Energy management and effici

Compressed air is one of the major energy consuming utilities in any industrial operation and is often referred to as the fourth utility. Various estimates indicate that about 2000 MW is consumed nationwide by compressed air system, and hence an obvious opportunity for energy conservation.

Air compressors are mainly classified into two types – the positive displacement type and the dynamic displacement type. Positive displacement compressors mechanically displace a fixed volume of air into a reduced volume. They deliver nearly constant volume when operated at fixed speed, while the discharge pressure is determined by the system load condition. Positive displacement compressors are of two types – the reciprocating and the rotary.

Dynamic type compressors mechanically impart a velocity to the air through the use of impellers rotating at high speed, in an enclosed housing. The air is forced into a progressively reduced volume. The volumetric flow will vary inversely with the differential pressure across the compressor.

The compressor is considered a lifeline product in all textile units given that all machineries are pneumatically operated. It is also apt to say that it is the fourth highest power consuming equipment for any textile unit and thus makes it all the more important to work towards energy conservation and energy management.

To have an efficient compressed air system, the parameters to be kept in mind prior to deciding on the compressor are sizing and selection of the air compressor, testing of the air compressor, compressed air plant layout and distribution and compressor cooling system.

Sizing and selection of air compressor

The selection of the type of compressor and capacity to be installed plays a very critical role in the total compressor energy consumption during the normal plant operation. As a first step,

ent compressed air solutions

the total estimate of compressed air requirement must be calculated taking into account all the pneumatic equipment connected in the plant during full load operation.

During normal operations in a plant, pneumatic devices are often operated at less than full load capacity, during which time the load factor plays a very critical role in estimating the total compressed air requirement at the design stage itself.

The points to be kept in mind prior to compressor selection are the quality of air required for the process, life cycle cost analysis and low maintenance (high reliability). Today the technology is shifting towards screw compressors as they are power efficient and are also very reliable. They do not require heavy maintenance. However, for higher capacity of above 2500 CFM, centrifugal becomes the most preferred choice because of its efficiency, reliability and the best-in-class power consumption cost.

Again, one of the most neglected aspect is compressor air piping which is size based on allowable velocity of compressed air in the pipeline, keeping a check on the pressure drop. If the pressure drop is high, the operating pressure at the generation has to be increased to match the requirement, which results in increased power consumption. Importantly, the pipeline should be with minimum joints, bends and fitting. The joints should be welded with no flexible or screwed joints so as to minimize leakage and pressure drop.

Testing of air compressor

Like the human body that requires frequent medical check-ups to ensure that all is well, compressors should be taken adequate care of. Over a period of time, performance of the compressor deteriorates due to poor maintenance, wear and tear and use of low quality lubricants. This dip in performance leads to increase in overall power consumption.

There are different ways of checking the efficiency of the compressor, through free air delivery (FAD), volumetric efficiency and specific power consumption. The nozzle method is the most preferred and accurate one and is approved by IS where the compressor receiver is connected with a specially designed nozzle and the testing is done as per the prescribed OEM recommendation. This gives a clear status about the FAD, VE and the specific power consumption.

As an OEM, Multivista Global recommends that this test be taken once every year to ensure that the machine is working at optimum efficiency, and if there be any course correction required the same needs to be looked into on priority basis to ensure proper upkeep of the machine and the specific power consumption.

Plant layout and distribution

The design of the compressed air plant layout and distribution of compressed air plays a significant role in the total energy consumption and this must be ensured at the design stage itself.

The following factors need to be considered while putting a compressed air system in place:

- Plant layout such as centralized compressor system or decentralized compressor system, and this depends on the plant as each system has its own advantages and disadvantages
- As for location, ideally compressors should be in a place where there is ample scope for free flow of air and also where it can induct clean, dry and cool air as all these factors play a major role in power consumption

It would be interesting to note that for every 4 degree Celsius reduction in intake air temperature, there will be a one per cent reduction in com-

pressor power.

Cooling system

Cooling of the air compressor is of enormous importance since it affects the energy efficiency. The cooling system could be either air cooled or water cooled.

The air cooled system has fan for forced cooling of the compressor through an in-built cooler. This is now the most economical and common way in which compressors are designed keeping in mind the economy, power factor, etc. However, this type of cooling is mostly used for lower size machine, where as water-cooled compressor are meant for heavy duty application where a separate cooling tower will be used to cool the water. In this case the efficiency of cooling is high, but a very few people adopt this considering the cost and space involved.

Case study

In a large textile company where five Kirloskar reciprocating compressors were working continuously on all the three shifts. The company felt the need for additional compressors in view of the shortage during peak time usage. A team of experts from Multivista approached the customers and undertook the site inspection on an O&M contract where the complete compressed air system, including piping, drier, etc., was maintained round the clock. In the first stage, all compressors were tested for efficiency. Assessment of every machine was done by experts to identify what was urgently needed for bringing the system to full efficiency.

Each compressor was thoroughly overhauled, and in a span of less than three months, all the machines were brought back to 95% + efficiency along with certain modification in piping layouts which facilitated stoppage of one 90 KW compressor. This ensured an annual saving of around Rs. 30 lakhs for the company.

Regular maintenance of any compressor is very important as per the OEM recommendation, since any attempt to save a little money will lead to huge loss later on through lower efficiency and higher power cost. ◆