INSTALLATION OF LOW-GRADE HEAT RECOVERY SYSTEM

(*For Varanasi Textile Cluster*)

Cluster Brief:

Varanasi is considered to be India's oldest city. The city exhibits a very rich amalgamation of religion, faith, culture and traditional practices. Apart from faith and religious values, Varanasi has been known worldwide for its typical and traditional hand woven Benaresi silk sarees. Textile industry has been a leading employment provider in the area. Most of the people associated with textile industry are into weaving (Handloom or power loom). In addition, most of the textile industry is home or cottage industry.

There are few industries in Varanasi with high volume of production and are involved in yarn dyeing and saree dyeing and printing activities. This number in Varanasi is mere 10. In order to form a sizable cluster, textile industries in Varanasi, Bhadohi, Chandauli and Jaunpur districts have been included to form one cluster. The total number of units after combining textile units in these districts comes to 40. The textile units visited in the cluster have at least one of the following processes:

1. Spinning
2. Mechanised weaving
3. Polyester yarn dyeing
4. Woollen yarn dyeing
5. Carpet yarn dyeing
6. Fabric (Saree) dyeing
7. Block printing
8. Screen printing
9. Digital printing
10. Garment manufacturing

The major energy consuming equipment installed and regularly used in the visited units are IBR-boilers/ thermic fluid heater, dyeing machines, dryers and hydro extractors. In Varanasi, out of 10 units; 2 units have thermic fluid heater installed and remaining have boilers without any heat recovery provisions.

Apart from electrical energy, the units use either rice husk or coal lumps to meet their thermal energy requirements. Based on the data collected from the units during surveys and energy audits, the contribution of both forms of energy is represented below:

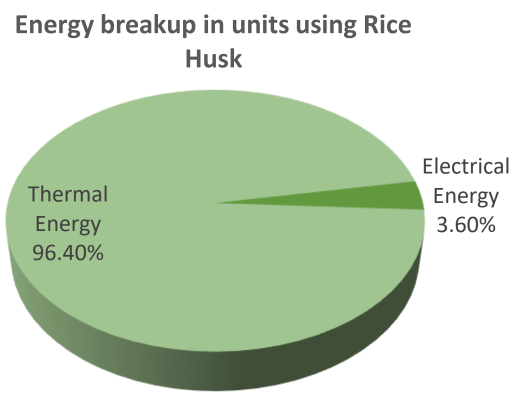

Figure 1: Energy break-up of units using rice husk as fuel

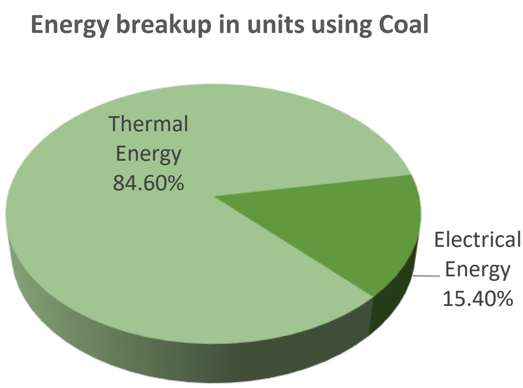

Figure 2: Energy break-up of units using rice husk as fuel

Existing practice:

In any wet processing unit in textile industry, thermal energy (steam or hot oil) plays a very crucial role. The thermal energy is needed for:

a. Preparing chemical solution;
b. Readying the fiber/ yarn/ fabric for dyeing;
c. Dyeing;
d. Printing and
e. Finishing

The dyeing process require water to be heated at a temperature of 85°C to 130°C. This temperature variation depends on the type of fabric being processed. The average temperature of water needed for dyeing process in Varanasi cluster is 95°C.

Once the process is completed, this hot water is flushed out of the dyeing machine and is sent to effluent treatment plant for treatment. At the effluent treatment plant, this water is collected and is retained for 6 – 8 hours before it is treated. This retention time is for allowing the water to cool down to a temperature of 45°C - 50°C.

Proposed technology:

Based on the detailed analysis, site visits and measurements during energy audit, it is proposed to install localized/ decentralized heat exchangers at each machine to recover the heat of the water used in dyeing machine and heat up the water for next batch/ cycle. This new system can raise the temperature of input water of dyeing machine from 30°C at present to up to 55°C, thus, reducing the heating requirement of the system.

