Scientists for People

Submission to NGT on mass fainting at Brandix India Apparel City

OA 448 of 2022

NGT appointed a joint committee after the second mass fainting incident at Brandix India Apparel City (BIAC) on 02 August 2022 with seven members. Chairman, JC nominated three more making a total of 10. It is more than four months since the joint committee is appointed and it has nothing to offer except ask for additional time and additional study by AU. They have not even specified the terms of reference for the proposed study. There is no evidence in the two interim reports of the members conducting any analysis of the incidents. Both reports have nearly identical core content taken from the Deputy Chief Inspector of Factories report. There is no evidence they have looked at similar incidents that occurred in several countries or collected published studies on such incidents.

Occupational hazards in Garment Factories:

Garment factories are not free from hazards. In Bangladesh, the garment industry caused 1626 deaths and 4829 injuries to workers in 22 years. Hundreds of Bangladesh factory workers who fell sick with stomach pains and vomiting could have been struck down due to a mysterious illness known as "mass psychogenic illness" (MPI). According to the National Social Security Fund, Cambodia from 2015 to 2017, workers in 32, 18, and 22 factories, had experienced Mass Fainting Illness. The number of workers affected in each respective year was 1806, 1160, and 1603, respectively. Garment and footwear factories were observed as high-risk units.

"A comprehensive literature review identified 31 number of OSH hazards of apparel sector in the global and local contexts and the levels of exposure of the employees to those hazards were identified through a questionnaire survey." [Thatshayini. P. & Rajini. P.A.D., Occupational Safety and Health Hazards of Apparel Sector: perspective of Northern Province employees of Sri Lanka, Journal of Business Studies, 5 (1), 26-47, 2018] (OSH - Occupational Safety and Health)

Garment factories are not pollution free. They have both physical and chemical hazards. But the JC unable to identify the cause for the fainting of women is trying to externalize the issue and blame neighbouring industries without a shred of evidence. This is both unscientific and unethical.

The premise that the incidents happened because of exposure to some harmful chemicals itself requires evidence. Several studies were done on the mass fainting of garment workers. We quote here from such a study. *"A mysterious phenomenon has plagued factories in Cambodia for years. In 2017, there were more than 1600 cases of factory workers in Cambodia fainting in various incidents. In 2018, a single incident resulted in more than 200 workers at a shoe factory simultaneously fainting at the workplace. So far, investigations from various organizations have documented various potential causes of the mass faintings. As much as the investigations give insight into possible contributing factors, none have looked at the problem as a whole.* ***Rather, each group sees the issue through their***

own lens based on their area of interest or scope of work. Looking for "the" single cause of mass fainting ignores the insight that there may be many component causes." [Erin C. Kawazu, Hyun Kimb, Mass fainting in Cambodian garment factories, Global Epidemiology 1, 100008, (2019)]

Violence against Women Garment Workers in India:

A study of garment workers in India "Eliminating Violence Against Women at Work" by Sisters for Change and Munnade published in June 2016 found:

Abuse and sexual harassment of female garment workers at work are routine.

1 women garment worker in 7 has been raped or forced to commit a sexual act.

1 women garment worker in 14 has experienced physical violence

Perpetrators of sexual harassment and violence enjoy widespread impunity

The majority of garment factories have no functioning grievance mechanism or internal complaints committee, as required by law, to investigate complaints of sexual harassment and violence.

Shikha Silliman Bhattacharjee, in a chapter on "Fast fashion, production targets, and gender-based violence in Asian garment supply chains", contributed to "Labor, Global Supply Chains, and the Garment Industry in South Asia" observed: *"Women garment workers reported facing sexual harm and suffering; gendered industrial discipline practices—including physical violence, verbal abuse, coercion, and threats; physically extractive labor practices with severe health consequences—a practice termed mining of the body (Nathan et al. 2018); unsafe workplaces; and the production of insecurity through reliance on contract workers, threats of termination, barriers to freedom of association and collective bargaining, and retaliation for reporting violence. Gendered cultures of impunity among perpetrators further undermine accountability for violence."* [Shikha Silliman Bhattacharjee, Fast fashion, production targets, and gender-based violence in Asian garment supply chains, in Labor, Global Supply Chains, and the Garment Industry in South Asia, Edited by Sanchita Banerjee Saxena, Routledge, 2019]

ND TV also ran an investigative video story "Truth vs Hype: Brands of Shame" on 9 July 2016 now accessible at https://www.ndtv.com/video/news/truth-vs-hype/truth-vs-hype-brands-of-shame-423115

Ignoring all possible contributing stress factors, sociological, psychological, physiological, environmental, and physical and sexual violence at work, JC is stuck with external emissions theory. Has been looking for a single cause of toxic exposure with the bias that sewing factories do not generate pollution. Had they cared to look at published studies on the indoor air quality of such factories they would have noted that chemical exposures also occur in garment factories.

