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STUDY OF SCREEN PRINTING FOR OPTIMUM CONSUMPTION OF INK IN DIFFERENT TYPES OF SCREEN WORK

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ABSTRACT: In screen printing ink is widely useful. Ink alone is used to print the substrate. The screen printing process for optimum consumption of ink in different types of screen work allows for the transfer of images using woven mesh and ink blocking stencils onto materials, such a poster paper or t-shirts. Screen printing machines themselves vary, as some simply aid in the printing processAim of this study is to reduce the consumption of ink along with the optimum utilization of ink and explore the possible ways of optimum utilization of the ink used in different screen printing processes especially in Sakurai &Graphica machine. In this paper is study of different screen printing processes used in printing industries, different jobs of the "Manohar Filaments, Pvt. Ltd. Barhi, of Sonipat" were taken into consideration. During project work jobs consuming moderate amount of inks were selected and the study was conducted on each selected job.

Keywords; Screen Processes, Screen Printing Ink, Screen Printing

I. INTRODUCTIN

SCREEN PRINTING

Screen printing technology is a well-established technique for the fabrication of electro analytical sensors. One prominent commercialization of screen printed electrodes was the personal glucose biosensor used by those suffering with diabetes, which is billion dollar per annum global market. Society is in a constant stare of growth and development and it is inevitable that demands for sensing devices related to clinical and industrial applications will increase; this is particularly true in the former case within UK where the recent budget cuts in NHS are pushing the onus onto individual self-monitoring. In order to achieve this, inexpensive and disposable, yet highly accurate and rapid, devices are greatly sought. Additionally the portability of such devices is of fundamental importance. Decentralized sensing is ever more necessary and thus traditional techniques utilizing highly expensive, immovable analytical equipment such as Gas Chromatography-Mass Spectrometers are not feasible for sensing outside the realms of standard laboratories. Examples of cases where portable, economical and sensitive sensors are highly desirable include; utilization in hospitals where there is a suspected drug over-dose, the personal monitoring of diseases such as diabetes (as detailed earlier), the detection of potential pollutants of toxins within environmental samples such as river water, the screening of drinking water at different sources, and also the rapid determination of naturally occurring biomolecules.

Screen printed electrodes not only address the issue of cost effectiveness but they also satisfy the previously much sought after criterion of highly reproducible and sensitive methods of detection towards target analyses, whilst maintaining the low cost production through scales of economy. The adaptability of screen printed electrodes is also of great benefit in areas of research; the ability to modify the electrodes with ease, through differing inks commercially available for the reference, counter, and working electrodes, allows for highly specific and finely calibrated electrodes to be produced for specific target analytes.1 Screen printing involves printing a thyrotrophic fluid through a mesh screen which defines the shape and size of the desired electrode. The thyrotrophic fluid contains a variety of substances including graphite, carbon black, solvents and polymeric binder. Depicts a schematic representation of the process of screen printing, where multiple layers and complex designs can be implemented. The inks utilized have a relatively high viscosity (3–10 Pa.s at a sheer rate of 230s-1) but when forced through the screen mesh by the squeegee blade, the ink undergoes sheer thinning allowing it to penetrate through the screen mesh which defines the final shape/design. Upon contact with the substrate, typically a ceramic or plastic material, the ink returns to its viscous state forming the intended shape/design with definition. Such final shapes/designs have thicknesses in the range of 20 to 100 mm and as such are thicker than those obtained by other printing methodologies, thus they are consequently termed ‘‘thick film technology’’. Note that the thickness can be readily controlled by the thickness of the stencil design and the mesh. Such designs can be printed onto ceramic substrates or plastic substrates depending on the intended application. In the latter case the cost is generally lower and the carbon print is better adhered to the substrate than in the former case.

