Sharpening the Saw

By Bill Sparks and Greg Ellis

Introduction

This is the second article in a series addressing specific issues associated with UV finishing in the wood industry. In "Too Hot To Handle" (*RadTech Report*, September/October 2001), temperature management issues were discussed. In this article, system basics and preventative maintenance of a typical UV-curing system will be outlined.

UV light has proven to be a fast and highly effective method of finishing wood. Manufacturers who are already using UV finishing in their production process, or those who are considering modifications to include UV in their existing systems, should be aware of a few basic elements in using and maintaining UV equipment.

UV Curing System Components

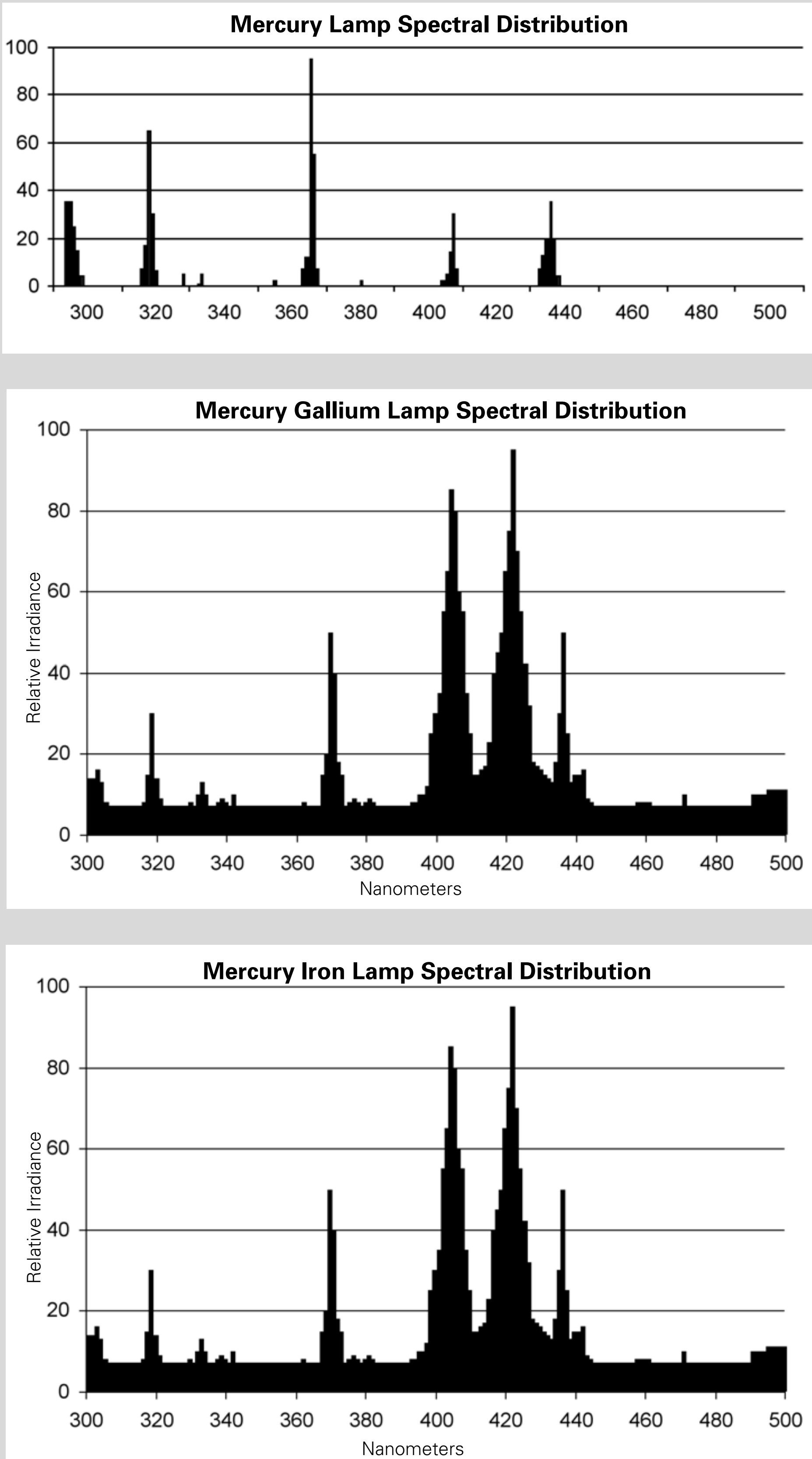
Each UV-lamp system includes the following basic components: housing for the lamp, the lamp itself, reflector, heat sink, cooling system and power supply. Various requirements to consider are proper airflow, access to the lamp, reflector designs, lamp type and temperature control. All UV-curable coatings have photoinitiators that respond to different wavelengths of UV light. An opaque coating used as a primer for molding may require a different UV energy output than a clear coating used for wood flooring. Assorted lamp types produce different wavelengths of UV light. For example, the lamp that is appropriate for a cabinet manufacturer who needs a clear coat or sealer for maple may not be as effective for a shutter manufacturer who needs a white primer on pine.

UV-lamp system.

