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CURING OF INKS USING UV LED

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Abstract: *Advances in technology have seen positive growth over past couple of years, for curing of inks in printing industries. Conventional method of curing inks which uses mercury lamps or ultraviolet lamps is now being replaced by ultraviolet LED (Light Emitting Diodes). UV-LED drying technology in printing is an energy-saving, environmentally friendly drying technology. Compared with the traditional UV drying method, it can reduce 70% -90% of the power consumption; In addition, the drying device does not produce ozone, no VOC (volatile organic matter) emissions. At present, the technology has become a research hotspot in the printing area.*

Drive circuit of UV-LED light source system is one of the key technologies of UV-LED drying equipment, as a single UV-LED chip power is only a few watts, which can't meet the demands of drying power, it is necessary to form a number of chips that integrated UV-LED light source system, which requires that the drive circuit has high stability in order to improve the reliability and the service life of the drying device. In this modern technology UV inks are not dried, but it is cured. As ultraviolet LED technology offers many advantages over conventional process, it is needed to be implemented in printing industries. As this technology is in its initial stage it is going to be first implemented on label printing industry. In this the UV lamp and UV LED curing time is carried out at different distances using UV inks. A hardware model is prepared which uses controller that is used to control the intensity of UV LED. An intensity sensor is placed close to LEDs which senses the level of intensity and sends the signal to the controller. Machine speed also plays a role in setting the UV intensity. All these parameters are checked at regular interval and processed by controller.

Keywords: *UV LED, curing system, drive circuit, UV inks, wavelength*

I. INTRODUCTION:

Now-a-days UV inkjet printing is being preferred technology as it is more economical, more flexible and safer for environment. UV inks needed to be cured using a heat source. For curing the inks mercury lamps or UV lamps are being used. However UV LEDs is fast emerging technology which is replacing mercury vapour lamps and UV lamps. Due to their advantages are more they can surely replace UV lamps in near future. They emit very less heat so they can be used on any surfaces and any type of material. Since these LEDs consumes very much less power, so curing temperature is also low, inks used is far less than conventional method and there is no danger if surface of lamp breaks UV LEDs are not only used for ink curing other object that include wood panel for furniture, building wraps, textiles, ceramic tiles and more.

UV LED technology in printing and drying is an energy saving and environmentally friendly technology. Currently there are many printing industry which are using traditional high pressure lamps such as UV lamp which contains heavy metal pollutants like mercury, energy consumed is very high and operating life is also less and because of that it requires frequent replacement. Even UV LED can be instantly turned on and off without the need for preheating time, it also cools very fast. UV Lamp provides photon which operates with an efficiency of 1 - 10%, to provide energy between 248nm to 500nm wavelength required for photochemical reaction. If this technology of UV LED drying is implemented on printing and packaging industry, they will be directly benefited, which can reduce energy consumption, VOC emissions and efficiency can be improved. UV curing of inks, adhesives and coatings have photo initiators that converts monomers to linking polymers and solidifies monomer material, when exposed to UV light. UV LEDs and UV lamps supply UV light for curing UV curable inks, coatings on different products. Earlier used curing techniques are very much time consuming and are not much efficient and this can cause uneven curing in many products. Because of this it is necessary to provide an improved UV curing method which can eliminate most of problems.

II. UV LED

A light-emitting diode is a p-njunction which, depending on thesemiconductor structure, designed to emitmonochromatic wavelengthsthroughout the entire electromagneticspectrum. It occurs atroom temperature as opposed to themore familiar incandescence whichis only produced when materials are heated to temperatures above 750ºC. Today, LEDs that emits infrared (870-980 nm), visible (390-780 nm), and some ultraviolet (365-405 nm) used in a wide variety of applications.

When a voltage source is connected to the LED with a forward bias, current flows from the p-side to the n-side (anode to cathode). As the electrons cross the depletion zone and fill a hole, they drop into a state of lower energy. The excess energy is released in the form of a photon that can transport electromagnetic radiation of all wavelengths, including infrared (IR), visible and UV light. The selection of semiconductor and doping materials determines the exact wavelengths emitted from the diode when the photon is released. Different dopants possess varying band gap energies that determine the specific wavelength that is emitted from an LED.

III **UV Curing**

UV A	320nm – 420 nm
UV B	280nm – 320nm
UV C	200nm – 280nm

TABLE 1:
UV light and their differences

When UV inks are exposed to UV light, photo initiators in the ink activate a polymerisation reaction resulting in ink drying. In this case the ink film dries completely as soon as exposure occurs. In addition, machine can run at their optimal speeds on different kind of substrates, absorbent and non-absorbent. LED UV consumes less energy as compared to UV lamps this is because, instead of emitting a spectrum of wavelength, LED emits light of given wavelength which is required for curing. Even LED generates zero heat so; the need to have chilled rolls is eliminated.

Conventional UV dryers use mercury vapour lamps that radiate UV light of wavelength between 100 to 380nm. These lamps generate heat which can affect the substrate and hence the system requires optimum cooling and also ozone is the byproduct of the process. These LEDs emit narrower spectrum of light than a conventional lamp. It eliminates shorter wavelength that create ozone and longer wavelengths that produce IR radiations. Therefore this kind of system is ozone free and also it requires lesser cooling.

Due to limited spectral wavelength, LED operates in UV-A region and thus it is considered to be safe as it is closer to visible light. UV-B and UV-C are commonly used for germicidal and sterilization. The wavelength emitted is not only harmful to microorganism but also it proves very dangerous to humans. These lamps should never be viewed from naked eye. If humans are exposed for long time in these wavelength causes skin cancer or loss of vision.

