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AN INTRODUCTION TO MEDIUM-WAVE GAS-CATALYTIC INFRARED CURING FOR AUTOMOTIVE APPLICATIONS

By Mike Duncan

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FORWARD

As a coatings product development chemist and R&D Director for major coatings suppliers for the last 41 years, I have seen many innovations for curing during this time. The I.F./US Autocure "Phoenix" is the most exciting technology that I have worked on. It is extraordinary in it's engineering and it's capability to cure automotive refinish coatings better than convection heating or other infrared curing systems.

The Phoenix can direct medium-wave infrared energy better than any other product on the market. The gas-cat IR emitters can attenuate to the shape of any vehicle. This allows a "one-pass" cure by the Phoenix portal, resulting in a potential productivity increase for the body shop, which is game-changing.

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INTRODUCTION

Gas-catalytic medium-wave infrared curing is being adapted for automotive coatings as a result of shorter cure cycles and smaller floor space requirements when compared to conventional spray booths.

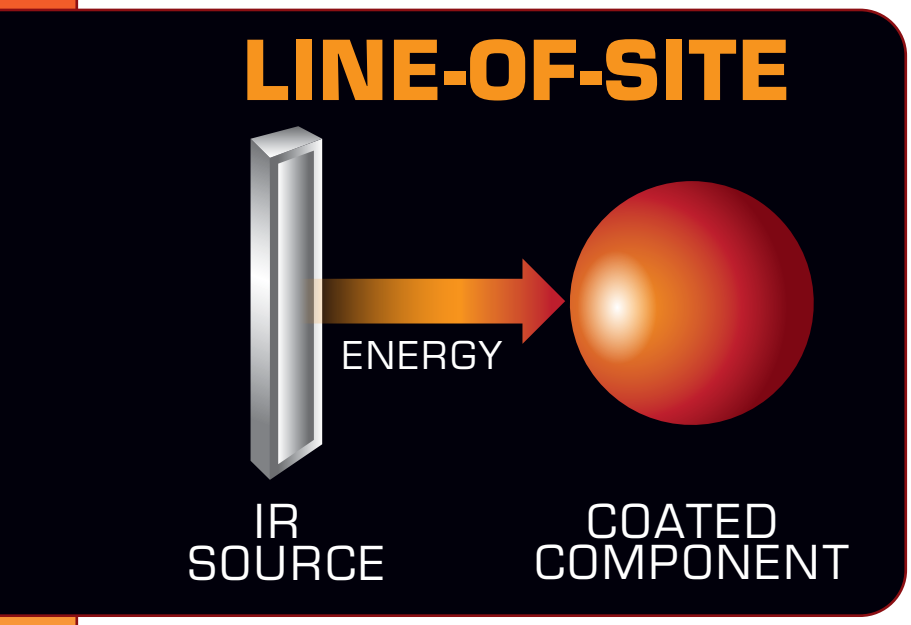
WHAT IS INFRARED?

Infrared (IR) radiation results in energy that travels rapidly in waves and falls on the magnetic spectrum between visible light and microwaves. The radiation's wavelength and frequency impact energy (temperature). With IR radiation, energy increases as the wavelength decreases.

With IR curing systems, some of the energy is reflected off the surface, some is absorbed into the coating, and some heats the substrate.

Traditional spray booths heat air to transmit energy to the substrate. IR energy may be transmitted to the substrate, but it may also be absorbed directly by the coating. As a result, when the IR equipment is properly matched with the application (automotive refinish) energy absorption by the coating is the primary curing method, while transmission of energy to the substrate may become a secondary method used to cure.

IR radiation is limited by line-of-sight since IR energy only travels in a straight line. Due to this limitation, IR energy can only be absorbed by sections of the component facing the source. This is a critical consideration when curing automotive components since they are rarely flat, uniformed surfaces.



Since most automotive components are quite adept at conducting heat, energy may be passed along the substrate, curing areas out of direct IR line-of-sight. Heat resulting from IR energy may also provide a degree of convection heating, which also helps to achieve non line-of-sight curing. However, these are poor substitutes for direct line-of-sight IR curing.

As IR curing systems heat the coating rather than the substrate, sensitive materials such as plastic can achieve much better results while limiting potential damage to the component. This is also an important consideration when repairing modern electric-powered vehicles or vehicles with sensitive electronic components.

IR systems are usually described as high, medium or low intensity. This refers to the energy level of the source. High Energy/Short Wavelength IR is well-suited to transmit energy directly to the substrate but is not as effective directing energy to be absorbed by the coating. Low Energy/Long Wavelength IR loses much of its energy in the form of convection heat and is therefore not as effective for curing.

Medium Energy/Medium Wavelength IR is the most widely used for curing because the energy can be absorbed directly by the coating.

Line-of-site limitations can be overcome by allowing the emitters to articulate, thus "cupping" the component.

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IR FACTORS THAT IMPACT FINISH QUALITY

Purity **-** Most IR sources emit energy over a broadband rather than at a single wavelength or frequency. Purity refers to the broadness of the band. Purity impacts curing since it determines the degree of IR radiation penetration.

Watt Density **-** Watt density refers to the amount of energy available at the surface of the coating. If the watt density is too high the coating will burn. Watt density is typically controlled by increasing/decreasing the number of IR emitters or by increasing/decreasing the distance between the emitter and the substrate.

GAS CATALYTIC IR

IR radiation can be generated from both electric and gas sources.

In the case of electric infrared, a lamp or bulb containing a filament provides the short wavelength IR. These lamps, bulbs, and associated reflectors all require regular maintenance. Dust or dirt accumulation will interfere with system performance.

