IJNRD.ORG ISSN : 2456-4184
INTERNATIONAL JOURNAL OF NOVEL RESEARCH AND DEVELOPMENT (IJNRD) | IJNRD.ORG
An International Open Access, Peer-reviewed, Refereed Journal

Analyzing the effect of Pressure and Flow Rate in Double acting Cylinder using Metering Out Control.

(Case study using Festo- Fluid Lab)

[1]Dr. B.Saravanan & [2]Dr. S.T.Saravanan

[1]Lecturer (SS) / Department of Mechanical Engineering & [2]Lecturer (SG) / Department of Plastic Technology
V.S.V.N. Polytechnic College, Virudhunagar, India

Abstract: In the field of Mechatronics and Automation, the speed of response is based on the Drive velocity. In this paper titled 'Analyzing the effect of Study of pressure and flow rate in double acting cylinder using metering out control', the actual study has been done on pneumatic double acting cylinder by varying the supply pressure and the flow rate. The time taken for the Cylinder for forward stroke and reverse stroke are determined for each pressure and flow rate. The analysis was made using the actual data gathered using data acquisition software. The results are analyzed to gather valid inferences.

Index Terms - Drive Velocity, Flow rate, Pressure, ANOVA

I. INTRODUCTION

The study was done to work out the time taken for a double acting cylinder to move from Inner Dead Centre to Outer Dead Centre for various Pressure and Flow rate. The idea is to determine the optimal pressure and flow rate that provides the maximum drive velocity. Normally the metering out controls are used in Automation due to its robustness and safety in operation. Hence the study has been done using Metering Out Control.

1. THE EXPERIMENTAL SETUP FOR THE STUDY

To analyze the drive velocity, with respect to various applied pressure and flow rate, a Double acting cylinder with Metering out control was setup as shown in Fig. 1 below.

Fig 1 Experimental Setup to study the flow velocity.

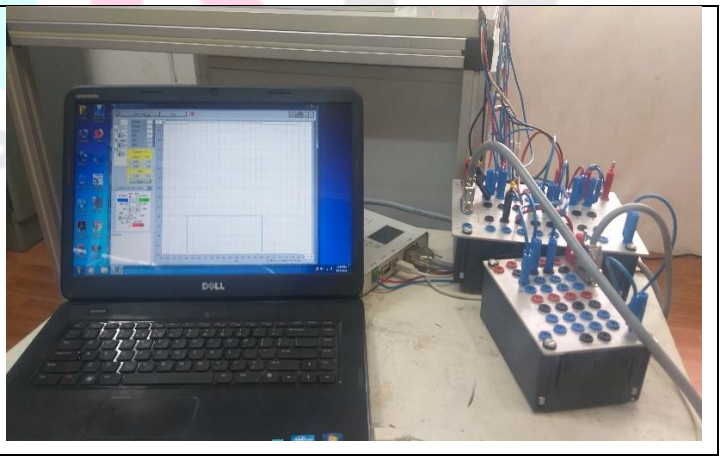

Fig 2 Data Acquisition system.

To gather the actual instantaneous data, Computer system with Festo Fluid Lab software and Data acquisition modules were employed. The real time data acquisition setup is shown in Fig. 2 above.

A. Methods adopted to measure the Readings

Pressure Setting: The pressure values can be set using Filter, Regulator & Lubricator (FRL) value. The values are set at 2 bar, 3 bar & 4 bar and the time taken for the forward stroke and return stroke were determined. The time between the Off time of Reed switch 1 and On time of Reed switch 2 is taken as time taken for the forward stroke. Similarly, the time between the Off time of Reed switch 2 and On time of Reed switch 1 is taken as time taken for the return stroke. Refer Fig. 3. below.