IV UV LED compared to Mercury arc lamp

LED, Mercury arc and microwave system emits UV light but UV LEDs have unique characteristics that make its spectral output very different from that of conventional systems. Firstly UV LED emits a monochromatic band of UV that is centred at some specific wavelength where as mercury arc are broad band emitters with output ranging from 200 and 445nm.

Conventionally mercury lamps were used to cure UV inks by their type of nature they emit extremely high heat. Only 5% of energy is useful in curing inks rest of 95% of energy is emitted as a heat in printing machine. LEDs are diodes that are energy efficient. An advantage of the array of LED is that if one diode fails there is minimum impact on intensity. Temperature of LED reaches maximum of 104 degree Fahrenheit where as mercury lamps heats upto140 degrees.

LED lamps uses 20% of energy in curing inks and rest 80% is converted into heat. This heat is discharged from the lamps by air or water cooled heat sink protecting machine from extreme heat.

UV LEDs operates for several years but mercury lamps operate only for 2000 to 3000 hours of usage. While using mercury lamp one needs to wait for few minutes after turning on the machine until it reaches its curing temperature due to this there is a loss of time. UV LED reaches its curing temperature soon.

It also yields the positive aspect of eliminating the infrared and UVC components. As a result, when compared to conventional curing, there is less heat transfer to the substrate and no harmful UVC rays or resulting ozone. The UV from current LEDs is all UVA with a slight visible component in the violet wavelength range. Secondly, UV-LED technology is that longer wavelength UV-LEDs (385, 395 and 405 nm) actually emit more UV irradiance at their peak wavelength than conventional UV bulbs.

The LED chips used to create the chart emit up to five times the peak irradiance of microwave and mercury arc systems; however, it is concentrated in a very narrow bandwidth. Thirdly, the output of a UV-LED is based on the amount of current flowing through the chip.

V PROCESS FLOW

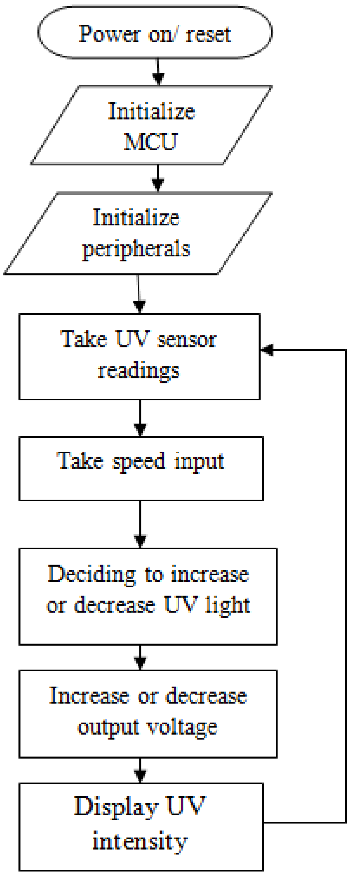

Figure 1: Flow chart of working system

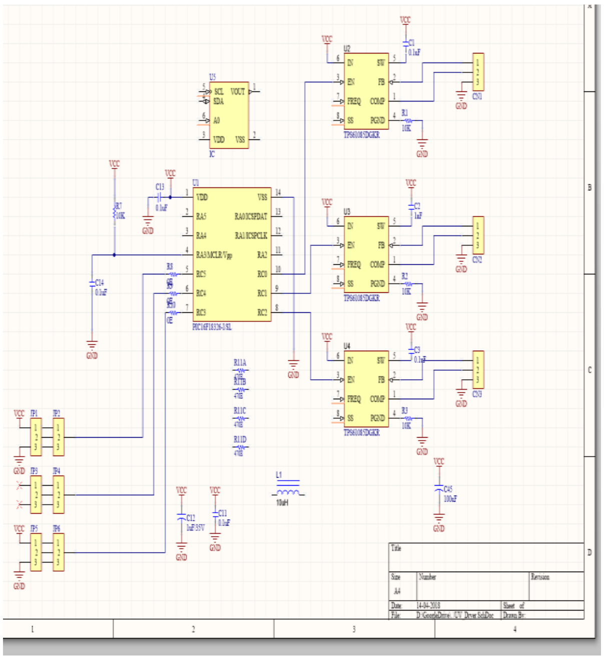

Figure 2: PCB design

CONCLUSION:

In this paper UV LED intensity is being controlled using controller. This closed loop control provides most efficient operation of UV LED. Controlling output intensity improves the quality of printing material. This technology of curing inks is far better than the conventional mercury lamps.

REFRENCES:

[1] Shao-Ru Ma, Jin-Yao LI, Gui-Shan Zhang, Tao MI, "The design of driver Circuit for light source system of UV LED green printing dryer,"ICMEA 2016.
[2] Herbet J. Wilde, James F Mengelkoch, "dry film curing machine with ultraviolet Lamp controls," EP0245441A1, 1987.
[3] Dr David Anderson, "Energy efficient UV LED curing without inerting", Lambson ltd, UK, 2012.
[4] Stephen B. Siegel, "UV LED control loop and controller for UV curing US0238111A1, 2004.
[5] Stephen B. Siegel, "UV printing and curing of CDs, DVDs, golf balls and other Products", US0154075A1, 2005.
[6] Ed Kiyoi, "The state of UV LED curing: An investigation of chemistry and Application", RadTech international, 2013.
[7] Ned Mohan, Tore M. Undeland, William P. Robbins "Power Electronics Converters, Applications, and Design" third edition, JOHN WILEY & SONS.
[8] Mark D. Owen, Tom McNeil, Francois Vlach, "High efficiency solid state light source and methods of use and manufacture", US8192053B2, 2012.