Lamp Construction

Lamps are made from pure silica quartz because of its high-temperature threshold and transparency to UV light. UV-curing lamps are ignited in two ways, by microwaves or by creating an arc between two electrodes. Arc lamps are the type most commonly found in the wood finishing industry because of their lower initial investment and wide range of applications, although microwave lamps are sometimes used for niche applications such as thick-pigmented coatings and fillers. Every UV-curing lamp, regardless of how it is ignited, contains a small amount of mercury. Two tungsten filaments are located on each end of an arc lamp. At startup, an arc of high voltage is sent across the lamp, heating it to the point that the mercury is vaporized and driven to a plasma state by either an arc or by microwave power, at approximately 10,000°K. The quartz bulb envelope operates at about 800-900°C. Traditional arc lamps have a useful life of 2,000 hours, but the lifetime is diminished if it is turned off and on repeatedly. Traditional designs also require roughly ten minutes to return to peak efficiency and output after being shut off. However, there are new designs available that have the ability to restart within five seconds in case of product stoppage and have lifetimes exceeding 4,000 hours. While arc lamps will gradually diminish in output over their operating life, microwave-powered lamps will maintain a nearly constant output for their entire life (6,000

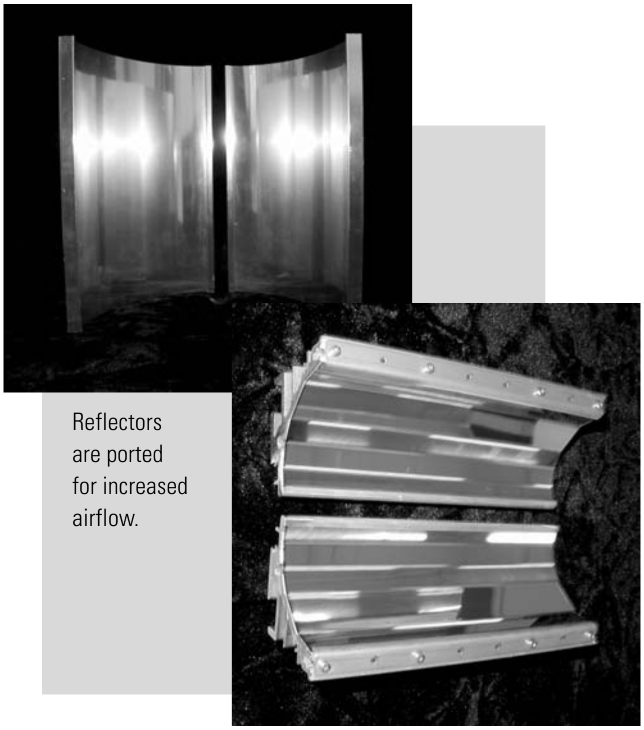
Figure 1: Spectral distribution of lamps



hours) and are not affected by the number of on-off cycles.

Additive Lamps

The standard mercury lamp emits a peak of UV energy at the 365-nanometer wavelength. Two other commonly used lamps are called additive lamps (sometimes erroneously referred to as "doped" lamps.) These lamps also contain mercury, but typically include small amounts of gallium or iron as well. The addition of halides to the mercury changes the spectral output of the lamp. For example, an iron lamp has a peak irradiance of UV energy at the 365-440 nanometer range, and a gallium additive lamp has a peak irradiance from 400-425 nanometers, whereas a standard mercury lamp has a peak at 365 nanometers. In essence, there are different types of lamps, each with a unique set of characteristics that may influence the curing process. See Figure 1. Equipment manufacturers and coatings suppliers will have all the necessary information to best determine how to meet the requirements of a given project. Good communication between the end-user, coatings supplier and equipment manufacturer will ensure the most satisfactory system design.



Reflectors are ported for increased airflow.

Reflectors

Because 70% of the energy emitted by the bulb is focused on the surface by the reflector, reflector design and composition are critical features of a UV-curing system. Reflectors are made from polished aluminum or borosilicate glass and can be focused or unfocused. Furthermore, the cooling process may be improved when reflectors are ported for increased airflow. There are also some new materials of construction available on the market that will significantly increase UV output. Consultation with a knowledgeable equipment supplier will determine what reflector types and system design will be best for any particular process.

Preventative Maintenance

A sound preventative maintenance schedule begins with regular radiometric measurement, which along with temperature control is vital to any operation. UV light is invisible to the naked eye, which means that radiometric measurement is the only way to accurately determine the amount of UV energy coming out of a system. Many companies manufacture these devices, and they are easy to use. Some of the more robust UV-curing systems now have on-line radiometric devices that can communicate with a PLC program.

Lamps are predominately cooled by forced air or water. Improper airflow across the lamp will cause problems with lamp cooling, resulting in blackening of the ends, or in extreme cases, the lamp will bow. When a lamp bows, the quartz has heated until it begins to melt. An unclean shop environment necessitates routine inspection of the filters on the blower, as well as filters for both the lamp housing and power supply. Clogged blower filters can disrupt the

Bowing can occur with insufficient cooling of the lamp.

required airflow across the lamp and cause the lamps and power supplies to overheat. Good equipment design and quality lamp construction can help with these issues.

In the wood industry, accessibility to the optics is a critical feature of any UV-curing system. By their nature, most wood manufacturing plants have dusty environments. Because the reflector is so important to focused energy, even a small amount of dust on the reflector will decrease the efficiency of a curing system. The lamp is similarly affected by residue. For example, the oil from a single fingerprint can "burn into" the quartz surface of the lamp and create a problem. Regular inspection and cleaning is necessary, and therefore a curing system must be operator-friendly. Some systems take up to an hour to inspect and clean. However, a properly designed system will require few, if any, tools to access the optics. In some instances, an inspection may be done on a system without stopping the production line. Cleaning of the lamp and reflector can be accomplished with a simple alcohol wipe-down.

Accessibility to the optics is a critical feature of a UV-curing system.

Preventative maintenance on a UV-curing system is like sharpening your saw, it maximizes productivity and reduces scrap. If a few simple steps are followed, the end-user can operate and maintain a successful curing system, and troubleshooting will be much easier in the event of a problem.

For more information on UV/EB curing consult *www.radtech.org*. ■

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