It may be noted that India has no standard for Indoor Air Quality (IAQ). There is no regulation of IAQ at any office or factory. A study was done at 30 offices in India with a total of 30000 employees, mostly software, in 2021. *"Out of the 30 offices studied, only one had all the indoor air contaminants within limits prescribed by standards. In 73% of the spaces, the levels of three or more*

contaminants did not meet the prescribed limits. Both indoor-generated contaminants and those entering from outdoors were a concern due to the adverse impact they have on occupant health. Carbon dioxide (CO_2) and nitrogen dioxide (NO_2) were the most common non-compliant contaminants indoors, followed by particulate matter (PM) and formaldehyde (CH_2O).” [Green Business Certification Institute India and Saint-Gobain Research India, 2021. Healthy workplaces for healthier people]

In all the peer-reviewed published studies we collected (about 140 in all), toxic emissions from external sources are never considered a probable cause.

Past Incidents:

In a study of the mass collapse of female workers in an electronics factory, the authors observed that the incident has more to do with psychological, sociological, and work environment factors.

“The illness outbreak involved a total of 90 female first-shift workers who reported a variety of nonspecific symptoms such as headache, dizziness, and lightheadedness in response to a strange odour in the workplace. Although environmental testing revealed some localized concentrations of a few airborne contaminants, no environmental toxins were discovered that could account for the continuing outbreaks of illness. An ad hoc sample of affected and nonaffected workers was surveyed to assess the influence of psychological, sociological, and work environment factors in the outbreak. Analysis of the data revealed that affected workers reported more physical discomfort (temperature variations, poor lighting) in the workplace as well as psychological job stress (increase in workload, conflicts with supervisors) than did nonaffected workers.” [Colligan, M. J., Urtes, M. A., Wisseman, C., Rosensteel, R. E., Anania, T. L., & Hornung, R. W. An investigation of apparent mass psychogenic illness in an electronics plant. Journal of Behavioral Medicine, 2(3), 297–309, (1979)]

Another study that reviewed the case of eight factories located in the capital city of Phnom Penh and two provinces in Cambodia that had experienced Mass Fainting Illness (MFI), considered physical, sociological, and psychological issues as possible causes.

“This study found factors that were associated with MFI, such as working at very high speeds, perceiving less influence on the choice of working partners, perceiving high temperature at work, having less opportunity to do their best at work (e.g., all handling tasks among textile factory workers are performed to expedite speedily and are dependent on their supervisors) and perceiving concern for losing a job in the next six months.” [Maly Phy, Twisuk Pungpeng, Chaweewon Boonshuyar and Thanu Chartananondh, Work-environmental determinants of mass fainting illness among textile factory workers, Journal of Health Research, Vol. 34 No. 2, pp. 112-122, 2020]

An investigative study published in “In These Times” in July 2015 stated:

“Seang Sokun, a representative from Coalition of Cambodian Apparel Workers Democratic Union, said he had been informed that the fumes at one factory had

caused the fainting. "The investigating team didn't use the right equipment," Sokun said, "They used their noses … and found nothing."

A recent comprehensive investigation also suggests an operative link between health and work environment. At the end of 2014, a study conducted by the International Labour Organization's (ILO) Better Factories Cambodia project, together with the Agence Française de Développement (AFD) and Angkor Research and Consulting Ltd., found high levels of food insecurity and anemia among Cambodian garment workers.

According to that study, 43.2% of the workers surveyed suffer from anemia and 15.7% of the workers are underweight. The study also found that garment workers spend around $9 per week on food, or $1.30 every day.

"Anemia and food insecurity can contribute to wide-ranging health problems for workers," said Better Factories Cambodia Program Manager Jill Tucker in a statement. "Anemia often leads to chronic fatigue, difficulty concentrating and low productivity. Addressing these anemia levels will be complex, but is key to improving productivity and business outcomes in the garment sector.""

[https://inthesetimes.com/article/garment-factory-workers-across-cambodia-are-fainting-by-the-hundreds]

One more study by Maly Phy and others observed poor ventilation as a likely stressor leading to MFI.

