UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

Global Environment Facility

Bureau of Energy Efficiency

INSTALLATION REPORT OF PILOT PROJECT OF AIR COMPRESSOR

AT

Prabhat Castings

GEF-UNIDO-BEE Project

On

Promoting Energy Efficiency and Renewable Energy in selected MSME clusters

In association with

For more information:

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1. Acknowledgement

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- Mr. Vikram Sainuche - Partner
- Mr. Mahesh Sainuche - Partner
- Mr. Veeresh - HOD Electrical Maintenance
- Mr. Nagraj - HOD Mechanical Maintenance
- Mr. Vinay - Accountant

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Partner,
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Mr. Sadanand D. Humbarwadi
Cluster Leader,
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1. Brief Introduction about cluster (BFC)

Belgaum is major center for foundry industry in Karnataka producing casting around 1.6 Lakh tons of castings per annum. Its products have a reputation for quality. But the growth of industry in Belgaum has suffered due to lack of (i) Infrastructure (ii) Latest technology (iii) Advanced testing facilities and (iv) Human skills.

Keeping all above points in mind, the industries in the cluster had decided to form Belgaum Foundry Cluster in the year 2004. The project has been completed in all respect by the year 2010 and BFC has started providing following common services to the foundries in Belgaum.

1. Construction of new roads at industrial estate.
2. Quality testing laboratory e.g. Spectrometer and CMM.
3. Common tool room facility e.g. VMC.
4. Simulation casting, 3D modeling and ERP modules for foundries.
5. Sand Reclamation Plant.
6. Common facilities like convention hall, training hall & multipurpose hall.

More than 150 foundries are presently availing technical services provided by Belgaum Foundry Cluster and BFC has informed that after the completion of Belgaum Foundry Cluster project, employment generation, production, exports & revenue from foundries in Belgaum have grown substantially in the range from 60% to 75% with improved productivity and quality. Presently in India, casting industry is picking up and has great potential to export. With this BFC is certain that Belgaum foundry industry will show substantial growth in future years to come. In addition to technical services provided by BFC, it has also taken up new projects to benefit the foundries in Belgaum for technology up gradation, productivity enhancement, and energy efficiency operations, to provide skilled work force & to implement lean manufacturing processes. Following are the projects undertaken by BFC for above requirements

i. UNIDO - ICAMT project for Technology Up gradation& Productivity Enhancement of foundry Industry.
ii. Lean cluster project for implementation of Lean Manufacturing Competitiveness.
iii. GEF-UNIDO-BEE project to promote energy efficiency & renewable energy.
iv. Training program on foundry technology.

Belgaum Foundry Cluster is identified by Department of Industrial Policy & Promotion Government of India as **"Model Cluster"** and one of the best project sanctioned under IIUS scheme of Ministry of Commerce & Industry, Government of India. During a meeting of The Institute of Indian Foundry men with Joint Secretary, DIPP on 12th September 2013 at New Delhi, Shri. D.V. Prasad, the then Joint Secretary specifically mentioned about Belgaum Foundry Cluster for their excellent performance as well as services rendered to the foundries in Belgaum for growth of industry.

Utilizing facilities provided by Belgaum Foundry Cluster the cluster will be able to improve quality of casting, enhancement of the productivity and growth in export in order to make Belgaum foundry industry at par with world class standards and internationally competitive will get customer's appreciation. Belgaum is a pioneer in the development of Foundry Industrial Sector in Karnataka prominently manufacturing Iron & Steel castings catering to the needs of General Engineering, Machine Tools, Automobiles, Tractor Components, Pumps& Motor Body castings.

Belgaum is having more than 150 foundries in the range from Small, Medium & Large Scale Industries producing more than 1.6 Lakh tons of casting per annum which is valued about more than 1000 crores per annum.

The objective of forming the Belgaum Foundry Cluster in the Year 2004, was to support foundries in Belgaum & nearby areas to enhance effectiveness & competitiveness for achieving excellence through world class infrastructure for the growth of foundry units in & around Belgaum & to make them internationally competitive**.**

1. Executive Summary

An energy audit team of **Belgaum Foundry Cluster (BFC)**, Belagavi, visited to foundry Unit located at P. B. Road, Belagavi for verification of Newly Installed Air Compressor (" ELGI" make). The team of BFC has done measurements in presence of Mr. Veeresh and Mr. Nagraj.

The team has logged all the electrical parameters at input by "Chauvin Arnox" make 3-phase power analyser (Voltage, Ampere, Frequency, kW, kVA, kVAr, P.F., THD, kWh etc.). The electrical parameter power of output is taken from compressor panel. Measurement records are tabulated in tables. At the end, conclusion is derived from measurements and analysis. Conclusion is derived based on existing conditions exists during audit measurement. It may vary time to time.

