Business Case: Steam Distribution

Support to Safety Retrofits and Environmental Upgrades in the Bangladeshi Ready-Made Garment (RMG) Sector

It is Worth to Upgrade the Steam Distribution System

The textile sector is a highly energy-intensive industry. Particularly in the dyeing and finishing processes large quantities of energy are continuously required to generate thermal energy in the form of hot water and steam. Steam provides process heating, pressure control, mechanical driving, and component separation and is also a source of water for many process reactions. To distribute steam to the various processes throughout the factory, extensive steam systems are installed. However, without proper design and maintenance small leaks and inefficiencies inevitably occur across the factory[1]. Improving and maintaining the steam distribution system therefore plays a key role in increasing energy efficiency and saving money.

Advantages of Waste Heat Recovery at a Glance:

- Improved energy efficiency
- Reduced water demand
- Reduced water treatment cost
- Reduced environmental damages

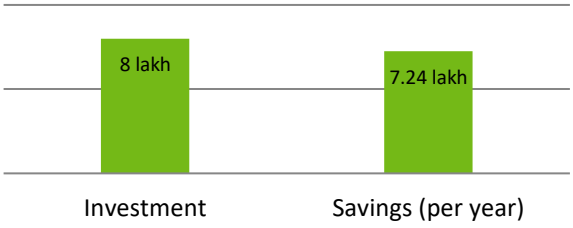
A well performing distribution system delivers sufficient quantities of high-quality steam at the right pressures and temperatures to the end uses. To ensure good performance the piping should be properly sized, supported, insulated, and configured with adequate flexibility. Furthermore, pressure-regulating devices such as pressure-reducing valves and backpressure turbines should be configured to provide proper steam balance among different steam headers. Adequate condensate drainage which requires adequate drip leg capacity and proper steam trap selection[2]is also essential.

In many cases steam distribution efficiency can already be significantly improved by fixing steam leaks and repairing or replacing steam traps. When combined with other measures such as pipe, valve, and flange insulation, these measures can usually save between 4.3% and 10%of the overall fuel demand in a textile factory[3].

The estimated annual cost savings resulting from the reduced fuel demand are between BDT 5.9 lakh and 23.5 lakh. As the investment for the retrofit generally ranges from BDT 4.2 lakh to BDT 12.6 lakh, the corresponding system payback period varies from2 months to 2 years.

Detailed information about the cost and benefits of improving the steam distribution system can be found on the next page, followed by a case study on page 3. Technical details on the installation and implementation process as well as legal requirements and possible means of financing can be found on pages 4 to 5.

Approximate Investment Cost and Annual Savings (BDT)



Case study result from Ornate knit Garments Industries Ltd

Further efficiency measures regarding steam generation and recovery are addressed in the following two additional Business Cases “Waste Heat Recovery” and “Boiler Retrofits”.

Steam and Gas Flowmeter used for steam and gas flow monitoring

[1]Greer, L. et al.(2013). NRDC’s 10 Best Practices for Textile Mills to Save Money and Reduce Pollution

[2]US Department of Energy (2004).Improving Steam System Performance: A Sourcebook for Industry

[3]Greer, L. et al.(2013). NRDC’s 10 Best Practices for Textile Mills to Save Money and Reduce Pollution

Saving Steam and Reducing Fuel Consumption

Improving and maintaining the steam distribution system bears significant energy saving potentials. The following table shows the results of multiple case studies from the RGM sector in Bangladesh:

Improved Energy Efficiency:

Improving Steam Distribution Performance through maintenance and insulation	GLGL commenced operation in 1995 as an export oriented knit factory located in Konabari, Gazipur with a built-up area of 8,688 m^2. GLGL has knitting, dyeing, cutting, sewing and finishing sections with a monthly production capacity of approximately 500,000 pcs of ready-made garments and 82 tons of dyed fabric.GLGL had several steam and heat leaks in its steam distribution system. With the help of regular check-ups and simple maintenance measures steam leaks were identified and closed and hot surface areas were insulated. As a result, GLGL was able to save 3,600 m^3 of natural gas per year (about BDT 25,000 per year).[4]
	Tung Hai Knitting and Dyeing Ltd. (THKDL) started operations in 2005 as an export-oriented sweater manufacturer. The factory is located in Savar, Dhaka with a built-up area of 16,263 m^2. THKDL has knitting, dyeing, washing, cutting, sewing and finishing facilities with a monthly production capacity of approximately 500,000 pcs of sweaters. THKDL had several steam leakages and bare surfaces in many areas of the steam distribution system. Simple maintenance and regular check-ups as well as insulation of bare hot surfaces resulted in savings of 11,500 m^3 of natural gas (about BDT 49,144 per year).[5]
Reducing Steam Consumption by installing steam traps	GLGL used steam irons without a steam trapping system for the individual irons. Without steam traps, steam was directly going to the condensate return line. By installing 20 G-traps the company was able to save 192MWh per annum (about BDT 1.5 lakh per annum in energy costs).[6]