"Poor ventilation under certain circumstances generates a high temperature, which can cause a loss of the concentration, the boredom and the exhaustion, resulting in a physical stress or a discomfort (Magnavita et al., 2011). Our study showed that workers agreed that a high temperature at work was significantly contributed to the risk of MFI." [Maly Phy, Twisuk Pungpeng, Chaweewon Boonshuyar & Thanu Chartananondh, Predicting factors of mass fainting illness among factory workers, Cogent Psychology, 7:1, 1849891 (2020)]

Based on all the published studies we are of the opinion that external emissions causing the mass faintings at Brandix is unrealistic. Unnecessary emphasis on that aspect repeatedly is unwarranted. There is no need for a study on the emissions from the nearby industrial estate. Conditions at Brandix are the problem.

Sick Building Syndrome:

Sick Building Syndrome is a new problem that came into existence after 1980 as offices became architecturally airtight for energy efficiency to overcome the energy crisis of the 1970s.

Definitions:

"A collection of nonspecific symptoms including eye, nose and throat irritation, mental fatigue, headaches, nausea, dizziness and skin irritations, which seem to be linked with occupancy of certain workplaces" (WHO, 1983)

"SBS is used to 'describe situations in which building occupants experience acute health and comfort effects that appear to be linked to time spent in a building, but no specific illness or cause can be identified'." (EPA, 1991)

"Sick Building Syndrome (SBS) is used to describe a situation in which the occupants of a building experience acute health- or comfort-related effects that seem to be linked directly to the time spent in the building. No specific illness or cause can be identified." [Sumedha (2008)]

The symptoms exhibited by the women workers at the time of the incidents were the same as for SBS. The 24 references presented below, show that the JC has for its own reasons chose not to check the indoor environment. Only after ascertaining the indoor air quality (IAQ) other factors should be considered. Indian study quoted on pages 2-3 showed that 96.67 % of workplaces in India did not meet IAQ standards.

Occupational safety and health hazards assessment done by Owino et al (2022) for four apparel factories in the Export Processing Zone of Kenya reported high concentrations of $PM_{2.5}$ in indoor air. *"Concentrations of $PM_{2.5}$ were measured using a portable real-time detector model, Turnkey Osiris Airborne Particulate Monitor with an accuracy of 0.1 µg/m^3. The mean value for $PM_{2.5}$ was 65.61 ± 31.5 with a range of 59.08 - 72.14 µg/m^3. Main $PM_{2.5}$ sources were found to be from Sewing/Embroidery > Cutting/Fusing/pressing > Fabric/relaxing/spreading > Packaging > Office departments respectively. The mean concentrations were above the WHO-acceptable levels of 15 µg·m^{-3} for 24-hour exposure."* These sample collections were done during the operating hours of the factory. No such data is available for Brandix. There is no indication that DF or APPCB officials have collected such data. Interim reports do not present any particulate pollution data.

Alwi et al (2021) studied the IAQ and SBS in a garment factory in Malaysia. They found *"The prevalence of SBS among workers was 82.1%. The most common reported symptoms were feeling heavy-headed, fatigue, and headaches with 85.0%, 83.3%, and 70.5% respectively. Other reported symptoms were nausea (25.5%), cough (64.7%), stuffy nose (58.4%), sore throat (58.2%), skin rash (54.4%), itchy scalp (35.8%), and eye irritation (19.7%)."*

Professor Alan Hedge of Cornell in a paper presented at a seminar in China in 1996 observed that personal, psychological, and occupational variables also affect reports of IAQ complaints and health symptoms.

https://ergo.human.cornell.edu/AirQuality/iaqslides96/ahpaper.html#:~:text=Mass%20psychogenic%20illness%20(MPI)%2C,Colligan%20and%20Murphy%2C%201982

"Unpleasant odors do not necessarily indicate hazardous indoor air and the absence of odors does not necessarily signify healthy air because many pollutants, like carbon monoxide, carbon dioxide, and airborne microorganisms have no odor. Field research also shows that thermal comfort variables, such as air temperature and air movement, affect perceptions of stale and stagnant air. Experiments show that judgements of acceptability correlate better with the percentage of dissatisfied people than judgements of odor intensity. Acceptability ratings change

with air temperature (from 68 deg F to 79 deg F - about 20 deg C to 26 deg C), and the higher the air temperature the lower the acceptability of perceived air quality"

"Research shows that IAQ problems and reports of the SBS generally are not caused simply by exposure to poor IAQ, but rather they occur because of the combined effects of various physical environment and non-environmental factors. IAQ complaints and the SBS are the outcome of complex processes, initiated by a set of stressful multiple risks which create personal strain.

