Texas Department of Transportation

Construction & Materials Tips

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Striping Technology Update

Like any other industry, the technology used in the traffic markings is constantly changing to accommodate new or improved methods and materials. For example, changes have been made in traffic paint and thermoplastic to improve the longevity, effectiveness and life-cycle costs of these materials. New traffic marking materials, such as multipolymers, are increasingly being used in an effort to improve upon what traffic paint or thermoplastic can provide on certain roadways. Different styles of contrast markings are being evaluated to find a style that best produces a contrast traffic marking for the price. New technology, such as mobile retroreflectometers, is improving the ability of districts to check the performance of their traffic markings.

The following article highlights these changes.

Overview

Over the past few years there have been several changes made in the materials used to delineate the roadway. The Asphalt, Chemical, and Traffic Materials Branch (ACT-T) of the Construction Division, Materials and Pavements Section and the Traffic Operations Division have been evaluating new traffic markings in an effort to improve the functionality and life-cycle costs of our roadway markings. This article describes the changes and work completed to date in the area of traffic markings and striping technology.

Existing Traffic Materials

♦ ***Traffic Paint***

Some of the changes made since 2001 for traffic paint:

- in 2001, the resin in the formulation - This change in resins created a more durable paint that allowed an improved ability to apply the paint in thicker films, with a similar set time (10 min. in a lab setting)
- the recommended application changed from 15-20 gal/mile to 20-22 gal/mile - This change provides a thicker film.
- change from Type II beads (21 mils or 0.5 mm) to Type III beads (43 mils or 1.1 mm) - Using the Type III bead allows for the application of thicker films without burying the beads. Also, Type III beads provide a more visible yellow stripe at night.

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This combination of a more durable resin, thicker film, and bigger beads optimizes the performance of the traffic paint. ACT-T recommends districts use traffic paint to stripe new surface treatments. The districts can return in the off-season to restripe with 100-mil thermoplastic. This strategy will provide the best and longest lasting stripe on new seal coats. The advantages to this strategy are:

- the paint striper (versus a thermoplastic truck) can more easily follow the seal coat crew; thus, delays can be avoided
- striping with traffic paint initially allows the rock to settle and
- restriping with thermoplastic in the off-season allows the asphalt to cure so there will be less bleeding of asphalt through the stripe.

Figure 1. Picture of Type III beads in traffic paint on a Grade 3 seal coat

♦ *Thermoplastic*

The 2004 Specifications book changes for thermoplastic:

- 100-mil applications are now required for all new surface treatments. This requirement provides enough thermoplastic material to fill in the valleys between the rocks of surface treatments.
- An epoxy sealer has been added to the approved sealers for use with thermoplastic markings. Epoxy sealers may be used for any road surface. Thermoplastic generally performs better with epoxy sealers, versus acrylic sealers or traffic paint, on concrete surfaces.
- Type III beads are now the default bead. Type II beads can still be used, but the bead type information must be stated in the general notes. Type III beads provide a more visible nighttime yellow. They also provide some wet night capabilities and recover faster than Type II beads after a rain.
- A 40-60% embedment requirement for drop-on beads has been added, which is the optimum embedment for traffic beads. A bead embedment handout has been created for the districts to use. Contact ACT-T at 512/506-5887 for more information.

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Figure 2. Bead embedment handout

♦ *Contrast Markings*

Several contrast and shadow markings test sections have been applied in the past several years. Contrast markings are markings where a white stripe is applied on top of a black background stripe. The black background may be longer than the white stripe so there is a black tail or lead-in to the white stripe. Shadow markings are those with a 10-foot white stripe followed by, or immediately before, a 10-foot black stripe. Shadow markings are easier for the contractor to restripe. Separate black and white stripes allows the striping truck to be less precise with a restripe without fear of striping out the black contrast marking.

A test is planned in Houston (Summer 2005). The contractor will use a clear epoxy binder beaded with black slag grit. When viewed by a driver, it is expected the clear binder with the black slag will appear as a black stripe. This binder/pigment system may become the standard for contrast striping. Using a clear binder will allow contractors to reload the striping truck with minimal cleaning.

