

# AUTOMATED FLOW CONTROL IN SOLID MATERIAL PACKAGING MACHINES

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**Abstract** - The electromagnetic vibratory feeders are commonly used in processing industries for controlling the gravimetric flow of granular materials. This mechanical drive offers easy and simple control of mass flow of materials. This project is to automate the filling process that takes place in solid materials packaging machines. Application of electromagnetic vibratory drive combined with power converters provides flexibility during work. The use of a silicon-controlled rectifier (SCR) implies a phase angle control. Phase angle control is used to accomplish vibration control by triggering SCR. By using a microcontroller-based control system designed for the converter, it is possible to achieve continuous variation of vibrations. This also enables the automation of whole system thus eliminating the manpower needed for monitoring the system.

**Key Words:** Electromagnetic Vibratory Feeder, Phase Angle Control, Solid Materials, Vibration Control, Filling Process.

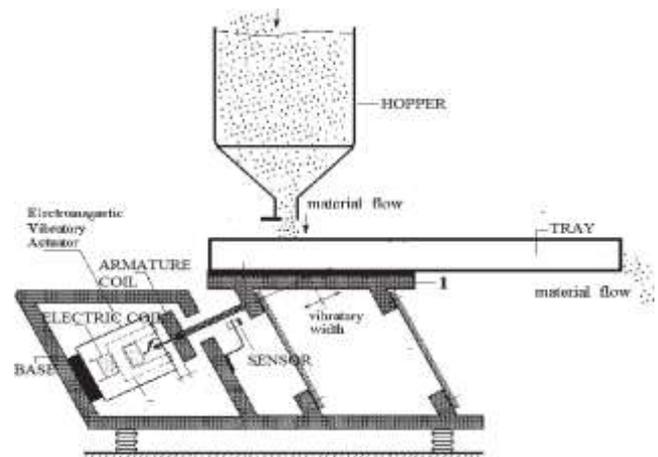
## 1. INTRODUCTION

DC drives have been replaced by Induction motors in many applications due to its rugged construction, cost effectiveness. Its application varies from domestic to industrial applications such as industrial robots, electric vehicles, elevators and so on. Speed control method is used to obtain energy efficiency when running machines at variable speed. The conventional speed control methods affected by mechanical wear and tear, less efficient and frequent maintenance requirement. Therefore, the use of power electronic devices and controllers play a vital role in improving the above factors and also help them in soft starting. To achieve this simple and compact power electronic controller circuit called AC voltage controller is connected between the input ac supply and the load (single phase induction motor). The controller possess two antiparallel SCR's to regulate the supply voltage to the load. By varying the firing angle of the thyristor the output voltage of converter is varied. There are two control strategies by which the output voltage is varied. They are:

- a) On - Off cycle control
- b) Phase angle control or Firing angle control

## 2. WORKING OF ELECTROMECHANICAL VIBRATORY FEEDER

The vibrating drive system consist of a vibratory motor which is commonly used in heavy-duty feeder applications, because greater forces are produced than electromagnetic drives. The unbalanced mass is placed on the shaft of the vibratory motor. The supply is given to the motor, it rotates and the unbalanced mass creates the centrifugal force. When vibratory motor is attached to an object it causes the object to displace.



**Fig -1: Vibratory Feeder**

As the motors rotate, the centrifugal forces move the vibratory tray in forwards and backwards opposite to the direction of rotation of motors. This fast and repeated displacement is witnessed as vibration at the output. The amplitude of vibration can be controlled by controlling the phase angle of the power semiconductor device used. To isolate the supporting structure from vibration of the feeder, the tray is suspended on coil.

## 3. PROPOSED SYSTEM

The principle of operation is once the material starts filling, the output voltage from the load cell varies. The load cells work on the principle that the strain gauge (a planar resistor) deforms when the material of the load cells deforms appropriately.

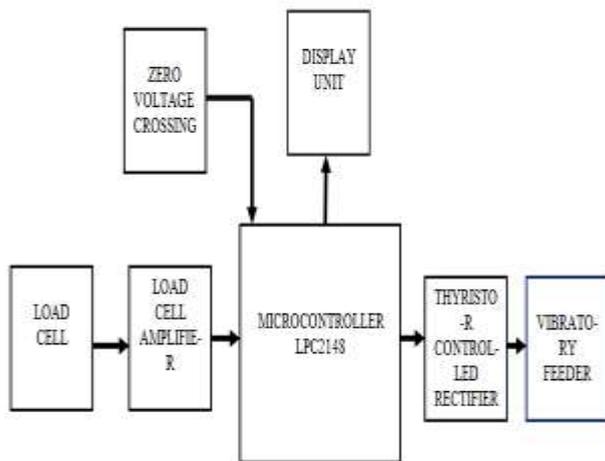


Fig -2: Block Diagram of phase angle vibrator control

Deformation of the strain gauge changes its electrical resistance, by an amount that is proportional to the strain. The change in resistance of the strain gauge provides an electrical value change that is calibrated to the load placed on the load cell. This amplified value is given to the analog to digital port of microcontroller (LPC2148). The digital value obtained is the weight which is displayed for the user monitoring purpose. Based on the digital value obtained, a pulse width modulation pulse is produced corresponding to the weight retrieved from the load cell. This pulse is given as the trigger pulse to the thyristor for achieving phase angle control. This phase angle controlled supply is given to the vibratory motor to achieve speed control. The speed control of the vibratory motor enables the control of vibration. Since the speed of the motor is controlled based on the load cell, it enables to achieve precise control of vibration and automate the entire process.

