Room

Bldg.	Department	Task	Chemical Source	Component	CAS#	PID Reading (ppm)	Correction Factor	Calculated Concentration (ppm)	ACGIH STEL
J	Laundry - Chemical Storage Room	Opening of Container	Detergent Solvent / Degreaser	Trichloroethylene	79-01-6	7	0.54	3.78	25 ppm

Longer term air sampling for TCE was conducted in the chemical storage room, laundry work area, and surrounding factory work areas. Results did not indicate any levels of TCE in these areas above the sample reporting limits (i.e. all TCE levels were <0.45 ppm).

It should be noted that there was some difficulty in determining the composition of many of the chemicals used in the factory. Material Safety Data Sheets (MSDS) were provided, however, sheets lacked specific chemical information (such as CAS #'s) and rather than listing specific chemical names often listed general chemical categories (e.g. mixture of halogenated hydrocarbons). Investigators were originally provided an incorrect CAS # for the degreaser compound, but further inquiry led to the discovery of the use of TCE.

Fabrics

In order to investigate the claim of certain garment styles presenting a risk of chemical exposure, readings were collected from the headspace of bags containing fabric articles as noted in Table 4 below.

Table 4. Headspace VOC Measurements

Article	Condition	Suspect Chemical Source	Component	CAS#	PID Reading (ppm)	Correction Factor	Calculated Concentration (ppm)
Blue Sweater	Washed with Degreaser (not dried)	Detergent Solvent / Degreaser	Trichloroethylene	79-01-6	1.1	0.54	0.594
Blue Sweater	Washed with Degreaser and Dried	Detergent Solvent / Degreaser	Trichloroethylene	79-01-6	0	0.54	0
Various Knitted Articles noted as odorous	Recently Knitted	Machine Oil	Various Hydrocarbons	Unknown	0.29	NA	NA

Although the garment that was washed with degreaser did exhibit a PID response (presumably TCE), after washing and drying the garment no longer exhibited a response (therefore only presenting a potential exposure risk to laundry workers).

An “oil” odor was observed in various knit styles examined by the investigation team and the headspace of the garments did show a low PID response (0.29 ppm). A similar odor was observed in the knitting areas of the factory. During the knitting process, small amounts of lubricating oil contact the yarn and may be retained resulting in the odor in the fabric. A review of the literature does not indicate health symptoms associated with inhalation exposure from “machine oils” except in cases where droplets are created and inhaled. The odor, though disagreeable to some, is not expected to present a health risk to workers.

Noise

Noise screening measurements did not indicate noise level in excess of 85 dBA in the general areas of the workplace (see Appendix B). High noise levels (>90 dBA) were measured in the laundry area; however this was already identified as an area requiring hearing protection.

Conclusions

General

Overall, there does not appear to be a single unified cause of the fainting events experienced at this factory (and potentially other factories in Cambodia). Though it is evident that odors are experienced from time to time and may be disagreeable, odor is not a good indicator of hazard. There is no evidence of “toxic exposures” from measurements or based on medical diagnosis. Additionally, evidence does not support the incidence of a mass exposure event such as a mass overexposure to carbon monoxide or a pesticide that could result in large numbers of employees suffering unconsciousness or other symptoms simultaneously.

Undoubtedly, there are issues related to the physical work environment at the factory that have affected the comfort of the employees. It is possible (and probable) that several workers initially suffered from illnesses such as low-blood sugar (due to lack or caloric intake), heat strain, or exhaustion causing them to lose consciousness; however it is likely that the majority of the illnesses were related to a mass psychogenic phenomenon.

Mass psychogenic illness (MPI, also known as epidemic hysteria, mass hysteria, and mass sociogenic illness) describes a syndrome of subjective symptomatology which develops suddenly and spreads contagiously in a well-defined population (workplace) in the absence of an identifiable chemical, physical, or infectious agent^c. A review of mass psychogenic illness in organizations identified several common characteristics.^d The table below summarizes these characteristics compared to M&V.

Table 5. Characteristics of mass psychogenic illness

Characteristics	M&V
Sex: Primarily Female	Confirmed
Environment: Work or School where membership of these organizational structures is neither completely voluntary nor transient. Financial need (work) or legal sanctions (school) require the individual’s active participation on a relatively continuous basis	Confirmed
Boredom: Typically involve industrial operations involved repetitive, perceptual-motor tasks performed at fixed work stations and fixed production paces.	Confirmed
Production Pressure: Workers under considerable pressure to increase production	Reported
Physical Stressors: Workers exposed to various stressors that are potentially bothersome, but not necessarily injurious. Examples include noise, air contamination from dust and lint, poor lighting, variations in temperature fumes or odors from various sources (e.g. solvents, vehicle exhaust, pesticides)	Confirmed
Labor-Management Relations: Problems such as discontent over supervisory techniques or strained / ambivalent relationships between the affected workers and their first line supervisors	Potential
Lack of Communication: Lack of ability to communicate with other employees due to noise or nature of work, or reluctance or inability on the part of the affected workers to discuss work-related dissatisfaction with others or with management	Confirmed

^c Colligan, M.J., L. R. Murphy. Mass Psychogenic Illness in a Shoe Factory. Int Arch Occup Environ Health 44, 133-138 (1979)

^d Colligan, M.J., L. R. Murphy. Mass psychogenic illness in organizations: An overview, Journal of Occupational Psychology, 1979,52, 77-90.

This case of industrial mass psychogenic illness was likely precipitated by a combination of physical (high heat, fatigue, lack of caloric intake to meet demands of the job) and psychological job stress (high pressure to work overtime and Sunday's) and other life stresses (limited financial resources). Often there is a physical stimulus trigger (an unusual odor) which is perceived by workers as the source of their discomfort. Mass media reports in Cambodia have made knowledge of other mass events at other factories relatively common adding to the anxiety and potentially causing further proliferation of the contagion reaction.

It is also possible that the triggering event was a physical ailment such as an employee who became dizzy or faint due to low blood sugar or heat strain as noted above. Other workers witnessed this event which may have provided these workers with an explanation of their work discomfort or resulted in high anxiety and triggered a contagion reaction. Studies have theorized that the first workers affected - the so-called "triggers" - may have symptoms caused by physical or psychological factors or both. The trigger, who may have a physical ailment such as low-blood sugar or heat illness, then results in psychological distress in other workers.^e

The contagion reaction likely occurred as in Figure 3 below (adapted from Olkinuora, 1984).

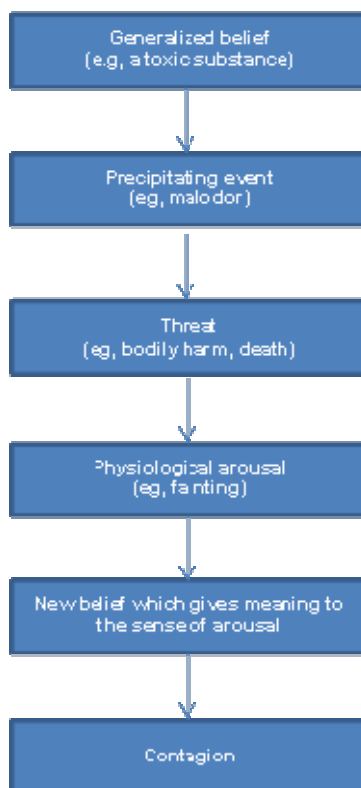


Figure 3. The contagion reaction

It is important to note that the use of the term psychogenic does not imply that the illness is not real or "in their head". The fact that an illness has a psychogenic component does not imply that the experienced symptoms are imaginary. The term "psychogenic" should not be confused with "neurotic" or "psychopathologic." In cases of psychogenic illness the individual is **not** to blame, as the lack of an identifiable chemical, physical, or infectious agent does **not** imply that there is not an identifiable source of stress or discomfort that underlies the illness and the contagion reaction.

