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CASE STUDY

Resource Efficient and Cleaner Production Indonesia

Textile Sector

PT SAI Apparel Industries
Semarang, Central Java, Indonesia

BACKGROUND

Industrialization is vital for economic development and has helped bring millions out of poverty in recent decades. But as more countries industrialize, growing consumption, rapid urbanization and unsustainable use of natural resources is exacerbating climate change and polluting the ecosystems on which we depend (UNIDO 2017) The pattern of current production and consumption, scale and speed of resource use has almost reached the limit of what planet can offer and sustain. While it is essential that industry continues to grow and prosper, it is also worth considering changing the mindset of the way industrial sector does business and becoming more efficient and responsive to resource consumption and waste generation.

INTRODUCTION

PT Sai Apparel Industries is a private company established in 1998. It is a highly reputable apparel manufacturing company that has 10,000 employees and good plan on production facilities spread over 18 hectares of land in Semarang. PT Sai Apparel Industries production facility is located in Jl. Brigadir Jendral Sudiarto KM 11, Kota Semarang, Central Java.

With guidance of buyer's environmental sustainability programs, PT Sai Apparel Industries identify and implement resource efficiency measures. Through the introduction of the RECP programme, new energy-efficient options were identified and implemented, focusing on the garment wash processing section. Unlike other processes, garment wash processing uses steam, waste water and chemicals, making it a key focus for RECP.

PROCESS DESCRIPTION

In this case study, the focus is on garment wash processing. The major operation unit in garment wash processing is shown in the diagram in **Figure 1.**
During the entire process, large quantities of materials like garment, water, chemicals and energy (electrical and thermal) are being used and they generate significant emissions that raise operation and waste management costs.

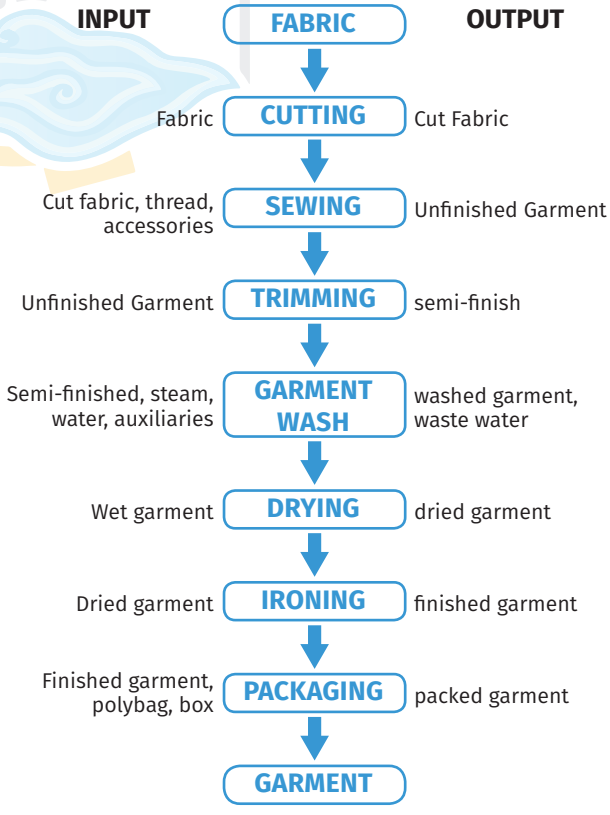

Figure 1: *Flow chart of garment wash processing*

RECP POTENTIAL

In accordance with the company's corporate philosophy, PT Sai Apparel Industries has initiated several resource conservation options, to move towards environmental and financial sustainability. The company RECP team along with RECP experts determined the resource efficiency baseline, specifically liquid pollution as well as greenhouse gas emissions from energy use.

The specific resource consumption presented in **Table 1** indicates that specific energy, water and chemical consumption in the company is higher compared to industrial benchmarks. As reported by management and experts, higher consumption of resources is due to several factors, for example old piping for water and steam distribution and high energy consumption due to high liquor to cloth ratio.

