

Pneumatic Multicolour Screen Printing Machine

Sanket A. Kachare¹ Nilesh N. Narwade² Vaibhav U. Mandle³ Harshad V. Shiraskar⁴ Prof. V.P.Sawant⁵

^{1,2,3,4}Student ⁵Assistant Professor

^{1,2,3,4,5}Department of Mechanical Engineering

^{1,2,3,4,5}Smt. Kashibai Navale College of Engineering

Abstract— Printing is an important way of sharing information. A lot of innovation has taken place over the centuries and now screen printing has an important place in manufacturing, newspaper, textile, medical industries. Conventionally, the Flat Screen Printing is done manually by moving the squeegee to and fro. We are developing a machine from Pneumatic pressure so as to create uniformly distributed pressure instead of unequal pressures. By introducing pneumatic pressure we are reducing the work of operator, achieving qualitative prints, minimize the time required for printing. By making the machine semiautomatic the cost of machine is reduced as compared to PLC operated machine. We are confident that our project will work and will have future scope of modifications.

Key words: Printing, Flat Screen Printing, Pneumatic, Screen Printing.

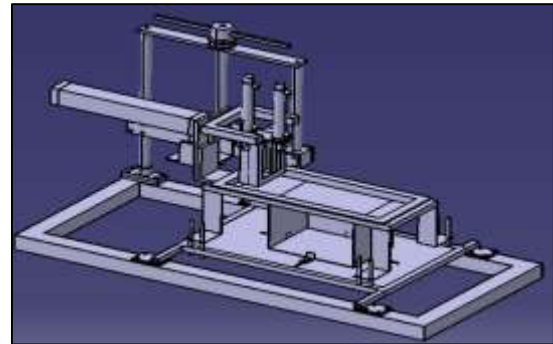


Fig. 1: Design & Working

One of the two squeegees is used to impregnate ink into the screen DTP surface on substrate and other is used to recollect the unused ink so as to make remainder available for next printing operation.

During forward stroke, one of the squeegees makes line contact with the object such that plane of squeegee and axial plane of substrate lie collinear with each other.

The position screw should be adjusted such that it would not impart the excess pressure along the line of contact of cylinder and squeegee in order to avoid damaging effect to screen.

I. INTRODUCTION

A. Printing

Printing is a process for reproducing text or images typically with ink on paper using a printing press or machine. It is an essential part of publishing and transaction printing.

The earliest form of printing was wood block printing about 2000 years old [1].

B. Screen Printing

Screen Printing is a stencil based process, it consist of closed non-image and open image areas. It is based on the principle of squeezing the ink through the open areas of the screen on substrate [4]. It is also known as silkscreen, serigraphy, and serigraph printing. One colour is printed at a time, so several screens can be used to produce a multi-coloured image or design.

Of all the printing techniques, screen printing has the most wide applications. Paper, textile, glass, any solid material can be printed using screen printing. The technology has a large application field extending to a decorative sticker manufacturing. This technique is most optimum to produce signs and displays, decorative automobile trim, battery logo and also in printed electronics. The main intention of our project is to reduce printing time, to enhance the printing quality, to reduce the cost of machine, and make the process semi-automatic & easy to perform.

II. DESIGN AND WORKING PRINCIPLE

Printing operation is carried using pneumatic cylinder. It utilizes two 50 mm stroke pneumatic cylinder for operating squeegee, one 300 mm stroke pneumatic cylinder for horizontal movement of squeegee and one cylinder hinge assembly for controlling moment curvature of cylinder and squeegee assembly.

III. OPERATION

Process of printing is optimized by metering the flow rate of air through cylinder to control the speed of operation and optimize it to obtain good printing quality.

Type of ink used for printing depends on the substrate. Preparation of ink containing proportional amount of thinner plays an important role in quality of texture to be printed.

Sequence of pneumatic operation also plays an important role in reducing the in process times, production time and also make a substantial use of the raw material involved in printing operation. Following sequence is recognized as the most efficient sequence for carrying out economical and enhanced printing operation:

- 1) Screen cylinder in retracted position and ink imprinting squeegee cylinder in active mode.
- 2) After spreading ink just near the start point of the DTP the expansion stroke of the screen cylinder starts and due to pressure exerted by squeegee on screen the ink impregnates screen and get printed on the substrate.
- 3) Ink collector squeegee cylinder and moment curvature control cylinder is activated simultaneously. Job is unloaded
- 4) As soon as job is unloaded the retraction stroke of screen cylinder starts till it attains a completely retracted position and another new job is loaded again.
- 5) Working pressure for all pneumatic cylinders is 4 bars.
- 6) Piston speed for obtaining good printing quality is 40 mm/sec.

IV. FRICTION FORCE AND SCREEN TENSION'S EFFECT ON QUALITY OF SCREEN PRINTING

In the process of screen printing the friction force between the screen and the squeegee plays an important role. While the squeegee passes the screen due to the friction force the position of the mask shifts [6].