^e M. Olkinuora. Psychogenic epidemics and work. Scand J Work Environ Health 10 (1984) 501-504.

Root Causes

Previous studies in MPI have postulated several social and physical stressors as the cause of the syndrome including work overload, high temperatures, authoritarian management style, boredom, unwanted overtime, etc.⁹ In this case, management places a high priority on production targets in deference to any other considerations. This pressure reportedly extends to line supervisors who reportedly pressure workers to work unwanted or excessive overtime and on normal rest days in order to meet production goals using the threat of non-extension of work contracts as a motivating device.

Workers and management have reported some limited cases of excessive overtime (more than the legally permitted 2 hours per day, Cambodian Labor Law AC AWARD 10/0) or working without 24 hour break / day off (Cambodian Labor Law LABOUR LAW ARTS 146-148); though these cases are generally limited to a small percentage of workers and generally only occur during peak production season.

Additionally, because of the implied threat of job loss reported by some workers, overtime for them is essentially non-voluntary, which is not in conformance with the law (Cambodian Labor Law PRAKAS 80/99).

The factory does not have an effective and functional employee communication system (e.g. effective grievance system that results in feedback, a functioning EHS committee). This leads to a dissatisfied, fatigued, and highly stressed workforce. Additionally, some workers may have low caloric intake (some may choose to eat less to save money). Upon experiencing a physical trigger as described above or a physical ailment (e.g. low blood sugar or heat strain) one or more employees may become dizzy or faint and this may then result in a contagion reaction and the MPI.

Recommendations

Physical Issues

It is important to address the potential physical hazards to workers as these can contribute to the overall stress of the workers, provide a triggering event for the contagion, or result in an illness in an individual that could also trigger the contagion reaction. However, it is very unlikely that a strictly physical approach to remediation will result in a total abolishment of similar mass fainting event. Psychosocial issues (see below) are likely to be more important in this case (and potentially many others in Cambodia or other countries).

Sumerra recommends the following actions to address potential physical hazards of the workplace:

- Boiler Odor
 - Increase the height of the boiler exhaust stack to reduce the risk of site locations falling within the plume field.
 - Isolate the outdoor boiler area by blocking flow of air from boiler area to occupied areas of the factory.
 - Fabrics, plastics or other non-wood products should **never** be incinerated in the boiler. These wastes should be properly disposed of by approved waste handlers.
- Dirt (and potential odor) from Cooling System
 - Develop a preventive maintenance program for the cooling system. This should include:
 - Regularly scheduled cleaning of the cooling system to remove dirt and debris. This will have the added benefit of increasing cooling and airflow efficiency.
 - Regular maintenance checks of operability of system components. Repairs should be made expeditiously.

^f Colligan, M.J et al, An Investigation of Apparent Mass Psychogenic Illness in an Electronics Plant. Journal of Behavioral Medicine, Vol. 2, No. 3, 1979

⁹ NIOSH. Health Hazard Evaluation Report. HETA 82-273-1239.1982

- Vehicle Exhaust
 - Develop and enforce an air quality policy for vehicle traffic and delivery / receiving. This should include strict rules regarding:
 - No idling of trucks near air intakes for building
- Thermal Comfort
 - Add additional cooling mechanisms for when outdoor air temperatures exceed 28°C. This may consist of:
 - Additional fans in the workplace to create more air flow (and therefore lower WBGT) and better perception of conditions. Increasing the air speed over the worker will improve heat exchange between the skin surface and the air.
 - Installation of air curtains in the upper areas of the building to drive perceivable air flow down to lower areas.
- Heat Stress
 - The easiest way to prevent heat stress is to provide a cooler environment (see Thermal Comfort above).
 - Develop a heat stress management program. This will include:
 - Training for workers and supervisors about the hazards leading to heat illness and ways to prevent them.
 - Training for workers to recognize symptoms in themselves and others.
 - Training and encouragement for workers to immediately report symptoms in themselves and others.
 - Workers should be taught about the effects of layered clothing and the proper attire for hot work environments.
 - A system to remind workers to frequently drink small amounts of water before they become thirsty to maintain good hydration. Simply telling them to drink plenty of fluids is not sufficient. During moderate activity, in moderately hot conditions, workers should drink about 1 cup every 15 to 20 minutes.
 - Monitor the temperature (or preferably the WBGT) of the workplace and activate special precautions when temperatures exceed general action limits.
- Rest & Recovery
 - Factory should comply with Cambodian Labor Law regarding overtime hours and rest periods
 - OT should not exceed 2 hours per day, except in exceptional cases upon which the factory obtains permission from the Ministry of Labor and the worker representatives.
 - Workers should be given a full day (24 hours) rest once every week.
 - OT should be voluntary (see Psychosocial Issues below)
 - Factory should provide appropriate covered rest area located away from potential pollution sources where workers can eat their meal and rest during break times.
- Chemical Management
 - Accurate material safety data should be obtained for all chemicals being used on site. All chemical mixtures should provide specific information (specific name, CAS#, % of composition) regarding the components of the mixture.

All of the actions taken by the factory to address the recommendations above, should be effectively documented, tracked and communicated to the factory workers. Feedback and input from the workers on the success or failure of implementation should be sought out and used to make further improvements to the work environment.

Psychosocial Issues

In a large workforce such as in this factory (~5000 workers), there certainly will be illnesses (some work related and some not) from time to time. In some cases, the frequency of these occurrences can be drastically reduced by implementing specific programs (e.g. heat stress management) or other health promotion activities. However, in all cases, in order to prevent contagion reactions the underlying psychosocial issues must be adequately addressed.

Employee communication is very important in achieving these goals. Effective worker communication channels reduce opportunities for misinformation, misunderstanding, unrest and mismanagement while promoting learning, teamwork, safety and innovation. Strong worker and management communication develops commitment from the workforce and ownership of the state of working conditions. As workers understand and protect their rights they contribute positively to the overall workplace setting while increasing the quality of products and productivity. Most importantly, it builds trust with workers aligning them with the business goals resulting in increased efficiencies and better profitability for the company.

Sumerra recommends the following actions:

- Establish an **effective** grievance process that enables employees to address their concerns regarding working conditions and terms and conditions of employment. In general, an effective grievance process includes:
 - A written grievance policy and implementing procedures. The policy should include:
 - Multiple channels for employees to raise concerns and provide input to management.
 - The ability to raise concerns confidentially (or anonymously), if the employee so desires without fear of retaliation.
 - Effective communication of the grievance policy to employees so that employees are aware of the grievance process and their right to raise concerns.
 - A means to document and track grievances to ensure there is a timely response back to the employee. Grievances should be brought to the attention of top management and responses clearly communicated.
 - For issues that may affect the wider work force, feedback should be provided to the employee, the unions, and all workers, noting actions (or lack of) and time tables for completion.
 - It must be made **very clear** that grievances, complaints and suggestions for improvement are **strongly encouraged** and will not, under any circumstances, result in retaliation.
- Establish an environmental health and safety committee. Committees should:
 - Be comprised of approximately an equal number of management and worker representatives.
 - Must have an elected chairperson.
 - Have members that serve a continuous term of at least one year.
 - Conduct meetings each month except months when quarterly inspections are conducted (see below).
 - Maintain meeting minutes from the meeting and the meeting minutes must be communicated or available to all employees.
 - Establish a system to allow the members to obtain suggestions from non-committee members.
 - Receive management response to all committee recommendations within 30 days.
 - Establish procedures for investigating incidents including injury accidents, illnesses, deaths, chemical spills and fires.
 - Conduct quarterly workplace safety inspections.
- Top management must **communicate** and **effectively demonstrate** that the safety and health of its employees is a top priority, on par with or preferably exceeding priority given to meeting production targets.
 - Management should ensure that workers feel informed about issues in the factory, and believe that, either as individuals or through their union representatives, they have input into management decisions which affect them.
 - Although management may implement a policy of voluntary OT, it should be **very clear** that supervisors or other management directly or indirectly inferring retaliation (loss of work or other disincentives) for not working OT **will NOT** be tolerated under any circumstances.
 - Provide health promotion activities such as learning programs regarding smoking cessation, proper nutrition, and general women's health.