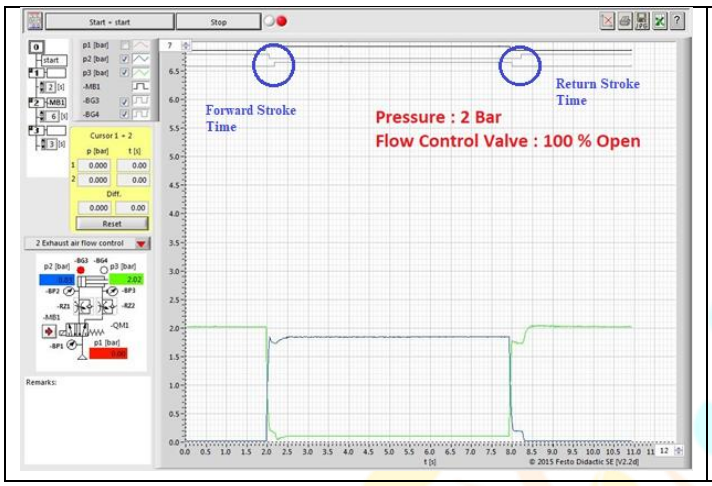

Fig 3. Time recorded for forward and return stroke.

Fig 4 Setting the Flow Level.

Flow Level Setting: The flow control value is set fully open and the flow rate is read using the Digital flow meter. The reading is displayed in Liters per Minute. (LPM). For this flow rate, the experiment is conducted for various pressure values and the readings are tabulated. The measured flow rate is adjusted to 50% of the displayed value by adjusting the Flow Control Valve. For this divide the displayed flow rate by 2. Set the flow rate for the worked out reduced flow by turning the screw of the flow control valve as shown in Fig4. Both the flow control valve are set to 50% of the flow and the readings are taken. Similarly, the flow rate is adjusted to 75% of the displayed value and the readings are taken.

B. The various Readings Taken

By adjusting the flow rate to 100%, 75% and 50% and by varying the pressure to 2 bar, 3 bar & 4 bar the time taken for forward stroke and return stroke using Metering out controls were taken. The data obtained is shown in Table I, below.

TABLE I. THE READINGS OBTAINED FROM THE STUDY

System Pressure (Bar)	Set Flow rate %	Flow Rate (LPM)	Time for Piston Movement (Sec)	
			Forward	Reverse
2	100	16.65	0.12	0.22
2	75	12.52	0.15	0.22
2	50	08.32	0.22	0.22
3	100	23.70	0.12	0.275
3	75	17.70	0.19	0.21
3	50	11.85	0.11	0.20
4	100	30.80	0.175	0.20
4	75	23.10	0.12	0.19
4	50	15.40	0.10	0.12

2. THE RESULTS AND DISCUSSIONS

It is evident from the above result that the time taken for return stroke is greater than the time taken for forward stroke. But as per reference [1], the forward stroke has to be slow as cylinder has more volume & the return stroke has to be quick. But as Metering Out control as shown in Fig 5 below is adopted in this study the values are as shown in Table I.

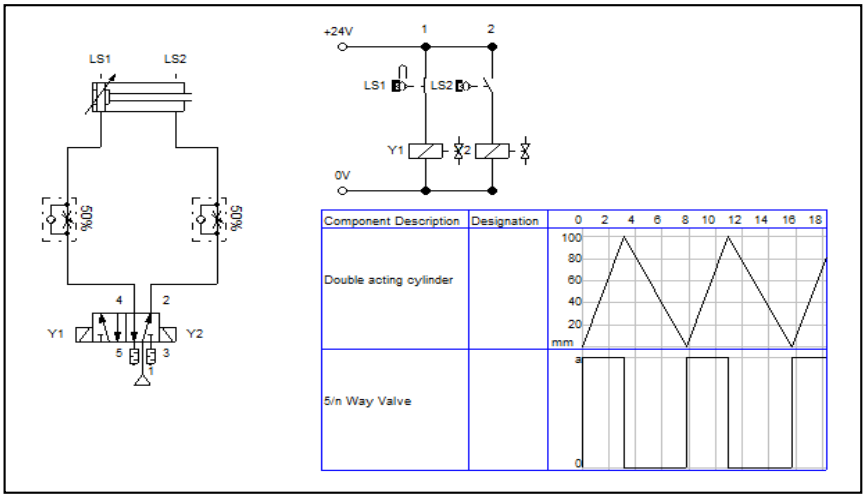

Fig 5. Metering Out Control – Simulation Study using FluidSim.