2. About Unit

The unit was established thirty years ago with the view for catering to domestic casting requirement & now it has started exporting also. The unit is technically equipped to satisfy the customers both for the domestic as well as for the international markets. The production, maintenance & quality systems are set to deliver the products to the satisfaction of customers. Blend of old experienced & young management manage the unit.

Its foundry unit manufacturing S.G. Iron & Cast Iron castings. It has green sand, No bake, CO2 sand & shell sand system. Mixer is used to mix the sand. Molding & core making is done by using machine as well as by hand molding. After casting is casted the Fettling /finishing is done in house only.

The unit manufactures components to cater to machine tool, earth moving equipment, pump & valve manufacturers. Product range weighs from 500 Gms to 800 kgs. Type of products is pump body, weights, housings, valve body. Unit produces average in the range of 1200 to 1800 MTs per Annum.

3. Energy conservation measures by Air Compressor

3.1 About Air Compressor

Air compressor accounts for significant amount of electricity used in Indian industries. Compressed air is the fourth utility of any type of industry/MSME, after electricity, gas and water. In general, compressed air systems are not well managed resulting in high-energy losses. Compressed air is highly energy intensive as only 10 to 30% of the electrical energy consumption is usually converted into compressed air and the balance is lost as usable heat energy.

Before installing new compressor in previous studies it is observed that two 50 HP reciprocating compressors were used alternatively, Which were replaced by one 40 HP screw compressor it acts as a base compressor and most of the time it is in loading condition. Compressor loading and unloading patterns are recorded.

3.2 About Variable frequency drive (VFD)

Matches compressor output with demand by varying motor speed. The power consumption reduces in line with the reduction in demand. This helps in eliminating the frequency of load-unload cycle and also the power wasted from the energy bill.

A fixed speed compressor operates on a load unload band of at least 8-10 psi around the working pressure whereas with VFD, Compressor can be operated within a band of 2 psi. Since the compressor is not operating under higher than working pressure requirements, there is substantial energy saving. For every 2 psi reduction in operating pressure, there is 1% power saving.

5.3 Its comparison with previous System

In a fixed speed compressor with star-delta starter, Starting current is as high as three times the full load current (FLC). With VFD starting current is less than the PLC. This helps to avoid using heavy rated components likes fuses, MCCB, Cable size, generator rating, isolators etc.

4. Technical Benefits of Proposed Technology

4.1 Benefits

- Low starting current
- High efficiency
- Improved power factor
- Reduced maximum demand

6.2 Summary of installation of Energy Efficiency Intervention

In the implementation arresting pressure drop & air leakages is done by ring main and addition of air receiver tank .Which helps to reduce air pressure from 7.2 bar to 6.8 bar, Reduction in set pressure & arresting leakages gives energy savings up to 10 to 15 % from the present consumption.

The air compressor is running towards the desired set pressure. Loading and unloading of the air compressor is minimized.

5. MEASUREMENT DETAILS

Table No 1 : Recorded data

Time:	V1	V2	V3	A1	A2	A3	kW	PF
MAX.	232.96	232.48	231.90	48.54	50.54	48.63	30.43	0.902
AVG.	230.38	230.31	229.68	38.08	40.20	38.07	23.44	0.870
MIN.	226.70	227.18	226.51	20.77	21.95	20.14	11.13	0.762

6. CALCULATIONS AND ANALYSIS

Table No 2: Details of Air Compressor

Sr. No.	Particulars	Unit	Value
1	Motor rating	kW	30
2	Rated Capacity	CFM	205
3	Operating Pressure	kg/cm2	7
4	Initial Pressure	kg/cm2	0
5	Atmospheric pressure	kg/cm2	1.013
6	Capacity of Receiver	M3	1
8	Pump Up Time	Sec	85
9	Load Pressure	Bar	7
10	Unload pressure	Bar	7.5

Table No 3: Design Details of Air Compressor

Sr. No.	Particulars	Unit	Value
1	Make	-	ELGI
2	Fab no.	-	BRFSO42007
3	Model	-	EG30-10 V
4	Year of Installation	-	2018
5	Purpose		Pneumatic utilities
6	Capacity of Receiver	M^3	1
7	Rated Capacity	M^3/Min	5.8
8	Rated Capacity	CFM	205