Gas IR systems utilize one of two methods to delivery energy. **Gas-catalytic** systems oxidize the fuel source without needing a flame. Other systems use a flame to heat a ceramic emitter to generate the IR radiation.

COATINGS FORMULATIONS AND PRODUCT SELECTION

Coating formulations used in IR systems are generally the same as formulations for convection-only curing. However, some re-formulation may be necessary to achieve the best results.

In general, existing products (primer-surfacers, primer-sealers, waterborne or solventborne basecoats, and clearcoats) from the major coatings manufacturers can be used with gas-cat IR curing systems. This is achieved through "dialing-in" of the hardener/reducer package, along with optimization of the curing portal parameters of speed and distance from the coating surface; as they relate to temperature achieved. In this regard, testing and recommendations developed by the gas-cat IR curing system distributor, working in conjunction with the coatings manufacturer are an immense asset to the body shop.

Since proper coating formulations respond well to fast heat-up rates, IR curing can result in improved finish appearance. For example, gloss may increase. It is imperative to conduct trial runs to determine the impact that IR curing will have on finish appearance.

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GAS-CATALYTIC IR CURING CONSIDERATIONS

Line-of-Site Curing **-** Due to line-of-site restrictions, for the best results, it is essential for the IR emitter to face the substrate.

Quicker Heat-Up Times **-** Gas-catalytic IR curing systems heat up much more quickly than conventional convection booths.

Reduction in Contaminants **-** IR curing systems do not require high airflows common in traditional booths, minimizing dust and dirt contamination.

Substrates **-** Various substrates absorb IR energy differently (emissivity).

Cure Speed/Degree **-** Gas-catalytic IR systems can cure components at a much faster rate than traditional convection booths in part since the system does not require the substrate to be heated before the curing process begins. Gas-catalytic IR systems generally result in 8-15 minute cure time ranges depending on component size. These emitters typically “dwell” on the substrate from 30-90 seconds.

Additionally, at “completion of the curing process” in a convection booth, the coating may only be around 40-60% cured. With IR systems, it is possible to achieve up to 75-90% cure, resulting in a finish that is much closer to a true “full cure.” This allows quicker assembly of parts, and/or earlier delivery to the customer.

Energy Consumption **-** Since IR curing systems directly heat the coated surface, there are no wasted BTUs to heat the entire coating or the surrounding air. Fans, pumps, and blowers are not needed to provide combustion air, pump thermal oil through heat exchangers, or to circulate heated air around the substrate.

Additionally, IR systems are more efficient than convection booths since more of the energy (heat) is delivered directly to the substrate. IR systems can be switched on or off in a matter of seconds, so less energy is wasted during warm-up.

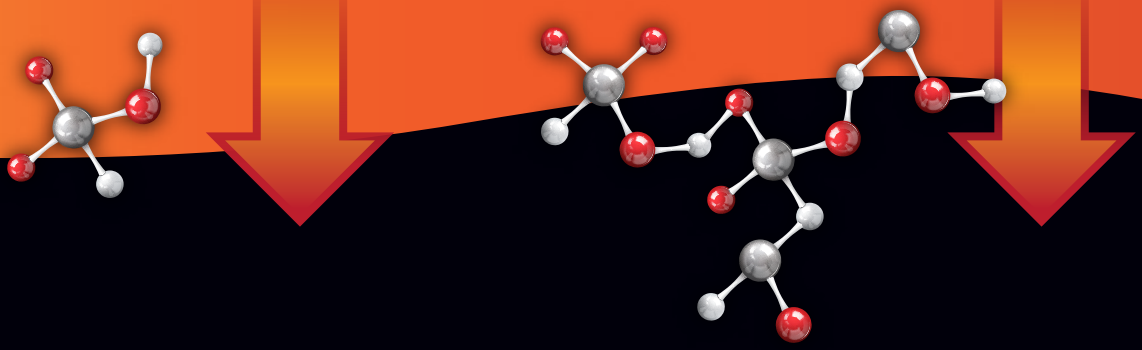
Lastly, IR emitters convert nearly 90% of their energy to heat, as opposed to traditional convection booths that only convert up to 60% of their energy to heat.

Traditional spray booths require long curing cycles. Even at “full cure” vehicles are only around 60% cured.

60% CURED

Medium-wave gas-catalytic IR curing systems dramatically reduces cure time and results in a finish that is up to 90% cured.

90% CURED



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CONCLUSION

Gas-catalytic medium-wave IR curing systems are being adapted for a wide range of applications and are particularly well-suited to automotive refinish. It is necessary to overcome some limitations such as line-of-site. However, the resulting decreased cure times, improved cure degree and overall appearance, and reduction in energy use make this technology appealing and growing in adoption.

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ABOUT THE US AUTOCURE "PHOENIX"

Development of the US AutoCure Phoenix system was born from a "wish list" created by body shop owners and painters who were familiar (and frustrated) by the available infrared systems.

I've heard of other curing systems that seem similar...

WHAT MAKES THE PHOENIX DIFFERENT?

1. Class 1, Division 2 certified
2. Fully robotic, 16 points of articulation
3. Gas-catalytic, medium-wave infrared system
4. Modular Design - Can be retrofitted to any existing booth
5. No Maximum Height/Length - Flexible to accommodate different vehicle sizes and applications
6. Floor mounted - Requires NO mounting to existing cabinets or booth walls
7. "One Pass" Curing System
8. Fully-automated - The Phoenix will follow the contour of the vehicle rather than relying on a fixed pattern
9. Booth Load Every Hour - Achieve 80 hours of paint time per 8 hour shift
10. **BUILT IN THE USA** - Proudly produced and maintained by hard-working Americans!

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