Other Benefits

Reduced Worker Heat Stress	Reducing the length of the existing steam pipes, and insulating control valves and fittings reduces the heat radiation from the system, resulting in a lower indoor ambient (room) temperature. This significantly reduces the workers` exposure to heat stress and the risk of adverse worker productivity and health effects resulting from such exposure. For more information please refer to the Business Case "Worker Heat Stress".
Reduced Noise Emissions	The installation of pipes with larger diameters creates a lower pressure drop for a given flow rate and reduces the noise emissions often associated with the steam flow.
Reduced Greenhouse Gas Emissions	When an effective steam distribution system reduces the demand for fossil fuels, the amount of GHG emissions is also reduced. The CO_2 emission factor is about 1.9 - 2.2 kg CO2eq per m3 of natural gas. (ref. 2014 IPCC Guidelines).

[4]PSES Case Study - GLGL

[5]PSES Case Study – Tung Hai Dyeing Garments Ltd.

[6]Ebd.

Calculating the Cost of Upgrading the Steam Distribution System

The examples from various companies show, that the average cost of upgrading the steam distribution system ranges from BDT 4.2 lakh to BDT 12.6 lakh.

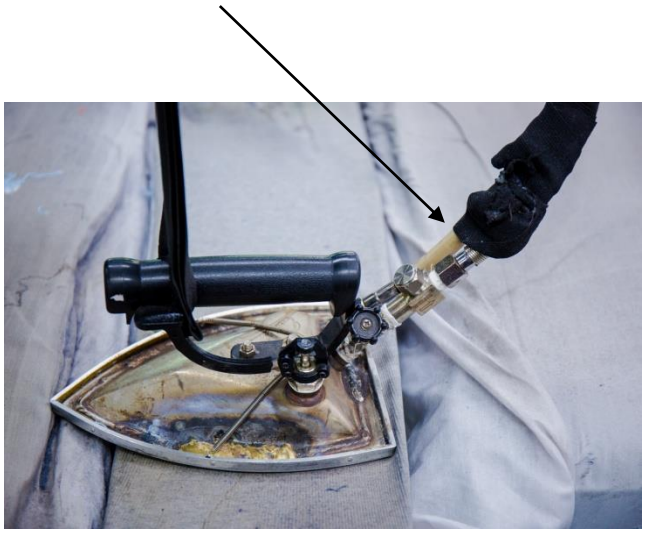
The following table shows typical investments required for the setup of a proper steam distribution system in the textile industry:

Possible investments[7]:

Type of Investment		Average Cost (BDT)	
Materials	**Rate (BDT)**	**Qty.**	**Cost (BDT)**
Valve (2"- 4")	4,000	8	32,000
Separator (4")	16,000	1	16,000
Insulation Jackets 1/2" thickness	2,400	8	19,200
Piping (DN 50)	2,500	60 m	150,000
Pipe insulations	1,200	360 m	432,000
Steam Accumulator (2m3)	160,000	1	160,000
Steam flow meter (3")	24,000	1	24,000
Total Costs			**833,200**
Average amortization period			**0.16-2 Years**

The purchase of an infrared thermometer may be useful to support the efforts of your maintenance team. The cost of a dust and water-resistant infrared thermometer will be in the range of BDT 12,000 to BDT 15,000.

G- Trap. Used In Steam Iron.



[7]Based on Case Study from Ornate Knit Garments Ltd.

Case Study Spotlight: Ornate Knit Garments Industries Ltd, Dhaka, Bangladesh

Description of the Factory

The Textown Group is a well-known textile- and garment exporter. The group has a full range of five production facilities located in Dhaka. Ornate Knit Garments Industries Ltd (Ornate Knit Garments) is one of the units in Dhaka, which started operations in 1990.

The factory currently employs 3,250 workers and has a monthly production capacity of 390,000 pieces.

Implemented Measures

The textile and garment sector is one of the main energy–consuming sectors in Bangladesh, having great potential to improve its energy efficiency. One energy-intensive production step is the generation of steam required in dyeing and ironing units of the factory.

