ABSTRACT

Need to conserve the natural resources and environment has shifted the focus on conserving energy in all domains. The present work aims to reduce energy usage in industrial compressed air supply systems by various possible means. Compressed air is used in almost all sections of industry. In the recent years, as industries are moving towards automation, the compressed air usage is also increasing. It has found that electricity usage accounts for 10 to 70 % of total electricity in industries. Studies have shown that there exists 15 to 50 % energy saving potential in the industrial compressed air systems.

A review of available literature has shown that (i) considerable potential exists for saving energy in industrial compressed air systems; (ii) reducing the delivery pressure settings and pressure bandwidth are found to offer considerable energy savings; (iii) variable frequency drives are found to be advantageous in certain cases; (iv) uncertain variations in compressed air usage makes the user to set the higher delivery pressures. However, methods or procedures to estimate the optimum delivery pressure and bandwidth settings are rare. The use of tools like fuzzy logic, target costing and reengineering may provide better results. Such attempts are rare.

Various possible ways of reducing the energy use in industrial compressed air supply system are taken for the present research work. The scope of the present research is:
(i) To develop a method to identify the optimum delivery pressure and pressure bandwidth that will offer maximum possible energy savings under fixed load conditions.

(ii) To develop a dynamic controller that can offer maximum possible energy savings for loads that vary in a specific pattern.

(iii) To develop an algorithm for finding the optimum delivery pressure settings for uncertain or randomly varying loads.

(iv) To use the new managerial approaches for possible reductions in energy use.

Arriving optimum values for each parameter which will result in minimum overall energy consumption under the given load conditions is the task taken in this research work. An iterative algorithm has been developed when the load of the compressed air system is almost constant. A dynamic control algorithm and a dynamic controller have been developed when the load is not constant but, varies in a known pattern. A fuzzy logic based approach has been attempted when the load pattern is uncertain or random.

These approaches have been applied to various industrial compressed air systems. The results are presented and discussed in detail. In addition, a totally new management based approach, a combination of Target Costing and Reengineering, has been applied for a textile yarn manufacturing industry. The major conclusions arrived out of these four studies are as follows:
i. The iterative algorithm has provided about 6.34% of energy savings in a medium scale engineering industry environment where the load is more or less constant.

ii. Under the same conditions, the dynamic controller embedded with a dynamic control algorithm can provide an additional savings of 0.75 to 2.25%.

iii. Using fuzzy logic based approach, optimum parameter settings for random or uncertain load conditions have been obtained. For the case studied, 7.18% energy savings has been obtained.

iv. Target costing (TC) and Reengineering (RE) approach, when employed in a medium size textile industry, upto 70% savings in energy cost has been observed.

Suitable procedures or methods to find out optimum parameters settings have been developed and their potential has been demonstrated. In general the energy conservation in compressed air system is a significant area where the proposed approaches could provide energy savings up to 70% which are significant.