Limitations

This investigation is limited to the conditions and practices observed and information made available to Sumerra. The methods, conclusions, and recommendations provided are based on Sumerra's judgment, experience and the standard of practice for professional service. They are subject to the limitations and variability inherent in the methodology employed. As with all environmental investigations, this investigation is limited to the defined scope and does not purport to set forth all hazards, nor indicate that other hazards do not exist.

Please do not hesitate to contact our office at +852 2824 8802 if you have any additional questions or concerns. Thank you for the opportunity to assist the factory and it's buyers in promoting a more healthful environment.

Respectfully,



Michael S. Andrew, MS, CIH, CSP



Appendix A: Materials and Methods

Employee Interviews

Employee interviews were conducted by representatives of Better Factories Cambodia and Puls Trading Far East Limited (H&M) in the local language. Interviewers used a questionnaire developed by Sumerra.

Temperature & Relative Humidity

Temperature and relative humidity measurements were made using a TSI Model 8762 Q-Trak IAQ Calc Monitor.

Carbon Monoxide

Carbon monoxide measurements were made using a TSI Model 8762 Q-Trak IAQ Calc Monitor.

Carbon Dioxide

Carbon dioxide measurements were made using a TSI Model 8762 Q-Trak IAQ Calc Monitor.

Volatile Organic Compounds

VOC measurements were made using the RAE Systems ppbRAE 3000. The ppbRAE 300 is a photo ionization detector (PID) with a 10.6 eV gas discharge lamp that is used to measure a broad range of volatile organic compounds (VOCs) (calibrated relative to isobutylene).

Particulates

Particle measurements were made using a TSI Model 8520 Aerosol Monitor. This monitor uses a 90° light scattering measurement to continuously determine airborne particle concentrations. Instrument is factory calibrated to A1 test dust (i.e., Arizona test dust). Results are expressed gravimetrically as milligrams per cubic meter (mg/m³).

Wet Bulb Globe Temperature (WBGT)

Measurement of WBGT was made using a QUESTemp° 34 area heat stress monitor. This monitor measures globe temperature, dry bulb temperature, wet bulb temperature, relative humidity, and Heat Index / Humidex.

Noise

Monitoring was conducted using a Faber Acoustics calibrated iPhone application and built in microphone. Measurements were made in “A” weighting scale and “slow” response.

Appendix B: Results Tables

1. IEQ Monitoring Data

Building	Department	Location	Time (Mil.)	Ventilation	Comfort		Pollutants		
				CO ₂ (ppm)	Temp. (°C)	%RH	CO (ppm)	VOC (ppb)	Particulate PM ₁₀ (mg/m ³)
A	Knitting	Walkway Near Door	13:29	405	34.9	51.6	2.3	0	0.03
A	Knitting	Knitting Area between machines	13:34	438	33.9	55.3	1.3	0	0.075
A	Knitting	Knitting Area between machines at wall	13:36	504	34	55.1	1.3	0	0.1
A	Dispatch	Middle of Area	13:39	408	33.3	56.9	1.2	0	0.09
A	Knitting	Walkway Opposite Main door (East)	13:44	448	33.1	58.8	1.2	0	0.09
A	Knitting	Knitting Area between machines at wall	13:45	400	32	59	1.2	0	--
B	Knitting	Walkway Near Door	13:51	441	33.3	58.5	1.2	0	0.11
B	Knitting	Knitting Area between machines at wall	13:55	430	33.5	57	1.2	--	--
B	Dispatch	Middle of Area	13:58	426	33.6	57.3	1.2	--	0.13
B	Knitting	Walkway East End	14:01	458	34	37.3	1.2	0	0.107
B	Knitting	Area Between Machines at North Wall	14:03	434	34.5	57	1.2	--	--
B	Knitting	Area Between Machines at South Wall	14:05	480	34.1	56.6	1.2	--	--
C	Accessory Separator	West End between work tables	14:13	432	35.4	52.6	1.2	0	0.191
C	Accessory Storage	East End between Racks	14:19	392	34.7	54	1.1	0	0.35
D	Auto Knitting	Middle of Building	14:22	735	29.3	29.2	0	100	0.6
D	Auto Knitting	East End Walkway	14:30	703	28.1	32.8	0	100	0.56
G	Linking	East End, North Wall	14:38	407	34	55.9	1.3	0	0.364
G	Linking	East End, between Work Tables	14:41	503	35.7	60	1.2	0	0.15
G	Stitching	East End, South Wall	14:45	381	33.1	59.3	1.2	0	0.15
G	Linking/Stitching	Walkway	14:47	400	30.8	75	1.9	0	0.34
G	Linking	West End, North Wall	14:50	422	29.7	77.7	1.5	0	0.35
G	Linking	West End Near Door	14:55	363	28.5	80.8	1.8	0	0.35
L	Linking	Walkway at West Door	15:20	362	30.5	69.4	1.3	0	0.36
L	Linking	West end, South Wall	15:23	367	27.9	82.7	1.9	0	0.34
L	Linking	West end, North side by Tables	15:25	411	28.5	82.7	1.9	0	0.375
L	Linking	East end at North Wall	15:29	377	29.7	74	1.5	0	0.375
L	Linking	East End, South Wall	15:32	500	30.3	75.4	1.8	0	0.351
J	Laundry	Receiving & Sorting	15:37	375	31.6	65.6	1.2	0	0.345
J	Laundry	Wash Area	15:40	365	32.4	63.8	1.2	0	0.341
J	Laundry	Wash Area, West End	15:50	--	--	--	--	100	--
J	Laundry	Chemical Storage Room	15:52	--	--	--	--	0	--
J	Sewing	Southwest Sewing Area	15:57	396	30.8	69.7	1.5	0	0.336
J	Sewing	Middle, West Side	16:00	375	30.5	71.1	1.3	0	0.392
J	Quality Check	Middle Room	16:02	400	29.8	74	1.3	0	0.392
J	Quality Check	Northeast Side	16:05	390	29.1	79.6	2.5	0	0.345
J	Ironing	Northeast Side	16:11	383	29.9	80.1	2.4	0	0.382
J	Ironing	Northwest Side	16:14	399	30	79.2	2.5	0	0.472
J	Packing	West Side	16:17	394	29.7	76.6	1.9	0	0.356
NA	Outdoor Air (Control)	In front of Building A	13:23	258	35.1	48.3	0	0	0.2
NA	Outdoor Air (Control)	Between Buildings B & C	14:10	366	36.8	50.5	0	0	0.115
NA	Outdoor Air (Control)	Between Buildings G & J	15:00	355	32.3	63.4	0	0	0.355
NA	Outdoor Air	Between Building L & Boiler Area	15:02	350	32.8	58.8	1.3	0	0.36
NA	Outdoor Air	Boiler Area	15:06	390	32.6	61.3	1.2	0	0.55
NA	Outdoor Air (Control)	Front Gate	16:23	352	30.5	705	1.3	0	0.315

