DEVELOPING AND INNOVATION OSSCILATING

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Developing and Innovation Osscilating Ink Distributor Roller System at HAMADA CD 500/600/ 700 Sheet Fed Offset in Order to Achieve High Quality Printing

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Abstract

SMEs in Printing Industry Today have been well developed. It was growth significantly at Indonesia. Many new comers with SMEs scale focus on packaging industry, seems like home industry with limitation machine resources and budget. These researches try to develop and utilize some small machine that big industries just throw it. Based on SMEs capacity and budget, HAMADA is suitable for their production. This machine is small, low electricity consumption, cheap and easy to operate it. However this machine have weakness in oscillating ink roll system. This weakness of this machine made this machine not possible produces high quality full color printing (CMYK). Although this machine rolls system suitable with full color print, it couldn't optimal in full color print. This system model of oscillating is hanging on the top of frame. It without any lock up and adjuster, just put on the top. When the diameter of roll reduces, or the connecting shaft vibration, it give impact with the quality of printing itself significantly become worse. So in other hand this machine could not print in full color (separation). Hamada is good machine, usually it used for monochrome print, for the SMEs need, this machine should be capable to separation print (full color). We try to develop and innovate this oscillating roll system, with some research in order to improve this machine capability and value. This system development help the SMEs could production and print in high quality as the Market needs. Hopefully with this new system development, this machine can help and increase SMEs printing quality and this machine itself become more valuable.

Keywords: Oscillating Ink Roll, Separation, Printing Quality, SMEs.

1. INTRODUCTION

Printing Industry in Indonesia was growth, especially in Packaging Industry, Digital Printing and Screen Printing Industry. SMEs also follow that growth by open new printing house. SMEs at Indonesia in this Industrial Sector year-by-year increase, although they have limitation in budget, they still survive and growth in this industry. Because of SMEs well developed at Indonesia, The needs of printing machine also increase too. Budget limitations become many SMEs barrier in investment. The market need push this industry to upgrade their product quality. Following that needs was big problem for SMEs. In the market only big company can fulfill the market needs. It was not fair for SMEs. In the research we try to develop and innovate simple printing machine that can be used by SMEs with small modals or budget. Hamada is simple sheet fed printing machine, this

machine population so many at Indonesia, especially CD models. In 80 - 90 eras, this machine become favorable in many printing house at Indonesia. This machine has simply models with standard technology, and user friendly. Today this machine didn't use anymore because of market needed for high quality printing. Big Printing House Company leaves these machines sometimes they just throw it as scrap.

This machine has weakness that not possible print separation (CMYK). Although factory specification of this machine suitable and possible to print separation it didn't work maximum. This models CD 500/600/700/800 is single color machine with compact and simple system. The weakness of this machine at oscillating ink transfer roll. This machine system of oscillating ink transfer roll used hanging models, without any adjuster and lock up. The system just put on the upper frames, the roller using bar with feet pin bar and plug in on the upper frame.

Pictures 1 explain the old system of this machine. This system has many weaknesses. The weakness this model didn't have any adjuster or lock up system that made the oscillating transfer ink not fixed for placement. Because of this, the qualities of printing become unstable. The worse weakness of this model if the Ebonite roller diameter becomes smaller because of abrasive sometimes the image didn't occurred on the paper. This model didn't have any adjuster to adjust that problem. Other problem, if the bushing feet vibration, it also give impact on impression between oscillating ink transfer roll to ink form and blanket, image not occurred or the ink couldn't well spreading so the printing result become blurring. This system made this machine possible print only one color (monochrome) although the specification of the machine capable to print separation.

Picture 1 Old models

In offset lithographic presses, based on (http://printwiki.org/Inking_System access on September 5, 2015) the inking system (also called the inker) consists of a train of at least ten (often more) rollers of various types, all-leading back to an ink fountain, a pan or trough containing the ink. A fountain blade (which can be adjusted using manual or motorized fountain keys) forms a barrier between the pan of ink and the fountain roller, and two fountain cheeks form the sides of the ink pan, contacting the edge of the fountain roller and the fountain blade to keep undesired amounts of ink from flowing through the remaining system.