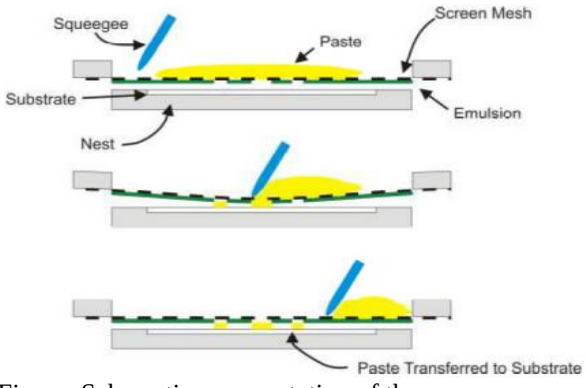
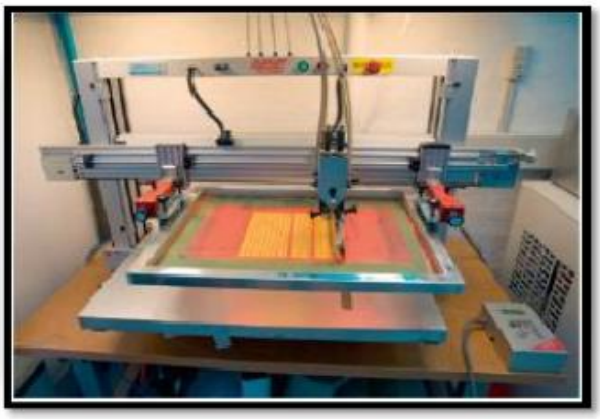


Figure: Schematic representation of the process screen printed manufacturing of electrodes

SCREEN PRINTING

- No loss of coating solution
- It requires a high viscosity and a low volatility′
- Screen of woven materials (synthetic fiber or steel′ mesh)
- It can be adapted to a roll-to-roll process′



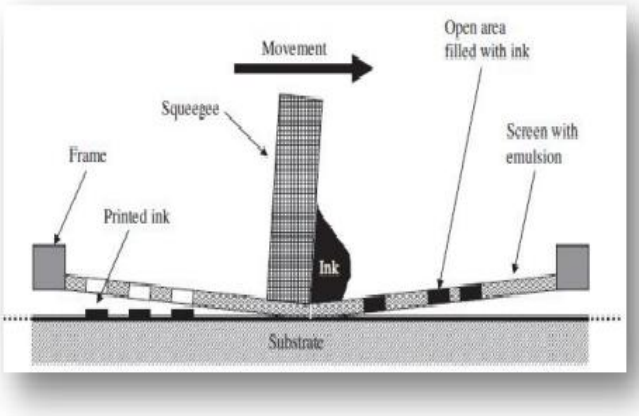


Fig: - screen printing

II. INK COLOUR, DRYING AND CURING CHARACTERISTICS

COLOUR

The technology of printing ink colour is based on the Young-Helmholtz theory of three colour vision which implies that white light is composed of light from a continuous spectrum of wavelengths, humans perceive only three broad bands of this light, blue, green and red light; any other colour of light is borne by an appropriate combination of these three 'primary colours'. 'Subtractive colours' are produced by 'subtracting' one of these three primary colours from white light, e.g., red and blue light together produce. When white light strikes an object, some of the light is absorbed and the remainder is reflected. The colour that we perceive as the colour of the object is the colour of the reflected light.

In printing inks, four different colours of ink are employed: cyan, magenta, yellow and black. All other colours can be formed by 'overprinting' these inks, e.g., red is produced by overprinting

yellow and magenta, as the yellow absorbs the blue light (because yellow is the emission of red and green light) and magenta absorbs the green light, leaving behind pure red light. Cyan, magenta and yellow add together to give brown colour usually.

In conjugated systems (one consisting of alternate single and double bonds in which π electrons are delocalized), the colour is due to light energy absorbed by the π electrons. They are characterized by a band gap, the energy of which falls in the visible region (the electrons of the second electron pair of the double bond).

DRYING AND CURING

After its application over the substrate to be printed, the ink undergoes drying or curing phenomena involving a series of cross linking and polymerization reactions that result in film formation thus binding the ink to the printed substrate. Ink drying or curing may occur by any one or by suitable combination of the following processes.

(I) EVAPORATION

Some inks dry or cure by the evaporation of the solvent. Generally, volatile solvents e.g., methylated spirits are used. However, solvents with boiling points above 120oC may also be used such as in screen printing inks to prevent the ink from drying during application.

(II) PENETRATION

For porous surfaces, printing inks are designed so that the solvent penetrates into the bulk of the printing surface and the dry ink is left on the surface.

(III) OXIDATION

In case of inks where drying oil is used as solvent, curing occurs by the reaction of atmospheric oxygen with instauration of oil.

(IV) RADIATION CURING

Involves a series of polymerization reactions which are instigated under the influence of radiations e.g., UV, falling on printed substrate. This process is considered as a 'green' curing route involving lesser energy and time.

(V) PRECIPITATION

This process is applicable to an ink system that is only sparingly miscible in water. Here, excess water (usually in the form of steam) is added to the ink system. The sudden increase in diluent concentration causes the solubility of the resin to decrease sharply and the resin precipitates onto the printed surface; the excess water precipitates off.

