

Value Added Printing - WITH UV INK KEY OPPORTUNITIES & CONSIDERATION

Nandini Choudhury, DIC India Limited

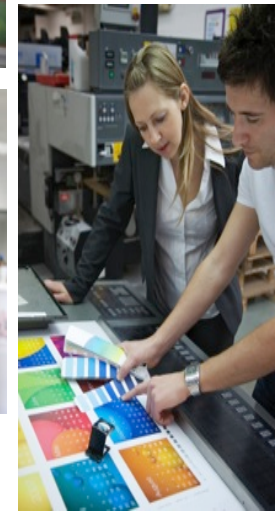
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2. Energy Curing (UV) technology
3. Process Parameter for UV curing
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5. Precautionary measures recommended in UV printing

Value Added Printing

The printing industry is desperate to differentiate printed matters by effects which will add value to the products. Potential improvements are:

- Improved rub resistance
- Clean copies with no marking
- Higher gloss
- Haptic effects



How can this been achieved

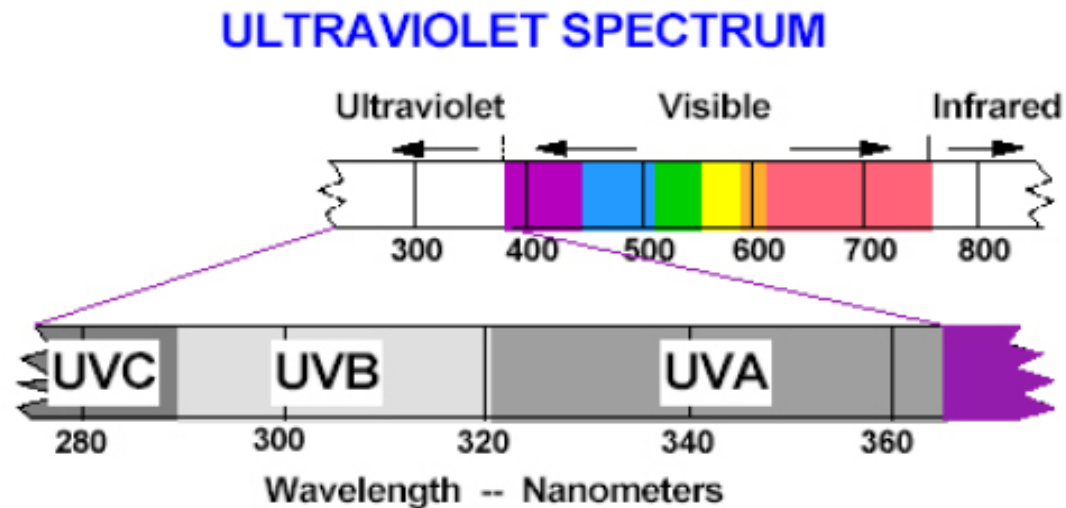
Value Added Printing

Potential approaches for newsprinters to achieve special properties/effects to differentiate from standard newsprint are:

1. Application of coatings
2. Use of Hybrid inks (coldset/heatset)
3. Use of energy curing inks



Wavelength Band Distribution of Ultraviolet Curing

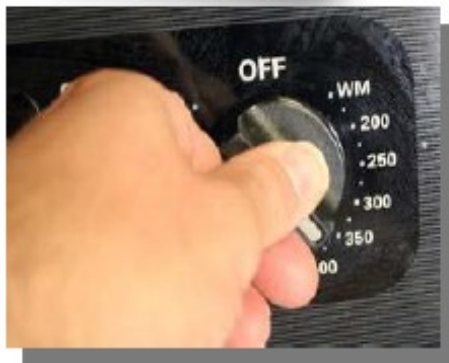


- UVA: 320-390nm Long-wave, cure
- UVB: 280-320nm Middle-wave, coating toughness, erythema response, medical applications
- UVC: 200-280nm Short-wave, germicidal (254 nm), absorbed by DNA, clear coats, surface cure, tack, chemical, scratch & abrasion resistance
- UVV: 395-445nm Ultra Long-wave, opaques & whites, thick coats, adhesion, depth of cure

Don't assume, clarify the UV bandwidth you are talking about

Energy Cure (UV) Technology

Bake at 350°F for 30 minutes



Oven Temperature
(°F) is similar to
Irradiance (Watts/cm²)



Bake Time (Minutes
or seconds) is
similar to Energy
Density (Joules/cm²)



Toothpicks are
your quality
control
Instrument

Energy Cure (UV) Technology

Bake at 350°F for 30 minutes

(350 x 30 = 10,500 Degree Minutes)