A ductor roller, the first roller in the roller train, alternately contacts the fountain roller and an oscillator roller, transferring a set amount of ink. The timing of the action of the ductor roller can be set in relation to the rotation of the plate cylinder, the timing of the oscillator, or at some other rate. It is important to ensure that the ductor roller only contacts the oscillator when the form rollers (the ink rollers that directly contact the plate) is over the plate cylinder gap, especially during the vibration that results when the ductor first contacts the oscillator (called ductor shock). The ductor roller is a crucial linking roller from the fountain to the rest of the roller train, making its proper setting and maintenance of vital importance to print quality. (See Ductor Roller.) Some web presses use continuous rollers in place of ductors, which are covered with bristles or raised designs to help transfer predetermined amounts of ink. Some web presses also use an Aller undulating ductor roller, which is a segmented roller, each segment mounted off-center in relation to the others. Some segments thus are in contact with the fountain roller while others are in contact with the adjacent drum roller. After a set period of time, the segments switch positions. This helps with the lateral distribution of ink across the press.

An offset inking system contains several oscillator rollers (also called drums or vibrators) that move laterally, or at right angles to the rest of the roller train. Their purpose is to not only work the viscous ink and make it thinner and workable (see Thixotropy), but also to ensure that faint images from the plate are not propagated through the inking system (see Mechanical Ghosting). Their lateral movement is typically set to the rate of plate cylinder revolution, but can be adjusted based on the body of the ink. Too frequent oscillation can result in ink starvation on the plate (in some cases), while too seldom oscillation can cause overinking. Oscillators in contact with the form rollers should oscillate at the maximum rate possible. Gears and chains move the oscillators, and they move adjacent rollers in the train by movement against their surfaces.

There are also a variety of intermediate rollers occupying various positions within the roller train. These intermediate rollers are called distributors or riders. Distributors typically sit between two other rollers, such as oscillators, and move by surface contact with the adjacent chain-and-gear-driven rollers. Distributor rollers are responsible for mixing the ink with small amounts of water to form a uniform emulsion. Riders are typically connected to only one other roller, such as an oscillator, and function solely to condition ink by sending it off on a kind of detour. Lithographic ink commonly attains a workable viscosity only after extensive working. Riders also collect various types of paper and ink debris. Having the smallest diameter of all inking rollers, riders therefore have the greatest number of rotations per minute, and they move due to surface contact with adjacent oscillators.

A printing press can have up to four form rollers, which transfer ink from the roller train directly to the printing plate. The form rollers can be lifted from the plate either automatically (as when the press is idle) or manually, should the press operator desire it. When the form rollers are not contacting the plate, the ductor roller is lifted from the fountain roller, cutting off ink flow through the system. One specific problem with form rollers involves the brief period of time when the form rollers pass over the plate cylinder gap. As they are still in contact with the rest of the roller train and make one complete revolution, they can become overloaded with ink, and their first revolution over the returning plate deposits a greater than desirable thickness of ink, commonly ending with a streak. Varying the diameters of the form rollers can help alleviate the problem. Another problem involves mechanical ghosting. Mechanical ghosting can be avoided by properly timed oscillators, or by use of an oscillating form roller. The setting of the form rollers to the plate has important consequences for the resulting print. Too much pressure on the plate can cause slurring, streaking (especially if the form rollers bounce at the end of the cylinder gap), and roller/plate wear and damage. The setting of the form rollers to the oscillators is also important (See Form Roller.)

Adjusting the amount of ink sent through the system can be done in two ways. The first is using the fountain keys to control the space between the fountain blade and the fountain roller, which controls the lateral distribution of ink through the system. These keys are usually adjusted based on the ink requirements of the particular plate. The second is by adjusting the dwell, or the amount of time the ductor roller contacts the fountain roller. The rate at which the fountain roller turns is also significant, and is referred to as its sweep, or the distance it moves before being contacted by the ductor roller. In general, it is a good idea to let it rotate through a longer distance, and adjust the fountain keys so that there is a thinner film of ink on the fountain roller. This allows the ability to make quick adjustments if necessary. Especially when printing colors, the fountain roller's sweep should be as contact as possible. All these basic settings should be made during make-ready, with only intermittent fine-tuning needed during the pressrun.

Some web presses utilize variations on this basic theme, such as a cam or eccentric roller controlled by a lever that controls the amount of ink transferred to the fountain roller. Other web presses-such as those used for printing newspapers-borrow from flexography the engraved anilox roller to transfer a finely metered film of ink to the remainder of the roller train.