III. RESEARCH OBJECTIVE

The objective of this thesis is to study screen printing processes for optimum consumption of ink in different types of screen printing to utilize the ink losses in printing technology in "Manohar Filaments, Pvt. Ltd. Barhi, of Sonipat"

RESEARCH METHDOLOGY

The whole study has been divided in 3 sub parts for screen printing process for optimum consumption of ink in different types of screen printing work

1. To study to reduce the ink loses in screen printing process.
2. To make desired print on several substrate using different ink in screen printing.
3. To study how to consume ink in different types of screen work.
4. Different jobs of the " Screen Printing Process" during project work consuming moderate amount of ink will be

selected and the study will be conducted on each selected job. Data collection will be done during the study.

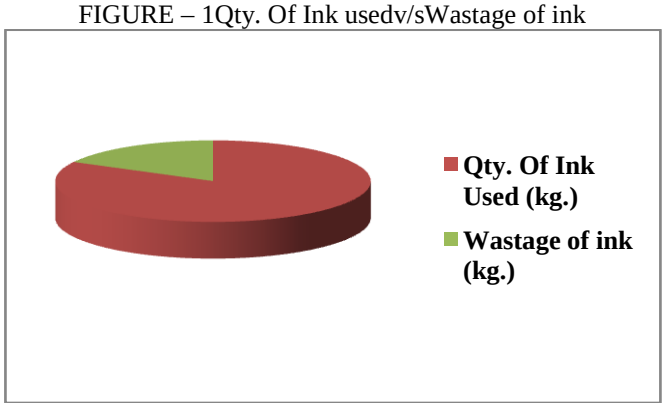
IV. DATA COLLECTION & ANALYSIS

MANOHAR FILAMENTS OFFSET PRINTING PRESS, SONIPAT
SCREEN PRINTING
Name of Machine - SAKURAI PTG MACHINE
No. of Units - SINGLE COLOR
Machine Speed - 600 impressions per hours
Change over time of job on machine - 30 Min.
Per day minimum production approx. - 3000-4000 Sheets
Copies wastage during production (per job) - 4 to 5 % Approx.
Types of ink - Perfecto Ink,
Screen stencil - Mesh 61T Thread per square inch
Coating used - KIWO 5+1
(For 8 hours working of machine.)

TABLE NO 1: DATA OF SCREEN PRINTING MANOHAR FILAMENTS OFFSET PRINTING PRES, SONIPAT FOR THE MONTH OF FEBRUARY, 2017

Sr. No	Types of printing	No. of days	Machine name	Qty. of ink in Kg. (approx.)	Wastage of ink during Printing in kg.(approx.)
1.	Screen Printing	24 days	Sakurai	360	75

FIGURE – 1Qty. Of Ink usedv/sWastage of ink

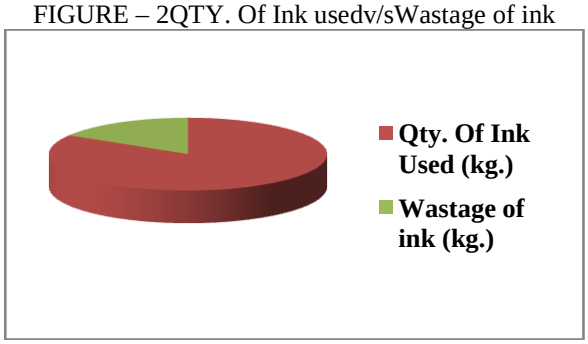


MANOHAR FILAMENTS OFFSET PRINTING PRESS, SONIPAT
SCREEN PRINTING
Name of Machine - GRAPHICA PTG MACHINE
No. of Units - SINGLE COLOR
Machine Speed - 200-250 impressions per hours
Change over time of job on machine – 25 Min.
Per day minimum production approx. - 1500-2000 Sheets
Copies wastage during production (per job) - 4 to 5 % Approx.
Types of ink - Perfecto Ink,
Screen stencil - Mesh 61T Thread per square inch
Coating used - KIWO 5+1
(For 8 hours working of machine.)

