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Asphalt Pavement and Problems

Prepared by: Civil Engineer

Farman Mohamad Faeq

What is Asphalt Pavement?

Before we begin discussing the ins and outs of seal coating, we should first discuss the basics of asphalt pavement and why one would want to apply sealer to its surface. Like any good craftsman, it is important we have a good grasp of the materials...

Asphalt pavement is known for its durability and resilience. It is this strength which makes asphalt pavement the best option for most all paved surfaces. Most state and federal governments highly prefer asphalt pavement because of its reliability and lasting life. If it is properly laid, it need not be replaced for twenty to twenty five years. Asphalt pavement is also the most popular choice for applications such as driveways, parking lots, roadways, airstrips and more. Asphalt is everywhere. Asphalt is also the most commonly recycled material in the United States—before paper or plastic! Approximately ٨٠% of all asphalt pavements is recycled when it is removed. Without question, if you are looking for lasting pavement for these applications, and one that can be used over and over again, asphalt pavement is the best choice.

What makes up asphalt pavement?

Asphalt pavement is made up of stone (aggregate), sand, additives and liquid (petroleum) asphalt. Liquid asphalt – a sticky black substance – is used as the binding material in asphalt pavements. It is viscous in nature and can also be found in semi solid forms. Another common term for asphalt is bitumen.

The pavement – once mixed – consists of ٩٠ to ٩٥% aggregate and sand, and ٥ to ١٠% asphalt or bitumen. Asphalt pavements high viscosity binds the materials that make up asphalt, while allowing it to simultaneously retain flexibility. The cooler the asphalt surface the less flexible the overall pavement. This flexibility found in asphalt pavement is one of its greatest strengths, allowing the surface to adapt to changing conditions produced by weather and the constantly changing surface beneath it. Another chief characteristic of asphalt is its ability to repel water. This is important because water, as we will see, is the greatest enemy of the asphalt surface. It is also the reason why asphalt contractors such as yourself are in business.

How is asphalt created?

The first step in creating asphalt pavement is called Predose. Here, depending on the asphalt formula, the aggregate components of asphalt pavement are weighed using a belt weighing instrument. A belt weigher is used so that the materials can simultaneously be weighed and taken to the next step in the process.

Step two involves drying of the aggregate components. A rotary drying drum is used to dry the components at roughly ٣٠٠ degrees. After drying the aggregate it is reweighed as drying can alter its weight. The preheated or dried components are now sifted and store in silos.

Next, the aggregates are transferred to the mixer. The binding element, or liquid asphalt, is kept in separate heated tanks so that it remains liquid suitable for mixing. Once the aggregate is in the mixer, the asphalt is added to the mixer according to a measured rate of flow. Both aggregate and binder are mixed thoroughly to form the paving material.

After the hot asphalt mix is created it is stored in a heated silo. Most asphalt plants have several chambers to store different recipes. The asphalt is stored and kept hot until it is transported by dump trucks to the job site. From the time the asphalt leaves the plant and throughout the paving process a high temperature has to be maintained. If the asphalt mix cools it cannot be compacted.

Asphalt Paving and Surface Preparation

It should be noted that before the asphalt pavement is applied, there is a great deal of preparation that occurs. In fact, unless the asphalt is being laid over existing asphalt (overlay), it is the preparation of the ground beneath the pavement that is the most important factor in the life of an asphalt pavement surface. Proper clearing, excavation, ground compaction and base materials require a great deal of expertise. Base materials can be compacted stone and/or an asphalt base with its own unique recipe. Regardless, without proper groundwork the life of the paved surface is greatly reduced.

Before the asphalt pavement can be applied to the surface (especially if it be an existing asphalt surface) it should first be prepared by spraying a thin coat of liquid asphalt binder (hot tack) using an asphalt distributor. This helps the newly paved surface create a greater bond between it and the surface beneath it.

Once the mix reaches the construction site, it is laid using an asphalt paver and compacted using asphalt rollers. Outside of laying the asphalt properly, the final quality of the asphalt pavement relies heavily on the quality of the asphalt mix and its compaction. Proper rolling methods have to be used to ensure proper compaction.