Various inking system and print quality problems can be caused by ink rollers that are out-of-round, due to either dropping them during cleaning (or other similarly-originating damage), or by excessive pressure from

other rollers in the roller train. Out-of-round rollers tend to bump when contacting the plate, and cause streaking. Metal oscillating rollers made from steel can become susceptible to roller stripping, or a loss of ink affinity. Another serious problem with ink rollers is glazing (also called glazed rollers). Glazing is an accumulation of dried ink pigment and vehicle, gum from the dampening system, and particles of paper coating or fiber caused by the ramifications of press chemistry and inadequate cleaning. The result of glazing is that ink rollers become increasingly unable to effectively transfer ink to and from each other. Glazing also reduces roller friction, which manifests itself in skidding and streaking. Ink rollers are susceptible to various types of ink build-up (in addition to glazing), such as ink cuffs. The fountain blade can also become damaged, and bits of dried ink can collect under it, preventing the fountain keys from moving it properly. If the blade becomes worn or warped, controlling ink flow effectively becomes difficult.

The various characteristics of the rollers are important. A roller must be as close to perfectly round as possible. A roller's total indicated run out is a measure of the difference in a roller's radius from its center to its surface. The maximum tolerance allowable for TIR is 0.0005 inch. A roller's hardness is measured using a type-A durometer, which measures the resilience of a surface from 0 (a very soft surface) to 100 (a very hard surface, such as cast iron). Rollers can increase in undesirable hardness with age, due to glazing. A roller whose hardness (also called its durometer) exceeds certain preset tolerances causes problems such as mechanical ghosting, streaking, and other problems. (See Durometer.)

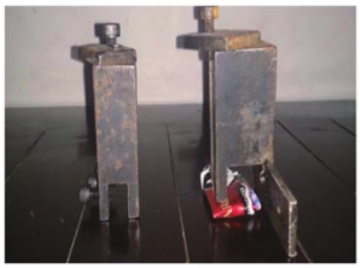
Some offset lithographic inking systems also employ add-on devices, such as an ink agitator to automatically stir a viscous ink that gets thicker upon standing); a fountain splitter to enable the press to perform two-color spot-color printing in one pass; a hickey-picking roller to remove dust and debris that can generate printing defects; an ink leveler to automatically keep the ink fountain replenished, and an Air Curtin to remove excess moisture from the inking system.

Oscillating ink transfer roll have core function in lithography press. If this system couldn't work properly, it gives impact to the printing quality directly. Oscillating Roll always move smoothly in order to spread ink very well. It works simultaneous follow the machine speed. If the oscillating ink transfer roll have problem, it means all printing process also get the impact too. In digital printing, oscillating seems like head unit.

2. MODIFICATION SYSTEM

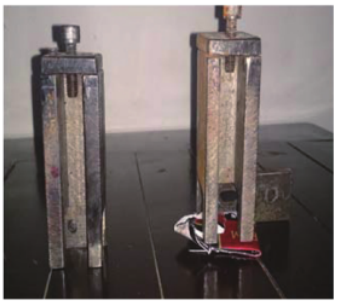
The development and innovation to fix this Hamada machine, CD model weakness, we did some research in order to found the optimal value of this new system. We research from the raw materials of component until the implementation of this new system. Considering with business value for SMEs scope. This machine has good economic value with new system on the oscillating ink transfer roll system. Solving this machine ink system problem first we need kind of equipment that have lock up system. This lock up system will help the oscillating ink transfer system at the machine fixed, no vibration, safety, and adjustable. Old system run without any lock up system just put on the upper with bushing feet on right side and left side knock down with ink form frame. The Lock Up system will be helps the operator easier to adjust the oscillator when the diameter of roll reduces with puller (0,2 – 0,25mm) gap. Vibration on oscillator moved also reduces because the shaft will be lock by lock up.