2. Heat Stress Monitoring Data

Building	Department	Location / Task	Time (Mil.)	WGBT (°C)
L	Linking	East End, Center	9:00	27.1
J	Sewing	North End	9:50	27.6
J	Ironing	North End	10:07	27.8
G	Linking	Between Stitching Machines	10:18	27.9
G	Linking	Thread Trimming	10:25	28
B	Knitting	Line B1, West End, South Wall	10:32	28.5
B	Knitting	Line B6, East End, North Wall	10:37	28.5
A	Knitting	West End, North Side	13:40	27
B	Knitting	Line B7, East End, North Wall	13:44	27.8
B	Knitting	Line B1, West End, South Wall	13:48	28
C	Accessory	West End, South Side	13:54	27.9
G	Linking	East End, North Side	14:10	27.1
G	Linking	West End, South Side	14:15	26.8
L	Linking	Middle, North	14:20	26.7
L	Linking	East End, South Side	14:26	27
J	Sewing	South End	14:44	29.1
E	Administration (Control)	Administration Offices	10:45	25.2
D	Auto Knitting	Middle of Building	14:05	23.3

3. Noise Monitoring Data

Building	Department	Location / Task	Time (Mil.)	Area Noise Levels (dB)	
				Max	Peak
L	Linking	At Worker, Stitching Machine	9:00	81.3	95.9
J	Laundry	Near Extractor	9:45	93.4	103.9
J	Sewing	At Sewing Table	10:02	83.5	106
D	Auto Knitting	West Side Between Machines	14:00	84.9	99.5
D	Auto Knitting	East Side Between Machines	14:02	84.5	99

4. TCE Air Sampling Results

Sample ID	Process	Task	Type	Result (ppm)
BP4730	Laundry	Chemical Room	Area Sample	<0.089
BP4745	Laundry	West End w/PID response	Area Sample	<0.089
BP4687	Sewing	Building J, South End	Area Sample	<0.092
BP4680	Sewing	Building J, North End	Area Sample	<0.093
BP4684	Sweater, Recently washed (no drying) with TCE mix	PID Response	Head Space Sample	<0.39
BP4647	Sweater, recently washed and dried	No PID Response	Head Space Sample	<0.45

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Occupational Hygiene Assessment Report

**Ghim Li (Cambodia) Pte Ltd
National Road No. 4
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Kandal Province
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September 30, 2011

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Introduction

Sumerra was retained to conduct an occupational hygiene assessment at the Ghim Li (Cambodia) Pte Ltd. factory located in Kandal Province, Cambodia. Sumerra staff conducted the assessment on September 8 & 9, 2011. Sumerra was assisted in the assessment by representatives of Better Factories Cambodia [International Labor Organization (ILO)] and Puls Trading Far East Limited (H&M).

The purpose of this investigation was to evaluate the environmental health conditions of the factory and identify the possible causes behind mass worker health symptoms (“fainting”) (see Case History below). The findings contained in this report are based on information gathered prior and during the assessment, the results of sample analysis and on-site observations from the assessment dates listed.

Case History

In recent years, outbreaks of mass fainting have been repeatedly reported in Cambodian garment and shoe factories. In the months preceding Sumerra’s evaluation, several occurrences were widely reported in both local and national media. There has been much speculation on the root causes of this phenomenon and reports have noted several environmental and social issues as potential factors such as: exposure to industrial chemicals, heat stress, overwork / excessive overtime, inadequate nutrition, noise exposure, and lack of ventilation.

The factory is a garment factory consisting of a main building containing the majority of production and a second building housing the embroidery departments. The factory employs approximately 2,000 employees. In the case of the subject factory, according to a review of information gathered from various sources:

- Mass symptoms occurred on three different occasions: August 26th, August 29th and August 30th, 2011
- Following the episodes, the factory closed on August 31th, 2011 to September 4th, 2011 and reopened on September 5th, 2011.
- In total, approximately 118 workers were reported as having symptoms (e.g. “fainting”, “feeling faint / unwell” per the following:
 - August 26th: 51 workers [1 fainting (losing consciousness), 50 feeling faint / unwell]
 - August 29th: 49 workers (feeling faint / unwell)
 - August 30th: 18 workers (feeling faint / unwell)

Methodology

The evaluation team conducted the following during the assessment:

- Visually assessed the factory areas for sources of health hazards that may offer explanation of worker health related symptoms such as fainting.
- Collected screening measurements in all areas of the factory for:
 - Temperature & Relative Humidity (RH)
 - Carbon Dioxide (CO₂)
 - Carbon Monoxide (CO)
 - Wet Bulb Globe Temperature (WBGT)
 - Total Particulates Mass (Dust) less than 10 μm in aerodynamic diameter (PM₁₀)
 - Levels of volatile organic compounds (VOC) using a photoionization detector (PID) calibrated to isobutylene
 - Noise
- Collected air samples for acetone in the spot cleaning and surrounding areas. Acetone is a solvent used for removing dirt and stains.

- Interviewed management and reviewed pertinent documents related to the events and general ESH.
- Interviewed union representatives.
- Interviewed:
 - 12 workers from the group exhibiting symptoms described as fainting.
 - 6 workers from a control group (no symptoms reported)
- Interviewed the treating physician at the hospital where workers were treated.

Additional materials and methods descriptions can be found in Appendix A.

Results & Discussion

Interviews

Management

The following notable information was obtained in an interview with factory management staff:

- The factory does have a formal Environmental Safety and Health (ESH) committee constituted by management, line workers, and union representatives for the purpose of regularly reviewing ESH issues. The ESH committee keeps meeting minutes, though no record is made of follow-up to recommendations and minutes are not posted for the general worker population to review. The ESH committee does not conduct inspections or investigate incidents.
- The factory does have a formalized written grievance system. However the factory reports that they do not have record of any submitted grievances.
- Management believes the cause of the fainting is that workers didn't get sufficient food (e.g. breakfast) before coming to work or workers were fatigued prior to coming to work.
- A report provided by the government indicted potential causes as:
 - "Lack of air circulation"
 - "Fabric cartons stacked too high (limiting air flow)"
 - "Use of pesticides behind the cooling system"

Employees

Interviews were conducted with employees to quantify the various symptoms and conditions in the factory at the time of the fainting episodes. Employees were divided into two groups, the subject group who reported "fainting / feeling faint" and a control group who did not report this symptom.

Table 1 presents the reported symptoms and conditions rank-ordered in terms of incidence rate for the entire sample.

Symptoms such as chest tightness and shortness of breath were much more common in the fainting workers than the control workers. These symptoms are common in hyperventilation syndrome (breathing in excess of that required for normal intake of oxygen and carbon dioxide produced by increased frequency or depth of respiration) that is often caused by anxiety. This conclusion is supported by the commonly reported condition of becoming ill when seeing another worker become ill (reported as "Anxiety due to Seeing others Faint").

Table 1. Summary of employee interviews

Reported Symptoms					
Subject Group (Fainted)			Control Group (no fainting)		
n = 12	Total # Workers	%	n = 6	Total # Workers	%
Shortness of Breath	11	91.7%	Headache	3	50.0%
Chest Tightness	11	91.7%	Severe Fatigue	1	16.7%
Headache	9	75.0%	Dizziness	1	16.7%
Dizziness	8	66.7%	Shortness of Breath	1	16.7%
Severe Fatigue	4	33.3%	Muscle Cramps	1	16.7%
Intense Sweating	3	25.0%	Intense Sweating	1	16.7%
Drowsiness	2	16.7%	Chest Tightness	1	16.7%
Muscle Cramps	1	8.3%			
Nausea	1	8.3%			
Eye / Skin Irritation	1	8.3%			

Reported Conditions					
Subject Group (Fainted)			Control Group (no fainting)		
n = 12	Total # Workers	%	n = 6	Total # Workers	%
Anxiety due to Seeing others Faint	12	100.0%	Belief in paranormal activity ("a ghost")	3	50.0%
Belief in paranormal activity ("a ghost")	4	33.3%	Dusty	2	33.3%
Poor General Health	3	25.0%	Hot	2	33.3%
Hot	2	16.7%	Stuffy / "No Air"	1	16.7%
Stuffy / "No Air"	1	8.3%	Anxiety due to Seeing others Faint	1	16.7%
			Long Hours / Lack of Sleep	1	16.7%

Union

The union's report was consistent with the reports of symptoms and conditions made by individual employees. Union representatives also reported that fabric and plastics have been burned in the boiler in the past resulting in strong disagreeable odors in the work areas, however, this practice was halted prior to the fainting events.

