

PAVEMENT RECYCLING : AN OVERVIEW

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INTRODUCTION

According to a report published by the Federal Highway Administration (1997), in the United States of America, asphalt pavement is the most recycled product (in terms of tonnage) compared to others such as newsprint, glass bottles, aluminum cans and plastic containers. Figure 1 below shows the comparison of recycled asphalt pavement to other products [1]

Deteriorated asphalt pavements are presently more commonly recycled, instead of overlaying them with new asphaltic concrete material or reconstructing them (depending on the type and seriousness of the distress), because of the following reasons/advantages:

- Reduced cost of construction.
- Conservation of aggregate, binders and transport fuel (for new materials).
- Preservation of existing pavement geometrics.
- Preservation of environment.
- Help to reduce reliance on landfills by reusing existing materials instead of disposing them.

The purpose of this article is to provide an overview of pavement recycling methods, choosing the appropriate recycling method and finally information on recent recycling projects completed in Malaysia.

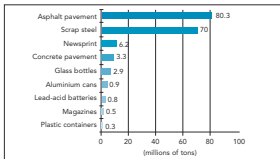


Figure 1: Comparison of Various Recycling Products (1)

TYPES OF PAVEMENT RECYCLING METHODS

A pavement which deteriorates gives poor riding quality, reduces vehicle traction due to lack of surface friction and increases vehicle user's maintenance costs. In addition, there will be excessive maintenance requirement on the road authorities when the distress is excessive and increasing traffic volumes will worsen the situation due to inadequate structural capacity of the pavement. Rehabilitation is needed to maintain the pavement at a certain desirable condition.

Pavement recycling can be combined with other preventive pavement maintenance treatments to provide a long lasting pavement that performs at a high level of serviceability. The Asphalt Recycling and Reclaiming Association (ARRA)

defines four different types of recycling method [2]

- (1) hot in-place recycling,
- (2) hot mix recycling,
- (3) cold in-place recycling, and
- (4) full depth reclamation.

Each of these methods are briefly explained as follows (including another method-Cold Mix Recycling (Central Plant) :



Figure 2: Drum Mix Plant for Hot Mix Recycling [2]



Figure 3: Hot In-Place Recycling [4]

Hot Mix Recycling (Plant Recycling)

In the hot mix recycling process, Reclaimed Asphalt Pavement (RAP) material (milled-off material from the existing pavement) is combined with new aggregate and on asphalt binder or recycling agent in a hot mix plant. The mix is transported to the paving site, placed and compacted.

The primary advantages of hot mix asphalt recycling are that significant structural improvements can be obtained with little or no change in thickness by improving the existing asphalt materials, performance of recycled mix is as good as conventional Hot Mix Asphalt (HMA) mix, and most surface deformation and cracking can be corrected by milling operations [2]

Hot In-Place Recycling (HIPR)

In the hot in-place recycling process, the existing asphalt surface is heated and scarified to a specified depth (usually 20 to 60mm). The scarified material is combined with aggregate and/or recycling agent. The mix is

then compacted. A new overlay may or may not be placed on the recycled mix.

The primary advantages of hot in-place recycling include elimination of surface cracks, filling of ruts and hole, leveling of shoves and bumps, re-establishment of drainage and crowns, and rejuvenation of aged asphalt. Also, by this method of recycling, aggregate gradation and asphalt content can be modified, traffic flow interruption and hauling cost are minimised [2]

Cold Mix Recycling

Cold mix recycling involves the removal of the pavement to a specified depth, ripping in-place, hauling the material to a central plant and further reduction in size by crushing, mixing the RAP with new binder and aggregate (if needed) without the application of heat, laydown, spreading and compaction. A wearing course over the cold recycled mix is then laid.

Cold mix recycling is used primarily to correct distress with base courses. It can also rectify pavement distress problems such as

reflection cracking, frictional resistance and improve ride quality without altering the geometry of the pavement [2]

Cold In-Place Recycling/Full Depth Reclamation

Cold in-place recycling is defined as a rehabilitation technique in which the existing pavement materials are reused in place along with the virgin material. The materials are mixed in-place without the application of heat. The single machine or single-pass equipment is capable of breaking, pulverising, and adding recycling agents in a single pass. Virgin aggregate, if required, can be spread on pavement surface, and included in the milling operation, and the recycling agent can be added in the milling chamber.

Cold in-place recycling can be performed in two ways: In partial depth recycling, 50-100mm of the asphalt layer is used to produce a base course. This is defined as cold in-place recycling. In full depth recycling, known as full depth reclamation, both asphalt and portions of unbound layers are crushed, mixed with binder, and placed as a stabilised base course.

The primary benefits of cold in-place recycling include significant structural improvement by improving the existing pavement materials, treatment of most types of pavement distress, and improvement of ride quality. Also, in this procedure, hauling cost is minimized, air quality problem (smoke or fumes) is minimised since no heat is applied, and widening of the existing pavement is possible [2]



Figure 4: Typical Cold Mix Recycling Plant [2]



Figure 5 Typical Cold In-Place Recycling Train

CHOICE OF RECYCLING METHOD

Recycling is one of the many alternatives available for rehabilitation of pavements. The particular choice of the rehabilitation technique should be based on engineering considerations and life cycle cost. The important engineering considerations should include present quality of pavement, type, extent, and severity of distress, the amount of traffic, and the

structural condition of the pavement. Economic considerations can be made by evaluating the cost of the pavement by any of the different methods such as present worth or equivalent uniform annual cost. The relative advantages and disadvantages of the different recycling alternatives should be considered before making a decision. Among other things, the merits and demerits should include considerations about economy,

removal of distress, effective quality control and traffic disruptions [2].

Hot in-place recycling is used to correct surface distress such as minor rutting, surface cracks and raveling. It can only be used where the road base is stable and the pavement structure has adequate structural capacity to withstand future traffic loadings.

Cold mix recycling (central plant) and cold in-place recycling/full depth reclamation can treat rutting in sub-surface layers; it is particularly suitable for roads with base problems or insufficient structural capacity. However, cold recycling requires a wearing course and may require a significant amount of curing time. Furthermore, there is a lack of proper guidelines for the method and experienced supervisors are needed for the project to be successful.

PAVEMENT RECYCLING PROJECTS IN MALAYSIA

Pavement recycling is relatively new in Malaysia. However, in the last few years, a number of recycling projects have been completed, particularly using the cold in-place recycling method. An example of a project using cold in-place recycling method using cement is the Federal Route 14 (km 99.5 - 105.0) Jalan Jerangau-Jabor. Cold in-place recycling using foamed bitumen has been used at Route 1581 (km 21 - km 35) Jalan Bukit Sagu - Cerul, Kuantan. Cold mix recycling (central plant) method has been applied for the rehabilitation of Federal Route 5 (Kapar - Sabak Bernam). Hot in-place recycling has been applied recently at Route 181 Jalan ke Pulau Indah, Kelang [3].

It is anticipated that more roads in the future are to be rehabilitated using recycling techniques in Malaysia rather than the conventional overlay method or mill and pave method.

CONCLUSIONS

The benefits of pavement recycling, types of recycling method and choice of particular recycling method have been discussed. Pavement rehabilitation (including the recycling method) rather than new road construction, is becoming more important as the country develops and its road network approaches maturity. As resources become scarcer and environmental concern becomes more widespread, it is anticipated that pavement recycling will become more important in the coming years. ■

REFERENCES

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