The lock up system like the picture above, it simple but has significant function, bolt on side has function for connect the lock up with the frame, replacing old model, knock down. Bolt on top side has function to lock the oscillating ink form transfer shaft become fixed and safe, other function for adjusting the impression of the oscillator roll with gap 2 – 2,5mm. Suppose the adjuster less than 2 mm, its mean the roll diameter was reduced need replacing (manufacture requirement 65mm), if more than 2,5mm its mean your roller too big. It cannot use because the oscillator must moved smoothly. The roller cannot make in bigger size, it must match with the manual book requirements. In old system possible to make it bigger because operators think it can reduce the vibration. It was big mistakes that sometimes happen at common. Implementation this new model will be show at



Picture 2 Lock up system

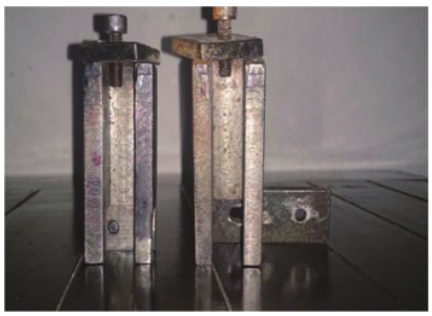
Picture 3 Lock up system



Picture 4 Lock up system with adjuster above

Picture 5 Lock system with adjuster from above

Picture 6 Lock up slot for oscillating shaft locked



Picture 7 Slot model inside

the picture 8. How to apply this lock up models and fixed position.

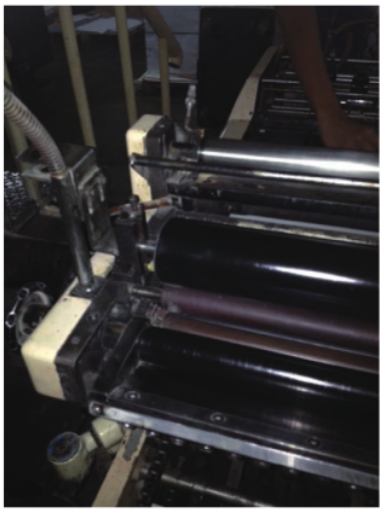
After finished installation, we try this new system to print separation, and the final result upgrade and possible to print separation (4 times print). Our evaluation, the waste of this machine used new system decreased significantly. For SMEs Industry, it was match with their need, and they possible to utilize this machine for print and fulfill the market needs. This research also finds the optimization of this machine capability and capacity with some replacement part research.

Taguchi Experiment

Taguchi techniques for quality engineering are intended as a guide and reference source for industrial practitioners involved in product or process experimentation and development [Ross]. The Taguchi philosophy provides tow tents: (1) the reduction in variation (improved quality) of a product or process represents a lower loss to society, and (2) the proper development strategy can

Picture 8 Old system

Picture 9 New system application



Picture 10 implementation

intentionally reduce variation [1].

It is a powerful method is a powerful for the design of high quality systems [2]. It provides simple, efficient and systematic approach to optimize designs for performance, quality and cost [3]. Taguchi method is efficient method for designing process that operates consistently and optimally over a variety of conditions. To determine the best design it requires the use of a strategically designed experiment [4]. Taguchi approach to design of experiments in easy to adopt and apply for users with limited knowledge of statistics, hence gained wide popularity in the engineering and scientific community [5] [6].

The design of this experiment has 4 controlling factors and every factor has 3 levels as in **Table 1**. And the fit of every experiment is how many waste of printing per

Picture 11 Finished implementation

2500.

The selection of appropriate orthogonal matrix is depending on the value factors and interactions expected and the value level of each factor. This determination will affect the total number of degrees of freedom that are useful for determining the type of orthogonal matrix chosen.

In the Taguchi method, orthogonal array can provide an effective experimental performance with a minimum number of experimental trials [7]. Total degrees of freedom is:

$$= (\text{Number of factors}) \times (\text{number of level} - 1)$$
$$= 4 \times (3 - 1)$$
$$= 8$$

The configuration of orthogonal arrays is determined with respect to total degrees of freedom of the targeted function. The degree of for L9 orthogonal array can be more than or at least equal to the determined process parameters. The proper orthogonal array of the experiment is L_9 (3^4). From this orthogonal, the number experiments should not be done in 81 experiments but only in 9 experiments. The determination of the quality characteristics of the measured control factors was provided by how many waste in printing after use this component. The level composition of the experiments use orthogonal array L_9 (3^4) as in **Table 2**

Experimental Procedure

First, we make some oscillator roller from some materials, our aim finding the best material of oscillator roll to improve and increase this machine capability. Printing in separation 4 colors consistently in color and quality although it print 4 times after new system was applied. We develop trial and error with 3 materials, Ebonite (manufacture recommendation), Rubber Roll

Table 1 Factor and levels used in the experiment.