Ornate Knit Garments covers its demand for thermal energy with a total of three steam boilers. Two of these were gas driven boilers, each with a capacity of 4.5 TPH. The third boiler was a waste heat boiler with capacity of 1.5 TPH. All boilers are operated at a pressure between 7.5 bar – 8.5 bars to generate steam for the ironing section. An assessment of the flanges, valves and steam pipe connecting points revealed that these were not insulated, resulting in a high surface temperature of 106°Cfor these parts of the steam distribution system. The first action to minimise unnecessary loss of heat was therefore to properly insulate the distribution system, including the pipes, flanges and valves. These measures immediately lead to significantly reduced surface temperatures of the respective systems parts from 106°C to 31°C (70%).

Additionally, Ornate Knit Garments decided to install 40 new G-type thermostatic steam traps in the ironing section to recover steam condensate. Instead of draining the steam condensate, steam traps capture and redirect the condensate to a tank from where it is returned to the boiler as feed water. With the installation of the steam trap and insulation, the water temperature in the condensate return tank increased from 83°C to 93°C.

Steam Line Jacketing

Investments and Savings

Initial investment for insulation and trap replacement was BDT 8 lakh. As a direct result of the reduced energy losses Ornate Knit Garments was able to achieve monthly energy savings of 48,267 MJ (equivalent natural gas saving 1,340 m^3). Moreover, the monthly energy saving from the installing the steam trap was calculated to be 264,537 MJ (equivalent natural gas 7,350 m^3). The combination of both measures reduced energy costs by BDT 60,390 per month. Thus, the initial investments could be recovered within 13 months.

Jacketing of all Steam Valve, PRV and others equipment's.

Key Performance Measures

Installing steam traps and insulating the steam distribution system reduced Ornate Knit Garments' demand for thermal energy by 0.8 MJ/pc (or 0.022 m^3/pc). Apart from the monetary savings, heat stress of the workers in the ironing section could be reduced significantly. The decrease in natural gas consumption also resulted in a reduction of Green House Gas emission of around 211t CO2eq. per annum.

Team Line Jacketing

References for the Upgradation of Steam Distribution Systems in Bangladesh

Although no binding legal references regarding the efficient use of energy have come into effect in Bangladesh yet (May 2018), the government has recognized the increasing importance of energy as a factor of economic growth and declared Energy Efficiency to be a cross cutting issue for the country. To improve the country'senergy efficiency, the Sustainable and Renewable Energy Development Authority (SREDA) in 2013 published the "Energy Efficiency and Conservation Master Plan (EECMP) up to 2030". The EECMP aims at improving energy intensity (national primary energy consumption per gross domestic product/GDP) in 2030 by 20% compared to the 2013 level. Under the action-plan of the EECMP, three EE&C programs are being promoted, namely, (1) Energy Management Program, (2) EE Labelling Program and (3) EE Buildings Program. In particular, the Energy Management program targets large industrial energy consumers in Bangladesh. Policy measures which are planned to be implemented in the next years include (amongst others): (i) Mandatory energy audits, (ii) energy consumption reporting and (iii) benchmarking. Furthermore, the authority is planning to develop and recommend procedures and regulations for the implementation of minimum energy performance standards and energy efficiency labelling for equipment and appliances[8].

Apart from this, the further development of energy prices (in particular of gas) in Bangladesh is relevant issue to be taken into account in the context of considering energy efficiency measures. In February 2017, the price of domestic gas was already hiked by 22.70%resulting in a price of BDT 7.35 per cubic meter of gas.[9] For 2018 the Government of Bangladesh plans to include LNG in the national Gas Grid by further increasing imports of LNG and developing the LNG import infrastructure. Since LNG is more expensive than domestic gas, the Energy and Mineral Resources Division took the initiative to off-set the cost by raising consumer prices. To cope with this price hike the Bakhrabad Gas Distribution Company (BGDC) recently proposed the Bangladesh Energy Regulatory Commission (BERC) to again hike commercial prices for gas by up to 70%[10].Given the increasing demand for natural gas, prices are expected to further rise in the future.