Hospital Medical Staff

The following notable information was obtained in interview with the treating physician at the hospital:

- The most common symptoms reported by the physician were fatigue, sweating, shortness of breath, and pale color. Some workers also reportedly showed signs of dehydration.
- Only two workers were unconscious upon arrival at the hospital. Both workers were diagnosed with very low blood glucose levels (hypoglycemic).
- In addition to the workers noted above, other workers were found to be hypoglycemic (having low-blood sugar).
- Other tests run on the workers did not indicate any specific abnormal conditions (e.g. elevated body temperature).
- The overall diagnosis was that some workers suffered from hypoglycemia and the others were cases of high anxiety from seeing others faint ("frightened").

Environmental Conditions

General Indoor Environmental Quality (IEQ)

A table of IEQ monitoring results is provided in Appendix B.

Observations

The following notable observations were observed during the evaluation:

- Wood smoke odor was observed in the outdoor boiler area and indoors at the north exit near the spot cleaning area (adjacent to the boiler area).
- Some employees and union representatives reported that fabric and plastics have been burned in the boiler in the past resulting in strong disagreeable odors in the work areas. This was not observed during the evaluation.
- At the time of the evaluation, the water curtain cooling systems (air is drawn across metal fins that are cooled by pumping cool water over the surfaces) were being removed and cleaned. Observation of the metal fins indicated severe corrosion (fins were over 6 years old) which likely results in poor performance (see Figure 1).
- Some cooling units were not in operation in certain areas due to the above mentioned cleaning process. Workers were not notified that this work was being performed and they may have experienced temporary discomfort.



Figure 1. Corroded metal fins of cooling system

General Ventilation

Ventilation is the term used to describe the amount of outdoor air provided in order to replace indoor air that has accumulated various contaminants (e.g. dust, chemicals) or bioeffluents (e.g. carbon dioxide produced from human respiration). Carbon dioxide levels were measured as an indicator of dilution ventilation. Carbon dioxide itself has no acute (short-term) health effects associated with low level exposure (below 5,000 ppm). Carbon dioxide levels significantly greater (e.g. 700 ppm) than the outdoor carbon dioxide levels (generally between 250 – 400 ppm) are indicative of poor dilution ventilation.

Results of the monitoring indicate that the rate of outdoor air ventilation in the factory was relatively high. Indoor carbon monoxide levels ranged from approximately 365 to 490 ppm with an average of 407 ppm. One should not confuse ventilation with air flow / air speed. Air flow / air speed affects the perception of thermal comfort (see Thermal Comfort and Heat Stress sections below). Even when ventilation rates are high, it is possible to have low air flow / air speed that is not perceivable to human senses.

Carbon Monoxide

Carbon monoxide levels ranged from 1.7 to 5.4 ppm in indoor work areas with an average concentration of 2.1 ppm. Carbon monoxide levels were well within recommended occupational exposure limits (e.g. ACGIH TLV[®] is 25 ppm 8-hour TWA^a).

^a American Conference of Government Industrial Hygienist (ACGIH). TLVs[®] and BEIs[®] Based on the Documentation of the Threshold Limit Values and Physical Agents & Biological Exposure Indices. 2011

However, the following conditions potentially resulting in abnormal exposure to carbon monoxide were observed:

- Outdoor areas outside of the boiler room indicated levels of up to 9 ppm of carbon monoxide, likely due to boiler exhaust (wood smoke odor was also observed). Additionally, the spot cleaning area (next to the boiler area) indicated a concentration of CO greater than the typical concentration found indoors in the main areas (5.4 ppm versus average of 2.1 ppm). Conditions could exist that would result in temporary elevation of CO concentration in this area.

Volatile Organic Compounds (General)

For monitoring of VOC's, a photoionization detector (PID) was used. For general screening of VOCs, the PID is calibrated to a single VOC (isobutylene) and results are used as a general estimate and for comparison of different areas. In cases where individual VOC's are known, a correction factor can be applied to calculate concentrations of that VOC.

Results of the screening of VOC's in the factory were generally unremarkable. With the exception of the spot cleaning area, responses were consistently from 0.050 to 0.200 ppm.

In the spot cleaning area, the PID indicated a response and a concentration of 0.800 ppm. Acetone is used in the area may have been the cause of this response; however, there was also a contribution of hydrocarbons from the boiler exhaust (see Chemical Exposures section below).

Particulates

Sources of particulates with specified occupational exposure limits (e.g. metals, silica, asbestos) were not identified. In general, particulate exposure would be related to airborne fabric fibers.

Concentrations of dust (measured as total mass of particles less than 10 μ m in aerodynamic diameter, PM₁₀) ranged from 0.06 to 0.39 mg/m³ in indoor work areas with an average concentration of 0.24 mg/m³. It is generally recommended to keep concentrations of inhalable particles at a concentration less than 10 mg/m³.

It should be noted that some persons may still find fabric fibers (even at low concentrations) irritating to the skin and upper airways (e.g. nose and mouth).

Thermal Comfort

Measurement of temperatures and relative humidity indicated several areas of high temperatures and high relative humidity. In several areas the indoor temperatures exceeded 30°C (see Appendix B for details). With the exception of the embroidery rooms (which were well air conditioned), the average temperature in the factory was approximately 30°C. Relative humidity consistently exceeded 65%.

Lack of air flow is often perceived as a lack of "ventilation" and "stuffiness", though as noted above in the Ventilation section; this is often incorrectly identified as such. Lack of perceived air flow can result in thermal discomfort.

Subsequent to the fainting episodes but prior to this evaluation, the factory had installed air curtains to drive air flow down to the occupied areas per recommendation from others (see Figure 2). Additional air flow was perceived, however, this flow was generally localized to the areas in close proximity to the air curtain. Areas more than a couple of meters from the curtain did not received any perceived air flow increase.



Figure 2. Air curtain installed to increase air flow

High temperatures, high relative humidity, and lack of air flow can contribute to heat stress and discomfort and is further evaluated below using another measure. This discomfort can lead to additional work related stress and potentially result in heat related illness (addressed below).

Heat Stress

In order to screen for heat stress exposure, the evaluator measured Wet Bulb Globe Temperature (WBGT). WBGT is a composite measure used to estimate the effect of temperature, humidity, air speed and solar radiation (outdoors). The ACGIH has published screening criteria to assist in judging heat stress exposure (see Table 2 below).

Measured WBGT can be compared to these limits to determine potential risk of heat related illness. The allocation of work is the amount of time expected to be spend in the high heat conditions. "Light" & "Moderate" refer to the amount of work (e.g. Light = Sitting with light manual work with hands or hands and arms, and driving. Standing with some light arm work and occasional walking; Moderate = Sustained moderate hand and arm work, moderate arm and leg work, moderate arm and truck work, or light pushing or pulling. Normal walking.) The action limit represents conditions for which a heat stress management program should be considered and the threshold limit value (TLV) is the limit under which it is believed by ACGIH that nearly all heat acclimated, hydrated, un-medicated, healthy workers may be repeatedly exposed without adverse health effects.

Table 2. Screening Criteria for ACGIH TLV[®] and Action Limit for Heat Stress Exposure^b

Allocation of Work	TLV [®] (WBGT in °C)		Action Limit (WBGT in °C)	
	Light	Moderate	Light	Moderate
75 to 100%	31.0	28.0	28.0	25.0
50 to 75%	31.0	29.0	28.5	26.0

Readings were collected on two days. On the second day, no water curtains were in operation. Results of monitoring on the first day indicate that the majority of work areas (the exception being the air conditioned work spaces for embroidery) of the factory exceed the ACGIH action limits for light and moderate work (see Table 2 above and Appendix B). In other words, there is a risk of heat related illness and a heat stress management program should be considered.

