

JOINT TRANSPORTATION RESEARCH PROGRAM

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Use of Recycled Asphalt

Introduction

The term Reclaimed Asphalt Pavement (RAP) is used to designate those materials that are obtained from the removal of and/or the process of pavement materials. Asphalt pavement can be removed by milling, which usually excavates the top 2 inches of the pavement, or by full removal of the entire pavement. The material is transported to a facility for processing, which typically consists of further crushing, screening, and storing. If properly treated, RAP may consist of well-graded aggregates coated with a bituminous asphalt (FHWA, 97). In fact, a large part of RAP is made up of mineral aggregate (93% to 97% by weight) and the rest is made up of hardened asphalt cement (3%–7%). The properties of reclaimed asphalt strongly depend on the type of aggregate and bitumen used for the pavement and on the reclamation, processing, and storage operations. There

is an opportunity to use more reclaimed asphalt in asphalt mixes and to find additional methods to utilize the reclaimed asphalt in highway fill sections. One of the deterrents for the employment of RAP in the past was reaching a minimum comfort level with the compaction necessary for the use of reclaimed asphalt in construction fill sections. Before using RAP in pavement—other than in asphalt layers, fills, and in confined areas—concerns regarding the granulometry of the reclaimed asphalt, the compaction and the long-term behavior and environmental impact (e.g., contamination and toxicity), if any, need to be addressed. Also, there could be advantages of using RAP mixed with other materials, e.g., gravel or crushed stone or chemically treated.

Findings

The literature is rich with reports describing the use of RAP. An in-depth review of the technical specifications of eight states, including Indiana, shows that RAP can be potentially used in fills, in pavement layers, and even in structural fills such as backfill in retaining structures. The following provides a summary of the most important findings.

1. RAP can be described as a uniform, non-plastic, granular material with a very low percentage of fines. It is formed by aggregate coated with a thin layer of asphalt and is often used mixed with other granular materials.
2. The addition of RAP to other aggregates decreases the maximum dry unit weight of the mixture and decreases the optimum water content. Those effects increase as the percentage of RAP in the mixture increases.
3. RAP also increases the Resilient Modulus of the blended aggregate but decreases permeability.
4. RAP can be used safely, as it does not pose any environmental concerns. The use of RAP falls in



RAP specimens at various levels of processing.

- line with EPA recommendations and limitations.
5. Economically, the use of RAP is advantageous as it can replace natural aggregate and is a more sustainable practice than using virgin aggregate.
 6. The most important disadvantage of RAP is that it displays significant creep. It seems that this is caused by the presence of the asphaltic layer coating the aggregate. Creep increases with pressure and with temperature and decreases with compaction. Creep can be mitigated by either blending RAP with aggregate or by stabilization with chemical compounds. Fly ash and cement have shown to decrease, albeit not eliminate, the amount of creep. Mechanical stabilizing agents such as geotextiles may also be used.
 7. While there is a financial benefit upfront in using RAP over the more expensive virgin materials, the savings can be easily offset by the need of frequent rehabilitation of the pavement due to its faster deterioration because of the creep deformations induced by RAP. Such rehabilitation work will incur additional costs that are taken by the users, because of traffic disruption.
 8. RAP requires proper transport and storage to prevent segregation and excessive moisture during storage.

Implementation

The following recommendations for implementation are provided.

- The use of RAP in pavement layers, either alone or blended with other materials, is not

recommended due to the large potential for creep, which will have a detrimental effect on the life of the pavement. RAP could be considered for use in pavements for low traffic roads, temporary roads, or for non-traffic bearing pavements such as shoulders.

- RAP may be used in embankment construction. The recycled material should meet the requirements of B borrow and have a particle size smaller than 2 in. in all directions. When used with other materials in one single embankment, the RAP should be separated from the other material(s) with a geotextile.
- It is recommended that the compacted lift thickness of RAP materials should not be greater than 6 in. RAP may be placed only below the pavement underdrains.
- A minimum 24-in. soil encasement, suitable for vegetation growth, is recommended when using RAP in the embankment

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