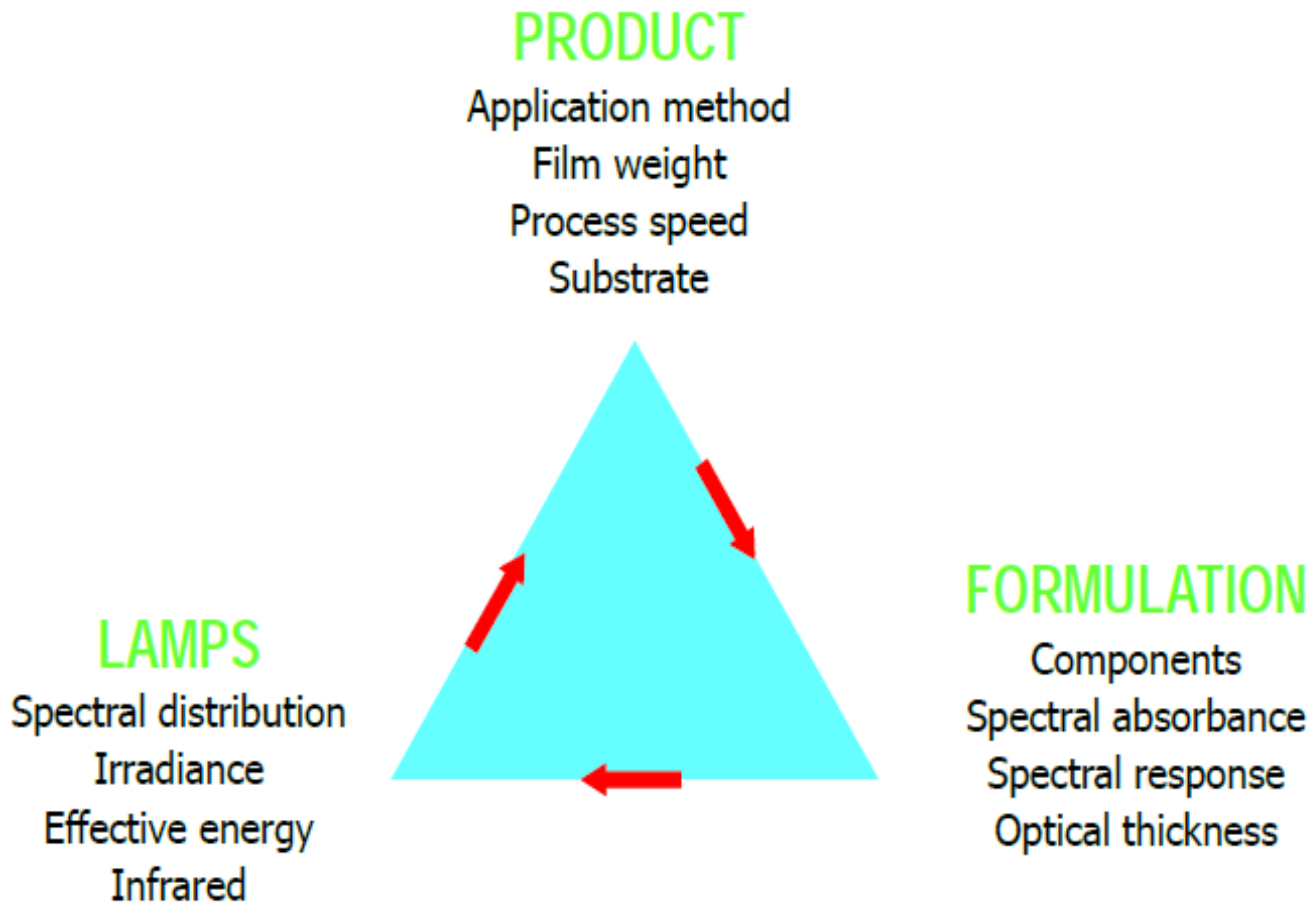
Option for Equal Degree Minutes:

- 700°F for 15 minutes?
- 175°F for 60 minutes?



