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PRELIMINARY ASSESSMENT OF THE EFFECTIVE APPLICATION OF SOLUTIONS TO IMPROVE WORKING ENVIRONMENT IN GARMENT ENTERPRISE

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ABSTRACT

The article introduces the study on applying some solutions to improve the working environment at a garment enterprise in the South Central Coast region and the economic-technical efficiency of the application of those solutions. After assessing the current status of the working environment and workers' health of the enterprise, the authors have advised enterprises to apply a number of solutions to improve working conditions such as establishing an occupational safety and health (OSH) management system; designing anti-heat ventilation system by exhaust fan system creating negative pressure in the workshop and cooling by Cooling Pad and re-organizing the lighting system. After more than a year of implementing these solutions, when re-evaluating, they all give positive results: reducing the temperature by 3-5.5°C, dust concentration from 0.15-0.45 mg/m³, increasing light intensity levels to 150-280 lux. As a result, the company's revenue also increased.

KEY WORDS: Improving, Working environment, Improvement measures, Economic-technical efficiency, Occupational safety and health, Occupational accidents and diseases, Workers' health.

INTRODUCTION

Textile and garment is one of the important industries in Vietnam with a large number of laborers, so improving the working environment in the textile and garment industry becomes a matter of concern to protect workers' health and contribute to increasing labor productivity and ensuring efficient production and business.

According to VCBS report (2022), currently there are about 8,000 textile and garment enterprises with small and medium scale in the country which accounting for the majority. The labor force of the textile and garment industry is very large with more than 1.5 million workers, accounted for 13% of the number of laborers in Vietnam. In 2021, the export turnover of the textile and garment industry reached 40.3 billion USD, increased 15.2% in comparison to 2020.

For the development of the garment industry, enterprises should meet the competitive

requirements with increasingly high product quality. Besides having to work overtime to keep up with economic contracts, working with high intensity and awkward postures, employees also have to bear many risks of occupational diseases due to the polluted working environment such as dust, noise and poor lighting. Even if there is a fire or explosion, it is dangerous to health and life because the workshops contain many flammable materials.

However, due to the application of solutions to improve the working environment does not show direct benefits, small enterprises with little capital are often not interested in these solutions. The study team's goal proves that just by applying simple and cheap solutions to improve the working environment, workers' health will be increased, occupational accidents will be reduced and through that labor productivity will also be increased. As the revenue and profit of the enterprise increase, the salary of employees also increases. In addition, building an OSH management system and

improving the working environment will help enterprises improve their corporate social responsibility, overcome technical barriers and have more customers in difficult countries.

Through this study, the participants want to prove to goods exporting enterprises especially garment enterprises that investment in improving the working environment is not too complicated and expensive, but brings good returns.

The enterprise selected for this study is Phan Rang Garment Co., Ltd., Ninh Thuan Province, in the South Central Coast of Vietnam, which was established in 2006 with the business field of garment production. Since its establishment, the enterprise has applied a number of national technical regulations but it is not synchronous and strict.

MATERIALS AND METHODS

The study was carried out in the sewing workshop No.1, Phan Rang Garment Co., Ltd., Ninh Thuan Province, Vietnam from July 2021 to December 2022.

In this study the following methods were used:

- + Review of published works on improving the working environment in the garment industry;
- + Data analysis;
- + Actual investigation and survey;
- + Design consultancy.

RESULTS AND DISCUSSION

1. Status of working conditions before renovation

- The enterprise has not implemented an OSH management system.

- There are a number of ventilation fans located in the factory, the lighting system is fluorescent tube lights hanging high on the ceiling, there are no

measures to improve the working environment; cramped production space. The working environment situation of the enterprise before applying the improvement measures measured by the study team is shown in Table 1.

Comment: Due to many reasons such as poor working environment, the labor intensity and rhythm is high, at the fabric cutting workshop, the number of workers suffering from eye strain, dizziness and fatigue after the shift is quite high (30-35%); at sewing workshops, the rate of eye fatigue is highest (22.42-22.67%), followed by fatigue (19.33-19.39%) and headache (15.33-16.97%).

