Technical Guide

"Energy Conservation in Compressed Air System"

Small and Medium Enterprises Development Authority

Ministry of Industries & Production

Government of Pakistan

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1. Disclaimer

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2. Introduction to SMEDA

The Small and Medium Enterprises Development Authority (SMEDA) was established in October 1998 with an objective to provide fresh impetus to the economy through development of Small and Medium Enterprises (SMEs).

With a mission "to assist in Employment Generation and Value Addition to the national income, through development of SME sectors, by helping increase the number, scale and competitiveness of SMEs", SMEDA has carried out 'sectoral research' to identify Policy, Access to Finance, Business Development Services, strategic initiatives and institutional collaboration & networking initiatives.

Preparation and dissemination of prefeasibility studies in key areas of investment has been a successful hallmark of SME facilitation by SMEDA.

Concurrent to the prefeasibility studies, a broad spectrum of Business Development Services is also offered to the SMEs by SMEDA. These services include identification of experts and consultants and delivery of need-based capacity building programs of different types in addition to business guidance through help desk services.

2.1 Industry Support Program

In order to enhance competitiveness of SMEs and achieve operational excellence, SMEDA established an Industry Support Cell (ISC) for provision of foreign technical support and knowledge transfer in collaboration with International Development Organizations. SMEDA's Industry Support Program (ISP) initially launched with Japan International Cooperation Agency (JICA) and actively engaged in reducing energy inefficiencies and improving production and quality of products with the support of Japanese Experts. Later on, similar activities with other international partner organizations like German Corporation for International Cooperation (GIZ), Training and Development Centres of the Bavarian Employers' Association (bfz), Germany, and United Nations Industrial Development Organization (UNIDO) were also successfully implemented.

3. Compressed Air System

Compressed air is a form of stored energy that is commonly used to operate machinery, equipment or processes. Compressed air is generated through compressors, powered by electricity, a typical air compressor takes about 7 volumes of air at atmospheric conditions, and squeezes it into 1 volume at elevated pressure (about 7 bar). The resulting high-pressure air is distributed to equipment or tools where it releases useful energy to the operating tool or equipment's and from there it expands back to atmospheric pressure.

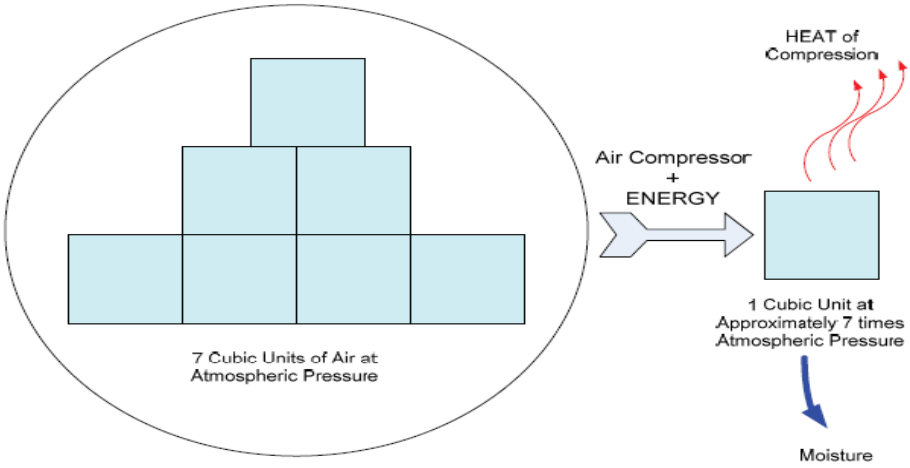

Figure 1: Production Cycle of Compressed Air

In the process of compression. And the subsequent cooling of air to surrounding temperature, heat and moisture, are released as result of process, illustrated in figure1. Depending on application, excessive moisture in compressed air needs to be managed as it causes problems with piping (corrosion) and end use equipment.

4. Compressed Air Costs

Electrical energy is the most prevalent energy source for industrial compressed air production. In many compressed air installations, there are often significant and unutilized energy-saving possibilities including energy recovery, pressure reduction, leakage reduction and optimization of operations through correct choice of a control and regulation system as well as the choice of compressor size.

When planning a new investment, it is advised to look as far into the future as possible and attempt to assess the impacts of new situations and demands that might affect the compressed air installation. Typical examples include environmental demands, energy-saving demands, increased quality requirements from production and future production expansion investments. Optimized compressor operations are becoming more important, especially for larger, compressed air-dependent industries. Production will change over time in a

developing industry and also compressor operation conditions as well. It is therefore important that the compressed air supply be based both on current requirements as well as on development plans for the future.