**Doubling the temperature from 350°F to 700°
doesn't bake the cake in half the time.....**

Key Components of UV Curing



**PROCESS CONTROL IS THE HEART & SOUL
OF UV CURING**

Key Elements of UV Lamp System

❖ UV ENERGY J/cm^2

- Total Energy Arriving at the coating surface
- Inversely proportional to speed

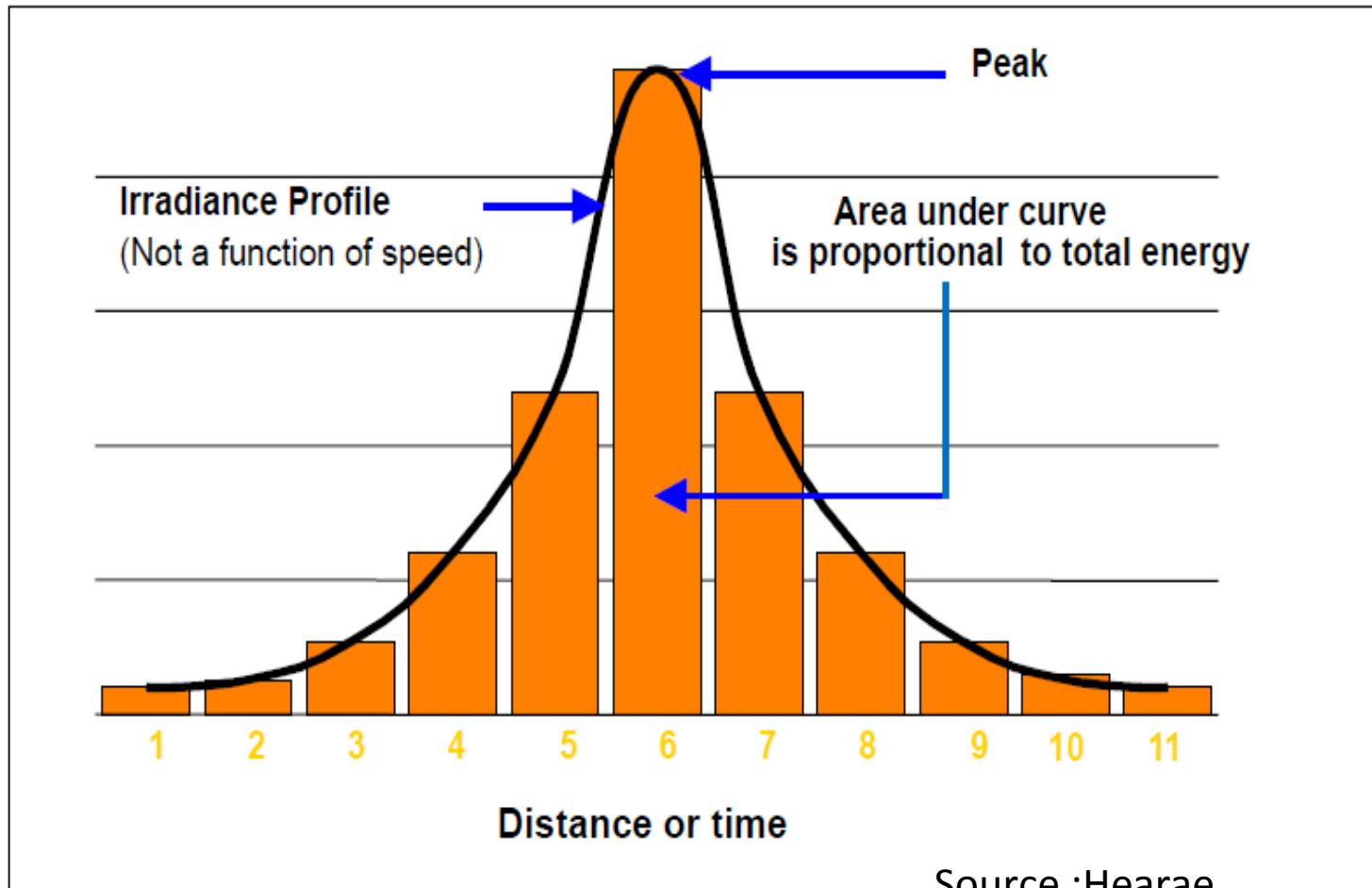
❖ UV IRRADIANCE $WATT/cm^2$

- Power of the light at the coating surface
- Characteristic of the lamp & geometry and design of the reflector
- Independent of Speed

❖ SPECTRAL OUTPUT OF THE BULB

- Wavelength Distribution

Peak Irradiance and Total Energy

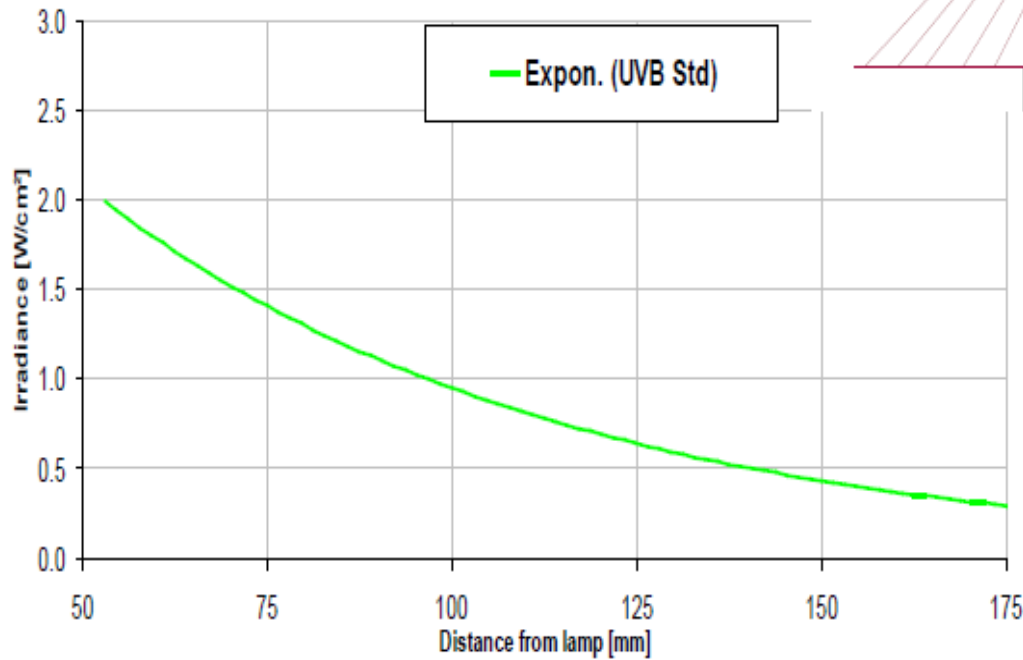
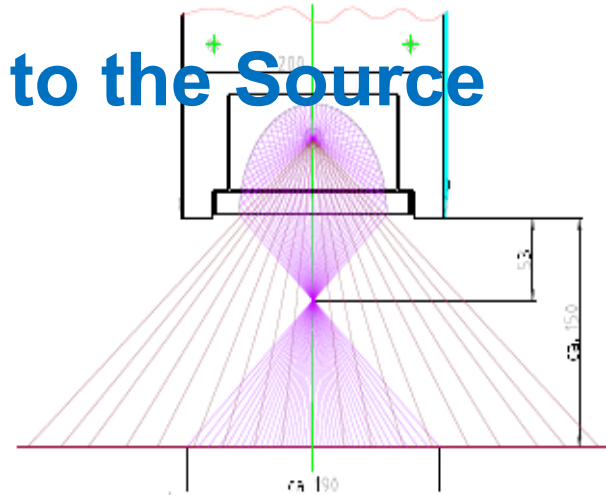