Analysis of Variance is done between the Forward Stoke timing and Return Stroke timing. It exhibits that there is a Positive Correlation between both the variables. The study also exhibits that as the Pressure Value is increased, the time for Forward Stroke and the Time for Return stroke gets reduced. Further regression analysis was done and the estimated time for the forward and return stroke were worked out for 5 bar pressure. The analysis shown in Fig 6 & 7 below.

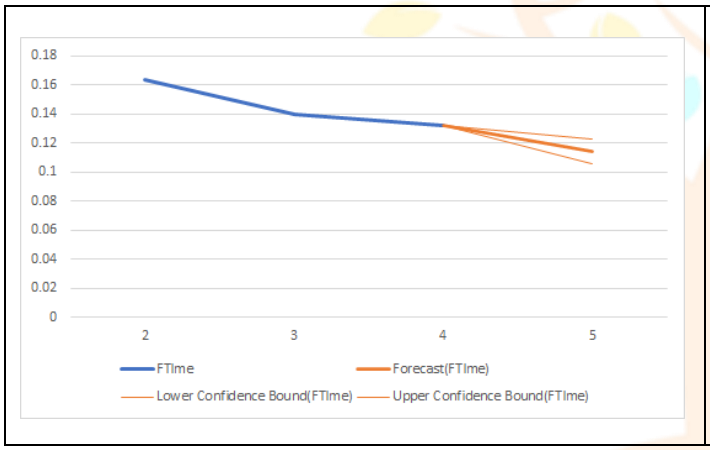

Fig 6. Graph Showing Estimated Forward Stroke Time at 5 Bar Pressure.

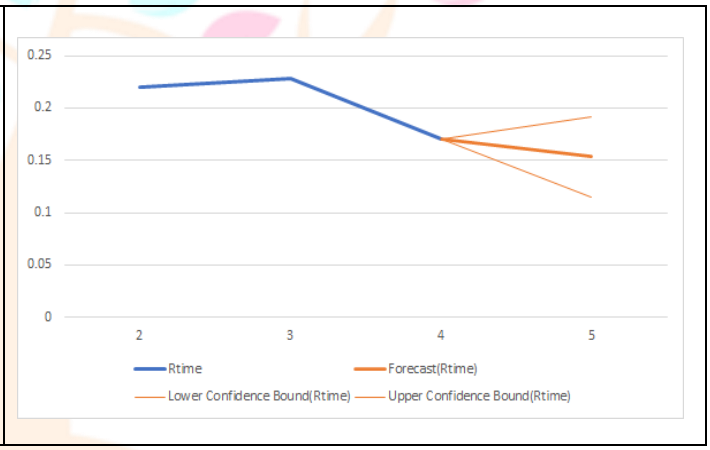

Fig 7. Graph Showing Estimated Return Stroke Time at 5 Bar Pressure

The study reveals that the pressure and flow rate directly increase the velocity of Drive. Further the study has been done without any load on the cylinder. Similar study has been done with load as per reference [2] and the velocities are studies. Similarly, the study has been carried out using Metering Out control on both sides. Similar study can also be done using Metering In control.

II. Acknowledgment

The authors wish to express their sincere thanks to the Principal Dr.S.Jawahar and the Head of the Mechanical Engineering Department Mr. K.Sivamurugan who would encourage the staff members to carry out research study in the advanced Lab facilities available in the Departments. Further the authors wish to recognize the works of Mr. A.Ananth, Skilled assistant, Automation Laboratory, who has been supportive in making the study and recording the readings.

References

[1] P. Beater, "Pneumatic Drives, System Design, Modelling and Control" *Springer Publications.2007*.

[2] Paul. G.Harris & Tom Whelan, "Modelling and Identification of Industrial Pneumatic Drive System", International Journal of Advanced Manufacturing Technology, pp. 1075-1086, June 2011.