#### 4. PHASE ANGLE CONTROL

In this method, phase angle is controlled by controlling the trigger pulse given to the thyristor. The trigger pulse generated depends upon the microcontroller based design. By triggering the SCRs T1 and T2, the output rms voltage is varied. Since the sine wave pattern is getting changed, harmonics will be introduced in the system.

The expression for rms value of output voltage for resistive load is given by:

$$V_{0(rms)} = V_s \sqrt{((\pi - \alpha) + (\sin 2\alpha)/2) / \pi}$$

Where ,

$$V_s = V_m / \sqrt{2} = \text{Rms value of input supply voltage}$$

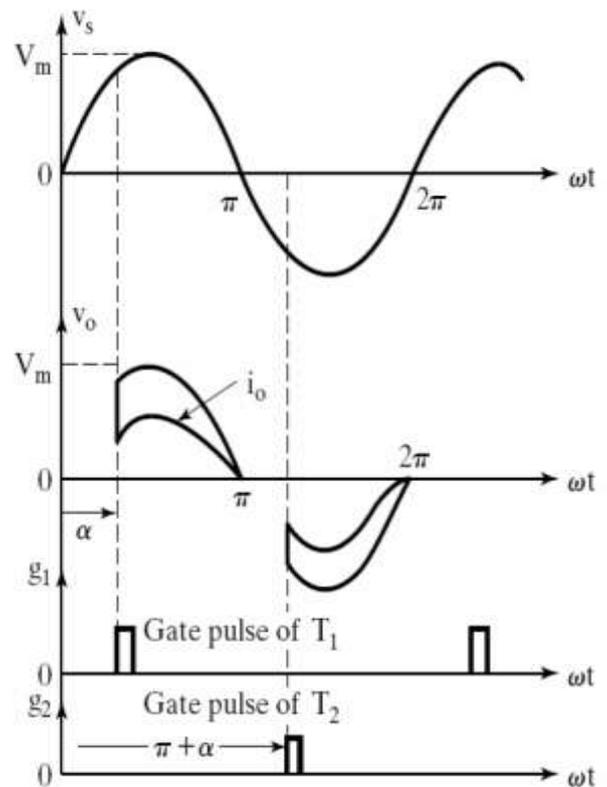


Fig -3: Input and Output wave form

Table -1: LOADED VALUES FOR VARIOUS FIRING ANGLES

S. No	$\alpha$ in deg	$V_o$ rms (V)	$I_o$ rms (A)	Speed (rpm)
1	0	229.6	7.37	1493
2	30	229.6	7.37	1493
3	60	229.6	7.37	1493
4	90	221.4	7.13	1491
5	120	157	5.64	1471

#### 5. CONCLUSION

The paper discusses the control of vibration of the vibratory feeder which is achieved by the speed control of induction motor via ac voltage controller. Phase angle control method is used to control the output voltage and hence the speed. Thus the request to increase the speed, accuracy and reliability of production processes, in order to increase the quality and effectiveness of time and energy, achieved through the implementation of phase angle control. This enables fine control of vibration at the same time automates the entire process. This system reduces the need for manpower and make it affordable for small scale industries.

**REFERENCES**

- [1] Rohit Gupta, Ruchika Lamba, and Subhansu Padhee, "Thyristor Based Speed Control Techniques of DC Motor: A Comparative Analysis," International Journal of Scientific and Research Publications, Vol. 2, Issue 6, June 2018.
- [2] E.S. Oluwasogo, and I.K. Okakwu, "Performance Analysis Of A Single-Phase Ac Voltage Controller Under Induction Motor Load," International Journal of Research in Engineering and Technology, Vol. 03, Issue: 06, Jun-2017.
- [3] Dr. Jamal A. Mohammed, "Speed Control of Single Phase Induction Motor Using Micro-Controller," ICIAC-12-13th April 2017.
- [4] M. Narayanan, R. Vidhya, P.Yuvaraj, "Phase Angle Control Method of Speed Control of Single Phase Induction Motor", International Journal of Innovative Research In Electrical, Electronics, Instrumentation And Control Engineering, Vol 3, Issue 11, November 2016.