On the second day (with no cooling operation) the majority of the work areas would exceed the TLV[®] for moderate work and therefore are at risk of adverse health effects related to heat stress.

Other factors must be taken into account such as work hours, clothing, and nutritional & hydration status. In this case, it was common to observe workers wearing double layers of clothing, including heavy cotton sweatshirts (see Figure 3). Double layers of clothing such as this may add up to 3^o to the measured WBGT for the worker.



Figure 3. Worker in Sweatshirt

ACGIH TLVs[®] are determined based on a normal 8 hour per day, 5 day work week. Reportedly, workers at Ghim Li do work overtime (up to 2 hours per day) and work 6 days per week putting further stress on workers bodies that could make them more susceptible to heat illness.

In summary, based on these results and observations, heat related illnesses would be a potential risk to workers in this factory.

^b American Conference of Government Industrial Hygienist (ACGIH). TLV[®]s and BEIs[®] Based on the Documentation of the Threshold Limit Values and Physical Agents & Biological Exposure Indices. 2011

Chemical Exposures

Spot Cleaning

Spot cleaners use acetone for cleaning of stains from garments. As noted above in the VOC section the PID indicated a response and a concentration of 0.800 ppm in the spot cleaning area. Assuming that the response was for acetone (there is likely also contribution of hydrocarbons from the next door boiler), the calculated concentration of acetone (0.88 ppm) was well below the ACGIH TLV[®] of 500 ppm.

Table 3. VOC Measurement Results in Spot Cleaning Room

Task	Chemical Source	Component	CAS#	PID Reading (ppm)	Correction Factor	Calculated Concentration (ppm)	ACGIH TLV [®]
Spot Cleaning	Spot Cleaner / Boiler Exhaust	Acetone	67-64-1	0.8	1.1	0.88	500 ppm

Additional air sampling for acetone was conducted in the spot cleaning area. Results indicate a maximum exposure of 15 ppm during spot cleaning operations and do not indicate a significant hazard.

Pesticides

Use of pesticides in factories in Cambodia is reportedly very common (at Ghim Li it is generally conducted once a month). At least one case of mass fainting in Cambodia was blamed (unknown if rightly or wrongly) on use of pesticides while workers were in the building. The government report reviewed during the investigation also mentions “use of pesticides behind cooling system” as a potential cause. However, there was no evidence that pest control was conducted during work hours or around the time of the fainting. Medical diagnosis does not indicate symptoms typically encountered with pesticide poisoning. Reports indicate pest control was conducted on August 6, 2011.

Noise

Noise screening measurements did not indicate noise level in excess of 85 dBA in the general areas of the workplace (see Appendix B). High noise levels (>90 dBA) were measured in the embroidery area; however these were already identified as areas requiring hearing protection.

Conclusions

General

Overall, there is no evidence of “toxic exposures” from measurements or based on medical diagnosis at this factory. Additionally, evidence does not support the incidence of a mass exposure event such as a mass overexposure to carbon monoxide or a pesticide that could result in large numbers of employees suffering unconsciousness or other symptoms simultaneously.

Undoubtedly, there are issues related to the physical work environment at the factory that have affected the comfort of the employees. It is possible (and probable) that several workers initially suffered from illnesses such as low-blood sugar (due to lack of caloric intake), heat strain, or exhaustion causing them to lose consciousness; however it is likely that the majority of the illnesses were related to a mass psychogenic phenomenon.

Mass psychogenic illness (MPI, also known as epidemic hysteria, mass hysteria, and mass sociogenic illness) describes a syndrome of subjective symptomatology which develops suddenly and spreads contagiously in a well-defined population (workplace) in the absence of an identifiable chemical, physical, or infectious agent^c. A review of mass psychogenic illness in organizations identified several common characteristics.^d The table below summarizes these characteristics compared to Ghim Li.

Table 4. Characteristics of mass psychogenic illness

Characteristics	Ghim Li
Sex: Primarily Female	Confirmed
Environment: Work or School where membership of these organizational structures is neither completely voluntary nor transient. Financial need (work) or legal sanctions (school) require the individual's active participation on a relatively continuous basis	Confirmed
Boredom: Typically involve industrial operations involved repetitive, perceptual-motor tasks performed at fixed work stations and fixed production paces.	Confirmed
Production Pressure: Workers under considerable pressure to increase production	Potential
Physical Stressors: Workers exposed to various stressors that are potentially bothersome, but not necessarily injurious. Examples include noise, air contamination from dust and lint, poor lighting, variations in temperature fumes or odors from various sources (e.g. solvents, vehicle exhaust, pesticides)	Confirmed
Labor-Management Relations: Problems such as discontent over supervisory techniques or strained / ambivalent relationships between the affected workers and their first line supervisors	Potential
Lack of Communication: Lack of ability to communicate with other employees due to noise or nature of work, or reluctance or inability on the part of the affected workers to discuss work-related dissatisfaction with others or with management	Confirmed

This case of industrial mass psychogenic illness was likely precipitated by a combination of physical (high heat, fatigue, lack of caloric intake to meet demands of the job) and psychological stress (belief in "ghosts" or "evil spirits" within the workplace; not uncommon in cases of MPI in certain ethnic groups^e) and other life stresses (limited financial resources).

It is likely that the triggering event was a physical ailment such as an employee who became faint and unconscious (as reported by the hospital) due to low blood sugar (confirmed through medical diagnosis) or heat strain as noted above. Other workers witnessed this event which may have provided these workers with an explanation of their work discomfort or resulted in high anxiety and triggered a contagion reaction.

Studies have theorized that the first workers affected - the so-called "triggers" - may have symptoms caused by physical or psychological factors or both. The trigger, who may have a physical ailment such as low-blood sugar or heat illness, then results in psychological distress in other workers.^f Mass media reports in Cambodia have made knowledge of other mass events at other factories relatively common adding the anxiety and potentially causing further proliferation of the contagion reaction.

^c Colligan, M.J., L. R. Murphy. Mass Psychogenic Illness in a Shoe Factory. *Int Arch Occup Environ Health* 44, 133-138 (1979)

^d Colligan, M.J., L. R. Murphy. Mass psychogenic illness in organizations: An overview, *Journal of Occupational Psychology*, 1979,52, 77-90.

^e Teoh, J.-J. & Yeoh, K.-L. Cultural conflict and transition: epidemic hysteria and social sanction. *Australian & New Zealand Journal of Psychiatry*. 7,283-295. 1973

^f M. Olkinuora. Psychogenic epidemics and work. *Scand J Work Environ Health* 10 (1984) 501-504.

The contagion reaction likely occurred as in Figure 4 below (adapted from Olkinuora, 1984).

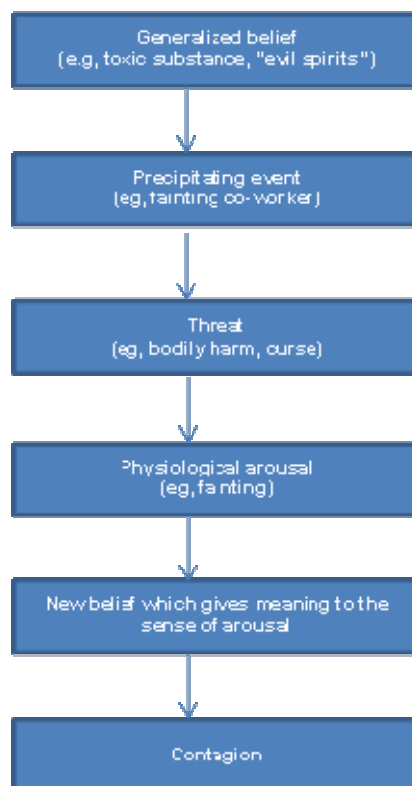


Figure 4. The contagion reaction

It is important to note that the use of the term psychogenic does not imply that the illness is not real or “in their head”. The fact that an illness has a psychogenic component does not imply that the experienced symptoms are imaginary. The term “psychogenic” should not be confused with “neurotic” or “psychopathic.” In cases of psychogenic illness the individual is **not** to blame as the lack of an identifiable chemical, physical, or infectious agent does **not** imply that there is not an identifiable source of stress or discomfort that underlies the illness and the contagion reaction.

