ASPHALT CONCRETE PATCHING MATERIALS AND EFFECTIVE PATCHING TECHNIQUES

IAPA Scholarship Research Report

ADRIANA DIAZ

Contents

List of Tables

Introduction

There are multiple asphalt concrete patching materials and effective patching techniques that the industry uses to solve the problem of pavement distress. Pavement distress is when the pavement is unsatisfactory and fails. The irregularity of pavement is also considered pavement distress. There are different asphalt pavement distress types, and each distress has different characteristics that define them. Some types of asphalt pavement distress include potholes, stripping, bleeding, raveling, shoving, and cracking. Each distress has different materials and techniques that could be implied to repair the problem. A possible answer to why pavement distress happens could fall back to the design and placement of asphalt. To get started, specific types, causes, and descriptions, including photos of asphalt pavement distresses, are listed in Table 1.

Table 1. Types of Asphalt Pavement Distress

NAME	PHOTO	DESCRIPTION
Bleeding		Bleeding is a film of asphalt binder on the surface of the pavement. Bleeding is a shiny, glass-like reflecting surface that is sticky when dry/hot and slippery when wet. Usually occurs during hot weather or traffic compaction. Bleeding is also caused by poor mix design or construction problems (2, 3).
Shoving		Shoving is a form of plastic movement, a wave (shoving) across the pavement surfaces. This distress usually occurs where traffic starts and stops. Shoving is described as roughness, unevenness, and irregular surface (3).

NAME	PHOTO	DESCRIPTION
Raveling		Raveling is the progressive disintegration of an HMA layer from the surface downward due to the dislodgement of aggregate particles. Raveling is described as losing debris on the pavement, rough, and collecting water in raveled locations. Raveling could be caused by aggregate segregation, inadequate compaction during construction, and asphalt binder aging (2, 3).
Joint Cracking		Joint cracking happens when asphalt concrete overlays rigid pavements over the underlying rigid pavement joints. Joint cracking is described as loose debris, moisture infiltration, and roughness. Joint cracking is caused by the movement of the rigid pavement slabs (3).
Thermal Cracks		Thermal cracks happen when temperature differences within the pavement cause thermal stress and shrinkage, which cracks the pavement. These cracks are also known as transverse cracks (2, 5).
Fatigue Cracks		Fatigue cracks are a series of interconnected cracks caused by fatigue failure of the asphalt concrete under repeated traffic loading. Fatigue cracks allow moisture infiltration, decreasing the pavement load support and creating potholes (2).

NAME	PHOTO	DESCRIPTION
Rutting		Rutting is a shear failure in the pavement. Due to traffic load, there are two types of rutting, one in asphalt concrete surface and another in subgrade soil.
Potholes		A Pothole is a bowl-shaped depression in the pavement surface that penetrates through multiple layers down to the base course. Potholes are generally the end result of cracks, including those listed above. Potholes are more prone to occur on roads with thin asphalt concrete surfaces. Potholes cause roughness and moisture infiltration, cause severe damage to the roads and vehicles (1).

Objective

This paper aims to understand asphalt concrete patching materials and find effective patching techniques to achieve improvement. This report develops a simple review of the critical factors of different destresses. This topic was chosen because states spend over 25 million Dollars on pothole patching itself. That is a significant amount of money for patching our highways, roads, and streets. Knowing this information could make one view asphalt pavements differently and help develop more proper techniques. The different techniques should be understood during the design process, and more time should be spent on construction to perform the proper technique needed for the type of distress/pothole.

Patching

The main reason patching is needed in asphalt pavement is to solve different distress visible at the pavement's surface. Pavement distresses can be hazardous and cause serious problems, especially severe weather conditions. Weather overpowers asphalt pavement and causes the asphalt pavement to break up. Thermal cracking and rutting are an example of weather overpowering the asphalt pavement. When the distress starts, it is best to start fixing the pavement to avoid issues at a bigger scale, like dangerous potholes causing vehicle damage. Over time asphalt pavement naturally becomes distressed and loses the load capacity; patching is done to avoid this. Poor design, like designed too thin for the load needed and poor construction (lack of compaction), is another cause of asphalt pavement distress leading to patching. Overall, we see many different reasons specific patching techniques need to occur (1).

Patching Materials

There are a couple of patching materials that are used for different reasons. There is a wide range, and they all fall into different categories. Permanent patching depends on the type of pavement, the type of patching, and how it should cure. However, for asphalt pavement patching, Hot mix asphalt (HMA) is the number one patching material used for semi-permanent patching. Other materials states have started using, like spray injection patching. Spray injection patching is typically used in the winter when HMA is unavailable. Lastly, cold asphalt mix is usually used for smaller potholes. More details are listed in Table 2 (1, 4).