Most studies of IAQ complaints and the SBS have found that there is good evidence that personal, psychological, and occupational variables also affect reports of IAQ complaints and health symptoms. Brooks and Davis (1992) summarize 3 sets of factors that appear to be common to most indoor air quality problems: the presence of point sources of pollution, the presence of a susceptible population, and inadequate ventilation. By studying and addressing all 3 sets of factors, satisfactory climate conditions and healthful indoor air quality can be created in any building."

The presence of indoor bioaerosols like bacteria, fungi, endotoxin, and p-1,3-glucan are not checked for in buildings M1 and M2. Endotoxin is a toxic substance bound to the bacterial cell wall and released when the bacterium ruptures or disintegrates. [Encyclopaedia Britannica] Indoor bioaerosols in the buildings should be checked and measures initiated to eliminate them.

SBS and mass psychogenic Illness have similar symptoms, "the most common being headache, memory loss, lightheadedness, dizziness, dry mouth, throat irritation, and nose and eye irritation."

SBS can lead to mass psychogenic illness and fainting for persons with severe anxiety and stress. Women garment workers with low paid insecure jobs and suffering workplace violence are susceptible to mass fainting. So, a detailed study of the indoor environment and HVAC system is a prerequisite to understanding the two incidents of mass fainting at Brandix India.

References:

Apte Michael G., William J. Fisk and Joan M. Daisey, Associations Between Indoor CO_2 Concentrations and Sick Building Syndrome: Symptoms in U.S. Office Buildings, Indoor Air; 10: 246–257, 2000

Ake Thorn, The sick building syndrome: a diagnostic dilemma, Soc. Sci. Med. Vol. 47, No. 9, pp. 1307-1312, 1998

Alan Hedge and William A. Erickson, Predicting sick building syndrome at the individual and aggregate levels, Environment International, Vol. 22, No. 1, pp. 3-19, 1996

Allan L. Rothman; Michael I. Weintraub, The Sick Building Syndrome and Mass Hysteria, Neurologic Clinics, volume 13, issue 2, 405-412, 1995

Alwi Nur Syahzanan, Mimi Haryani Hassim, and Nurul Ainun Hamzah, Indoor Air Quality and Sick Building Syndrome among Garment Manufacturing Workers in Kota Bharu, Kelantan, Mal J Med Health Sci 17(SUPP8): 51-58, Oct 2021

Au Yeung Y. N., W. K. Chow, Veronica Y. K. Lam, Sick Building Syndrome: A Case Study, Building and Environment, Vol. 26, No. 4, pp. 319-330, 1991

Brasche S., M. Bullinger, M. Morfeld, H. J. Gebhardt and W. Bischof, Why do Women Suffer from Sick Building Syndrome more often than Men? Indoor Air 2001; 11: 217–222

Bullinger M., M. Morfeld, S. von Mackensen, and S. Brasche, The Sick-Building-Syndrome —Do women suffer more? Zbl. Hyg. Umweltmed. 202, 235-241 1998/99

Charlotte Brauer, Henrik Kolstad, Palle Ørbæk, Sigurd Mikkelsen, The sick building syndrome: a chicken and egg situation? Int Arch Occup Environ Health 79: 465–471 2006

Finn Gyntelberg, Poul Suadicani, Jan Wohlfahrt Nielsen, Peder Skov, Ole Valbjmn, Peter A. Nielsen, Thomas Schneider, Ole Jargensen, Peder Wolkoff, C. K. Wilkins, Suzanne Gravesen, Sven Norn, Dust and the Sick Building Syndrome, Indoor Air, 4: 223-238 1994

Gail Kinman, and Miriam Griffin, Psychosocial factors and gender as predictors of symptoms associated with sick building syndrome, Stress and Health 24: 165–171, 2008

Jouni J.K. Jaakkola, Olli P Heinonen, and Olli Seppanen, Mechanical Ventilation in Office Buildings and the Sick Building Syndrome: An Experimental and Epidemiological Study, Indoor Air, 2,111-121, 1991

Marjaanlaa Lahtinen, Pekka Huuhtanen and, Kari Reijula, Sick Building Syndrome and Psychosocial Factors - a Literature Review, lndoor Air 1998; Suppl. 4: 71-80

Nils Eriksson, Jonas Hoog, Berndt Stenberg AND JAN SUNDELL, Psychosocial Factors and the "Sick Building-Syndrome". A case-referent study, Indoor Air 1996; 6: 101-110