Justification of technology selection:

In the existing system, the input water to the dyeing machine is at ambient temperature. This would mean that the temperature of water would vary from 20°C to 35°C. In different stages of dyeing process, the temperature of hot water required varies between 60°C to 130°C.Installing the low grade heat recovery system by installing decentralised heat exchangers could raise the temperature of feed water up to 55°C to 60°C. This will increase the heat content of the input water to the dyeing machine leading to a reduction in existing fuel consumption (rice husk).

Despite the advantage of reduction in fuel consumptions, there are certain challenges, listed below, that are needed to be addressed before this technology gets popularized in the cluster:

- Space requirements: There is always a possibility in the unit that space is constraint to install new system so the design of the piping system will be customized based on setup within the unit and this could also impact the costing of the system.
- Awareness: Most of the local units are not aware of such systems. Couple of units tried installing such system on their own by getting the heat exchangers fabricated locally, but due to lack of technical knowhow, the system was not successful and the unit became wary of such system

Energy & monitoring saving:

For calculating the energy and monetary benefits, a typical case is considered where fuel consumption is 5200 kg per day and current temperature of feed water is at 32°C which is proposed to be raised to 55°C after installation of the proposed low grade heat recovery system. The benefits envisaged through implementation of this technology have been summarized in the table below:

Parameter	Unit	Value (As is)	Value (To be)
Number of Working days in a year	No.	300	300
Average daily production of the unit	kg	2000	2000
Average water requirement for the dyeing process (Considering MLR of 1:10)	liter	20000	20000
Average hot water requirement in the dyeing process	%	50%	50%
Average hot water requirement in the dyeing process	liter	10000	10000
Average temperature of input water to dyeing machine	°C	32	55
Average temperature of hot water required in dyeing machine	°C	90	90
Temperature difference between input water and hot water required	°C	58	35
Amount of heat required to raise the temperature of water	kCal	580000	350000
Estimated system efficiency of indirect heating system	%	70%	70%
Actual amount of heat required to raise the temperature of water	kCal	828571.43	500000
Efficiency of boiler as measured	%	75.54%	75.54%
Calorific Value of Rice Husk	kCal/kg	3600	3600
Amount of fuel required to generate required steam	kg	304.68	183.86
Amount of fuel saved in a day	kg		120.82
Cost of 1 kg rice husk	₹ / kg		5
Total Amount of fuel saved in a year	kg		36246
Total cost of fuel saved in a year	₹		181230
Estimated cost of installing low grade heat recovery system	₹		500000
Payback	months		34

The benefits can be summarized as:

- ✓ Reduction in production time
- ✓ Reduction in fuel consumption
- ✓ Reduction in retention time at effluent treatment plant

Replication Potential:

Based on the surveys, audits and discussion with associations and unit owners, it is estimated that the technology has a replication potential in at least 20 units of the cluster. Based on replication potential in 20 units, the overall project benefits will be as follows:

Parameters	Units	Values
Annual rice husk saving (one unit)	kg/year	36246
No of units for replication	no's	20.00
Annual Fuel saving (considering replication in 20 units)	kg/year	724920
Total financial savings in 20 units	INR/year	3624600
Estimated investment in technology considering replication in 20 units	INR	10000000
Total TOE reduction	TOE	261

Availability of the technology

There are good many technology providers available in India and many of them have their base in Delhi and UP. The following are the technology providers available in the cluster.

1. Radiant Group

S-19, MIDC, Bhosari, Pune – 411026, Maharashtra, India

2. Mark Engineers

   I-312/2, H Road, Phase II, G.I.D.C. Estate, VatvaOpp. Meghmani Organics, Gate No.2, Ahmedabad - 382445, Gujarat,

3. Heat Exchanger India Pvt. Ltd.

   246-A, 2nd Floor,Atlantis K-10 - Tower "A", Opp. Vadodara Central mall, Sarabhai main Road, Alkapuri, Vadodara - 390007, Gujarat

Effect on the process

This technology has no effect on the existing production process. It will reduce the production time per batch and will reduce the fuel consumption required for generation of thermal energy.