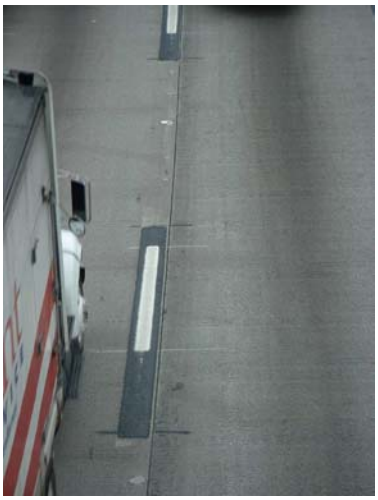

Figure 3. Contrast markings with a lead-in and tail.

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♦ ***Raised Pavement Markers***

Due to increases in truck traffic, increased use of Grade 3 sealcoats, and marker durability problems, an increase in raised pavement marker failures has been noted. To address this issue, ACT-T has been evaluating new pavement markers constructed to be more durable.

ACT-T contacted leading marker manufacturers and requested samples of their most durable markers for road testing. Test variables include road surface (Grade 3 sealcoats, hot mix asphalt [HMA] and concrete) and average daily traffic (ADT). ACT-T expects to have a new, updated list of approved markers once enough data has been collected (tentatively by late Spring 2005).

In conjunction with the above road tests TxDOT has contracted with the Texas Transportation Institute to conduct research on marker durability problems. Research Project 0-5089, "Raised Pavement Marker Improvements," is a three-year project to establish correlations between laboratory tests and road performance which a material specification can be developed. Test procedures for qualifying raised pavement markers and for routine testing of marker quality and guidelines on proper marker application are the other objectives of the research project.

In addition to the new markers, a thermoplastic adhesive is being evaluated on several of these test decks. To date, the adhesive has performed well on both concrete and asphaltic surfaces and may be included in the specification for marker adhesives.

New Traffic Materials

♦ ***Multipolymers***

Multipolymer materials were introduced to the department as a cost effective means of striping concrete highways with a high average daily traffic (ADT). Multipolymer materials are two-component paints that have been modified to perform as traffic markings. The two components must be mixed in the equipment at the appropriate mix ratios upon application. Heating is generally involved to increase the fluidity and sprayability of the material. The three types of multipolymer materials that have been used to date are epoxies, modified urethanes, and polyureas.

> *Epoxies*. Epoxies have a set time of approximately 40 minutes under normal conditions.* The set time is dependent upon temperature and may take an hour or more as the air and road temperature drops. Epoxies are not UV stable; their color may fade over time. Epoxies are more moisture tolerant than thermoplastic or modified urethanes and polyureas, therefore, epoxies will have less adhesion problems. Faster setting epoxies are available, but, they do not have the life expectancy, adhesion capabilities, or the UV stability of the slower setting epoxies.
>
> *Modified urethanes*. Modified urethanes are urethanes with an epoxy component. This material can be sprayed from an epoxy truck without cleaning out the epoxy from the tank. Modified urethanes are slightly more expensive than epoxies but are more UV

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stable; as a result, the colors are less prone to fading. Modified urethanes also have a faster set time, usually less than 20 minutes under normal conditions.* The set time is dependent upon air and road temperature. Modified urethanes are susceptible to adhesion problems from moisture in the road surface. It is important to ensure that the pavement is dry prior to striping.

Polyureas. Polyureas are more durable, UV stable, and set quickly (usually within 2-5 minutes under normal conditions) than either epoxies or modified urethanes. Unlike epoxies or modified urethanes, the set time for polyureas is not as dependent upon air or road temperature so it is possible to apply them in colder temperatures without having the set time issues associated with the other multipolymers. Polyureas, like modified urethanes, are susceptible to moisture in the road surface. A dry pavement prior to striping is important. Polyureas are not compatible with epoxies and cannot be mixed with them. They generally cost more (as much as 50–100% more) than either epoxies or modified urethanes.

**NOTE*: Normal conditions are defined as dry at 70°F.

Multipolymers require a special striping truck and are susceptible to incomplete curing if the mix ratios are off. Incomplete curing can be caused by varying pump pressures or obstructions in the line. Polyureas may have more problems with incomplete curing versus epoxies or modified urethanes since they have a lower tolerance for off-mix ratios.

Problems that have occurred with multipolymers include long set times for epoxies, especially due to cold temperatures, and incomplete curing due to off-mix ratios. The nighttime yellow for polyureas has also been an issue since the pigment system used in the material has not had the opacity needed to provide a good retroreflective yellow color.