Olivier Michel, Roberta Ginanni, Microbial contamination and sick building syndrome, AEROBIOLOGIA, 6, 51 – 53, 1990

Ooi, P., Sick building syndrome: an emerging stress-related disorder? International Journal of Epidemiology, volume 26, issue 6, 1997

Owino A. Otieno, Paul M. Njogu, Dennis Magu, Occupational Safety and Health Hazards in Apparel Processing Factories Posed by Respirable $PM_{2.5}$ in Export Processing Zone, Machakos County, Kenya, Open Journal of Safety Science and Technology, 12, 43-50, 2022. https://doi.org/10.4236/ojsst.2022.122004

Paula H. Vance, and Alice S. Weissfeld, The controversies surrounding sick building syndrome, Clinical Microbiology Newsletter 29:10, 2007

Pawel Wargocki, David P. Wyon, Jan Sundell, Geo Clausen and P. Ole Fanger, The Effects of Outdoor Air Supply Rate in an Office on Perceived Air Quality, Sick Building Syndrome (SBS) Symptoms and Productivity, Indoor Air 2000; 10: 222–236

Richard Menzies; Robyn Tamblyn; Jean-Pierre Farant; James Hanley; Fatima Nunes; Robert Tamblyn, The Effect of Varying Levels of Outdoor-Air Supply on the Symptoms of Sick Building Syndrome, The New England Journal of Medicine, 328, 12, March 25, 1993

Rotton J. and S. M. White, Air pollution, the sick building syndrome, and social behavior, Environment International, Vol. 22, No. 1, pp. 53-60, 1996

Sumedha M. Joshi, The sick building syndrome, Indian J Occup Environ Med. Aug; 12(2): 61–64, 2008

Thirumalaikolundusubramanian P., S. Shanmuganandan, A. Uma, Tight or sick building syndrome, Energy and Buildings, 15 - 16 795 – 797, 1990/91

Wan G. H. and C. S. Li, Indoor endotoxin and glucan in association with sick building syndrome, Aerosol Sci. Vol. 29. Suppl. 1, pp. S130941310,1998

Yuhjung John Tsai, M. Eric Gershwin, The sick building syndrome - What is it when it is? COMP THER. 2002;28(2):140–144

Human Rights:

Human Rights groups in Sri Lanka complained to Human Rights Commission on Brandix for their treatment of workers during the pandemic.

"Over 1500 garment workers and their family members have tested positive for COVID-19 at the Brandix factory in Minuwangoda, Sri Lanka. The factory reportedly continued to maintain production to achieve set targets and failed to stop the developing health crisis among the workers.

Rights groups filed a complaint with the Human Rights Commission of Sri Lanka after the military rounded up workers late at night on 11 October and allegedly forcibly took them to quarantine centres. Workers - the majority women - report the facilities are unsanitary and they have suffered cruel, inhumane and degrading treatment. Rights groups have also requested the Department of Labour and Ministry of Health to conduct an investigation into the incident."

[https://www.business-humanrights.org/en/latest-news/sri-lanka-garment-workers-arbitrarily-detained-and-quarantined-in-unsafe-conditions-activists-file-complaint-with-govt-bodies/]

As is normal, Brandix denied unsafe conditions but workers were infected with Covid 19 because the workers were forced to work to meet production targets.

Covid -19:

"ECONOMYNEXT – Sri Lanka is battling a resurgence of the COVID-19 pandemic, with a fresh cluster that emerged over the weekend around an apparel factory now moving past 1,000 confirmed cases – the single largest yet in the island.

The number of COVID-19 positive cases detected at the Brandix plant in Minuwangoda, Gampaha, rose to 1,022 a short while ago, with 190 new patients identified as at 2 pm today (07), the National Operating Centre for the Prevention of COVID-19 (NOCPOC) said. A 39-year-old supervisor at the Brandix factory tested positive for the novel coronavirus in the early hours of Sunday (04). Aggressive testing of the employee's direct contacts has subsequently confirmed the spread of the disease within the factory." (October 7, 2020)

[https://economynext.com/brandix-cluster-passes-1000-confirmed-cases-in-sri-lankas-biggest-covid-19-outbreak-yet-74514/]

"ECONOMYNEXT – Over 50,000 of Sri Lanka's free trade zone (FTZ) workers are at risk of exposure to COVID-19 as a result of the unexpected Brandix apparel factory cluster which at last count was at 1,034 confirmed cases.