Once the asphalt mix is compacted on the driveway, it should be left for solidifying. A minimum of ٢٤ hours is required for the asphalt mix to solidify before it can be used. If enough time is not allowed for solidification, then it will result in poor a quality pavement. The asphalt mix should be well compacted using the right weight rollers depending on the thickness of the driveway.

Once the asphalt paving is complete it is left to the elements of time and weather. Over time, with the constant influence of rain, snow, heat, cold and the rest, the asphalt pavement and surface beneath it will begin to slowly degrade and breakdown. Asphalt maintenance – including crack sealing, pothole patching and seal coating – can all be used to protect and extend the life of the already long life cycle of asphalt pavement. Asphalt seal coating is not only a means of maintaining old asphalt, but can also be used early in the life cycle of asphalt pavements to protect and greatly extend its life.

With so much asphalt in the world, asphalt seal coating and pavement maintenance are BIG business. Stick around for our next chapter where we'll learn what causes asphalt pavement to destabilize and deteriorate, how to diagnose the cause, and how to prescribe the cure!

Other issues that need treatment before maintenance:

Oil Spots - oil spots are a common problem in parking lots and driveways. These areas must be treated before seal coating or the oil and chemicals will seep up through the newly applied material and render your sealed surface ineffective. There are number of great products for treating these types of issues. Ask your material supplier what they offer.

Grass - Poorly maintained parking lots will often have grass growing up through the cracks. Cleaning the cracks should be standard practice before sealing them. Use a heat lance to burn out the crack and/or blow out the cracks depending on the severity of the problem.

Mud, tree sap, berry stains, etc - Anything that would sit between the asphalt and the sealer must be removed. Without removing it the sealer cannot properly adhere to the asphalt and will eventually (sooner than later most likely) peel off. Blowers, push brooms, pressure washers, and gas powered brooms are all tools you should have in your pavement maintenance arsenal.

The Deterioration of Asphalt Pavement and its Causes

Asphalt pavement is known for its durability and resilience. Its strengths make it a highly used material for many pavement applications and the preferred material for most state and federal road projects. Like all paved surfaces however, it too is susceptible to deterioration due to the laws of mother nature. Despite the great longevity of a properly laid asphalt pavement, it can be cut short due to poor surface preparation and construction technique or simply long term exposure to the elements.

Let's take a closer look at what causes deterioration.

Deterioration of constructed asphalt pavement is natural. It's natural because over time the materials that make up asphalt begin to break down and become affected by elements such as rain, sunlight and chemicals that come into contact with the pavement surface. The liquid asphalt binder that is the "glue" of the pavement begins to lose it's natural resistance to water, allowing it to penetrate into and underneath the pavement. Once this happens, the surface can quickly fall prey to a number of different types of deterioration.

Deterioration of asphalt pavements can also be due to factors that go beyond just normal wear and tear causing premature deterioration. The premature deterioration of asphalt pavement is usually due to failures in construction – or human error. This can be due to a number of factors including:

- Insufficient or improperly compacted base below the asphalt.
- Over or under compaction of asphalt.
- Improper temperature of asphalt when applied.
- Poor drainage.

When asphalt pavement is constructed and maintained properly it wears out slowly and can last up to ٢٥ years or more. Proper maintenance is key to protecting it from the external factors that wear it out.

Factors that cause deterioration in pavement include.

Water - over time and especially without proper maintenance water penetrates the asphalt, washes out the base underneath it, causing it to crack, break down and collapse.

Sunlight - Oxidation breaks down and dries out the once flexible liquid asphalt that holds the aggregate together. This causes raveling and shrinking cracks which allow water to penetrate beneath the surface.

Chemical / petroleum exposure - the introduction of chemicals to asphalt, including gas and oil, can soften the asphalt and cause it to break down more rapidly.

