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Sustainable Asphalt-Rubber Chip Seals Key to Cape Cod Town's 20-Year Preservation Plan

BY JEFFREY COLBY, P.E. AND ROBERT BETSOLD

Even before words like “sustainability” and “recycling” were a central focus in the pavement industry, a robust **asphalt-rubber chip seal** program has been the cornerstone of the pavement maintenance program for the Town of Yarmouth, Mass.

Known as one of America's best summer destinations, approximately 6 million visitors descend to Cape Cod each year for their vacations. Located in the heart of the mid-Cape region, with borders on Cape Cod Bay and Nantucket Sound, the Town of Yarmouth is the third-most populous community on the Cape with approximately 23,000 full-time residents plus

another 75,000 seasonal residents and visitors.

The town's very diverse road network is made up of over 1,100 roads totaling 151 miles of municipally owned roadway and 93 miles of private roadways. These miles range from main roads with ADT counts over 15,000 to many short neighborhood streets with less than 50 vehicles per day.

Maintaining such a unique network of pavement with a short construction season and a large influx of traffic during that season presents many challenges for the community. However, for over 20 years, the town has found tremendous success

utilizing asphalt-rubber chip seals as the go-to treatment for their roadways.

YARMOUTH'S CHIP SEALS

Chip seals have been widely used by communities across the state and Northeast region for many decades as a key part of their pavement programs. Early “oil and stone” applications gave way to emulsion-based chip seal treatments, which became mainstream in the 1990s and early 2000s. Like many communities looking for ways to address deteriorating roads with tightening budgets, Yarmouth began using chip seals on neighborhood and secondary roads as part of its pavement program.



Application of heated and pre-treated 7/16-in. aggregate as part of the asphalt-rubber chip seal process in Yarmouth, Mass.



Building on early emulsion chip seal success, throughout the early 2000s, the town looked towards expanding its chip seal program by incorporating the asphalt-rubber chip seal treatment.

Initially used on some of the higher volume roadways that would previously not have been considered for chip seals, the performance and benefits of the asphalt-rubber application made it a clear choice for expanded use across the community. Thus over the past 10 years, asphalt-rubber chip seals have become the most widely used pavement treatment in the town.

Throughout the evolution of the chip seal program—both emulsion and asphalt-rubber—the town has continually engaged with residents about the applications. Since 1993, the town has maintained a **road condition database** as part of their road maintenance program. This program—which covers roadways, sidewalks, parking lots and drainage construction—helps to determine the most cost-effective use

of municipal funding. Press releases and community notices, as well as the residents' strong familiarity with chip sealing over the years, have been integral in the success of the program.

ASPHALT-RUBBER CHIP SEALS

The asphalt-rubber chip seal processes used by Yarmouth outwardly appear very similar to traditional emulsion-based chip seals. However, there are several significant differences in the materials that greatly impact the application process and performance.

If needed, advanced prep work is completed on the roadways as needed, including placement of a shim or leveling course of hot mix asphalt and sealing of cracks larger than approximately 1/4-in. wide. Immediately preceding treatment, the pavement is swept to assure the pavement surface is properly clean.

Utilizing an asphalt distributor with internal heating and agitation, crumb

rubber-modified asphalt is sprayed on the pavement at approximately 350 deg F. A chip spreader immediately follows the distributor placing single-sized, 3/8- or 7/16-in. aggregate that has been heated and pre-coated through a hot mix plant.

Yarmouth utilizes two variations of the asphalt-rubber chip seal process, depending on the type of road and traffic volumes. The 20 percent rubber application, utilized on higher volume roads, is applied at a rate of approximately 0.60 gal./sq. yd. of crumb rubber-modified asphalt with an aggregate application rate of approximately 35 lb./sq. yd.

On lower volume roads, the 10 percent rubber variation is used with approximately 0.40 gal. of crumb rubber-modified asphalt and approximately 30 lb. of heated and treated aggregate per square yard.

Following placement of the aggregate, pneumatic- or rubber-tire rollers complete a minimum of three passes over the entire treated surface of roadway to assure proper



In Yarmouth, All States Construction places hot spray crumb-rubber modified asphalt seal, to be followed immediately by chip spreader



Camp Street in Yarmouth during application of the asphalt rubber chip seal in 2012 (left) and after 11 years of in-place performance

orientation and embedment of the aggregate in the asphalt rubber. After rolling is complete, excess aggregate is swept from the surface by rotary pick-up sweepers. In most cases, normal traffic activity is completely resumed within one hour.

EMULSION VS. RUBBER SEALS

As previously mentioned, there are many similarities between the asphalt-rubber and emulsion chip seal processes. However, the very distinct difference in the liquids contributes significantly to the variance between the applications.

In the Northeast, most emulsion chip seals utilize a CRS-2L (latex modified) or CRS-2P (polymer modified) emulsion sprayed at approximately 160 deg F. With a typical application rate of 0.42 gal./sq. yd., the residual asphalt content is approximately 0.28 gal./sq. yd. Cover aggregate is usually applied at a rate of about 25 lb./sq. yd. To allow the emulsion to properly cure, roads are typically not swept until after two days of curing.

Comparatively, asphalt-rubber chip seals utilize a hot applied asphalt binder that has been modified or blended with either 10 or 20 percent crumb rubber. The addition of rubber, which contains polymers and antioxidants, into the binder raises the

softening point and increases low temperature flexibility, creating a more durable and crack-resistant seal.

Additionally, different from an asphalt emulsion, the entire 0.60 gal./sq. yd. of applied binder remains on the road as the residual content. This allows for the higher aggregate application rate of 35 lb./sq. yd. Also, as the asphalt-rubber binder is thermal set (similar to hot mix asphalt), asphalt rubber chip seals are swept immediately following rolling and do not require a curing period.

ENVIRONMENTALLY BENEFICIAL

The asphalt rubber chip seal treatment provides an overall win-win situation for the Town of Yarmouth as both a sustainable and recycled process, and one that also provides a substantial financial benefit compared to alternative options.


Over the past 20 years, the town's overall pavement condition index has increased from the mid-60s to the mid-80s. Calculations have found that the use of asphalt-rubber chip seals have been a very cost-effective treatment that has saved the town millions of dollars in road maintenance funds over the same time period.

While the initial reason for starting the use of chip seals—and specifically

asphalt-rubber chip seals—was for financial reasons, the environmental aspect of the treatment has become equally important to the town and its residents.

The town has been very active in identifying opportunities for recycling and improving sustainability. Over the more than 20 years of using asphalt-rubber chip seals, **the town's pavement maintenance program has utilized the equivalent of more than 125,000 recycled scrap tires on its roadways.**

The town has also been creative over the years by using excess aggregate from its chip seal projects for various other projects throughout the town, maximizing both the financial value of the program and use of all available natural resources.

Looking ahead, the town plans to continue to widespread use of asphalt-rubber chip seals, while continually evaluating opportunities to grow and expand on its processes that provide both sustainable and cost-effective benefits to the community. 

Colby is the Department of Public Works director for the Town of Yarmouth, Mass., and Robert Betsold is director of marketing for All States Materials Group in Sunderland, Mass.