Environmental improvement of a large-scale football manufacturing industry in line with the FIFA Eco-design requirements

Abstract

Pakistan is the second-largest manufacturer of high-quality footballs worldwide. The current study was conducted to improve the environment of a large-scale football manufacturing industry located in Sialkot. The objectives of this study were to conduct an environmental baseline study of the industry considering noise, air, water, solid waste, and energy aspects, and to construct an environmental management plan of the industry for environmental improvement. Quantitative and qualitative surveys were used to collect data. Temperature, humidity, light intensity, noise, suspended particulate matter and gaseous emissions (CO, Ozone, SO_2, NO_2, NH_3, H_2S) were measured by using different instruments on-site. The results have shown that the relative humidity was high in the bladder dipping hall (77%) and material cutting hall (72%) as compared to OSHA standards (i.e. 20-60%). The suspended particulate matter in the powder coating area was very higher (14535 $\mu g/m^3$) than NEQS/PEQS limits (i.e. 500 $\mu g/m^3$). Ammonia (NH_3) gas concentration was very high in the dipping hall (48.6 ppm), machine stitching hall (1.7 ppm), thermo-fitting hall (2.5 ppm), pasting hall (10.83 ppm), and bladder fitting hall (3 ppm) as compared to the standard value (i.e. 0.4 ppm). Sulfur dioxide (SO_2) gas concentration in bladder fitting hall (3.3 ppm), thermo-fitting hall (1.62 ppm) and dipping hall (1.54 ppm) was higher than the standard limit of PEQS (i.e. 0.12 ppm). Nitrogen dioxide (NO_2) gas concentration in the printing hall (0.108 ppm) and dipping hall (0.136 ppm) was higher than the standard limit of PEQS (i.e. 0.08 ppm). The noise level was high in panel punching hall (108.37 dB), cutting area (86.06 dB) and press cutting hall (108.7 dB) as compared to the NEQS limit (i.e. 80 dB). The analysis of drinking water samples revealed that the studied parameters (pH, EC, TDS, alkalinity, nitrate, chloride, sulfate, arsenic, total coliform) were within the limit of the WHO and PEQS except for bacterial contamination (i.e. total coliform). The total coliform bacteria were found 80 CFU/mL exceeding the WHO and PEQS limits (i.e. 0 CFU/100 mL). In the quantitative survey, a self-designed questionnaire was developed to examine the work-related occupational health, safety, and environment in different halls of the industry. It was observed that workers feel back

pain and shoulder stiffness for working straight 8 hours. The area around the workplace was with chemical and water spillage and the ventilation system inside the industry was very poor. In the qualitative survey, in-depth interviews were conducted from the focus group of the industry. The environmental management plan of the industry was also developed. It was observed that the proper ventilation system was not installed inside the bladder dipping hall. Workers were facing ammonia poisoning inside the dipping hall due to the use of ammonium-based solvents and very high humidity. It is recommended that for the control of ammonia in the dipping hall, special masks for the adsorption/absorption of ammonia along with goggles are recommended. To avoid noise exposure in panel cutting/press cutting and panel sorting hall, the panel sorting area can easily be isolated/cordon off by having soft partition. To prevent any bacterial contamination in drinking water, it is required to add a UV system with all drinking water points and fix white-colored ceramics tiles for proper cleanliness. Small scale wastewater treatment plant comprising of chemical and advanced oxidation (ozone) is suggested for the proper treatment of wastewater. To manage solid waste, a cleanup drive is recommended to manage waste. It is also recommended that the industry should appoint a team for environmental, health and safety.