[8]SREDA (2015). Energy Efficiency and Conservation Master Plan up to 2030

[9]Mahfuj Risad (2018). Titas, Bakhrabad, Karnaphuli sought Price hike of Gas. Available online at: https://energybangla.com/titas-bakhrabad-karnaphuli-sought-price-hike-of-gas/. Last checked on 08.05.2018

[10]Sanchita Shetu (2018). Commercial gas price might rise by 70%, household gas could cost double. Available Online at: https://www.dhakatribune.com/bangladesh/power-energy/2018/03/22/commercial-gas-price-rise/. Last checked on 08.05.2018

Key Steps Required for Implementation

As per experience, the upgradation of the steam distribution system within a factory will approximately take one (1) Month to install (including planning and design).

In order to take advantage of this cost saving opportunities, consider following key steps[11]:

- **Repair steam leaks**: Minimizes avoidable loss of steam
- **Minimize vented steam**: Minimizes avoidable loss of steam
- **Ensure good insulation** of steam system piping, valves, fittings, and vessel: Reduces energy loss from piping and equipment surfaces
- **Implement an effective steam-trap maintenance program**: Reduces passage of live steam into condensate system and promotes efficient operation of end-use heat transfer equipment
- **Isolate steam from unused lines**: Minimizes avoidable loss of steam and reduces energy loss from piping and equipment surfaces
- **Utilize backpressure turbines instead of** steam pressure reduction valves(PRVs)[12] as a more efficient method of reducing steam pressure for low-pressure service

Further technical information on some of the major opportunities available to improve the energy efficiency and productivity of industrial steam systems you may refer to the Steam System Survey Guide[13]developed at the request of the U.S. Department of Energy's Office of Industrial Technologies.

Availability of Materials in Bangladesh

The majority of required materials can be sourced via local traders' certain components need to be imported. You may contact Ornate Knit Garments Industries Ltd. for their recommendation.

Nature of Services Required to Support the Implementation

- Pre–assessment of steam distribution system to identify leaks and weak spots
- Installation and Insulation services conducted by a certified operator required for the steam system. Steam trap installation can be conducted by in-house engineers
- Maintenance services for steam distribution system conducted by either in-house engineers or external service providers

[11]US Department of Energy (2004).Improving Steam System Performance: A Sourcebook for Industry

[12]www.energy.gov/sites/prod/files/2014/05/f16/steam20_turbogenerators.pdf

[13]Available at: https://www.energy.gov/eere/amo/downloads/steam-system-survey-guide. Last checked on: 16.05.2018

Sources of technical support/expertise used

For further technical details and guidance regarding the upgradation of steam distribution systems following resources can be used:

- US Department of Energy (2004). Improving Steam System Performance: A Sourcebook for Industry
- US Department of Energy (n.d.). Steam Tip Sheets[14]
- American Society of Mechanical Engineers (2009). Energy Assessment for Steam Systems
- Armstrong International (n.d.). Installation and Testing of Inverted Bucket Steam Traps. Bulletin 307
- National Insulation Association (2013). Mechanical Insulation Design Guide

Possible Sources for Financing

SREUP credit line could be a good source of financing for such an investment.

Main Feature of SREUP Credit Line	
Loan Type	Normally Term Loan
Discount	Provision and possibility of 20% discount from loaned amount
Loan Tenure	3-5 years in general and in special case up to 7 years
Loan Limit	Normally up to 1 Million Euro and can be increased up to 3 Million Euro in special cases
Interest Rate	7% p.a. (maximum)
Grace period. Debt : Equity Ratio. Repayment	All issues are subject to agreement between borrower and lender

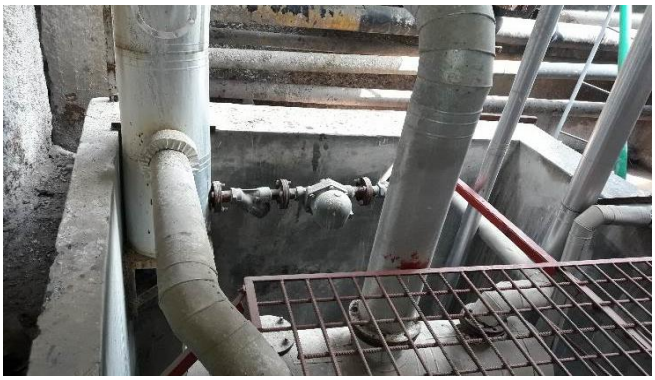
Steam Flowmeter setup for steam Monitoring

[14]Available online at: https://www.energy.gov/eere/amo/tip-sheets-system

Conclusion

Few more photos of equipments are shown here for better understanding of how it works.

Steam Flow meter to monitor and measure steam pressure



Condensate Recovery System/Pump

Thermostat