Source :Hearae
US

Elements of Irradiance

Irradiance and Distance to the Source

Irradiance is dependant on the distance to the lamp
F600 H-Bulb

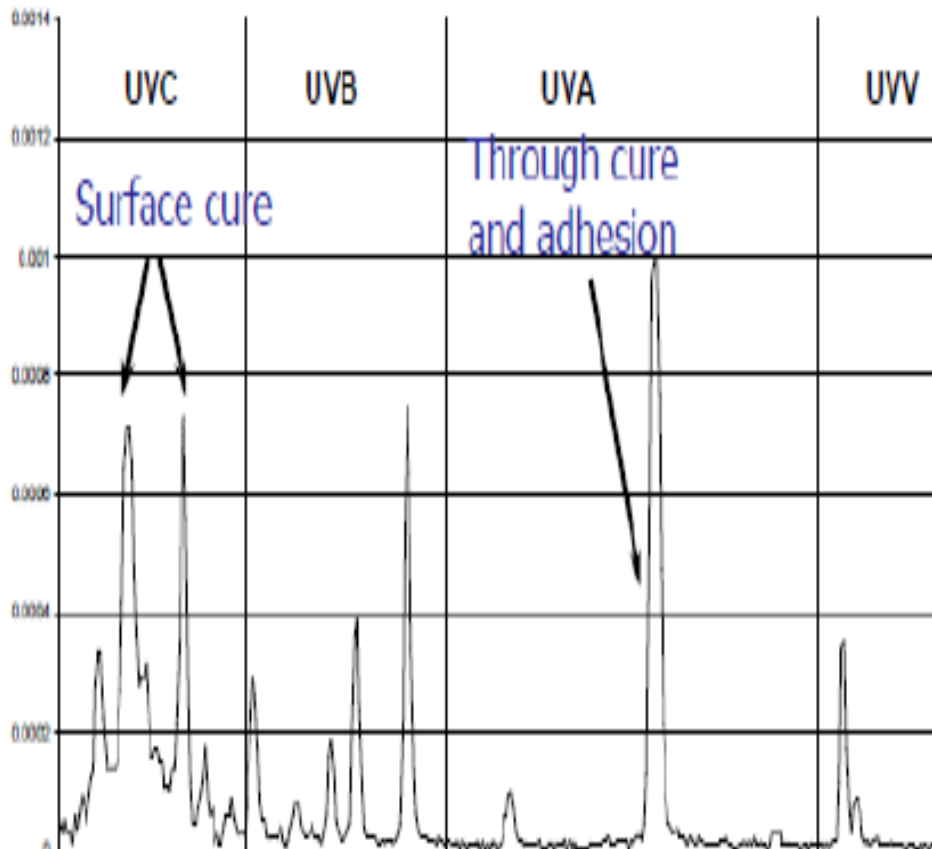


FOCAL LENGTH IS THE KEY FACTOR OF IRRADIANCE

Rules of UV Curing

UV output
high power
Mercury lamp

“Output spectrum UV lamp
should match the
absorbance spectrum of
the PI”

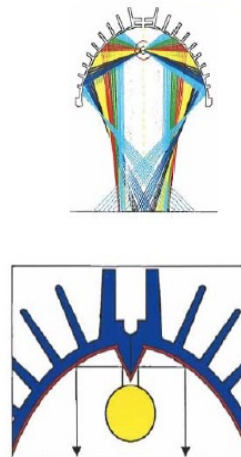
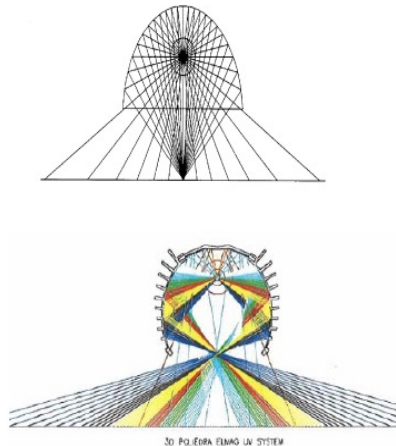


