

Caltrans Surface Recycling

Technical Fact Sheet



What is surface recycling?

Surface or in-place recycling is the process of removing the top portion of an existing asphalt concrete pavement surface, reworking the material (reclaimed asphalt pavement, or RAP), and placing and compacting the reworked material back on the pavement. The process of reworking may include combining the RAP with stabilizing agent, recycling agent, new aggregates, or virgin HMA in order to restore or improve the pavement structure and/or surface condition.

Surface recycling can be done at ambient temperature (cold in-place recycling, or CIR) or at elevated temperature by heating the road surface (hot in-place recycling, or HIR).

When and where should they be used?

Surface recycling can be used for maintenance as well as for rehabilitation or reconstruction. The functional performance of pavements can be improved, since the top one to four inches are reworked and can correct such deficiencies as rutting, raveling, and surface cracking, thus improving the ride quality as well as structural integrity. Surface recycling is not recommended when the underlying pavement layers are structurally deficient.

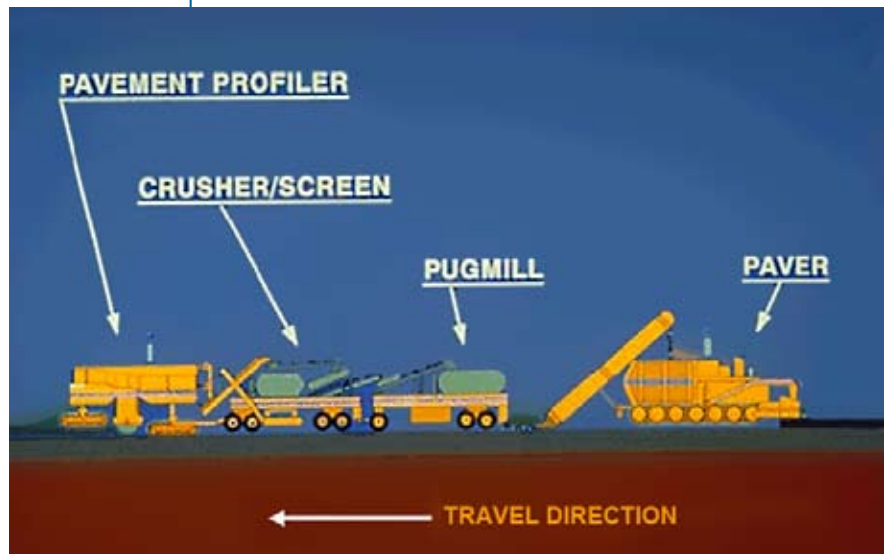
The **CIR process** is to recycle a portion of an existing asphalt concrete pavement by milling, sizing and mixing with additives such as an emulsified recycling

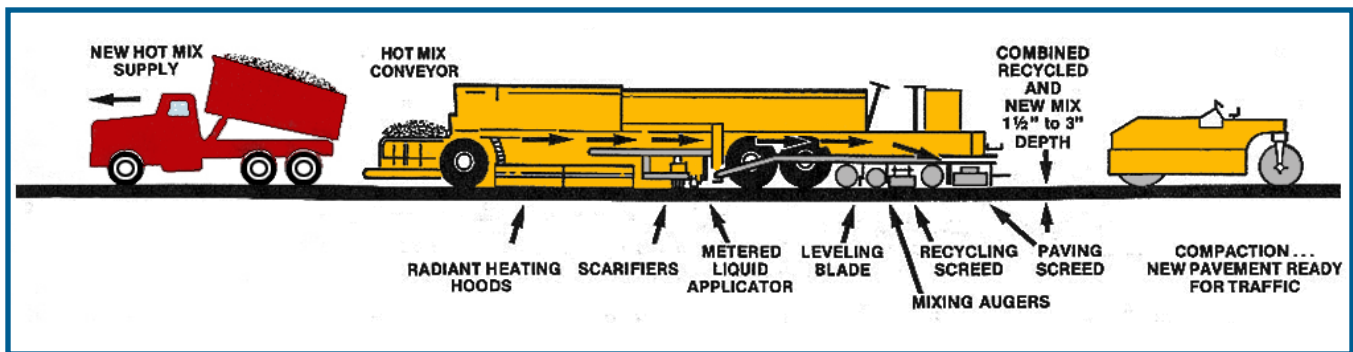
agent, asphalt foam and in some cases a very small percentage of cement or lime. The depth of milling typically does not include any unbound base material, although a small amount may be acceptable. The CIR process is most often used on secondary or low volume roads with a chip seal surface and highways with a thin HMA overlay. The steps in CIR include:

- Milling the existing asphalt layers to depth from 2 to 4 inches.
- Size the reclaimed material, mix with additives, and relay.
- If needed, add virgin material before relaying the recycled mix.
- The recycled pavement then receives a new overlay or seal coat.

The CIR construction may be performed with single or multi-unit equipment trains, and also typically requires warm, dry weather for optimum results.

Multi-Unit CIR Equipment Train





Single pass HIR repaving train

The **HIR process** is designed to soften the existing surface with heat, and mechanically loosen the material (RAP), mix the loosened material with recycling agent, aggregate, or virgin HMA, and relay the recycled material without removing it from the pavement site. The depth of milling typically does not extend beyond the existing asphalt concrete pavement, and no underlying unbound material is included. The HIR recycled pavement may be used as a new pavement surface without the need for overlay or seal coat. The steps in HIR include:

- Heating and milling of the asphalt layers to a depth from one to two inches.
- Size the RAP, mix with recycling additives, and relay.
- If needed, add virgin aggregates or HMA, before remixing, and relay.

The HIR process can be performed as either a single-pass operation that combines the restored pavement surface material with virgin material, or as a two-pass operation, in which the restored pavement surface material is re-compacted and the application of a new wearing surface follows at a later time. Three different processes are commonly used in HIR, including:

- Surface recycling (heater scarification)
- Repaving and remixing.
- Remixing.

Currently, Caltrans has a specification for only HIR remixing. A specification for repaving will be developed in the future. Air pollution concerns may preclude heater

scarification from being used in California. All of these methods are aimed at warming the surface of the existing asphalt concrete pavement and then restoring the damaged or worn surface to new-like condition.

Summary

Both CIR and HIR require the evaluation of the pavement condition prior to construction. Samples of the existing asphalt concrete pavement are required for testing the existing materials properties, and for use in performing a mix design to determine the proportion of RAP, additives, and other materials such as aggregate and new HMA to restore the pavement material to its desired properties.

Key references

- Caltrans, "Maintenance Technical Advisory Guide," Sacramento, CA, 2007
- Federal Highway Administration (FHWA), National Highway Institute, *Reference Manual, Module 2-5 In-Place Recycling*, FHWA-NHI-131050, Asphalt Pavement Technologies, 2003
- Asphalt Recycling and Reclaiming Association (ARRA) and Federal Highway Administration (FHWA), *Basic Asphalt Recycling Manual*. 2001.
- Kandhal, P.S. and R.B. Mallick, *Pavement Recycling Guidelines for State and Local Governments*, Participants Reference Book, Publication No. FHWA-SA-98-042, Federal Highway Administration, Washington, D.C., 1997.