Table 2. Patching Materials (1, 4)

PATCHING MATERIALS	DESCRIPTION
Cold Mix	Cold mix is the most common asphalt type that usually everyone thinks. Cold mix is when aggregate is produced in a pugmill before transporting to a job site. The cold mix does not require heat for application, which could be laid down during colder temperatures. Cold mix asphalt is used for minor asphalt patching, including small cracks and temporary patching.
Hot Mix Asphalt (HMA)	HMA is stronger and durable asphalt concrete. It is a mixture of asphalt binder, well-graded and high-quality aggregate. HMA is usually used for larger projects, including highways and parking lots. HMA is heated up to 350°C before being shipped to the job site. Hot mix is a more permanent patching material.
Spray Injection Materials	Spray injection is made of crushed aggregate and emulsified asphalt. When spray injection material is delivered to the job site, Aggregate and emulsions are mixed and then sprayed to cracks.

Patching Techniques

Patching techniques vary depending on the type of patching. The strategies depend upon the severity and extent of the stress. Some repairs may eliminate or reduce the asphalt stress on the pavement surface but may not correct the underlying problem. Different techniques include standard techniques like the throw and go/throw and roll method and permeant techniques. A list of the techniques and equipment is listed in Table 3 (2).

Table 3. Patching Techniques (2)

TECHNIQUES		EQUIPMENT	SUMMARY
Throw and Go/Throw and Roll		Truck, Hand Tools, and Shovel	They are used for temporary pothole repair. HMA or cold mix is placed into a pothole. A truck tire compacts the material until a crown is formed. Traffic opens immediately.
Edge Seal		Truck, Hand tools, Shovel, and Tamper	Similar to throw and go/throw. HMA or cold mix is applied to a pothole. A truck tire compaction and a slight crown are verified. One day is allowed for drying the patching area. A layer of cover sand is placed to avoid tracking.
Semipermanent		Truck, Hand tools, Compaction Device, Air Compressor, Straightening Device	Water and debris are removed from the pothole. The pothole is cut using a saw to square up the area. Patching material is applied and mounded in the center of the hole and then tapered. Then is compacted using vibratory compaction equipment.
Spray Injection		Spray Injection Device	Most cost-effective patching technique. Water and dirt are removed from the pothole, a tack coat of binder is then sprayed on the sides and bottom of the hole. Asphalt and aggregate are then sprayed into the target area. Lastly, a layer of cover aggregate is placed.
Permanent Patching		Truck, Hand tools, Compaction Device, Air Compressor, Straightening Device	For larger potholes, the pothole area is cut with a saw cut. Surfacing materials are excavated down to a stable base. A tack coat is applied to vertical faces, and a prime coat is applied to the base of the hole. Asphalt mixture is filled into the hole, and vibratory or roller compaction is done at the end.

Conclusion

In general, this report focuses on understanding patching materials and techniques. Understanding and studying different techniques could help have more permanent repairs vs. repairing pavements multiple times. The report indicates the repair materials and equipment types like cold/hot mix patching and spray injection patching. As well as techniques like edge seal and throw and go/throw and roll. Avoiding multiple repairs is the objective of understanding asphalt concrete patching materials and effective patching techniques.

References

(1) NCHRP synthesis 463 - pure.ulster.ac.uk. (n.d.). Retrieved November 30, 2021, from https://pure.ulster.ac.uk/ws/portalfiles/portal/11446172/nchrp_syn_463.pdf.

(2) pavement interactive. Pavement Interactive. (n.d.). Retrieved November 30, 2021, from https://pavementinteractive.org/reference-desk/pavement-management/pavement-distresses/.

(3) Ramez Hajj, PhD Yujia Lu. (n.d.). Current and Future Best Practices for Pothole Repair in Illinois. Retrieved February 2021.

(4) Evaluation of Pothole Patching Materials - home - Rutgers Cait. (n.d.). Retrieved November 30, 2021, from https://cait.rutgers.edu/wp-content/uploads/2018/05/fhwa-nj-2001-002.pdf.

(5) CIP 42- thermal cracking of concrete - NRMCA. Thermal Cracking. (n.d.). Retrieved December 14, 2021, from https://www.nrmca.org/wp-content/uploads/2020/04/42p.pdf.