Pavement Recycling – Saving our Natural Resources and Money Too!

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It is a well-known fact that pavements are very expensive to rebuild. Unfortunately, asphalt pavements deteriorate relatively quickly when compared to other types of infrastructure. This is why the T2 Center strongly urges local agencies to implement an aggressive preventative maintenance program that focuses on preservation. However, even when pro-active maintenance programs are implemented, all pavements will still require reconstruction at some point in time. Also, structural improvements are necessary for pavements that were poorly designed or constructed, or are carrying much more traffic today than was initially planned because of increased growth. Since it is very expensive to structurally rehabilitate roads, local agencies MUST consider all possible alternatives to ensure that the limited tax dollars are invested wisely. One possible approach to structurally rehabilitating roadways that can provide a cost-effective solution is pavement recycling. This article will discuss two common types of asphalt pavement recycling: cold in-place recycling and full depth reclamation.

Before Recycling

After Recycling

These recycling techniques are used to rehabilitate the surface and base courses of a structurally failed pavement. In these processes, existing pavement materials are uniformly pulverized and blended with a stabilizing agent to produce a new, stronger base course that is free of distresses. The Asphalt Recycling and Reclaiming Association (ARRA) defines cold in-place recycling (CIR) as a partial depth recycling process that rehabilitates the upper portion of an existing pavement. CIR is only used to stabilize hot mix asphalt and aggregate materials. It is not used to stabilize the supporting soil material below the pavement. If the supporting soil requires stabilization, full depth reclamation is typically

used. ARRA defines full depth reclamation as a full depth recycling process where the entire pavement and a pre-determined portion of the supporting soil below the pavement (subgrade). More in-depth guidelines for when to use each process and when to use the different types of stabilizing agents will be discussed in Part 2.

Cold In-Place Recycling Process

This process starts with a specialized milling machine where a down cutting head grinds up the old pavement to a controlled depth, usually 3 to 5 inches. The milled material is mixed with a stabilizing agent in a mixing chamber. A computerized device on the milling machine can adjust the amount of emulsified asphalt cement depending upon the depth and type of material being milled. The revitalized material is placed back down on the roadway as a new base course using a standard hot-mix asphalt paver. When the recycled material is initially placed down back down, it is in a fluffy state due to the high air void content. Therefore, a steel-wheeled (minimum 12-ton) roller is used for initial compaction in order to remove the "fluff." Next, the new base is rolled with a heavy (minimum 25-ton) pneumatic-tired roller that is used to achieve the desired level of compaction necessary for long term performance.

When paving with hot-mix asphalt concrete, the mixture must be compacted quickly to assure that the proper density has been achieved before it has cooled off. With CIR, this is not a problem. Since the emulsified asphalt used to stabilize the milled pavement material contains water, the mixture must be allowed to cure. If the rolling starts too soon, the excess moisture will hinder the compaction process because the voids are overfilled. Also, prematurely sealing the surface will retard the initial curing process.

a) Pre-Milling around Utilities

b) In-place Recycling

c) Paving with Hot-Mix Paver **d) Compaction w/ Pneumatic-Tired Roller**

Full Depth Reclamation

Full depth reclamation (FDR) is a technique used to stabilize the entire flexible pavement section and a predetermined portion of the underlying soil (subgrade). In general, the FDR process is similar to CIR. However, there are a few differences that will be discussed briefly. First, as stated above, FDR is a full depth reclaiming process used to stabilize the entire flexible pavement section and a predetermined portion of the underlying material. Typically, the depth of milling ranges from 6 and 16 inches. Second, there are many possible stabilizing agents including emulsified asphalt, expanded asphalt, portland cement, hydrated lime, fly ash and calcium chloride. The type of soil to be stabilized will dictate which type of stabilizing agent should be used. Laboratory testing is necessary to determine which type is most effective for the specific situation. The third major difference is that a paving machine is not used. After being mixed with the stabilizing agent, the reclaimed material is placed back down on top of the milled surface. A motor grader is then used to achieve proper cross-slope and profile.