Root Causes

Previous studies in MPI have postulated several social and physical stressors as the cause of the syndrome including work overload, high temperatures, authoritarian management style, boredom, unwanted overtime, etc.^{9h} In this case, the factory does not appear to have such an extreme pressure put on production targets, however workers may still end up overworked (excessive overtime and lack of rest day) during peak periods. Though records were not provided, workers reported some excessive overtime (more than the legally permitted 2 hours per day, Cambodian Labor Law AC AWARD 10/0) and working without 24 hour break / day off (Cambodian Labor Law LABOUR LAW ARTS 146-148) from time to time.

The factory does have an ESH committee and a formal grievance system; however, there remains limited communication with employees and no mechanism for employee feedback on decisions made by the factory. A good example is the case of cleaning of the cooling system. Workers were not made aware of the timing of this work. Certainly management must have expected that temperatures in the workplace would be higher during this work, yet this was not communicated to the workers and no special precautions were taken to heighten awareness of potential heat illness.

⁹ Colligan, M.J et al, An Investigation of Apparent Mass Psychogenic Illness in an Electronics Plant. Journal of Behavioral Medicine, Vol. 2, No. 3, 1979

^h NIOSH. Health Hazard Evaluation Report. HETA 82-273-1239.1982

As noted above, the likely trigger in this case was the fainting of workers with low-blood sugar. Additional workers may suffer from low caloric intake (some may choose to eat less to save money) and will be at risk of similar illnesses.

Recommendations

Physical Issues

It is important to address the potential physical hazards to workers as these can contribute to the overall stress of the workers, provide a triggering event for the contagion, or result in an illness in an individual that could also trigger the contagion reaction. However, it is very unlikely that a strictly physical approach to remediation will result in a total abolishment of similar mass fainting events. Psychosocial issues (see below) are likely to be more important in this case (and potentially many others in Cambodia or other countries).

Sumerra recommends the following actions to address potential physical hazards of the workplace:

- Boiler Odor
 - Do not allow air from the boiler area to be drawn into interior spaces or the spot cleaning area.
 - Fabrics, plastics or other non-wood products should **never** be incinerated in the boiler. These wastes should be properly disposed of by approved waste handlers.
- The Cooling System
 - Based on the condition of the components of the cooling system (highly degraded), the factory should consider a plan to replace the current components. The factory is encouraged to investigate new or different cooling technologies.
 - Develop a preventive maintenance program for the cooling system. This should include:
 - Regularly scheduled cleaning of the cooling system to remove dirt and debris. This will have the added benefit of increasing cooling and airflow efficiency.
 - Regular maintenance checks of operability of system components. Repairs should be made expediently.
- Thermal Comfort
 - Add additional cooling mechanisms for when outdoor air temperatures exceed 28°C. This **may** consist of:
 - Additional fans in the workplace to create more air flow (and therefore lower WBGT) and better perception of conditions. Increasing the air speed over the worker will improve heat exchange between the skin surface and the air.
 - Installation of additional air curtains in the upper areas of the building to drive perceivable air flow down to lower areas. Currently only workers in close proximity to the installed air curtains have any benefit.
 - Installation of cooling systems in areas currently not served by such systems such as the cutting and fabric inspection areas.
- Heat Stress
 - The easiest way to prevent heat stress is to provide a cooler environment (see Thermal Comfort above).
 - Develop a heat stress management program. This will include:
 - Training for workers and supervisors about the hazards leading to heat illness and ways to prevent them.
 - Training for workers to recognize symptoms in themselves and others.
 - Training and encouragement for workers to immediately report symptoms in themselves and others.
 - Workers should be taught about the effects of layered clothing and the proper attire for hot work environments.
 - A system to remind workers to frequently drink small amounts of water before they become thirsty to maintain good hydration. Simply telling them to drink

- plenty of fluids is not sufficient. During moderate activity, in moderately hot conditions, workers should drink about 1 cup every 15 to 20 minutes.
- Monitor the temperature (or preferably the WBGT) of the workplace and activate special precautions when temperatures exceed general action limits.
- Contingency plans for any activities (e.g. cleaning of cooling system), that may result in higher risk of heat related illness.
- Rest & Recovery
 - Factory should comply with Cambodian Labor Law regarding overtime hours and rest periods
 - OT should not exceed 2 hours per day, except in exceptional cases upon which the factory obtains permission from the Ministry of Labor and the worker representatives.
 - Workers should be given a full day (24 hours) rest once every week.
 - OT should be voluntary.
- Spot Cleaning Area
 - The spot cleaning area should be designed so that air directionally flows from behind the worker and is exhausted outdoors. Additionally, the area should not be designed to allow exhaust from the adjacent boiler to be entrained in the work area.

All of the actions taken by the factory to address the recommendations above, should be effectively documented, tracked and communicated to the factory workers. Feedback and input from the workers on the success or failure of implementation should be sought out and used to make further improvements to the work environment.

Psychosocial Issues

In a large workforce such as in this factory (~2000 workers), there certainly will be illnesses (some work related and some not) from time to time. In some cases, the frequency of these occurrences can be drastically reduced by implementing specific programs (e.g. heat stress management) or other health promotion activities. However, in all cases, in order to prevent contagion reactions the underlying psychosocial issues must be adequately addressed.

Employee communication is very important in achieving these goals. Effective worker communication channels reduce opportunities for misinformation, misunderstanding, unrest and mismanagement while promoting learning, teamwork, safety and innovation. Strong worker and management communication develops commitment from the workforce and ownership of the state of working conditions. As workers understand and protect their rights they contribute positively to the overall workplace setting while increasing the quality of products and productivity. Most importantly, it builds trust with workers aligning them with the business goals resulting in increased efficiencies and better profitability for the company.

Sumerra recommends the following actions:

- Enhance the **effectiveness** of the grievance process by:
 - Providing effective communication of the grievance policy to employees so that employees are aware of the grievance process and their right to raise concerns.
 - A means to document and track grievances to ensure there is a timely response back to the employee. Grievances should be brought to the attention of top management and responses clearly communicated.
 - For issues that may affect the wider work force, feedback should be provided to the employee, the unions, and all workers, noting actions (or lack of) and time tables for completion.
 - It must be made **very clear** that grievances, complaints and suggestions for improvement are **strongly encouraged** and will not, under any circumstances, result in retaliation.

- Enhance the role of the environmental health and safety committee. Committees should:
 - Have a freely elected chairperson.
 - Have members that serve a continuous term of at least one year.
 - Make available (e.g. posting) and communicate meeting minutes to all employees.
 - Establish a system to allow the members to obtain suggestions from non-committee members.
 - Receive documented management response to all committee recommendations within 30 days.
 - Establish procedures for investigating incidents including injury accidents, illnesses, deaths, chemical spills and fires.
 - Conduct quarterly workplace safety inspections.
- Top management must **communicate** and **effectively demonstrate** that the safety and health of its employees is a top priority, on par with or exceeding priority given to meeting production targets.
 - Management should ensure that workers feel informed about issues in the factory, and believe that, either as individuals or through their union representatives, they have input into management decisions which affect them. Actions (see example of cleaning of cooling coils and lack of worker knowledge above) should be communicated thoroughly and precautions should be taken as necessary.
 - Provide health promotion activities such as learning programs regarding smoking cessation, proper nutrition, and general women's health.