**ABSORPTION SPECTRUM OF PHOTOINITIATOR AND
UV LAMP OUTPUT ARE CORELATED**

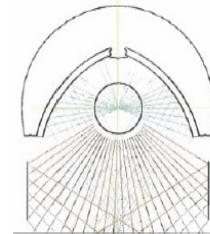
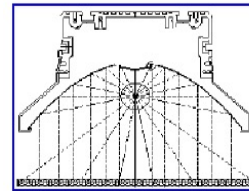
Rules of UV Curing

Lamp Power Settings: this are the bulb setting and is not the effective amount of UV generated or effective amount reaching the surface.

Reflector: 60 – 80% of energy reaching the substrate depending on reflector type and conditions



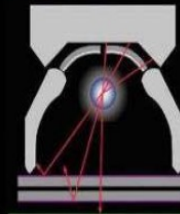
Parabolic Reflectors



Dichroic Reflectors

Dichroic Reflector Comparison

*Maxim mixed-mode reflector geometry—
dichroic-coated quartz lenses*



• Most IR energy passes through the reflectors due to the small degree angles of incidence.

Rules of UV Curing

Process Variables: Reflectors

Clean and well maintained reflectors will guarantee the desired light output

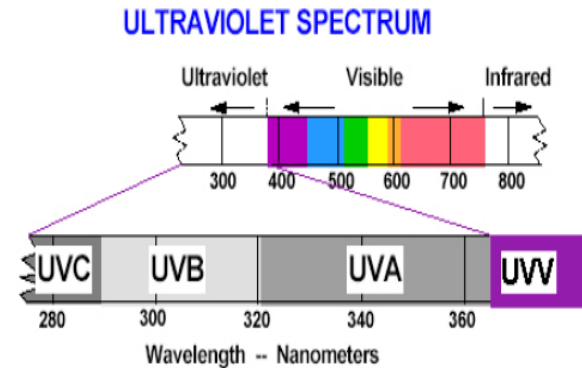


**A CLEAN REFLECTOR MAY
DOUBLE UV OUTPUT**

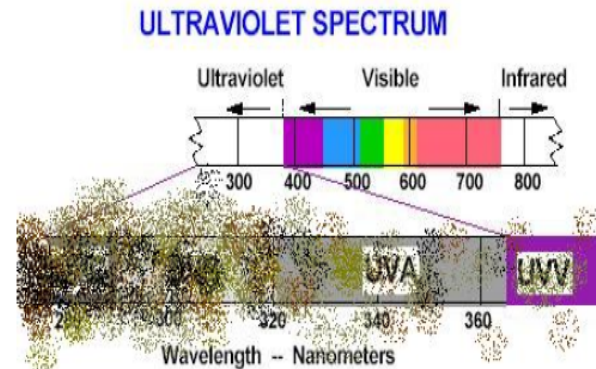
Images Courtesy DDU Enterprises

Conditions of Curing

A clean bulb and reflector delivers the whole spectrum



A dirty bulb delivers only a scattered spectrum and a reduced intensity



A MULTI CHANNEL RADIOMETER ALLOWS YOU TO COMPARE SHORT AND LONG WAVE RATIO AND IDENTIFY CHANGES
UVC: UVA; UVC : UVB

Abrasion Resistance

Toughness

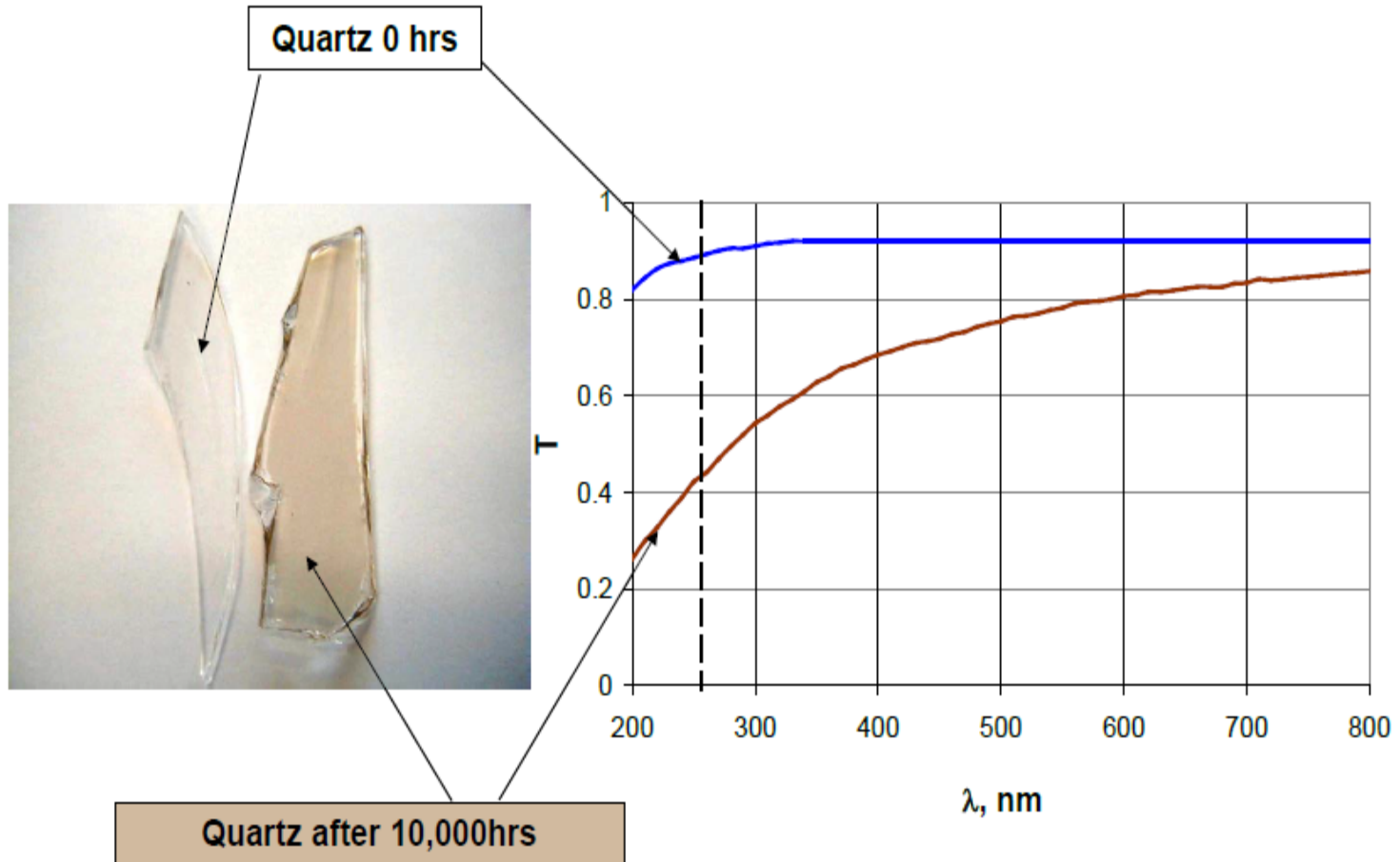
Adhesion

Adhesion & TiO₂ Cure

Source : Crescent

Process Variables: Lamp Life

Quartz Darkening



SOURCE : HEARAEUS

Process Variables: Bulb Age

Hour Meter

- Numbers of hours on the current UV bulb
- Hour meter does not indicate the numbers of starts and stops of the bulb
- Hour meter does not indicate at what temperature the bulb is generating UV light
- Hour meter does not tell you the amount and type of UV

