## INSTALLATION OF COMBUSTION CONTROL 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. 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:

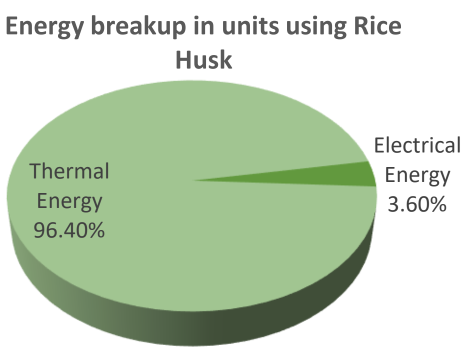


*Figure 1: Energy break-up of units using rice husk as fuel*

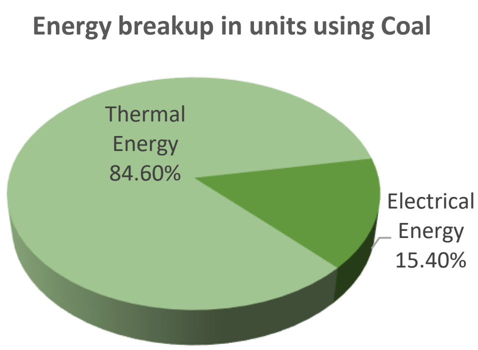


*Figure 2: Energy break-up of units using rice husk as fuel*

## 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

This thermal energy is generated in either boilers or thermal fluid heaters. But these systems do not operate on their own, they need a whole auxiliary support system to operate. The thermal energy is generated by combustion of fuel and transferred to the medium (water for generating steam or oil to absorb heat). The efficiency of any thermal energy generation system highly depends on the combustion efficiency. Any fuel, to burn, requires certain amount of oxygen/ air. If the supply of oxygen is low, the combustion will stop or will be incomplete combustion, on the other hand, if the supply of oxygen/air is high, it would lead to blowing away of unburnt fuel/ Energy.

This supply of oxygen in the thermal energy generation system is maintained with the help of forced draft (FD) fan and induced draft (ID) fan. Most of the systems maintain the appropriate flow of oxygen/ air manually by mechanical dampers. The operator may open or close these dampers based on the need or experience. In these manual operating systems, the actual amount of air needed and flowing is not known.

## Proposed technology:

We suggest to install a closed loop system which will include an online oxygen analyzer and VFD on ID and FD fans. The oxygen analyzer will analyze the oxygen content in the flue gases and will send a feedback signal of 0-20mA to VFD which will then regulate the speed of the ID an d FD fans. This in turn will regulate air flow and maintain the optimum draft in the combustion chamber of the thermal energy generation system.

## Justification of technology selection:

Using the closed loop feedback system will optimize the air flow in combustion chamber of the thermal energy generation system. The two major observations that came out from the audits and surveys conducted in the units in Varanasi and Bhadohi are:

1. The oxygen content in the flue gases varied between 12% and 17%;
2. The mechanical dampers were permanently closed between 40% and 60%

