

Successful Implementation – Energy Conservation Measure

Measure
Use of high efficiency electrical tools in place of pneumatic tools
Equipment
Compressed air system
Industry / Sector
Foundry
Year of Implementation
1999
Cost Benefit Analysis
⊞ Type of Measure: Short term
⊞ Annual Energy Savings: 2.48 lakh kWh
⊞ Actual cost savings: Rs. 8.90 lakh
⊞ Actual investment : Rs. 3.50 lakh
⊞ Payback: 5 months
Implementation Highlights
<ul style="list-style-type: none"> ☞ Very simple measure and ease in replacement of tools ☞ Can be implemented with out the help of the external expertise ☞ High conversion efficiency ☞ Availability of various makes and models to suit the application ☞ Earlier the electric tools had less precise torque control, shorter lives and lacked the safety of compressed air powered tools. These drawbacks are no longer there with the latest range of electric tools.

Summary

Significant energy savings (about 50%) can be envisaged by replacing the inefficient pneumatic grinders with energy efficient electrical grinders.

Background

Plant has five reciprocating air compressors, which are located in centralized compressed air room. During normal operation 2 X 750 cfm compressors are operated.

Comp code	Capacity cfm	Motor kW	Rated Pr kg/cm ²
Comp #1	307	65	10.6
Comp # 2	307	65	10.6
Comp #3	307	65	10.6
Comp # 4	750	132	9.4
Comp # 5	750	132	9.4

Compressed air is mainly used for operation of pneumatic tools (grinders, hammers), molding machines, mould cleaning application, atomising fuel in ladle burners, etc.

Monitoring the loading and unloading times of compressors at different times on various days was carried out to estimate the compressed air generation quantity for the normal plant operating conditions. The average compressed air generation was estimated at 1100 cfm.

Plant used pneumatic grinders for fettling operation. The operating efficiency of these tools is very poor due to conversion of electrical energy to pneumatic energy and then to mechanical energy.

Estimation of compressed air requirement and power consumption:

Equipment	No.of units	air requirement per unit, m ³ /min	air requirement, cfm at continuous operation	air requirement, cfm at actual operation	Eq. Power consumption, kW
Die grinders	14	0.62	308	154	28.2
Grinders - (heavy)	9	1.59	508	254	46.5
Total	23		816	408	75

The pneumatic grinders consumed about 75 kW of the power, which is about 35% of total power consumption of the compressors. The operating efficiency of these tools is very poor due to conversion of electrical energy to pneumatic energy and then to mechanical energy.

Plant replaced these pneumatic grinders with electrical grinders.

Equipment	Units replaced	Power input, kW per unit	Power consumption, kW	Saving, kW	Annual energy savings, kWh	Cost savings, Rs	Investment, Rs
Grinders - die	14	1.5	21	7.2	57274	206188	210000

Grinders - heavy	9	2.5	22.5	24.0	190422	685517	135000
Total	23			31.27	247696	891705	345000

Currently light weight, high frequency, high efficiency electric grinding tools are available with ELBS facility. In the view of high efficiency of these power tools, pneumatic grinders were replaced with electric grinders.

Details of techno-economics:

Power savings	: 31 kW
Total annual energy savings	: 2.48 Lakh kWh
Annual cost savings	: Rs. 8.9 Lakh
Investment	: Rs. 3.45 Lakh
Payback period	: 5 months

Principle

Compressed air is probably the most expensive form of energy available in a plant. Compressed air is also clean, readily available, and simple-to-use. As a result, compressed air is often chosen for applications in which other energy sources are more economical. Users should always consider more cost-effective forms of power before considering compressed air.

In pneumatic tools the energy efficiency is very poor, since the electrical energy is converted into mechanical energy and from then it is converted into pneumatic energy, and at the place of usage the pneumatic energy is again converted to mechanical energy. ie. The Energy conversion takes place four times. Hence the combined efficiency is as poor as 10-20%.

While in the case of electrical tool the electrical energy is converted directly to mechanical energy at the usage point.

Implementation issues

- ☞ Initially there was resistance from the plant personnel, that the electrical tools are heavy and also cause safety hazards.
- ☞ Plant has to go for slow replacement of tools as and when the pneumatic tools were called for replacement.
- ☞ Not all pneumatic tools can be easily replaced.