Process Variable to Understand and Track

Characteristics of UV Consumables

	Conventional oil-based 100% production
Inks	polar
Blankets & rollers covers	NBR (polar)
Washing agents	non-polar
	Combi or alternating Conventional/UV
Inks	polar - non polar
Blankets & rollers covers	HNBR
Washing agents	polar - non polar
	UV inks 100% production
Inks	non polar
Blankets & rollers covers	EPDM (non polar)
Washing agents	polar

Conditions of UV Curing in News Paper Press

SUBSTRATE TYPE	ULTRA VIOLET CURING
Newsprint, standard, improved	Yes, but picking problem
Super calendared	Yes
Coated	Yes
INK TYPE	Polymer based
Ink drying by	
evaporation	0%
absorption	0%
curing	100%
SPECIAL CLEANING SYSTEM	Yes
SPECIAL BLANKET SYSTEM	Yes
SPECIAL ROLLER COVERING	Yes

Conditions of UV Curing in News Paper Press

	ULTRA VIOLET CURING
WET ON WET TRAPPING	Yes
Automated Ink delivery system, pump	Difficult, special pump and pipes
DRYING METHOD	Heat transfer from UV lamp
Dryer cooling	Cooling of lamps/exhaust air
Chill rollers after drying	Not normally needed
Cooling around printing units	possibly
Air emissions control required	Yes to control Ozone
Energy Source For drying	Electricity
Comparative power consumption	Moderate to high
Drying consumables	Lamps 1-1000hr/inert gas
Position of dryer	Last unit
Space Required for dryer	Moderate

Conditions of UV Curing in News Paper Press

REPRODUCTION QUALITY	
Screen Ruling	133
Total Area Of Coverage	280-300
Ink gloss	Moderate-High
Paper Moisture level after drying	Minimum moisture loss
Smearing	No
Set Off	No
Paper discolouration	Minor risk
Production speed	5-12m/s
Ink slinging, misting	High mist extraction required

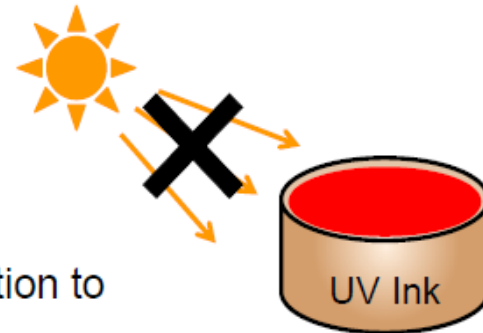
Conditions of UV Curing in News Paper Press

