INSTALLATION OF MICRO-TURBINE FOR POWER GENERATION

(*For Surat Textile Cluster*)

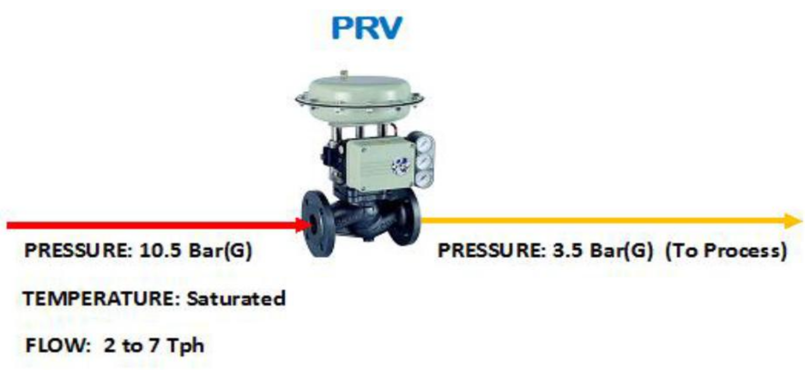
Cluster Brief:

Surat, known as the synthetic capital of India, is house to about 400 textile processing units, involved in processing of synthetic sarees and dress materials. The textile processing units can be broadly classified into 'Dyeing' units and 'Printing' units. Most of the units have the facilities of both dyeing and printing. The sarees and dress materials produced in Surat cluster are not only marketed in India but also exported to various countries. The textile processing units in Surat, are mainly micro, small and medium enterprises (MSMEs)and are spread over various location like Palsana, Sachin, Pandesara and Surat city industrial areas. The main raw material for the cluster is polyester grey cloth which is sourced from local polyester producers in and around Surat. Majority of the industries located in Surat are wet processing units which requires high amounts of thermal energy in the form of steam and thermic-fluid, leading to a high share of energy cost. The sector is unorganized in nature, mostly using old and inefficient technologies. There is a significant potential to make these units energy efficient and cost competitive, through accelerated adoption of energy efficient technologies in the cluster.

Existing practice:

In the textile manufacturing process, boiler is used as key utility device to provide steam at required quantity and pressure for various process requirements. Boiler of rated capacity between 6 tph to 12 tph are most commonly used in the sector. Most of these boilers are designed for a delivery pressure of 10 kg/cm^{-2}. The process pressure requirement in typical textile processing units varies from 3.5 – 4 kg/cm^2. To meet the process pressure requirement, a pressure reducing valve (PRV) is used in the steam line. This valve reduces the pressure generated in the boiler to the pressure required at the process level. The steam generated in the textile processing varies to the range of 20-80% of the design capacity.

The general arrangement in a typical textile processing unit is shown below:

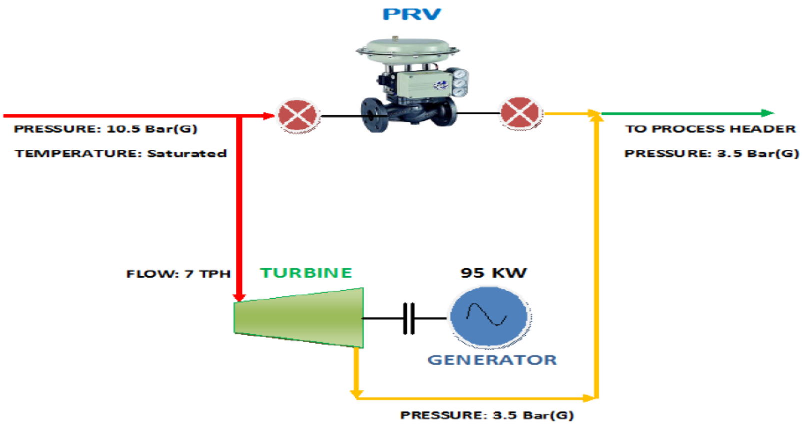


Case : with PRV alone

Proposed technology:

The unutilized pressure energy in the textile process plant PRV / PRDS, which is otherwise simply throttled, can be conserved by installation of micro-turbine in the steam line to generate power which can be used as captive power by the unit. In the process, the microturbine is installed parallel to the PRV. The exit line from the turbine is connected to the process line. The microturbine reduces the steam pressure to the required process (Back) pressure. In addition, it converts this pressure energy to high velocity that gives an impulse to rotate the turbine wheel at a speed of 12000 RPM. This high speed is reduced through a reduction gear box to 1500/3000 RPM to generate incidental clean, green electric power.