Table 1: *Baseline data and potential of RECP in the unit*

Components	Unit	Baseline before RECP	RECP potential	Potential Cost Saving USD/year	Remarks
Production*	Piece/ year	16,981,333	21,000,000	NR	production data based on 20,000,000 pieces/ year
Total electrical energy	MWh/ year	7,201*	6,435	-------	
Specific Electricity Consumption	kWh/ piece	0.42	0.37 (11,9%)	110,000	Electricity cost = 0.11 USD/kWh
Total Diesel	MT/ year	21,000	16,800		
Specific Diesel Consumption	kg/ piece	0.016	0.009 (43.7%)	84,000	Diesel cost = 0.6 USD/L
GHG emissions*	T/year	8,160	6,457 (20.9%)		GHG reduction 1,703 T/ year
Water consumption	M3/ piece	0.035	0.021 (40%)	56,000	Water cost = USD 0.2/ M^3
Specific WW generation	M3/ piece	0.011	0.006 (45.5%)	40,000	Waste water cost = USD 0.4/M^3
TOTAL				**290,000**	Saving USD 0.0145/ piece

POTENTIAL REDUCTION OF RESOURCE EFFICIENCY & EMISSION

Table 1 presents the existing consumption and the potential for savings that can be obtained by implementing RECP measures. For ease of comparison and in accordance with benchmarking studies, resource consumption is calculated per piece of product output.

A total of 28 RECP options were identified during the study and after pre-screening 19 were selected for detailed feasibility analysis and subsequent implementation of techno-economically viable and environmentally desirable RECP solutions.

During the initial stage of implementation, particular attention was paid to those measures which could be carried out at low and medium cost to the unit. Thus far, the unit has implemented 13 RECP options as part of RECP implementation and others options are into consideration. The RECP team and project team estimated the potential for RECP savings USD 438,000 per year, which are presented in **Table 1**.

The results achieved from implementation of 13 techno-economic viable options with an investment of USD **398,667** are compiled in **Table 2**. The management also decided to continue RECP activities in the company even after the completion of the project activities in order to identify and implement additional techno-economically viable RECP options for garment wash processing, reduce water consumption, reduce the volume and load of wastewater, as well as to optimize the thermal & electrical energy consumption.

THE IMPLEMENTATION OF RECP OPTIONS AT PT SAI APPAREL INDUSTRIES

One of the most effective ways of creating more efficient resource usage is to ensure the optimized management of resource use through a dedicated, structured framework that improves performance and maximizes resource consumption and reduce waste generation over time. Number of RECP options were identified during the RECP assessment in PT Sai Apparel Industries and feasibility analysis was conducted by RECP team of PT Sai Apparel Industries. Some of the selected and implemented options are listed below in **Table 2**.

Table 2: *RECP Options Implemented by PT Sai Apparel Industries*

No	RECP options already implemented	Investments
1	Balancing current and voltage in the electric power system.	No Cost
2	Replacing capacitor bank to major motors and main distribution	USD 15,723
3	Replacing the Induction Motor with Servo Motor.	USD 342,890
4	Make notice to turn off the air conditioner and lighting when there is not used.	No cost
5	Turn off machines not actually in use.	No cost
6	Regularly maintain all equipment - heating, ventilation, cooling, and dust.	Low cost
7	Install lighting circuits on off in production area which can be switched off individually	USD 4,526
8	Install LED lamp for all office and production	USD 14,329
9	Use low flow in toilet / restroom.	No cost
10	Regularly maintain all pipes from leaks	Low cost
11	Reduce freshwater consumption and use recycle water for washing production	USD 2,377
12	Installing rain water container in laundry area for washing.	USD 1,020
13	Use condensate water to produce steam in a coal boiler	USD 17,802
Total investment		**USD 398,667**

It was reported that the company has made investments of approximately USD 398,667 to implement the above RECP options, resulting in reduction in energy consumption as well as a reduction of over 1,252 tons of GHG emissions per year. Savings on water consumption and wastewater generation was achieved by 31.4 per cent and 27.3 per cent as presented in **Tabl e 3**.