Proposing to apply solutions to improve working environment and results

Establishment of an OSH management system

In order to manage the working environment well, the study team has proposed that enterprises take five successive steps, as follows:

Step 1: Consolidate the OSH management systems in accordance with regulations, make a plan to assess the risks of occupational accidents and occupational diseases at each employee's job position;

Step 2: Implement risk assessment that may cause occupational accidents and occupational diseases at each employee's job position: Identify dangerous and harmful factors;

Step 3: Summarize results of assessment of possible risks of occupational accidents and diseases: Rank the level of risk that may cause occupational accidents and diseases for employees at each job position;

Step 4: Eliminate hazards of occupational accidents and occupational diseases; alternative work processes safer; use technical measures; apply

Table 1. Working environment before applying improvement measures (Time: 10.00-12.00, August 12, 2021)

No.	Sampling locations	Air temperature (°C)	Air humidity (%)	Concentration of dust (mg/m ³)	Noise levels (dBA)	Speed of winds (m/s)	Lighting intensity (lux)
1	Outside	31,8	80,5	0,23	68,5	0,5	
2	Fabric cutting area	33,2	83,7	1,45	89,0	0,17	520
3	Sewing area 1	33,9	86,5	1,56	88,5	0,15	600
4	Sewing area 2	33,5	86,8	1,65	87,5	0,15	585
5	Ironing area	34,5	83,4	0,85	86,0	0,25	545
6	Finished product inspection	33,6	84,6	1,15	87,0	0,10	485
7	National technical regulation (QCVN) [1], [2], [3], [5]	≤ 32	≤ 80,0	1,0	85,0	0,2-1,5	700

administrative measures; reasonable use of PPE;
 - Step 5: Check, regularly monitor and correct any errors that arise.

Organize ventilation and cooling; reduce dust concentration in the workshop

For studied enterprises, due to low budget and limited orders, the authors apply a simple, inexpensive but technically effective solution which is the calculation method to organize air exchange in the form of negative wind pressure in the workshop by using an exhaust fan on one side of the vertical wall, the opposite wall is a cooling pad and after obtaining the consent of the enterprise, we have calculated for sewing workshop No.1 as follows:

- Workshop area: 80 x 45 x 6.5m; having 400 employees; choosing the air exchange coefficient in the workshop to be $n=20$. The ventilation capacity is calculated: 468,000m³/h; effectively reducing the temperature in the workshop down from 3.5°C-5°C; the wind speed in the workshop is from 1.3-1.6m/s (which satisfying the requirements of Vietnam standards).

- With ventilation capacity of 468,000 m³/h, choosing 14 axial fans HTF.1100, power: 8.4 kW, cost (including installation): 52,500,000 VND.

- Regarding cooling, choosing 68 cooling pads placed on the opposite wall, cooling water flow: 1.4m³/h; cost: 35,802,000 VND, pump capacity: 1.5kW. Total cost of the whole system: 88,302,000 VND. As a result, dust concentration in the workshop is also reduced due to being diluted. The advantages of the proposed negative pressure ventilation system: environmentally friendly; low cost, easy installation, stable operation, no maintenance cost; the air flow rate and mounting position can be adjusted accordingly (see Figure 1).

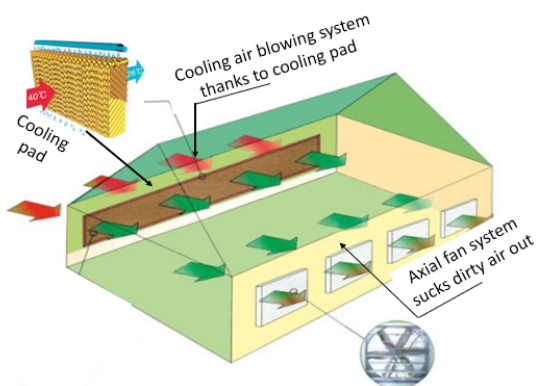


Fig. 1. Ventilation system to cool and reduce dust concentration

Renovate the lighting system

The current lighting system is not reasonable (the lights are hanging at a height of 3.0m from the sewing table, using 1.2m fluorescent bulbs). The team replaced the 200 fluorescent lights with 1M2 T8 N02 M21/20WX1 LEDs that emit higher levels of light than conventional fluorescents but use less energy. Cost of buying and installing lights: 20,700,000 VND; the power capacity of the lights is 4 kW. The light intensity at the sewing table increases from 115-280 lux, reaching: 750-800 lux (QCVN: 700 lux) (see Figure 2).