Limitations

This investigation is limited to the conditions and practices observed and information made available to Sumerra. The methods, conclusions, and recommendations provided are based on Sumerra's judgment, experience and the standard of practice for professional service. They are subject to the limitations and variability inherent in the methodology employed. As with all environmental investigations, this investigation is limited to the defined scope and does not purport to set forth all hazards, nor indicate that other hazards do not exist.

Please do not hesitate to contact our office at +852 2824 8802 if you have any additional questions or concerns. Thank you for the opportunity to assist the factory and it's buyers in promoting a more healthful environment.

Respectfully,



Michael S. Andrew, MS, CIH, CSP



Appendix A: Materials and Methods

Employee Interviews

Employee interviews were conducted by representatives of Better Factories Cambodia and Puls Trading Far East Limited (H&M) in the local language. Interviewers used a questionnaire developed by Sumerra.

Temperature & Relative Humidity

Temperature and relative humidity measurements were made using a TSI Model 8762 Q-Trak IAQ Calc Monitor.

Carbon Monoxide

Carbon monoxide measurements were made using a TSI Model 8762 Q-Trak IAQ Calc Monitor.

Carbon Dioxide

Carbon dioxide measurements were made using a TSI Model 8762 Q-Trak IAQ Calc Monitor.

Volatile Organic Compounds

VOC measurements were made using the RAE Systems ppbRAE 3000. The ppbRAE 300 is a photo ionization detector (PID) with a 10.6 eV gas discharge lamp that is used to measure a broad range of volatile organic compounds (VOCs) (calibrated relative to isobutylene).

Particulates

Particle measurements were made using a TSI Model 8520 Aerosol Monitor. This monitor uses a 90° light scattering measurement to continuously determine airborne particle concentrations. Instrument is factory calibrated to A1 test dust (i.e., Arizona test dust). Results are expressed gravimetrically as milligrams per cubic meter (mg/m^3).

Wet Bulb Globe Temperature (WBGT)

Measurement of WBGT was made using a QUESTemp° 34 area heat stress monitor. This monitor measures globe temperature, dry bulb temperature, wet bulb temperature, relative humidity, and Heat Index / Humidex.

Noise

Monitoring was conducted using a Faber Acoustics calibrated iPhone application and built in microphone. Measurements were made in “A” weighting scale and “slow” response.

Appendix B: Results Tables

1. IEQ Monitoring Data

Department	Location	Time (Mil.)	Ventilation	Comfort		Pollutants		
			CO ₂ (ppm)	Temp. (°C)	%RH	CO (ppm)	VOC (ppb)	Particulate
								PM ₁₀ (mg/m ³)
Accessory Store	Middle of Room	12:11	383	28.7	74.1	2.5	70	0.056
Sewing	Northeast Corner in front of Maintenance Shop	12:22	395	29.2	69.5	2.2	60	0.1
Sewing	Between Line 40 & 41	12:27	444	29.8	67.6	1.9	103	0.17
Sewing	Between Line 37 & 38	12:32	424	30.3	65.5	1.9	106	0.2
Sewing	Between Lines 22 & 23	12:35	422	30.3	65.3	1.9	107	0.21
Sewing	Between Lines 19 & 20	12:39	393	30.2	65.5	1.9	112	0.15
Sewing	Between Lines 4 & 5	12:43	436	30.1	67.6	1.9	102	0.2
Sewing	Walkway Between Lines 2 & 8	12:46	370	29.9	67.3	1.9	98	0.223
Ironing	Next to Line 7	12:50	404	30.3	68	1.7	111	0.2
Packing	Middle of Packing Area	12:55	373	29.8	69.4	1.9	106	0.33
CTPAT Storage	Middle of Area	12:59	373	29.6	69.6	1.9	95	0.25
Sewing	Between Lines 11 & 12	13:03	410	29.6	68.4	1.7	104	0.275
Sewing	Between Lines 26 & 27	13:06	450	29.9	67.7	1.9	111	0.34
Sewing	Walkway between Lines 42 & 47	13:10	432	30.1	67.7	1.9	114	0.265
Sewing	Between Lines 50 & 51	13:15	490	30.3	67.2	2.2	218	0.39
Outdoor Air	Driveway North Side	13:18	420	30	67.2	6.2	520	0.505
Spot Cleaning	Spot Cleaning room	13:29	460	--	--	5.4	800	--
Sewing	Between Lines 31 & 32	13:34	410	29.9	68.7	1.9	138	0.24
Cutting	Between Groups 1 & 2	13:38	378	29.6	70.6	1.9	162	0.33
Cutting	Group 6	13:43	388	29.6	69.7	1.9	157	0.315
Fabric	Inspection Area	13:48	376	29.6	69	1.9	151	0.288
Embroidery	North Room	13:53	365	26.8	78.7	2.3	137	0.22
Embroidery	South Room	14:05	370	27.9	78.8	1.9	147	0.219

2. Heat Stress Monitoring Data

Department	Location / Task	Time (Mil.)	WGBT (°C)
8-Sep-11			
Accessory Store	Middle of Room	12:11	26.8
Sewing	Northeast Corner in front of Maintenance Shop	12:22	26.9
Sewing	Between Line 40 & 41	12:27	27.4
Sewing	Between Line 37 & 38	12:32	27.6
Sewing	Between Lines 22 & 23	12:35	27.4
Sewing	Between Lines 19 & 20	12:39	27.2
Sewing	Between Lines 4 & 5	12:43	27.4
Sewing	Walkway Between Lines 2 & 8	12:46	27.1
Ironing	Next to Line 7	12:50	27.7
Packing	Middle of Packing Area	12:55	27.1
CTPAT Storage	Middle of Area	12:59	27
Sewing	Between Lines 11 & 12	13:03	27.4
Sewing	Between Lines 26 & 27	13:06	27.5
Sewing	Walkway between Lines 42 & 47	13:10	27.4
Sewing	Between Lines 50 & 51	13:15	27.7
Outdoor Air	Driveway North Side	13:18	27.5
Sewing	Between Lines 31 & 32	13:34	27.4
Cutting	Between Groups 1 & 2	13:38	27.7
Cutting	Group 6	13:43	27.1
Fabric	Inspection Area	13:48	27.1
Embroidery	North Room	13:53	25.7
Embroidery	South Room	14:05	26.1
9-Sep-11*			
Sewing	Between Lines 40 & 41	12:07	28.2
Sewing	Between Lines 43 & 44	12:19	28.6
Sewing	Line 28, Near Plastic Barrier	12:26	28.8
Sewing	Line 27, Near Plastic Barrier	12:32	28.9
Ironing	At Ironing Table	12:40	29.1
Sewing	Line 2	12:45	28.5
Cutting	Group 3	12:55	29.1
Fabric	Inspection Area	13:01	29
*Cooling system off line for cleaning			

3. Noise Monitoring Data

Department	Location / Task	Time (Mil.)	Area Noise Levels (dB)	
			Max	Peak
Sewing	Various Locations	10:00	82.1	90.0
Embroidery	North Room (Machine Running)	14:00	87.3	103
Embroidery	North Room (Machine Not Running)	14:00	80.6	93.8
Embroidery	South Room, Between two Running Machines	14:04	91.3	105.6
Embroidery	South Room, Middle of Room	14:04	86.8	99.9

4. Acetone Air Sampling Results

Sample ID	Process	Task	Type	Results (ppm)
BP4716	Spot Cleaning	Spot Cleaner (note no cleaning done with acetone until 13:30)	Area Sample (Head Zone)	1.7
BP4678	OA	Outside of Spot Cleaning Area	Area/Control Sample	<0.35
BP4611	Spot Cleaning	Spot Cleaner	Area Sample (Head Zone)	15

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