OPERATIONAL ISSUES	ULTRA VIOLET CURING
Switching between ink types	Difficult
Ink water Balance	Critical, maintain minimal dampening
Temperature Control of printing unit	Recommended

HANDLING OF UV INK

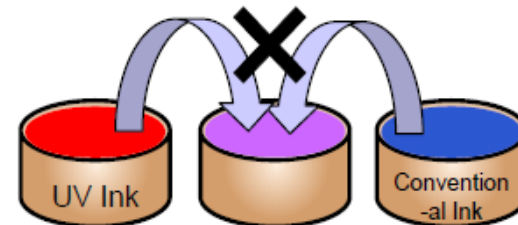
☆ Keep out UV ink to direct sunlight

Don't put UV ink near fluorescent light. (within 1m) Shield sunlight at press room as much as possible. It's preferable to use UV-cut lamps in press room. Especially it should be pay attention to medium, weaker color ink, OP varnish and clear.



☆ Don't mix conventional ink into UV ink

If you mix conventional ink with UV ink, It should be caused gelation due to be causes poor curing at printing process.



☆ Avoid mixing silver/gold ink and normal color ink as much as possible

Gelling stability get extremely worse. When it needs mixing them, the mixture ink should be run out each printing job.

ENVIRONMENTAL CONSIDERATIONS

- Air Pollution Emission
- Waste Disposal
- Recycling of UV printed matter

Air Pollution Emission

- UV has no significant VOC or HAPS
- Emissions from cleaning activities
- Solvents used for cleaning must have VOC vapor pressure $E < 10\text{mm Hg @ } 20\text{Deg C}$
- UV curing system must be vented to atmosphere as Ozone is produced (except LED lamps)

Waste Disposal

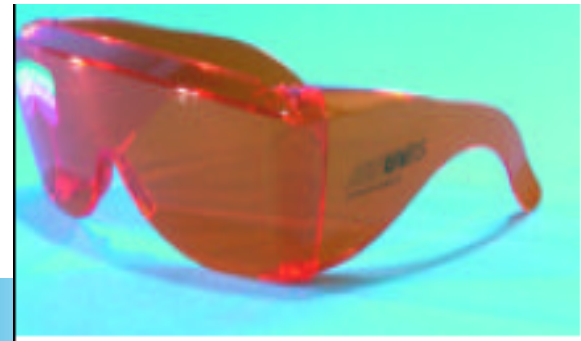
- Monomer , oligomers are hazardous waste.
- Some photoinitiators are reprotoxic hazard
- Monomers with draize rating > 3.2 are potent skin sensitizer
- Non pigmented part of ink is more hazardous
- Has to be labelled toxic if the extract is more than 100 parts per million and EPA toxicity characteristic leaching procedure
- Shop towels
- UV lamps should be treated specially to avoid discharge of Mercury

Recycling of UV Printed Matter

- UV cured printed matter can be recycled e.g. into lower grades back boards for folding paper boxes, corrugated containers, wall board, roofing paper, filler board
- UV cured printed matters can be upcycled with the introduction of flotation cells into the recycling process

Safety & The UV Process

- Exposure to UV radiation will evoke erythema on normal skin
- Suitable material used for shielding is CONTROL CURE CLEAR(#F007-002).
- Direct UV light should not be visible, minimize the reflected light.
- Use black UV absorptive paint on reflective surface.
- Protective clothing's such as SAFE-T-CURE D shields against UV rays.
- UV Filtering safety glass, filters up to 500nm.



CONDITIONS TO AVOID

❑ Conditions that induce self curing

- Sunlight
- Fluorescent light after long time of exposure
- Fire or flame
- Extended storage at high temperature(over 95⁰F)
- Rust
- Strong acid,bases ,oxidizing material
- Metal container
- High Shear pumps

CONDITIONS TO AVOID

- ❖ Conditions which can prevent ink from normal curing
 - Excessive oxygen
 - Foreign particles of dust
 - Too thick of an ink layer
 - Old or dirty lamps and reflectors
 - Insufficient energy to cure

Chemical Cure

- ❖ Ensure full cure of UV inks
- ❖ UV inks are cured 90-95%
- ❖ Inert atmosphere enhance the through cure at faster press speed
- ❖ Insufficient cure releases residual unreacted photoinitiator or acrylate during which could be a health hazard while handling
- ❖ Perform regular extraction tests of printed matter to determine potential risk through uncured ink components. This is very important for high speed presses.
- ❖ The greater the porosity of the substrate the lesser is the cure.

Ozone Safety

- Ozone formation can be eliminated by using ozone free quartz lamp
- A nitrogen atmosphere eliminates ozone
- Ozone can be eliminated by exhausting cooling system air outside the building
- Ozone test strips can measure ozone periodically within UV curing system



Precautionary Steps

Personal Hygiene

- a) Always change work clothes at the end of the day
- b) Contaminated clothing should be cleaned
- c) Use soap & water for cleaning hands. May use UV Hand Cleaner.
- d) Use barrier cream (#I002-03) after washing to prevent penetration of UV material into the skin.
- e) UV skin lotions (#I002-01) to be used to replenish lost skin oil.