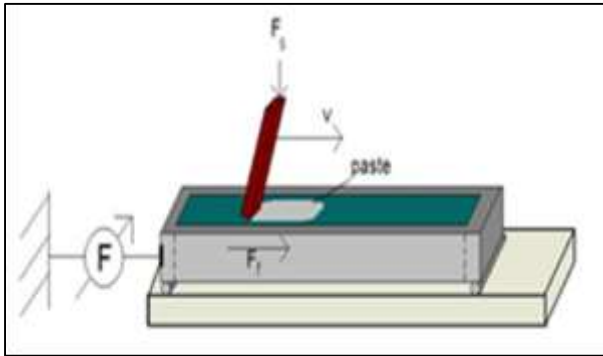


Fig. 1: Measurement setup for determining the friction force between the squeegees.

By this measurement the relationship between the friction forces (F_f) and the printing speed (v) and squeegee force (F_s) was estimated. Every thick film paste is viscous and has a non-Newtonian rheology suitable for screen printing. The shear stress, τ , for this kind of fluids can be described by the Ostwald de Waele relationship:

$$\tau = (dv/dy)^n$$

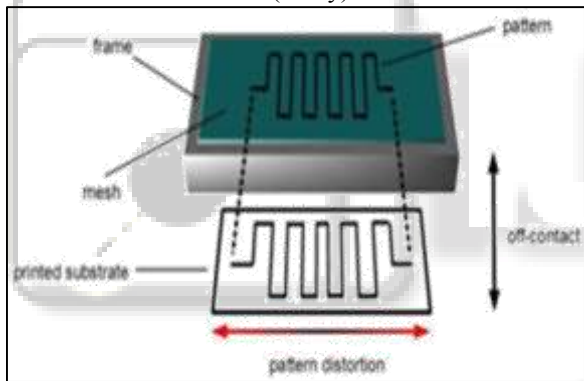


Fig. 3: Shows the shear stress and paste velocity during screen printing. Thick film paste is a shear-thinning fluid, thus n is positive but lower than 1.

The image shift was examined, where the screen tension was in the region of 2– 3.3 N/mm, the off-contact was 0.9–1.5 mm and the applied friction force was based on the measurement. The reduction of screen tension can affect the quality of the printing in other respects. The deflection force of the screen is decreasing, so the separation of the substrate and the screen cannot start right after the squeegee passes on the screen. This off-contact distance has to be modified in the function of screen tension to keep the screen from sticking to the substrate during printing because adhesion causes many separation problems that damage the quality of the printed film. [6]

In our study the initial screen tension was 3 N/mm and the off-contact was the industrial standard (1 mm) which resulted in adequate printing quality [3]. In order to avoid adhering, the off-contact has to be increased according to Fig. 4.

As the squeegee force has not been changed, the paste is being printed with the same pressure, and due to the modified off-contact the elastic force resulting from screen

deflection and the paste adhesion has the same force condition as at the initial screen tension and off-contact [2].

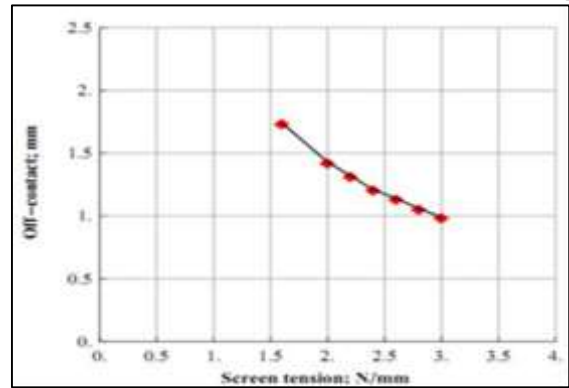


Fig. 4: Off-contact compensation in the function of screen tension.

V. RESULT

Sr. No	Parameters	Manual Operated M/C	Semi-Automati c M/C	PLC Operated M/C
1	Cost	₹ 25000 To 35000	₹ 36000 To 40000	₹ 100000 To 150000
2	Time/Product*	3 Min	1 Min	0.5 Min
3	Labour	2	1	1
4	Printing Quality	As Per Operator	Better	Better
5	Construction	Simple	Less Complicated	Complicated
6	Use In Industries	Small Scale	Small, Medium & Large Scale	Large Scale

Table 1: Result

- (* Time shown in minute for specific length of job)
- (Data is collected from market survey)

VI. CONCLUSION

As per our objective, we have developed a Flat Screen Printing machine having low cost compared to PLC operated machine.

The Flat Screen Machine developed can apply uniform pressure (pneumatic) on screen instead of varying pressure in case of manual printing machine.

The printing quality is increased due to knowledge of screen tension effect on print quality.

The pneumatic operation is fast so the production time is reduced. This machine can be used in printing small as well as large number of objects.

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