Table 3: *Results of RECP Options Implemented (as on July 2019)*

No	Compo-nents	Unit	Before RECP	After RECP	Savings (USD/ year)	Remarks
1	***Production***	pieces/ year	16,981,333	19,863,875	NA	Demand -based
2	***Specific Electricity Consumption***	kWh/ pieces	0.42	0.39 (7%)	65,551	Electricity cost = 0.11 USD/kwh
3	***Specific coal consumption***	kg/piece	0.016	0.012 (25%)	47,673	Diesel Cost = USD 0.6/ Liter
6	***Specific water consumption***	m^3/ piece	0.035	0.024 (31.4%)	43,700	Water cost = USD 0.2/M^3
7	***Specific WW generation***	m^3/ piece	0.011	0.008 (27.3%)	23,837	Waste water cost = USD 0.4/M^3
9	***GHG emissions****	T/year	8,160	7358 (9.8%)		GHG reduction = 1,252 T/ year
TOTAL					**180,761**	Saving USD 0.0091/ piece

The reduction achieved so far implementing RECP options are approximately 62.3 per cent of estimated savings potential and 73.5% per cent GHG emissions reduction. RECP is sustainable when it becomes internalized, which has been the case at PT Sai Apparel Industries due to management support and proactive RECP team. During the current RECP assessment, several additional measures were recommended by an international RECP expert, which will be assessed and implemented in accordance with a company review in the future. In the next phase, it is important to continue to collect information on future improvements.

ADDITIONAL RECOMMENDATION OF RECP MEASURES BY PROJECT

1. Install an economizer to preheat feed water and an air pre-heater headed for preheat combustion air.
2. Install a thermocouple to measure the stack gas temperature at stack gas outlet after the air pre-heater to determine maintenance interval.
3. Optimize cloth: liquor ratio to reduce water, steam, chemicals, and energy consumption.
4. Optimization of compressed air as per usage requirement.
5. Recover and reuse condensate as boiler feed water or process water.

CONCLUSION

Highlights of RECP implementation

1. **Reduced specific water consumption 31.4%**
2. **Reduced specific wastewater generation 27.3%**
3. **Reduced specific electricity consumption 7.1%**
4. **Reduced GHG emissions 9.8%**
5. **Improved working environment and Occupational Health and Safety**

The implementation of energy-efficiency measures contributes significantly to enhance profit margins, reduce GHG emissions and improve the workplace environment. For example, in reducing discharge of air emissions, better working conditions and improving the quantity and quality production. As part of the project implementation, a monitoring programme undertook a feasibility analysis of identified options and documented improvements. In hence, the company is now aiming for a market expansion by diversifying its product range.

RESOURCE EFFICIENT AND CLEANER PRODUCTION

Resource Efficient Cleaner Production (RECP) is a new and creative way of thinking towards products and the production processes. It is achieved by the continuous application of preventive strategies to minimize the generation of wastes and emissions. RECP strategy comprises the following eight practices, which are also applied in the demonstration of RECP at PT SAI Apparel Industries:

1. **Good Housekeeping (GHK):** appropriate provisions to prevent leaks and spills (such as preventative maintenance schedules and frequent equipment inspections) and to enforce existing working instructions through proper supervision, training etc.
2. **Input Material Change (IMC):** replacement of non-renewable inputs by low carbon, renewable feedstock.
3. **Better Process Control (BPC):** modification of working procedures, machine instructions and process record-keeping to operate processes at higher efficiency and lower rates of waste and emission generation.
4. **Equipment Modification (EM):** modification of production equipment and utilities (for instance through the addition of measuring and controlling devices) in order to run processes at higher efficiency and lower rates of waste and emission generation.
5. **Technology Change (TC):** replacement of technology, processing sequence and/or synthesis pathway in order to minimize rates of waste and emission generation during production.
6. **On-site Recovery/Reuse (RR):** reuse and recycling of wasted materials and energy (thermal energy) in the same process or for another useful application within the company.
7. **Production of Useful By-Product (BP):** transformation of wasted material into a material that can be reused or recycled for another application outside the company.
8. **Product Modification (PM):** modification of product characteristics in order to minimize resource usage and associated environmental impacts of the product during or after its use (disposal) or to minimize the environmental impacts of its production.

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