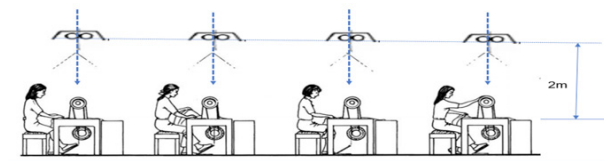


Fig. 2. Replacing the lighting system

Reduce the impact of noise

According to Huong Nguyen Quynh (2012), Vietnam National Institute of Occupational Safety and Health, an industrial sewing machine has a noise levels from 78.5 to 81.4 dBA (depending on the type of fabric and the machine operating time). The noise in the workshop is increased by 4 to 6 dBA due to the noise resonance of 400 sewing machines, when placed only 1.7m to 1.8m apart/machine. The best solution to reduce noise is to distance the machines, reduce the density. However, in the current situation of revenue decline, it cannot be done. The proposed option is to provide noise-canceling earplugs for employees, as wearing the sound intensity is reduced from 5-8dBA.

More than a year after designing and applying the above solutions to improve the working environment, through surveys, the working environment as well as the workers' health at the enterprise has also improved significantly (see Table 3 and 4).

Comment: After applying ventilation and lighting solutions, the air temperature in the workshop decreased from 3.5-5°C, the air circulation speed increased from 1.25-1.5 m/s, dust concentration decreased from 0.6-1.40 mg/m³, light intensity increased from 125-280 lux, reaching the allowable requirement of 700-750 lux.

Comment: It is shown that after more than a year of applying solutions to improve working conditions, the number of employees experiencing health

symptoms such as fatigue, headache, dizziness, etc., after the shift is significantly reduced (from 15%-32%); due to satisfactory lighting, the number of employees suffering from eyestrain reduced by 18%.

Evaluation of the economic-technical efficiency of the applied solutions to improve the working environment

To evaluate the efficiency of production and business through the applied solutions to ensure OSH, improving the working environment is considered as a difficult job; it depends on many factors of which the working environment is just a small part and the impact is usually indirect and cannot be directly determined through financial values. The factors include:

- Group of external factors: Consist of the world economic environment, market situation and economic policy of the State. It can be seen that it is difficult for enterprises to influence the group of external factors. However, enterprises can take advantage of this group such as improving the working environment to maximize support for enterprises in increasing markets that require

corporate culture, corporate social responsibility, thereby developing production and business.

- Group of internal factors: Consist of labor resources, capital, technology, current status and ability to organize management and production organization. The improvement of the working environment will affect the labor source and production organization, improving workers' health and well-being at work, maintaining high labor intensity throughout the day, so labor productivity is improved.

In fact, in 2021 and 2022, the enterprise has almost no change in the group of internal factors (reduced personnel by 3.13%, considered unchanged), during nearly two years of operation of the enterprise. None of the company's employees have been infected with Covid-19. Therefore, in order to relatively evaluate the impact of improving working conditions, reducing accidents and diseases, we consider other factors to be fixed; only the working environment is changed. Despite being directly affected by the Covid-19 pandemic, thanks to flexibility in solutions, Vietnam's textile industry in general and Phan Rang Garment Co., Ltd. in

Table 2. Working environment after applying improvement measures (January 29, 2023)

No.	Sampling locations	Air temperature (°C)	Air humidity (%)	Concentration of dust (mg/m ³)	Speed of winds (m/s)	Lighting intensity (lux)
1	Outside	31.6	78.5	0.25	0.65	
2	Fabric cutting area	28.6	80.5	0.25	1.75	730
3	Sewing area 1	27.3	81.7	0.23	1.65	740
4	Sewing area 2	27.5	82.6	0.21	1.60	728
5	Ironing area	29.2	80.5	0.15	1.60	715
6	Finished product inspection	28.8	80.6	0.25	1.63	760
7	National technical regulation (QCVN) [1],[2],[3],[4]	≤ 32	≤ 80	1.0	0.2-1.5	700

Table 3. Workers' health status after applying solutions to improve working environment (January 2023)

