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Drying and curing techniques for in-line flexographic printing

Scope

The technical information contained herein identifies the various types of drying methods available to the flexographic converter.

Safety precautions

Observe all safety precautions suggested by the equipment manufacturers.

Introduction

Most segments of the printing or graphic arts industry employ dryers to increase productivity, expand capabilities and enhance quality. Dryers are designed to match the press, substrate and the printing ink, varnish or coating to be dried.

The corrugated industry is no exception. This paper covers dryers for in-line printing and finishing machinery to dry inks, varnishes or coatings applied with flexographic printing techniques.

Types of dryers

Hot air (HA)

An indirect method of drying flexo inks and varnishes. Warm air typically 150°F - 250°F, impinges on the printed sheet surface at <10,000 feet per minute. Heat and air combine to accelerate evaporation of water and amine in the ink. The forced hot air heats and excites the low molecular weight molecules in the ink or varnish, bringing the water vapors directly to the surface. The forced hot air scrubs the moisture-laden boundary layer of air and an evacuation system removes the warm moist air from the substrate surface.

Off press heating systems are generally gas or oil-fired. On press heating systems are electrical. Temperature and air flow can be adjusted for machine speed.

Forced hot air is not color sensitive and does not overheat the substrate or press and is relatively easy to operate. Efficiency for a given space or dwell time is not as high as Infrared dryers.

Infrared drying (IR)

An indirect method of drying flexo inks or varnishes. IR dryers use radiated heat energy in either short or medium wave length in the electromagnetic spectrum, or a combination of both.

Systems are electrically powered.

Radiated heat energy passes through the air boundary layer exciting the volatile molecules (water & amines), which immediately permeate and evaporate from the ink or varnish surface. Short wave length infrared dryers are the most popular, as it is possible to expose flexo ink or varnish to a higher level of heat energy for a shorter given dwell time, with a reduced risk of fire.

Short wave infrared lamps emit 100% radiated heat energy and have filaments that operate at approximately, 4,000 F and can be turned on and off in less than 1 second.

Medium wave infrared lamps emit 50% radiated heat energy and have elements that operate at approximately 1,500 °F and can be turned on and off in not less than 6 seconds.

IR dryers are temperature adjusted for ink or varnish through SCR power controls and can be zone controlled across the machine width.

IR dryers are becoming a very popular dryer type due to their proven efficiency and improved safety standards.

Ultraviolet curing (UV)

UV curing is a direct method of curing UV inks, varnishes or coatings on corrugated board. UV lamps emit photons, which are absorbed by photoinitiators in the UV ink, varnish or coating causing the ink, varnish or coating to polymerize.

At the present time, UV drying is usually employed to cure UV over print varnishes or coatings applied in-line over dried flexo inks and then finished at high speed. UV varnishes are 100% solids and offer high gloss, abrasion and scuff resistance.

At the present time there are number of off and in-line UV systems operating in the US with an increasing number of installations being reported.

Table 1. Considerations for selection of the appropriate drying system

Physical Considerations	Hot Air (HA)	Infrared Short & Medium Wave (IR)	Ultraviolet (UV)
Drying process	Evaporation	Evaporation	Photo-polymerization
Ink or varnish & type	Ink & varnish water	Ink & varnish water	Varnish UV
Available heat energy	<200°F	<1500°F MW <4000°F SW	Not applicable
Response Time (at start up)	<7 minutes	>6 seconds MW <1 second SW	*1-7 minutes
Response Time (to shut down)	<5 minutes	>6 seconds MW <1 second SW	1-7 minutes
Zone Control	No	Yes	Yes
Fire Risk	No	Yes	Yes
Energy source	Electric, gas & oil	Electric	Electric
Appropriate location	Interstation & after last flexo	Interstation after last flexo	After last flexo

* Times given are for initial start up. Start up during operations is from standby mode and is instantaneous.