Table No 4: Operating Parameters

Sr. No.	Particulars	Unit	Value
1	Operating Pressure	kg/cm^2	7.5
2	Initial Pressure	kg/cm^2	0
3	Atmospheric pressure	kg/cm^2	1.013
4	Capacity of Receiver	M^3	1
5	Pump up time	Seconds	85
6	Inlet air temperature	^oC	35

Table No 5: Table of Analyzed parameters

Sr. No.	Particulars	Unit	Value
1	Actual FAD	M^3/Min	5.23
2	Actual FAD	CFM	184
3	Volumetric Efficiency	%	90.04
4	Motor input power	kW	30.4
5	Efficiency of Motor	%	0.93
6	Shaft input power	kW	28.3
7	Operational SPC	kW/M3/min	5.8
8	Specific power consumption	kW/CFM	0.16
9	Standard specific power consumption	kW/CFM	*0.19*
10	Loading	%	92%
11	Unloading	%	8%
12	Loading	kW	30.4
13	Unloading	kW	11.13

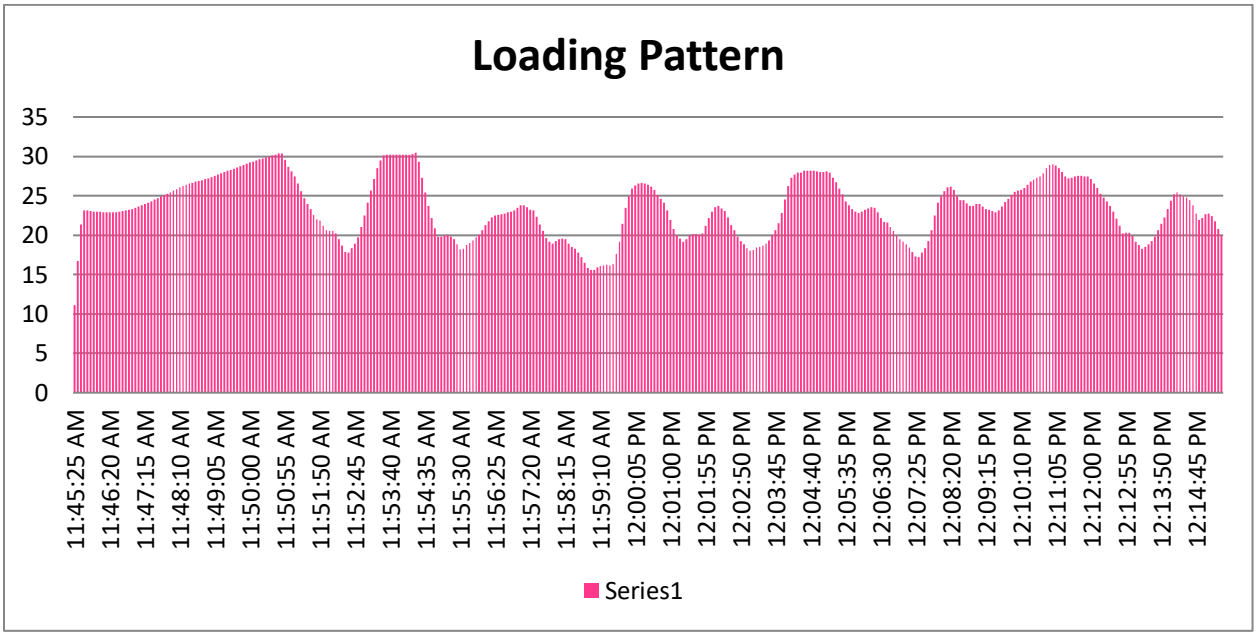
Table No 6: Energy saving Post Implementation

Description	UOM	After	Before
		ELGI Screw comp.	**I/R Reciprocating BOP Comp.**
Capacity Flow (FAD)	CFM	184	136
Discharge Pressure	Kg/cm^2g	7	7
Rated power	kW	30	37.5
Recorded power	kW	23	24
Coolant water pump	kW	0	1.5
Total Pkg power	kW	23	25.5
Rated power per CFM	kW/CFM	0.16	0.28
Specific Power per CFM	kW/CFM	0.13	0.19
Say for 140 CFM requirement	kW	17.50	26.25
Savings/ hr	kWh		8.75
Power Saving per annum	**kWh**		**43680**
Reduction in GHG emissions	tCO_2/year		36.69
Savings/ Annum	**INR**		**390499**