Symptoms of disease	Fabric cutting area N=20		Sewing area 1N=152		Sewing area 2N=158		Finished product inspection N=35	
	Q	R,%	Q	R,%	Q	R,%	Q	R,%
Tiredness	2	10.0	6	3.80	8	5.06	1	2.86
Headaches	1	5.0	5	3.29	6	3.80	0	0.0
Insomniac	3	15.0	7	4.60	7	4.43	2	5.71
Stress, anger	1	5.0	3	1.97	3	1.89	0	0.0
Dizziness	0	0.0	2	1.32	4	2.53	2	5.71
Musculoskeletal and joint pain	1	5.0	7	4.60	6	3.80	3	8.57
Stomachache	2	10.0	2	1.32	5	3.16	1	2.86
Tinnitus	0	0.0	1	0.66	3	1.89	0	0.0
Eyestrain	1	5.0	4	2.63	7	4.43	0	0.0
Ear, nose and throat pain	2	10.0	5	3.29	8	5.06	1	2.86

particular have firmly overcome all difficulties and continue to achieve great results. Data from the Ministry of Industry and Trade showed that in the first quarter of 2022, Vietnam's textile and garment continued to be in the top of billion USD export, contributing 8.84 billion USD to the country's export turnover and increased by 22.5% year-on-year. Phan Rang Garment Co., Ltd. also gained more markets, increased exports and revenue (see Table 6).

Comment: In reality, the revenue of an enterprise is influenced by many factors including the working environment. For the sake of comparison, we assume that in nearly 2 years, except for changes that positively affect the working environment for employees, other factors remain unchanged and are assumed to be fixed. On the basis of Table 6, it can be analyzed that, after nearly 2 years of applying solutions to improve working conditions, the enterprise has changed in the direction of growth as follows:

- Revenue per worker in 2021 (before applying solutions to improve the working environment):

E revenue/worker=85.854 million VND: 725 workers

= 118.42 million VND/worker

Revenue per worker in 2022 (after applying solutions to improve the working environment):

E revenue/worker = 119.230 million VND: 703

workers

= 169.60 million VND/worker

We have the average revenue growth per worker after 2 years: 43.22%, while the number of workers decreased by 3.03%.

CONCLUSION

The authors have had 2 years of study at Phan Rang garment factory, Ninh Thuan Province, South Central Coast. Thanks to the agreement of the enterprise, the study group designed and applied a number of solutions to improve the working environment such as designing and constructing a ventilation system to prevent heat from reducing dust concentration; renovating lighting system both save electricity and increase the level of lighting; providing more PPE for workers.

The results obtained are as follows:

- Regarding the working environment: Reducing the temperature in the workshops from 3.5°C to 5°C; improve lighting efficiency from 125 to 280 lux, air circulation speed increases from 1.25 to 1.5 m/s, dust concentration decreases from 0.6 to 1.40 mg/m³.

- Regarding workers' health: It can be seen that after more than a year of applying solutions to improve working environment, the number of

Table 4. Evaluation of the effectiveness of solutions to improve enterprise's working conditions and economic efficiency

No	Contents	Time		Note
		2021	2022	
<i>I</i>	<i>Number of employees</i>			
1	Total number of employees (people)	725	703	22 increase
2	Female workers (people)	595	586	09 increase
<i>II</i>	<i>Occupational accidents and diseases and improving the working environment</i>			
3	Total number of occupational accidents (cases)	12	05	58.33% reduce
4	Number of people who died from occupational accidents (people)	0	0	No accidents
5	Number of days off work due to occupational accidents (days)	51	15	50.70% reduce
6	Occupational accident expenses (emergency services, treatment, paid time off due to accidents, compensation, subsidies...) (million VND)	166.0	58.0	65.06% reduce
7	Number of days off work due to illness, diseases (days)	910	328	36.04% reduce
8	Insurance expenses for sick leave (million VND)	361.203	131.24	63.66% reduce
9	Total expenses for occupational accidents, illness, diseases and sick leave (million VND)	452.70	189.24	58.19% reduce
10	Expenses for measures to improve working conditions applied (ventilation, lighting, PPE...) (million VND)	205.0	664.5	224.14% increase
<i>III</i>	<i>Revenue and profit</i>			
11	Revenue (million VND)	85.854,0	119,230.0	38,87% increase
12	Profit(million VND)	10.423,0	14,586.0	39.94% increase

workers with fatigue, headache, dizziness, etc., after the shift decreased significantly (from 15.0% to 32.0%).

- Regarding occupational accidents and diseases: Occupational accidents decreased by 58.33%; the number of days off work due to occupational accidents decreased by 50.70%; the number of days off work due to illness and disease decreased by 36.04%; total costs for occupational accidents, illnesses, diseases and sick leave decreased by 58.52%.

- Economic efficiency: Revenue increased by 38.87%; profit increased by 39.94%.

As mentioned above, working environment is only a small factor affects the production and business activities of the enterprise. But through the results achieved, it is also possible to see the positive role of a good working environment.

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