TABLE NO 2: DATA OF SCREEN PRINTING MANOHAR FILAMENTS OFFSET PRINTING PRES, SONIPAT FOR THE MONTH OF MARCH, 2017

Sr. No	Types of printing	No. of Days	Machine Name	Qty. of ink in Kg. (approx.)	Wastage of ink during Printing in kg.(approx.)
1.	Screen Printing	27 days	Graphica	184	36

FIGURE – 2QTY. Of Ink usedv/sWastage of ink



Name of Press
Date:- Name of supervision:-
TABLE NO. 3 - Check list for SCREEN PRINTING machine
Please Tick (√ /x) For Each Job

Sr. No	Check Point	Job 1 (√ /x)	Job 2 (√ /x)	Job 3 (√ /x)	Wastage of Sheets (approx.)
1.	Speed of Machine.				
2.	Type of screen printing ink in In feed unit at start of Machine.				
3.	Function of screen printing unit.				
4.	Suitable grade of printing substrate for respective jobs.				
5.	Preparation of job for Machine.				
6.	Printing time for screen printing substrate				

7.	Proper amount of work pressure unit & inking unit.				
8.	Apply ink according to printing job				
9.	Coating used in stencil making also affect the ink consumption				
10.	Machine speed setting according to job and substrate.				
11.	Printing time for printing substrate.				

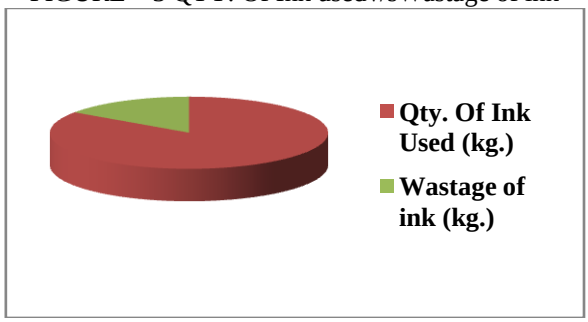
V. RESULT & DISCUSSION

DATA OF SCREEN PRINTING APRIL MONTH FOR SAKURAI MACHINE AFTER IMPLEMENTION OF SUGGESTION POINT CHECK LIST

TABLE NO 4: DATA OF APRIL MONTH

Sr. No	Types of printing	No. of Days	Machine Name	Qty. of ink in Kg. (approx.)	Wastage of ink during Printing in kg.(approx.)
1.	Screen Printing	24 days	Sakurai	362	66

FIGURE – 3 QTY. Of Ink usedv/sWastage of ink

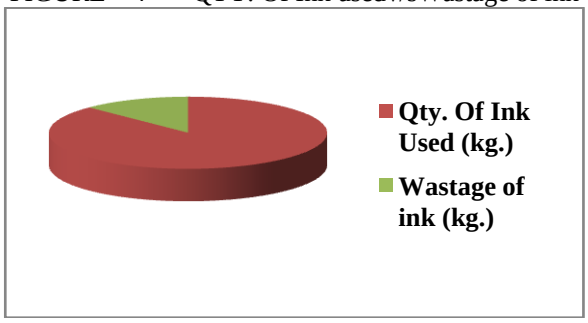


DATA OF SCREEN PRINTING MAY MONTH FOR GRAPHICA MACHINE AFTER IMPLEMENTION OF SUGGESTION POINT CHECK LIST

TABLE NO 5: DATA OF MAY MONTH

Sr. No	Types of printing	No. of Days	Machine Name	Qty. of ink in Kg. (approx.)	Wastage of ink during Printing in kg.(approx.)
1.	Screen Printing	26 days	Graphica	180	26

FIGURE – 4 QTY. Of Ink usedv/sWastage of ink



VI. CANCLUSION & FUTURE SCOPE

This research focuses on consumption of ink and explores the possible ways of optimum utilization of the ink used in screen printing processes of "Manohar Filament Sheet-fed Offset at Sonipat"**.** In all four cases when check list get adopted number of wastage goes down by approx. 15 to 20% and consumption of screen printing ink goes down by approx. 500 to 600 gm. Ink depending up on the job and machine availability. These preliminary results can be used in future. Check point suggestion incorporated in screen printing section on Sacurai and Graphicaafter consultation with various press authorities may be indicative for other presses. They may modify, increase or decrease the factors to be considered.To implement the suggestions properly we generate a check list in form of table to check the different factors before all jobs to be handled on particular Machine on daily printing. And the check points help to reduce the consumption of screen printing ink along with optimum consumption of screen printing inks. The study may be concluded in a manner that, if all suggestion were implemented in matter of practice on screen printing Section / sheet fed offset Machine, consumption of screen printing ink will go done along with controlled / minimized wastage and it helps to cost reduction and make our production cost effective or increase productivity.However researcher feels that limited facilities or infrastructure was available in city like Sonipat. The result may vary depending upon the type of Machine/Technology, and skills of Man power.

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