The truth is no asphalt is exempt from deterioration no matter how well it is constructed. Asphalt deterioration begins immediately. Even in normal conditions substantial deterioration can begin to take place after ٣ to ٥ years. It is normal after this amount of time for asphalt to begin to turn gray, become brittle and start cracking. Water begins entering the cracks, freezes and thaws during the yearly cycle and causes larger cracks and potholes. Rain enters the cracks and causes base damage. These all contribute to a worn out asphalt pavement and must be stopped before it's too late.

Below is a list of the different types of asphalt deterioration caused by the preceding factors:

Cracking - There are many different types of cracking that can occur, and believe it or not they all have names. They include: edge cracks, slippage (caused by improper compaction), reflection (older cracks occurring in a new overlay), edge joint, shrinkage and widening.

Distortion - Caused by improper pavement construction, deterioration of the underlying base or existing asphalt and high load factors, asphalt distortions include: channels or ruts, corrugations and shoving, grade depressions, upheaval and utility cut depressions.

Disintegration - Types of asphalt disintegration includes potholes, raveling, gas and oil spillage.

Just as you paint a new house to protect it from the elements, asphalt must also be protected to maximize its lifespan. Sealing the pavement with a quality asphalt or coal tar based sealant is the best way to protect this valuable investment. In fact, it is recommended that new asphalt be sealed within ٦٠ to ٩٠ days of the application (after it has cured, hardened) to begin protecting it from the elements.

Just as surface preparation is critical to constructing a sound asphalt pavement, so to is surface preparation critical for a successful sealcoat job. In our next article we will discuss preparing the existing asphalt in preparation for seal coating. After all, a good seal coating job is ٩٥% surface preparation.

١٣ Pavement Defects and Failures You Should Know!

With all the snow and ice over the last week on the east coast I thought it would be an appropriate time to look at some of the identifiable ways asphalt is adversely affected by weather – and other conditions. After all, correctly identifying pavement problems and their causes is at the heart of our business. Below we have identified and pictured ١٣ specific distresses/failures any pavement contractor should be able to identify.

(١) Alligator Cracking

Alligator cracking is a load associated structural failure. The failure can be due to weakness in the surface, base or sub grade; a surface or base that is too thin; poor drainage or the combination of all three. It often starts in the wheel path as longitudinal cracking and ends up as alligator cracking after severe distress.

FIX: Because a structural failure is taking place the only possible solution to alligatoring is to perform a full-depth patch.

(٢) Lock Cracking

Block cracks look like large interconnected rectangles (roughly). Block cracking is not load-associated, but generally caused by shrinkage of the asphalt pavement due to an inability of asphalt binder to expand and contract with temperature cycles. This can be because the mix was mixed and placed too dry; Fine aggregate mix with low penetration asphalt & absorptive aggregates; poor choice of asphalt binder in the mix design; or aging dried out asphalt.

FIX: Less severe cracks measuring ١/٢ inch or less can be sealed to prevent moisture from entering into the sub grade. More severe cracks should be fixed by removing the cracked pavement layer and replacing it with an overlay.

(٣) Longitudinal (Linear) Cracking

Longitudinal cracking are cracks that are parallel to the pavements centerline or lay down direction. These can be a result of both pavement fatigue, reflective cracking, and/or poor joint construction. Joints are generally the least dense areas of a pavement.

FIX: Less severe cracks measuring ١/٢ inch or less can be sealed to prevent moisture from entering into the sub grade. More severe cracks should be fixed by removing the cracked pavement layer and replacing it with an overlay.

(٤) Transverse Cracking

Transverse cracks are single cracks perpendicular to the pavement's centerline or lay down direction. Transverse cracks can be caused by reflective cracks from an underlying layer, daily temperature cycles, and poor construction due to improper operation of the paver.

FIX: Less severe cracks measuring ١/٢ inch or less can be sealed to prevent moisture from entering into the sub grade. More severe cracks should be fixed by removing the cracked pavement layer and replacing it with an overlay.

(°) Edge Cracks

Edge Cracks travel along the inside edge of a pavement surface within one or two feet. The most common cause for this type of crack is poor drainage conditions and lack of support at the pavement edge. As a result underlying base materials settle and become weakened. Heavy vegetation along the pavement edge and heavy traffic can also be the instigator of edge cracking.