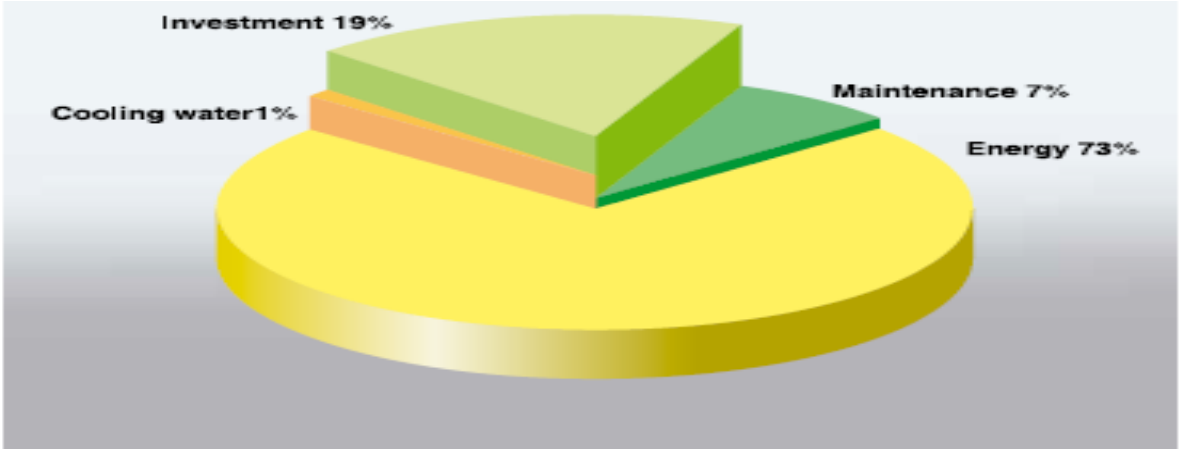

Figure 2:Cost of Compressed Air (Source: Atlas Copco)

Energy costs are clearly the dominating factor for the installation's overall cost. It is therefore important to focus on finding solutions that comply with demands for performance and quality as well as the demand for efficient energy utilization. As energy consumption often represents approx. 73% of the overall cost shown in above figure-4, care should be taken in selecting the regulation system. The significant difference in the available regulation systems exceeds the significant differences in types of compressor. An ideal situation is when compressor full capacity is precisely matched to the application's air consumption. This frequently occurs in process applications. Most types of compressors are supplied with their own on-board control and regulation system, but the addition of equipment for shared control with other compressors in the installation can further improve operating economy.

Speed regulation has proven to be a popular regulation method because of its substantial energy saving potential. Think carefully and allow pneumatic application requirements to govern the selection of pressure regulation of supplying equipment in order to obtain good results.

If only a small amount of compressed air is required during the night and weekends, it may be profitable to install a small compressor adapted to this off-peak requirement. If, for some reason, a particular application needs a different working pressure, this requirement should be analysed to find out whether all compressed air production should be centralized in a compressor central plant, or whether the network should be split up according to the different pressure levels. Sectioning of the compressed air network can also be considered to shut down certain sections during the night and on the weekends, in order to reduce air consumption or to allocate costs internally based on air flow measurements.

As energy accounts for about 73% of the overall lifetime operation cost, it is very important to design and purchase the most efficient components for compressed air system. It is recommended to make purchase decision on the overall expected lifetime operation costs, and NOT just on the initial cost of the equipment.

Based on above information, it is very important to control and monitor the major factor that contributes in overall lifetime operation cost i.e. electricity.

Most facilities can easily save 10-20% of their compressed air energy costs through routine maintenance such as the fixing of air leaks, lowering air pressure and replacing clogged filters. Higher saving numbers can be gained by choosing better compressor control, adding storage receiver capacity, upgrading air dryers and filters and also best distribution network design.

5. General Tips for Energy Conservation in Compressed Air System

The following steps should be adapted for conservation of utility in Compressed Air System.

i. Compressors should be placed in closed, dust free and environmentally controlled cramped space to achieve maximum efficiency utilisation.

Figure 3: Compressor's Room

ii. The suction inlet must easily be accessible to fresh, mist free cold air.

iii. Ventilation system must be as per requirement of compressor's air suction inlet design.

iv. There must be a rudimentary storage attached directly to Compressor sans any mechanical bending to avoid pressure drop and demand load directly on Compressed Air system.

