ABSTRACT

In practical industrial applications of pneumatic systems, the issues of energy saving are receiving attention due to the considerable amount of compressed air wasted in operation. This research investigates methods of energy saving for compressed air in conventional and pneumatic servo systems. It is divided into two parts. The first part is the theoretical study which includes the develop of a mathematical model for each part of the applicable of pneumatic circuits solved by MATLAB/SIMULINK program to find out the energy consumption and the efficient pneumatic circuits for different flow rates and pressures. The second part is the experimental work which puts emphases on the designed efficient circuit in the theoretical parts.

Practically and for comparison purposes, eight main circuits were used five as open loop circuits and three as closed loop circuits; to work of these circuits experimentally a MATLAB/SIMULINK working program was design and constructs eight different models for circuits used depending on the function of operation.

Theoretically results for a conventional pneumatic system, the maximum air saving for bridging methods at 8 bar supply pressure is 27% while for cutoff method it is 22% at 2 and 3 bar, for 50N vertical load with air booster it is 20% at 6 bar, a pneumatic servo system for bridging method air saving is 15% for 4 bar supply pressure while 9% with vertical load at 8 bar.

Experimentally in conventional pneumatic system using position sensor instead of proximity switch reduced in air consumption 39.5% at a pressure of 8 bar and time taken was reduced by 30.8 seconds while for a bridging method air saving 23.5% was recorded at 6 bar, cutoff method recorded in air saving 16% at a pressure of 2 bar, with a time increase of 5.5 second. In the vertical load 50 N, the maximum reduction in air consumption was recorded in air booster method 16.7% at 6 bar with a time increase of 25 seconds. For the closed circuits, in a bridging method maximum recorded reduction in air consumption was 13.3% at a pressure of 8 bar, with an increase in time of 1.75 seconds, while for bridging-cutoff method, the witnessed maximum gain in distance of expansion was 39.6 mm and for

return 76.8 mm at a pressure of 8 bar, for vertical load 50N in cutoff-bridging method the maximum gain in distance was 34.5 and 36.31 mm at 8 bar for expansion and return, respectively.

This study has shown some difference between theoretical and practical results. This is due to the high compressibility of air, friction and some assumptions and approximations used to simplify the solution.