Programme Coordinator of Dabindu Collective Chamila Thushari told EconomyNext that despite the prevalent situation in the country, factories in the Katunayake FTZ have pressured employees into reporting to work." (October 8, 2020)

[https://economynext.com/50000-ftz-workers-at-risk-of-covid-19-exposure-in-sri-laka-activist-74604/]

"Staff who fell ill saw the company doctor, but many went back to the production line having been told that the factory's owner Brandix, which makes clothes for brands including Gap, Victoria's Secret and Marks & Spencer, had orders to fulfill.

Now, the district of Gampaha, where the factory is located, is at the centre of Sri Lanka's biggest coronavirus outbreak, with more than 7,000 cases - over half the national total.

More than 1,000 of the factory's 1,400 workers have tested positive for COVID-19, putting Brandix - one of Sri Lanka's largest apparel companies - in the spotlight.

Sri Lanka's attorney general has ordered an investigation into whether the apparent spread of the disease from the factory could have been prevented, saying it "endangered human life"."

[https://www.reuters.com/article/us-health-coronavirus-sri-lanka-workers-idUSKBN27K08Z]

"The company has also appointed an independent committee to probe the allegations by one of its employees who claimed that workers were forced to work with fever in the Minuwangoda plant and has assured that if these claims was factual, appropriate action would be taken."

[https://www.business-humanrights.org/en/latest-news/sri-lanka-brandix-comments-on-accusations-of-endangering-garment-workers-contributing-to-rise-in-national-covid-cases/]

Here at Brandix India also work continued with reduced number of workers during covid phases. Workers were issued passes to attend work. Details about their infection status are not available.

Energy Issues:

Garment factories consume considerable energy for maintaining thermal comfort at work. A study done in Sri Lanka garment factories on energy audit is presented here.

"From the study, it has been found that the major energy consumer is air conditioner which records average percentage of 46 % of the total energy consumed. Whereas, the areas-wise assessment reveals that sewing area consume major part of the energy which is in the range from 40-65% of the total energy consumed. It has also been found that the potential for energy saving in this sector is in the region of 15-30%." [Jananthant R, Ameer S, Shiyamini R. Comparative study of energy assessment from apparel industries: the context of Sri Lanka. First International Conference on Industrial and Information Systems, ICIIS 2006, August 8-11, 2006, Sri Lanka]

From the above study, it is clear that the energy consumption in Brandix Intimate Apparel is substantial as it involves sewing operations and air conditioning. To save energy operating the AHUs at lower capacity or reducing fresh air intake could lead to the accumulation of pollutants like CO_2 in the indoor air. Our modelling and simulation of the air handling system appended to this report showed that at low fresh air flows below number of air changes of 2 could exponentially increase CO_2 concentration in the building to a level that causes dizziness, nausea, headache etc. Our ventilation study "Mass fainting of women workers at Brandix" is appended.

Annual report for 2020-21 of Brandix presents the conditions maintained in the building.

- *"Modification of air handling units (AHUs) to increase the flow of air fresh into the building*
- *Maintenance of indoor room temperature of centralised HVAC systems between 27-30°C, with evidence indicating that lower temperature zones create a more favourable environment for viral activation*
- *Maintenance of indoor carbon dioxide (CO_2) levels below 900 ppm by resetting the building management systems (BMS) and /or manual adjustment of fresh air dampers and monitored monthly through the use of portable CO_2 analysers"*

[https://brandix.com/images/brandix-sustainability-report-2020-21.pdf]

Joint committee has not presented any data on any of the conditions like temperature and airflow rate maintained in buildings M1 and M2 at BIAC, Achyutapuram. Brandix installed sensors for 6 gases but not for CO_2 a reliable indicator for IAQ. Such data indicate the quality of the indoor environment of the workplace.

Recommendations:

In absence of information on the indoor environment in buildings M1 and M2, there is an urgent need to examine the actual operating data of the AHUs over a period including the days on which the incidents of fainting occurred.

JC should examine

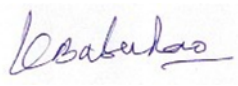
- The actual operating data of the AHUs
- Check the adequacy of fresh air rate from each of the 4 AHUs input to the buildings.
- Calculate air change rates and verify meeting the standards.
- Indoor air temperature at various locations within the buildings
- Indoor air quality to be measured. It should include bioaerosols.
- Map the work location of the fainted workers and examine for patterns of affected workers within the building.
- Monitor Carbon dioxide concentrations within the building at different locations as per the pattern evolved from the mapping above.
- Brandix to hire ventilation consultants to study air exchange efficiencies in M1 and M2.