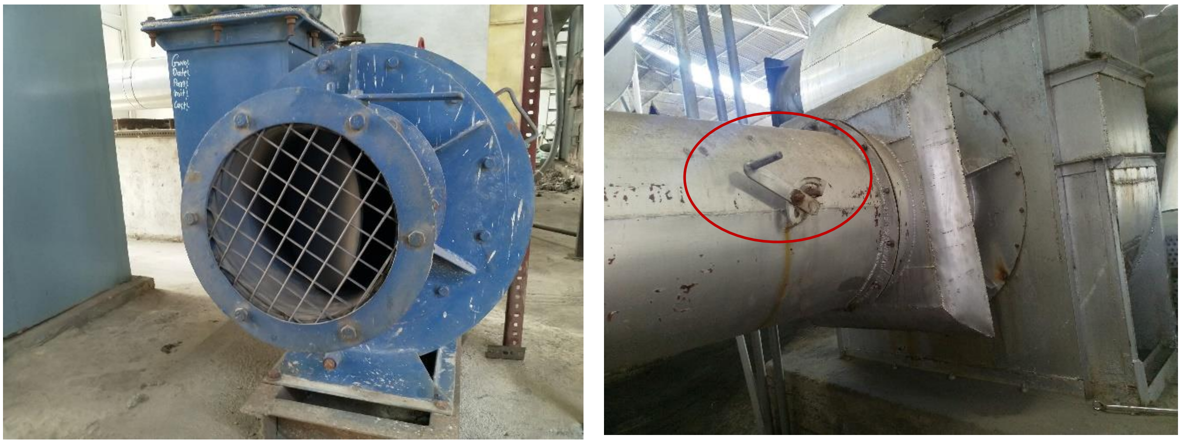

*Figure 1: Damper partially opened*


*Figure 2: Flue gas analysis results at a unit*

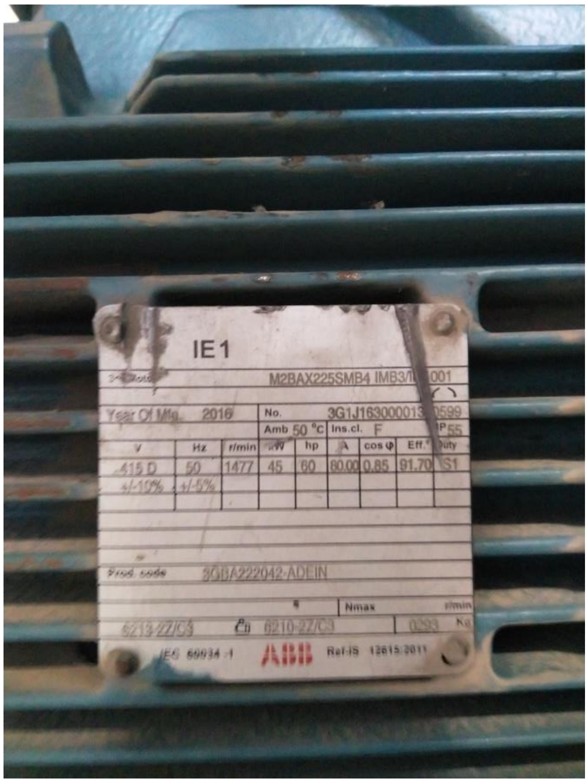


*Figure 3: Nameplate of a representative ID fan motor*

There are dual benefits of installation of this closed loop system:

1. Optimization of oxygen/air flow as per actual requirement will reduce fuel consumption
2. Reduction of speed of ID and FD fans with VFD will reduce electricity consumption in these two motors. Thereby, eliminating the need of mechanical damper.

Despite the benefits of the technology, following challenges needs to be addressed in order to propagate this technology in the cluster:

- Skilled manpower: As the technology is closed loop so its operation requires good understanding and maintenance so manpower with higher skill set is required. Currently, most of the operators operate the boiler based on experience and gut feeling.

- Additional costs: The cost of system does include components such as oxygen sensor that are required to be changed on frequent basis and may result in additional operating costs.
- Lack of awareness and unavailability of service providers at arm's length: As there are none closed loops installed in the cluster, so there are no service providers within and around the cluster. Also, the unit owners are unaware of closed loop systems and associated benefits.

### Energy & monitoring saving:

For calculating the energy and monetary benefits, a typical case of is considered having 30 hp ID fan and 20 hp FD fan with 6 ton per day consumption of rice husk operating for 9 hours each day. The benefits envisaged through implementation of this technology has been summarized in the table below:

| Parameter | Unit | Existing | Proposed |
|---|---|---|---|
| **Feed water flow rate** | kg/hr | 5 | 5 |
| **% $O_2$ reduction in stack emission** | % | 14 | 6 |
| **Excess air** | % | 200 | 40 |
| **Theoretical air requirement** | % | 4.6 | 4.6 |
| **Quantity of air per kg of fuel** | kg | 13.8 | 6.44 |
| **Fuel consumption** | kg/hr | 667 | 667 |
| **Total air supplied** | kg/hr | 9,200 | 4,293 |
| **Energy recovered** | kCal/day | | 2,416,435 |
| **Fuel saved per day** | kg/day | | 3,717,592.6 |
| **Reduction in electrical energy** | kWh/day | 129.5 | 60.5 |
| **Annual operating days** | days | | 300 |
| **Annual energy recovered** | kCal | | 3,717,592.6 |
| **Annual fuel saved** | kg | | 318,651 |
| **Annual electrical saving** | kWh | | 20,727 |
| **Annual monetary saving** | ₹/year | | 1,195,865 |
| **Capital cost for combustion control** | ₹ | | 1,200,000 |
| **Simple payback period** | Years | | 1.0 |

The benefits can be summarized as:

- ✓ Reduction in fuel consumption
- ✓ Reduction in electricity consumption
- ✓ Reduction in inrush current, thus improving the life of motor
- ✓ Increasing the temperature in flue gases leading to increased potential of waste heat recovery

### Replication Potential:

Based on the discussion with associations, units, sample survey and energy audits, it is estimated that the technology has a replication potential in almost all units in Bhadohi, Chandauli and Jaunpur. This would mean, a replication potential in approximate 25 units. Based on replication potential in 25 units, the overall project benefits will be as follows:

| Parameter | Unit | Amount |
|---|---|---|
| **Annual electricity saved (one unit)** | kWh/year | 20,727 |
| **Annual  fuel saved saving (one unit)** | tons/year | 318.65 |
| **No of units for replication** | no's | 25 |
| **Annual electricity saved (considering replication in 10 units)** | kWh/year | 518,175 |
| **Annual  fuel saved saving (considering replication in 10 units)** | tons/year | 7,966.25 |
| **Annual savings in electricity cost in 10 units** | ₹/year | 4,404,488 |
| **Annual savings in fuel cost in 10 units** | ₹/year | 25,492,000 |
| **Total financial savings in 10 units** | ₹/year | 29,896,488 |
| **Estimated investment in technology considering 10 replication** | ₹ | 30,000,000 |
| **Total GHG emission** | kg/year | 117,153.60[1] |
| **Total TOE reduction** | TOE | 53.85 |

## 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. Siemens
   Plot No. 78, JIL Jagatjit Industries Ltd., Tower A & B, Sector 18, Gurgaon - 122015
2. ABB
   14 Mathura Road, Faridabad
3. L&T
   Electrical & Automation Campus, Unnati Building, A-600, TTC Industrial Area, Shil-Mahape Road, Navi Mumbai - 400 710
4. YASKAWA India Pvt Ltd
   Plot No. 426, Udyog Vihar Phase 4, Gurgaon, Haryana - 122016

## Effect on the process

This technology has no effect on the existing production process, it will only reduce the fuel consumption required for steam generation and electricity consumption of the ID and FD fans. In addition, since the system will improve the overall combustion process, there is a possibility of increase in temperature of flue gases, which can then be useful in improving the potential of waste heat recovery by installing air preheater or economizer.

[1] GHG savings have been calculated based on replication in 3 units in Varanasi that are using coal in boilers.