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The Global Leader in Infrared Cameras

THERMACAM® INFRARED CAMERA

MAXIMIZE YOUR ASPHALT INVESTMENT

SEE IT | MEASURE IT | REPORT IT

Infrared Scanning Revolutionizes Asphalt Paving

Until recently, the premature failure of asphalt pavement by potholes, raveling and cracking was a poorly understood and costly phenomenon. Now, infrared thermal imaging provides a highly affordable and convenient inspection method that provides a whole new level of quality control during mat laydown, greatly increasing the performance and service life of highways.

Since the mid-1980s, many highways were engineered for service lives of 15 years, but have been failing much sooner. In 1995, in a unique collaborative effort, the State of Washington Department of Transportation (WSDOT) and the University of Washington (UW) began to research the cause. Initial investigations were made on U.S. Interstate 5, then under construction, and subsequently on many other roads. The research revealed the culprit to be excessive temperature variations in the hot mix asphalt (HMA) pavement surface, or mat, of a road during laydown. A FLIR ThermaCAM® infrared camera was used for the research and FLIR cameras continue to be used for road construction quality analysis by WSDOT.

Combining their findings, Joe Mahoney, Prof. of Civil and Environmental Engineering at UW, and Kim Willoughby, Pavement Structure Engineer at WSDOT, found that cooler areas of mix cure with lower final densities than do hotter areas due to trapped air and segregation of the aggregate within the cooler fraction. These lower density areas are particularly susceptible to wear and degradation from weather and traffic, and are likely to exhibit early failure.

Chilling is bad for road construction

The U.S. EPA limits the high temperature of HMA at the batch plant to 330°F to limit emissions, while the U.S. DOT limits the low temperature to 310°F to enable it to cure and adhere properly. This narrow 20°F temperature range must be maintained as the asphalt is loaded from the plant hopper into the truck, and both agencies require verification from the batch plant to verify regulatory compliance.

But en route the HMA cools, especially where it is exposed to the atmosphere. In addition, the national trend of growing premature surface failures coincides with increased nighttime paving operations, which became necessary because of growth in daytime traffic densities. The cooler night-time air increases the temperature differential within batches of mix during transport.

Curing the curing problem

To solve the problem, contractors are increasingly turning to self-propelled material transfer vehicles (MTV) for example, the Roadtec Shuttle Buggy,® to accept the HMA from the truck, remix it to assure uniform thermal and aggregate dispersion, and offload it into the paver. Without an MTV, the truck unloads directly into the paver, where unmitigated differential cooling can lead to problems down the line. Washington allows a 25°F differential in the freshly applied mat; Georgia, only 20°F. In no case should the temperature of the fresh HMA mat laid down by the paver be less than about 170°F, because it is then too stiff to roll.

A new generation of infrared cameras makes asphalt thermal imaging as easy as taking a photograph. The ThermaCAM E-Series IR cameras from FLIR Systems, the global leader in infrared cameras, are the most compact, lightweight and innovative infrared inspection cameras ever developed. They weigh only $1^1/_2$ pounds and fit easily in the palm of the hand or on a toolbelt. They provide crisp thermal imaging, precision temperature measurement and in-field JPEG image storage, all to verify thermal uniformity during laydown. FLIR is introducing several new E-Series models to address the varying inspection and budget requirements for state, municipal, institutional and commercial customers.

"Truly, it is hard to describe the positive effect that FLIR's impact has had for us and the paving industry," said Prof. Joe Mahoney of the University of Washington. "I hope you sell hundreds to the paving industry!"