Conclusions:

In absence of information except for the interim reports of JC available through the NGT website, drawing any conclusions is inappropriate. But based on the literature presented above and a number of such fainting episodes reported in several countries, we are certain that no external chemical emissions are involved in the two incidents. If external emissions are indeed the cause for the fainting incident, similar fainting events must have been reported in the neighbourhood work places. In the absence of such an information, one can only conclude that local conditions were responsible for the mass fainting incident.

Conditions leading to poor ventilation of the factory buildings are eminently possible and can affect the workers adversely. Thorough examination of the AHUs and ventilation system is essential before making any conclusions.

We are certain that without correcting and improving the working environment at Brandix Intimate Apparel, more such mass fainting incidents will repeat.



Dr K Babu Rao | Dr K Venkat Reddy | Dr C V S Murty

Dr Ch Venkateswarlu | Dr D Rambabu | Dr Ahamed khan

Encl: Mass fainting of women workers at Brandix, a report

Mass fainting of Women Workers at Brandix

Assessment of Indoor Air

Several such fainting incidents happened in garment factories around the world. Most reported cases are from Cambodia. Ath Thorn, president of the Cambodian Labour Confederation told The Phnom Penh Post that each year between 1,000 and 1,500 workers faint on the job.

"The scientific explanations for fainting are numerous and varied, touching on aspects of physics, biology and psychology but the most common proximate causes in these incidents are chemical fumes, poor working conditions and excessive overtime. We have also seen negligence on the part of employers. They have their employees working in what amounts to **a big metal box with closed doors and windows and little ventilation**, which makes them very hot. Adding to the problem, **factories often use chemicals improperly causing lingering fumes**," Thorn said. [https://www.phnompenhpost.com/national/group-reveals-finding-factory-fainting-phenomenon]

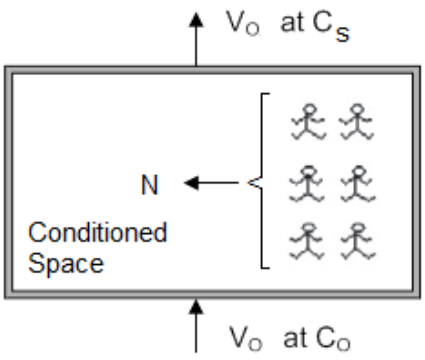
Scientists for people has been informing the relevant authorities on the need to check the ventilation system of the factory buildings and also the experts nominated to investigate the accidents. Unfortunately, these experts are stuck with the idea of external source of emissions and refuse to refresh their minds.

So, we decided to check the ventilation system performance based on theory and available limited data and demonstrate the potential for accumulation of pollutants in the indoor air of the factory buildings.

Total capacity of the AHUs for each of M1 and M2 = 124800 CFM = 212,036 m^3/hr is the only information listed in the interim reports of the Joint Committee. Vital information on the rate of fresh air supply is missing.

We consider and check through simple simulation how the pollutant carbon dioxide builds up in the building for different rates of fresh air. First, the simple basic equations that tell the story.

A Steady-state Mass-balance equation for CO_2 or any pollutants in a ventilated space can be written as



Vo * Co + N = Vo * Cs

Where,

- Vo = outdoor airflow rate, m^3/s
- Cs = CO_2 concentration in the space, mg/m^3
- Co = CO_2 concentration in the outdoor air, mg/m^3
- N = CO_2 generation rate, g/s

The above equation can also be rearranged to get ventilation rate V_o

$V_o = N/ (C_s – C_o)$

And also, steady-state pollutant concentration C_s, can be calculated using

$C_s = N/V_o + C_o$

For carbon dioxide, ambient air concentration is

C_0 = 415 ppm =747 mg/m^3

If we propose to limit the concentration of CO_2 to a maximum of 1000 ppm, the safe level without adverse effects.

C_s = 1000 ppm = 1800 mg/m^3

No of workers = 1000

Normal at rest person:

Breathing rate for normal sedentary person = 6 L/min per person

Exhalation concentration of CO_2 = 42000 ppm = 75600 mg/m^3

Release rate of CO_2 = 6 x 1000/1000 x 75600 = 453600 mg/min

V_o = 453600 / (1800 – 747) = 430.77 m^3/min = 25,846 m^3/hr

$C_s = N/V_o + C_0$

M1 or M2 Building volume V_b = 20000 m^3

Number of Air changes = Fresh air rate/ Building volume = V_o/V_b

In workplaces, air needs to be changed between 8 and 12 times per hour and there should be at least 10 cubic meters of air per worker. [Ergonomics in the garment industry, P195] A value of 10 litres per second per person is recommended in many guides as a suitable value for most commercial buildings." [UK code of practice] Air per worker is 20000/1000 = 20 m^3 and is adequate.