To date, all the multipolymers have performed well. Multipolymers are good choices for concrete roadways, especially concrete roadways with a high ADT. Polyureas may be an especially good choice if cold temperatures or lane closures are an issue.

Figure 5. Epoxy application with Type IV and Type I beads

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♦ *Thin-line Thermoplastic*

Thermoplastic materials consist of four general components: binder, pigment, glass beads, and filler material. Thin-line thermoplastic, also known as "plastic paint", contains all of the above components except for glass beads. The binder content for plastic paint is also higher. Where the minimum thickness of thermoplastic on new hot-mix asphalt surfaces is 90 mil for centerline markings and 60 mil for edgeline markings, thin-line thermoplastic is applied at 20-25 mil. Thin-line thermoplastic was introduced to the department as an alternative to traffic paint. Contractors have generally used it in the past for striping parking lots.

In April 2003, thin-line thermoplastic was applied in the Atlanta and Tyler Districts. Retroreflectivity data that was gathered indicated that the thin-line thermoplastic traffic markings lost traffic beads within a very short time. The performance of thin-line thermoplastic is greatly affected by its inability to remain liquid long enough for the beads to embed properly, thus the beads are easily worn away.

The latest application of thin-line thermoplastic has performed well initially. The contractor switched to using treated Type I beads and made other adjustments, like lowering the bead gun closer to the stripe, to obtain a quality initial stripe. We are monitoring this project for long term performance.

Due to data that has indicated inconsistent performance of thin-line thermoplastic, a directive was issued instructing the districts to require a warranty from the manufacturer if this system is to be specified.

Figure 6. Thin-line thermoplastic application showing bead loss

♦ *Self-Priming Thermoplastic*

Self-priming thermoplastic is an alkyd thermoplastic, modified to achieve adhesion on concrete surfaces and aged asphalt surfaces without the need of a primer or sealer. This material was

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introduced to the department by a thermoplastic manufacturer as a competitive traffic marking alternative to multipolymer materials for concrete surfaces. This material has performed well to date with little or no adhesion failures.

- ***Lead-free Yellow Thermoplastic***

Currently the yellow pigment specified for thermoplastic is lead chromate. Though this pigment is glass encapsulated and thermoplastic material containing it can pass the EPA's Toxicity Characteristic Leaching Procedure (TCLP) for heavy metals, it poses serious health risks for workers in thermoplastic manufacturing facilities. Also, the trend with environmental regulations is to remove lead or chromium from all materials to which the public may be exposed. Due to these concerns several states have already adopted lead-free organic pigments for their yellow thermoplastic.

ACT-T has been evaluating various versions of lead-free yellow thermoplastic for almost two years. The lead-free yellow thermoplastics are performing well to date, retaining their yellow color adequately enough to conclude a lead-free yellow thermoplastic can perform in Texas. The department anticipates having an initial material specification for an organic yellow thermoplastic ready for this year's seal coat season. This specification will be modeled after the specification used by the California DOT.

Mobile Retroreflectivity Vans

Since the collection of retroreflectivity data has become an important part of striping projects to satisfy either performance requirements, 250 mcd/lux/m2 for white or 175 mcd/lux/m2 for yellow, many contractors rely on mobile retroreflectivity vans to collect their data. Houston has awarded a contract to have a mobile retroreflectivity van available for the collection of retroreflectivity data. The mobile van will enable the district to assess the performance of their traffic markings. ACT-T is also working towards developing the technology so that it is possible to equip department trucks with the mobile retroreflectivity units. By being able to utilize the technology, it is expected to save the department money and have the technology more readily available throughout the state.

The use of this technology is in the beginning stages. Many issues have yet to be resolved. For example: how to define a reasonable measurement zone, how to present the data, how to interpret and process the data, and developing effective follow-up procedures.

At this time, a nationally recognized certification procedure for the mobile units does not exist. It is important to ensure that these units are checked for accuracy before approving their use. ACT-T has developed an interim acceptance procedure to check the accuracy of the mobile units and is available to assist the districts in this regard.

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Figure 4. Mobile retroreflectivity van

Additional Information

For additional material selection and application inspection information refer to the Pavement Marking Handbook.

Contact Information

Please address any questions about the content of this article to Johnnie Miller, P.E. at 512/506-5889.