Handling & Storage

- Area has to be ventilated
- Wear UV resistant Nitrile gloves & Neoprene aprons
- In case of accidental spillage on body use neutral pH 6 liquid soap for cleaning
- In case of spill immediately contain UV spill clean up granules, wipe off with a tough industrial soap towel
- Store UV inks in Black Polythene container.
- Storage temperature 15 degC to 30 deg





**WHAT
NEXT**

LED VS MERCURY LAMPS

MERCURY LAMPS	LED LAMPS
CONTAINS MERCURY	NO MERCURY
DELAYED IGNITION	INSTANT IGNITION
PLASMA DISCHARGE	SOLID STATE
HIGH ENERGY CONSUMPTION	LOW ENERGY CONSUMPTION
IR RADIATION	NO IR RADIATION
BROAD BAND EMISSION	MONOCHROMATIC EMISSION

UV LED ARE FUTURE INNOVATIONS FOR CURING PROCESS

UV LED FOR WEB PRESS

- 17 W is suitable for speed of 30000 copies/hr
- As there is no heat generation there is no curling ,web break.
- Uses collimating optics for through curing.
- The total energy is 20KW
- LED inks are light unstable ,so opaque covering on the ink duct is suggested.
- ❖ DISADVANTAGE
- ❖ UV light below 350 nm is not available
- ❖ Restricted choice of photoinitiators
- ❖ Limited output
- ❖ High press speed limitation
- ❖ Expensive

Types of UV lamps

■ High pressure mercury Lamp

- Wavelength : 200nm-450nm
- Better curing for surface of ink film
- Suitable for non-color inks

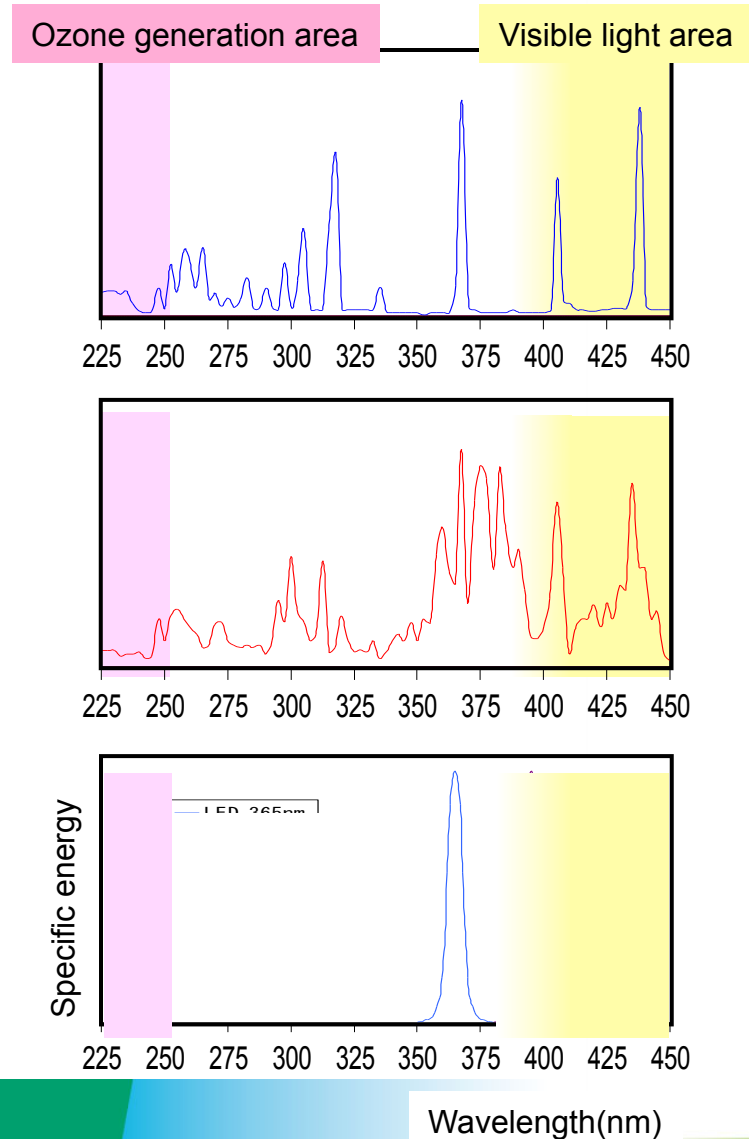
↑ In general ,use in mixed

■ Metal halide Lamp

- Wavelength : 200nm-450nm
- Better curing for inside of ink film
- Suitable for color ink

■ UV-LED Lamp

- Wavelength : 365nm or 385nm
- Irradiation intensity is high compared with radiant tube type



UV/EB Curing – *Invisible but Everywhere*™





Color & Comfort by Chemistry