FIX: The first step-in correcting the problem is to remove any existing vegetation close to the edge of the pavement and fix any drainage problems. Crack seal/fill the cracks to prevent further deterioration or remove and reconstruct to full depth fixing any support issues.

(٦) Joint Reflection Cracks

These are cracks in a flexible pavement overlay of a rigid pavement (i.e., asphalt over concrete). They occur directly over the underlying rigid pavement joints. Joint reflection cracking does not include reflection cracks that occur away from an underlying joint or from any other type of base (e.g., cement or lime stabilized).

FIX: For less severe cracks (less than ١/٢ inch) crack sealing will prevent the further entry of moisture into the sub grade. If the cracks are more severe the removal of the cracked pavement layer followed by an overlay may be required.

(٧) Slippage Cracks

Slippage cracks are crescent-shaped cracks or tears in the surface layer(s) of asphalt where the new material has slipped over the underlying course. This problem is caused by a lack of bonding between layers. This is often because a tack coat was not used to develop a bond between the asphalt layers or because a prime coat was not used to bond the asphalt to the underlying stone base course. The lack of bond can be also caused by dirt, oil, or other contaminants preventing adhesion between the layers.

FIX: All of the areas exhibiting the “stretch marks” will need to be removed and will require a partial or full depth patch.

(^) Pot Holes

Small, bowl-shaped depressions in the pavement surface that penetrate all the way through the asphalt layer down to the base course. They generally have sharp edges and vertical sides near the top of the hole. Potholes are the result of moisture infiltration and usually the end result of untreated alligator cracking. As alligator cracking becomes severe, the interconnected cracks create small chunks of pavement, which can be dislodged as vehicles drive over them. The remaining hole after the pavement chunk is dislodged is called a pothole.

FIX: Full depth replacement patch

(٩) Depressions (bird baths)

Depressions are localized pavement surface areas with slightly lower elevations than the surrounding pavement. Depressions are very noticeable after a rain when they fill with water.

FIX: Depending on the severity of the depression the asphalt may have to be removed and replaced (severe). Less severe depressions can be fixed by applying a thin surface patch or infrared patch.

(١٠) Rutting

Ruts in asphalt pavements are channelized depressions in the wheel-tracks. Rutting results from consolidation or lateral movement of any of the pavement layers or the sub grade under traffic. It is caused by insufficient pavement thickness; lack of compaction of the asphalt, stone base or soil; weak asphalt mixes; or moisture infiltration.

FIX: If rutting is minor or if it has stabilized, the depressions can be filled and overlaid. If the deformations are severe, the rutted area should be removed and replaced with suitable material.

(١١) Shoving

Shoving is the formation of ripples across a pavement. This characteristic shape is why this type of distress is sometimes called wash-boarding. Shoving occurs at locations having severe horizontal stresses, such as intersections. It is typically caused by: excess asphalt; too much fine aggregate; rounded aggregate; too soft an asphalt; or a weak granular base.

FIX: Partial or full depth patch

(١٢) Upheaval

Upheaval is a localized upward movement in a pavement due to swelling of the sub grade. This can be due to expansive soils that swell due to moisture or frost heave (ice under the pavement).

FIX: Full depth patch

(١٣) Raveling (very porous asphalt)

Raveling is the on-going separation of aggregate particles in a pavement from the surface downward or from the edges inward. Usually, the fine aggregate wears away first and then leaves little "pock marks" on the pavement surface. As the erosion continues, larger and larger particles are broken free and the pavement soon has the rough and jagged appearance typical of surface erosion.

There are many reasons why raveling can occur, but one common cause is placing asphalt too late in the season. This is because the mixture usually lacks warm weather traffic which reduces pavement surface voids, further densification, and kneading of the asphalt mat. For this reason raveling is more common in the more northern regions (Snow Belt).

FIX: Apply a thin hot-mix overlay. Other solutions could include: sand seal, chip seal, slurry seal or micro-surfacing.