ESSENTIAL TO:

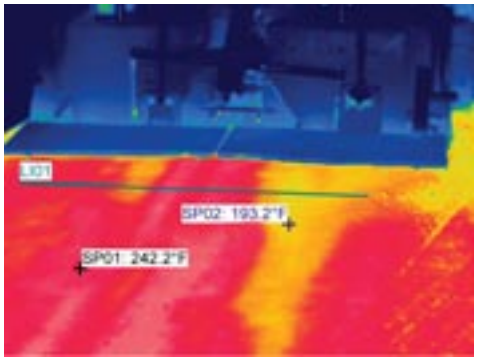
- CONFORM TO GOVERNMENT TEMPERATURE REQUIREMENTS
- MEASURE HMA TEMPERATURE AFTER TRANSIT
- MINIMIZE THE NEED FOR AGGRESSIVE ROLLING
- AVOID POTENTIAL FINES AND PENALTIES
- PREDICTIVE MAINTENANCE OF EQUIPMENT

FEATURES:

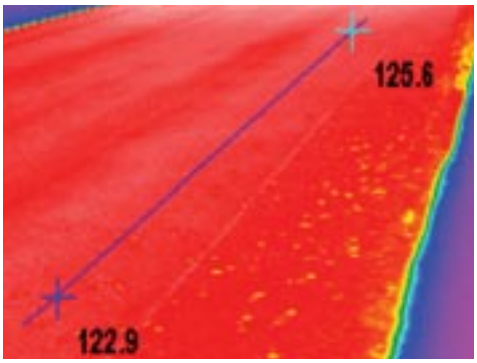
- POINT AND SHOOT
- QUICK, ACCURATE THERMAL MEASUREMENT
- HANDHELD AND EASY TO USE
- LIGHTWEIGHT YET DURABLE
- LCD SCREEN FOR EASY VIEWING
- FULL COLOR INFRARED OR B&W IMAGES
- IMAGE STORAGE
- SUBSTANTIVE REPORTS
- LONG-LIFE LITHIUM BATTERIES

Now you can SEE how you're paving!

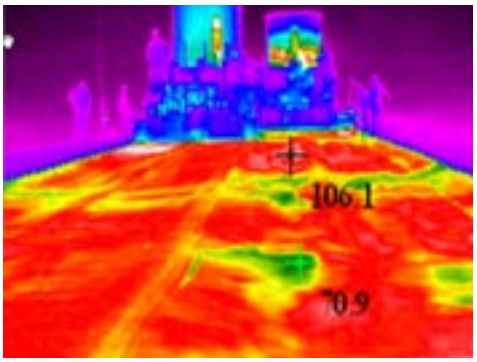
The thermograph reveals a temperature differential of about 50 Fahrenheit degrees in this mat directly behind the paver. The cooler areas could be a concern for poor adhesion, but are still hot enough to be successfully rolled. However, this differential would be out-of-spec for state highways in some states, including Washington and Georgia.



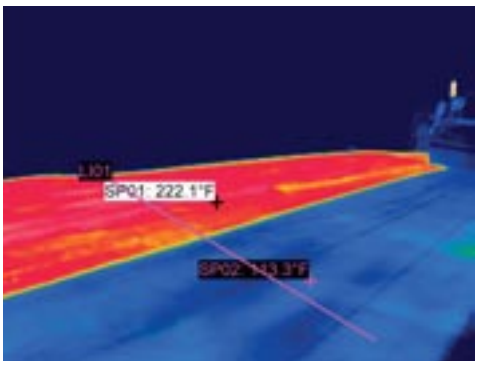
With only a 3 Fahrenheit degree differential, the longitudinal section shown in the thermograph indicates that this cooling asphalt mat exhibits exceptional thermal uniformity. The mean density of this asphalt mat is 2,205 kilograms per cubic meter, with a maximum of 2,247 kg/m³ and a minimum of 2,179 kg/m³. The visual photo of the road taken a year later shows no evidence of wear or degradation.



Asphalt that is cooler than about 170°F is relatively stiff, resists rolling, cures to a lower density than hotter areas and is prone to premature failure. Note the low-temperature spots in the thermograph, which are as cool as 70.9°C (159.6°F) and correlate exactly with the visibly worn spots in the visual photo of the same section of roadway.



The thermograph shows the contrast in temperatures between the cool, curing lane to the right (113.3°F) and the hot mat being laid down on the left (222.1°F).



(All images on this page are courtesy of Kim Willoughby, Washington State Department of Transportation)

About FLIR Systems

With over 30 years experience and more than 30,000 of its IR cameras in use, FLIR is the undisputed global leader in infrared systems. From industrial to military applications, thermography professionals have made FLIR their number one choice. No other company offers such a wide range of infrared cameras, software, service, training and support.