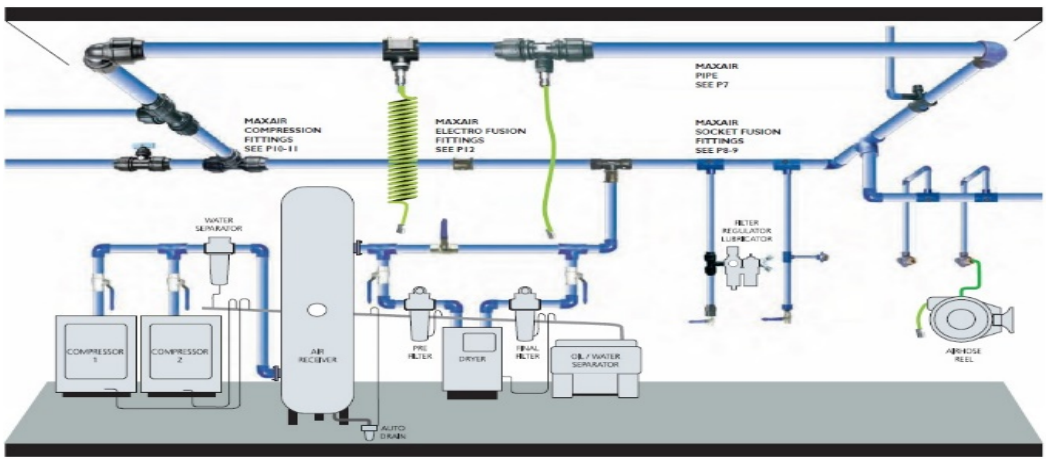

Figure 4: General Layout Design

v. The selection of allocation network should be as per CFM entailment of end use equipment. Ensure availability of data sheet of end use machine attached to system, which includes details regarding CFM and standard pneumatic pressure.

vi. Avoid using welded fitting for network always use Air tight and approved fitting for pneumatic system.

vii. Connect auxiliary tank to avoid intermittent surges from furthest installed equipment in network.

viii. Complete network must not be design as per rule that there shouldn't be more than a 1 bar drop across 100 feet pipe length in network.

ix. Network must be provided with a drainage leg to take out moisture accumulated in the network to prevent pressure drop and equipment rusting.

x. Pre filter, Post filter and In-line filters must be installed to feed dry air to system.

xi. Air Dryer must be installed to trap and extract moisture from compressed ambient medium. Ensure the working of Dryer regularly to prevent discharging high temperature air into the system.

xii. Dropping line that connect system's Air to the end use equipment must not be carried through bottom of pipe, instead it should be connected with header pipe at the top surface to avoid direct inflow of accumulated water towards equipment.

Figure 5: Efficient Connection

xiii. Avoid sharp bending or fittings in order to avoid turbulence inside the distribution network.

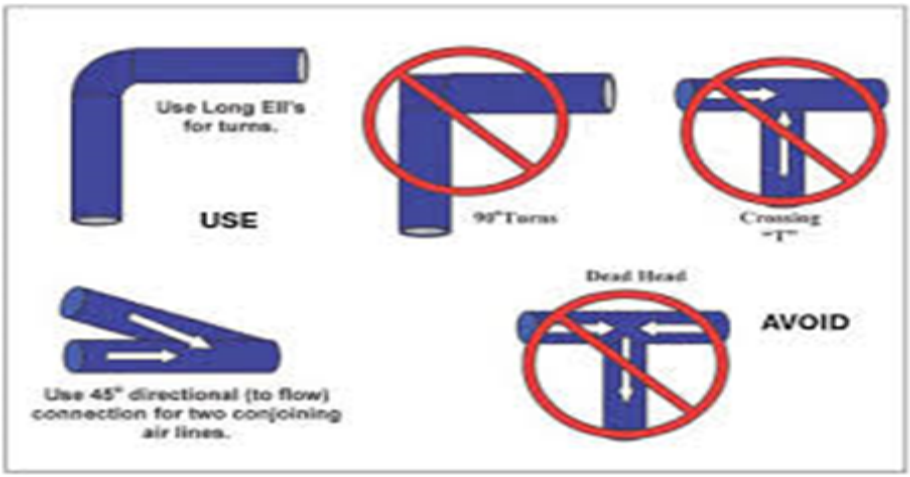

Figure 6: Precedent for Various Joints

xiv. Pressure setting of devices must be as per entailment of allocation network and load attached to the system; moreover, increase in pressure without demand always increase cost of production.

xv. Maintenance of entire system including Compressors, Dryers and all auxiliary equipment attached to the system must be ensured for to avoid unnecessary down time.

xvi. Compressor's oil should be changed after completion of advised working hours.

xvii. To avoid unentailed intrusion in compressor's operation please make the entire area confined and only authorised personnel should deal with system's parameters.