a) Reclaiming Machine b) Grading with Motor Grader

c) Compaction w/ Pneumatic-Tired Roller **d) Compacted Stabilized Base Course**

Pavement Surface

Due to the high air void content in the recycled or reclaimed base course, the surface must be sealed prior before freezing temperatures set in. The period of time necessary to ensure adequate curing varies depending upon such factors as the depth of the base course, the type of stabilizing agent and the time of year (environmental factors). Typically, the surface remains uncovered for 7 to 14 days. This does not case a problem for the traveling public since traffic can drive on the completed base course during the curing period.

The surface covering can range from a thin surface treatment such as a chip seal or micro-surfacing for low volume roads to a thick overlay for high volume roads. A common practice is to use a thin overlay (1 1/2 to 2 inches thick). To ensure that the agency is constructing the most cost-effective road possible, it is strongly recommended that a pavement analysis and design be performed.

Advantages of CIR/FDR

The benefits of CIR and FDR are similar:

1. Cost Savings

Since these techniques utilize existing materials, the major cost is labor and machinery. Therefore, in most situations where these techniques are applicable, the cost savings can range from 20 to 40 percent or more. Some of the factors that will affect the cost of a project are the size of the project, amount of reprofiling, removing or adding materials (if necessary), amount of preparation work and type of stabilizing agent.

2. Environmentally Friendly

These processes reuse the existing aggregates and asphalt cement in the roadway, thereby saving our natural resources. Land filling or hauling of new or old materials is normally not required. Also, since these are cold processes, no fuel is burned to heat the new materials.

3. Loss of Curb Reveal Reduced or Eliminated

In comparison to the patching and thick overlay option, these techniques can maintain curb reveal by removing some of the existing material in an initial pass of a small milling machine. Subsequent passes of the large milling machine will redistribute the remaining material. This will lower the top of the finished base course and maintain curb reveal.

4. Profile and Cross-slope Restored

Bumps and dips can be removed from a road by redistributing milled material. Also, material can either be added or removed. Also, the cross-slope can be modified to improve drainage or other safety problems.

5. Recycling/Reclaiming is Faster

These processes can be 30 or 40 percent quicker than typical reconstruction where the existing road can be removed and a new road built. Also, only one lane needs to be closed at a time and can be driven on immediately after compaction, thus reducing traffic problems in the construction zone.

6. Restoration of Existing Pavement Conditions

Recycling or reclaiming can be used to rehabilitate most types of pavement distress. This includes cracked pavements, fatigue cracks, transverse cracks, reflection cracks, potholes and raveling. Pavements that have rutting or high asphalt contents present may be restored through these processes, but may require additional additives to stabilize the materials.

Specifications

As a result of the recycling and reclaiming processes reusing the existing in-place materials, there can be more variability in material properties than when using standard materials that are produced in a plant. In order to minimize an agency's financial risk in the rare case that there is a premature failure, it is recommended that agencies require the contractor to warranty the base course from defects for a specified period of time (the T2 Center suggests a 5-year warranty period).

Someone knowledgeable in these processes must carefully prepare the warranty specification. The specifications should provide basic requirements such as excluding all

equipment not capable of properly performing the work, defining acceptable weather conditions, requiring pavement cores and lab testing, providing traffic control, profile and cross-section requirements, and requiring that all material be properly milled – including material around all obstructions. Also, the warranty specifications must carefully spell out what constitutes a failure in the recycled or reclaimed base course and how the failure is to be repaired. However, the specifications must not contain any requirements that could possibly prevent the contractor from providing a base course that is capable of meeting the warranty's performance requirements. When a warranty specification is used, a proper pavement design is necessary to ensure that the pavement structure is structurally adequate to handle the anticipated traffic loads.

For more information about CIPR or FDR or want the Kercher Engineering to make a field visit to assist in the evaluation of reconstruction alternatives, please call us at your earliest convenience.