Since the system can utilize saturated steam, it becomes highly beneficial for industries using saturated steam. The schematic diagram showing micro-turbine in process is shown below:



Case : WITH PRV CLOSED & BYE PASS FROM TURBINE

Justification of technology selection:

Micro-turbine based power generation is best suited for textile processing plant, where there is significant differential pressure available in the generated steam pressure and steam being used in the process. Some of the advantages of the system are:

- ✓ The turbine is coupled directly to a small Induction Generator, which synchronizes the power produced with the local plant grid without the need of sophisticated and expensive control mechanisms.
- ✓ The system can utilize saturated steam; it becomes highly beneficial for industries using saturated steam.
- ✓ The pressure energy, which otherwise was wasted can be conserved and utilized to generate useful electricity.
- ✓ The turbine is designed for various flow-rates; so that maximum generation efficiency can be ensured at various flow rates.
- ✓ The turbine is designed to perform well even in the presence of slightly wet steam (upto 5%)

- ✓ Micro turbines offer many advantages compared to other technologies for small scale power generation, including greater efficiency, light weight, compact size, the small number of moving parts, lower emissions and lower electricity costs, etc.

Energy & monitoring saving:

For calculating the energy and monetary benefits, a typical case of a boiler of 8tph capacity delivering steam at 8 kg/cm^2 at 169.6^{0}C at generation end and using steam at 3.5 kg/cm^2 at 142.9^{0}C at process end is considered.

Sl.No.	Parameter	UoM	Generation	Process End	Remarks
1	Maximum steam flow	tph	8		As autual
2	Inlet pressure	kg/cm^2	8	3.5	As measured
3	Temperature	^{0}C	169.6	142.9	As measured
4	Enthalpy	kCal/kg	661.1	653.9	From steam table
5	Enthalpy Loss	kCal/kg	7.2		Enthalpy (As is) - (Enthalpy (To be)
6	Total available energy	kCal/h	57600		Enthalpy Loss * Steam flow per hour *1000
7	Turbine efficiency	%	75		As per design
8	Total power generated from turbine	kWh/h	50.23		(Total available energy *0.95)/860
9	Power generated (@90% loading)	kWh/d	1085		90% loading assumed
10	Power generated annually	kWh/y	330932		operating days/year = 305
11	Annual power consumption of unit	kWh/y	9351642		As reported
12	Percentage of grid power saving through captive generation	%	4		(Annual power generated through turbine / Annual Power consumption) *100
13	Power tariff	Rs/kWh	6.87		As reported
14	Annual monetary savings	Rs in lakh/y	22.74		Annual power generated * tariff
15	Investment	Rs in lakh/y	43.5		As per budgetary offer
16	Simple payback	years	1.91		Investment/ monetary savings

The benefits can be summarized as:

- ✓ 9351642 kWh of power generated from waste pressure loss
- ✓ 4% of grid power saving through captive generation
- ✓ Payback less than 2 years

Replication Potential:

Based on the discussion with associations, units, sample survey and energy audits, it is estimated that the technology has a replication potential of 20% in the cluster. Based on 20% replication, the overall project benefits will be as follows:

Parameters	Units	Values
Annual electrical energy saving (one unit)	kWh/y	9000000
Annual electrical energy saving (one unit)	GJ/y	32384
Annual electricity saving (considering 20% replication)	kWh/y	720000000
Annual CO_2 emission saving (one unit)	tCO_2/yr	8100
Annual CO2 emission saving (considering 20% replication)	tCO_2/yr	648000
Estimated investment in technology (one unit)	Rs in Lakh	43.5
Estimated investment in technology considering 20% replication (assuming price down due to demand aggregation)	Rs in Lakh	3132
Lifetime energy savings (in 10 years)	TJ	25907
Lifetime CO_2 emission saving (in 10 years)	tCO_2	6480000

Availability of the technology

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

1. NCON Turbo Tech Pvt. Ltd.
2. Kessels Engineering Work Pvt. Ltd.
3. Capstone Turbine Corporation

Effect on the process

This technology has no effect on the existing production process, it uses the otherwise unutilized pressure energy to generate captive power.

Reasons for unpopularity:

This technology has yet not penetrated the cluster because of the following reason:

- ✓ Less knowledge
- ✓ Higher capital cost of the technology
- ✓ No one has yet demonstrated the results of the technology to all unit owners in the cluster.