7. OBSERVATIONS AND COMMENTS

9.1 Power quality analysis reports

Graph No. 1: Air Compressor Loading Pattern on Full plant operation



Graph. No. 2: Air Compressor Loading Pattern on Partial plant operation

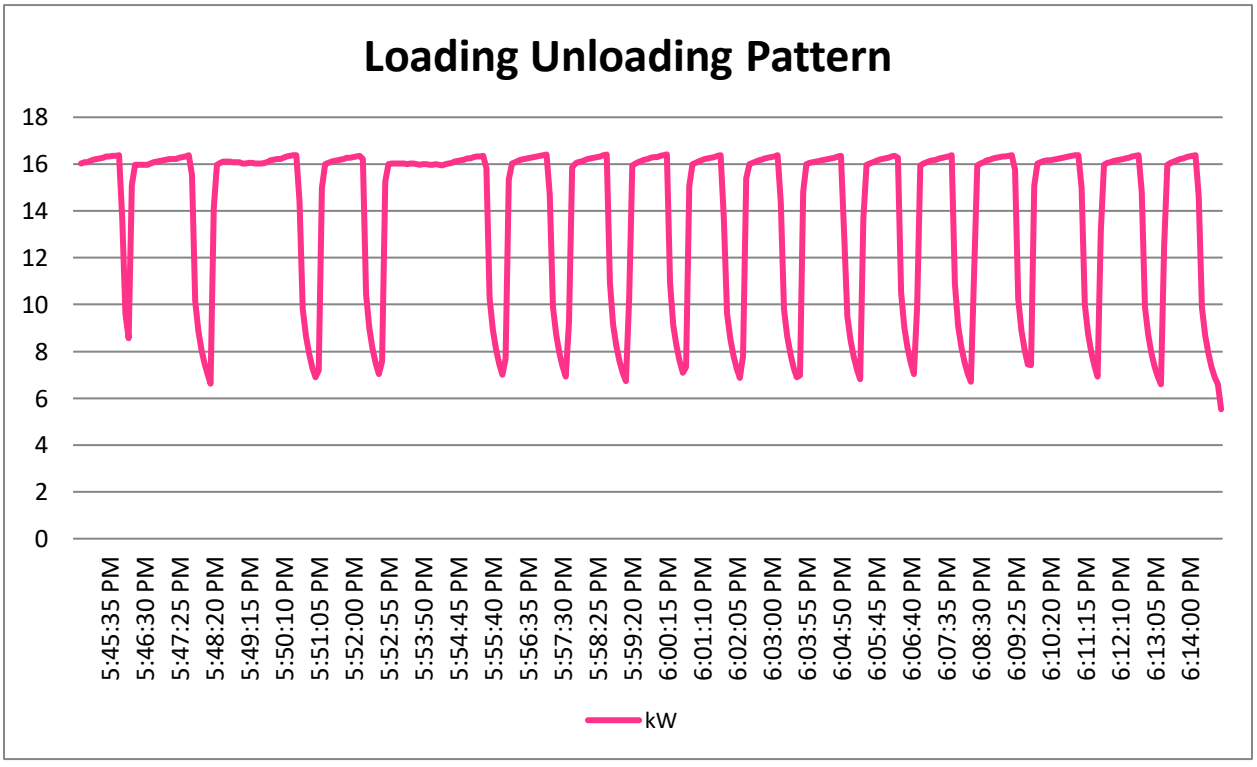


Table No. 7: Calculations of Loading Unloading under partial plant operation

Parameters	Unit	Full Plant Operation	Partial Plant Operation
Rated free air delivery	m3/min	5.80	5.80
Actual free air delivery	m3/min	5.22	5.22
% FAD	%	90.01	90.01
Loading power	kW	30.43	16.42
Unloading power	kW	11.13	5.53
Electricity consumption	kWh	23.51	16.54
Specific electricity consumption at 8 bar pressure	kWh/ m3	4.50	3.17
	kWh/100 CFM	12.75	8.97
Time on load (T)	Min	0.00	1.41
Time on unload (t)	Min	0.00	0.47

Table No. 8: Energy saved due to VFD application

Parameters	UOM	Full Plant Operation	Partial Plant Operation
Loading time	%	92.4	75
Unloading time	%	7.6	25
Maximum loading power	kW	30.43	16.42
Minimum unloading power consumption	kW	11.13	5.53
Power Consumed	kWh	23.50	16.54
Power saved due to VFD	kWh		6.96
% of Power reduced due to VFD	%		29.62
Power saved due to VFD	kWh/Annum		17372
Power saved due to VFD	INR/Annum		155307

8. PHOTOS

1. Previous installation of reciprocating compressor

2. New compressor received and Unpacked.

3. Compressor inspection by chartered engineer.

4. Compressed Airline inspection by chartered engineer.

5. Airline

Save energy live green.