On the day of the second incident, 940 workers were present in M1.

Based on the air change criterion:

Fresh Air rate for air changes = 8 x 20000 m^3/hr = 160,000 m^3/hr

Fresh Air rate for air changes = 12 x 20000 m^3/hr = 240,000 m^3/hr

Total capacity of the four AHUs serving each building is not adequate to supply fresh air to the buildings as per ergonomic standard for garment factory.

Based on the fresh air per worker criterion:

Fresh air required as per UK code = 10 x 940 = 9400 l/s = 9400 x 3600/1000

= 33,840 m^3/hr

What the fresh air rate is during the actual operation is unknown. JC or Director of factories officials have not collected that information for their reports.

Taking the fresh air rate supplied varying between 5000 m^3/hr to 60000 m^3/hr and the carbon dioxide generation for sedentary persons, the steady state CO_2 concentration reached in the buildings are tabulated below.

S No	Fresh Air Rate, m^3/hr	Air Changes	CO_2 Concentration	
			mg/m^3	ppm
1	5000	0.25	6190	3439
2	10000	0.5	3468	1927
3	20000	1	2108	1171
4	40000	2	1427	793
5	60000	3	1201	667

It is evident that fresh air supply is a critical parameter and there is every possibility of CO_2 concentrations jumping up due to maloperation. Symptoms exhibited by workers are possible from exposure to high CO_2.

But for women in the occupation of tailoring and sewing, the metabolic equivalent task rating is 2.5. So, the carbon dioxide generation rate is much higher than the value taken in the above computations.

Carbon dioxide emission from persons and their activity:

Activity	**Respiration per Person *(m^3/h)***	**Carbon Dioxide Emission per Person *(m^3/h)***
Sleep	0.3	0.013
Resting or low activity work	0.5	0.02
Normal work	2 - 3	0.08 - 0.13
Hard work	7 - 8	0.33 - 0.38

- *1 m^3/h = 0.5886 ft^3/min (cfm)*

https://www.engineeringtoolbox.com/co2-persons-d_691.html

Taking the maximum emission for the normal work of 0.13 m^3/hr, carbon dioxide generated in the building = 1000 x 0.13 = 130 m^3/hr = 233.68 kg/hr = 54.91 g/s

Taking the equation $C_s = N/V_o + C_o$ and using the above data

C_s = 54.91 x 1000 x 3600/20000 +747 = 10630 mg/m^3

S No	Fresh Air Rate, m^3/hr	Air changes	CO_2 Concentration,	
			mg/m^3	ppm
1	5000	0.25	40282	22379
2	10000	0.5	20515	11397
3	20000	1	10630	5756
4	40000	2	5689	3161
5	60000	3	4042	2246

'The calculations presented above clearly demonstrate the need to thoroughly examine the ventilation system operational data and refine the calculations with actual field data inputs. If left alone and keep arguing about external emissions there will be repeated incidents of mass fainting. Ventilation is expensive and to cut costs AHUs are operated with low fresh air input to save energy.

Industrial ventilation experts, like the Green Building Council of India, should be engaged to study the performance of the ventilation system. Air change efficiency within the building should be assessed.

The epidemiological study report by NIN and ICMR on the second incident included in the interim report indicates localized effects due to the poor mixing of air inside the building.

"Analysis of the patient line list provided by the industry:

Of the 2069 employees in the industry during the afternoon shift, 129 developed symptoms (Attack rate – 6 per 100 people). Employees of the M1 section were affected more (12 per 100 people, 119/999) when compared with the M2 section (1 per 100, 7/780) and the L section (1 per 100, 3/290). Females (7 per 100) were affected more than males (only 1 out of 278). **The attack rate among the quality auditors (78 per 100, 18/23) was disproportionately higher** than the sewing machine operators (8 per 100, 85/1084)."

A few points to consider are:

In all the ventilated buildings at Brandix CO_2 detectors should be installed and monitored. Air exchange efficiency should be studied to get air distribution quality in the building.

Map the location of all the victims in the first and second incidents in buildings M1 and M2.

Try to reason and assess why more workers in M1 are disproportionately affected compared to those working in M2.

Allowing work in those buildings should be based on a thorough study by real ventilation experts and not court experts of APPCB or DF.

Scientists for People