Code	Controlling Factor	Level		
		1	2	3
A	Diameter (mm)	64	65	66
B	Material	Ebonite	Stainless steel	Rubber
C	Impression (mm)	2.0	2.5	2.5
D	Temperature (0C)	60	65	80

Tabel 2 Experiments of orthogonal matrix L_9 (3^4)

Experiment	Factor			
	A	B	C	D
1	1	1	1	1
2	1	2	2	2
3	1	3	3	3
4	2	1	2	2
5	2	2	3	1
6	2	3	1	2
7	3	1	3	2
8	3	2	1	3
9	3	3	2	1

with 70" hardness, and Stainless Steel Acid Resistant also with vary diameter of the oscillator roll. We figure out into 3 sizes of diameter, 64mm, 65mm (manufacture recommendation) and 66mm. our reason why we also consider with the size, in order to eliminate the user mind for modification in size and materials. Their reason why they change the materials, because of maintenance cost reduction. Others reason why the modified in size, bigger it means long durability and the position they think it will be fixed on old system. Smaller it means the oscillator roll can moved gently and smooth because the gap bigger. In old system couldn' t adjusted and vibration. Old system this machine possible print on single color only, it couldn' t print on separation.

Next step, we use same file and same plate but different oscillator roll material and size. It took one month. Our quantity print is 2500 print (5 rims) for each materials and size. After finish of the print we evaluate the waste, temperature when print in 5000 print/hours speed, also with standard impression adjuster gap. After we get the results, next step analyze use Taguchi Method to found the best results of diameter, temperature, impression and waste.

Results and Analysis

The result of the experiment use orthogonal array L_9 (3^4) shown as in the **Table 3**. There are 9 experiments done. The number of waste in every printing showed the fit of the experiments activity.

Experiments shown in **Table 3** give results that 4th experiment give the optimum result. With combination factor of diameter, material, impression, and controlled temperature give the smallest waste of printing. And for achieving this result the design of tools should use ebonite material, set at diameter 65mm, with 2.5mm impression gap, and the temperature is controlled at 65℃.

3. Analysis of The Result

Finally after we did many research and observation on new system with vary materials and size. This machine will achieve optimum with recommended material from manufacture. Oscillator ink transfer roll will be suitable and achieve high performance in new system with Ebonite Material, Size 65mm with 2,5mm impression gap adjuster and for printing quality will be maximize in 65℃ for the temperature on ink form system. This research give clearly information, this machine no need make any modification in size and material of the oscillator. It was need lock up system in order to make the oscillator fixed, no vibration and adjustable.

This modification has high business value for SMEs industry, they can build business with small budget of investment in printing industry. Hopefully printing industry can develop and reduce unemployment. Based on Ministry of Industry data, from last three years, SMEs in printing industry was increased. This value

Tabel 3 Result of the experiments

Experiment	1	2	3	4	Waste per 2500
	Diameter (mm)	Material	Impression (mm)	Temperature (℃)	(%)
1	64	Ebonite	2.0	60	16
2	64	Stainless steel	2.5	65	24
3	64	Rubber	2.5	80	12
4	65	Ebonite	2.5	65	4
5	65	Stainless steel	2.5	60	12
6	65	Rubber	2.0	65	6
7	66	Ebonite	2.5	65	11
8	66	Stainless steel	2.0	80	12
9	66	Rubber	2.5	60	10

has significantly increased at screen-printing industry, packaging and digital printing. In packaging industry used machine like Hamada, Solna and Man Roland was increased in sales. We think this is good opportunity for printing industry.

4. Conclusion

The conclusion after the research finished, with new system applied, this machine HAMADA, CD models could print with high quality that acceptable in market. This machine price is cheap and the development of new system cost also cheap. It was suitable with SMEs Industry scale capability. They can improve their production house with small machine with separation print. In Economic and Business Value, this machine possible to get good profit for SMEs, low cost in operational, production and waste possible to control. Efficiency and Effective could be achieved. Hamada itself also increase for the value, because can print separation with good register. This machine although simple, it has alignment on feeder, have gripper cam on delivery unit. Register on print possible to be consistent.

SMES industry scales, for the beginning no need to make high cost investment, sometimes until over budget on investment, no need. Hopefully this research result can help all SMEs who work in Printing Industry by utilize established company waste.

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