FLIR's ThermaCAM series of thermal imaging cameras have long set the standard for thermographic testing and analysis. Today they are the most widely used non-contact temperature measurement infrared cameras in the world.

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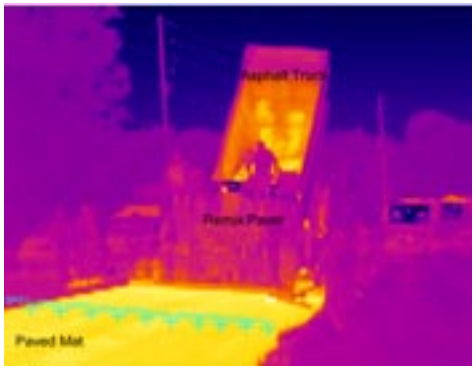
ON COVER:
The self-propelled Roadtec Shuttle Buggy® material transfer vehicle from Roadtec, a division of Astec Industries, has revolutionized the asphalt laydown industry. If used properly it can minimize thermal and aggregate segregation and eliminate three to four haul trucks from the average paving job.

Check Your Temperature with Infrared!

Prepared by Peter Wu
Office of Materials and Research, Georgia Department of Transportation, Forest Park, Georgia

Georgia state DOT specifications require that the temperature difference between the lowest and the highest points on a transverse direction across an asphalt paving mat shall be no more than 20°F. This requirement is even stricter than that currently used by the state of Washington DOT, which allows no more than 25°F variance throughout a hot mat. Investigations using a remix paver were recently performed by Dr. Peter Wu of the Georgia Department of Transportation, using a FLIR infrared camera. The example shown is of a road surface laid down with a train that included a remix paver. "It seems the remix paver does solve a mixture temperature segregation problem for an asphalt paving project," said Dr. Wu.



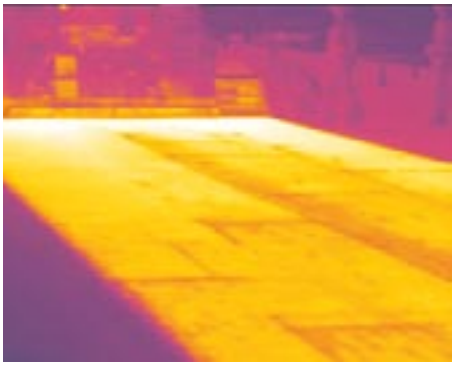
In this thermograph, ten points on the paved mat were selected about 5 feet behind the paver. The difference between the highest temperature (244.6°F) and the lowest temperature (236.6 °F) is only 8°F, which is well within the Georgia state requirement of 20°F. The mat shown was laid by a train that included a remix paver.

Astec Industries: Paving a Way to Success

ASTEC: A World Leader in Paving Equipment

Astec made a direct correlation that "cold" spots in the asphalt pour of traditional paving machines would inevitably result in road damage. In the mid 1990's Astec turned to thermal imaging, also called thermography, to prove the effectiveness of their new Roadtec Shuttle Buggy design. Thermography is the production of non-contact infrared, or "heat" pictures, from which temperature measurements can be made.

The Shuttle Buggy material transfer vehicle incorporates a re-blending hopper system featuring remixing augers that mix the hot asphalt before it is transferred to the paver and laid. Proper reblending of hot mix asphalt before placement is critical to temperature consistency throughout the laid asphalt. Uniform asphalt pavement temperatures lead to consistent road densities, thus preventing premature failures in asphalt roads.



Thermal image indicates a uniform temperature mix, essential for pavement smoothness.

If trucks dump hot asphalt directly into the hopper of the paving machine, heat loss begins immediately on the exposed surface of the mix and around the perimeter of the truck during haul-time or delay-time at the job site. Traditional paving equipment does not completely re-blend the hot asphalt. Therefore, thermal non-uniformities can exist in laid asphalt, leading to varying densities and areas with different resistances to wear and degradation.