Cold In Place Recycling and Full Depth Reclamation

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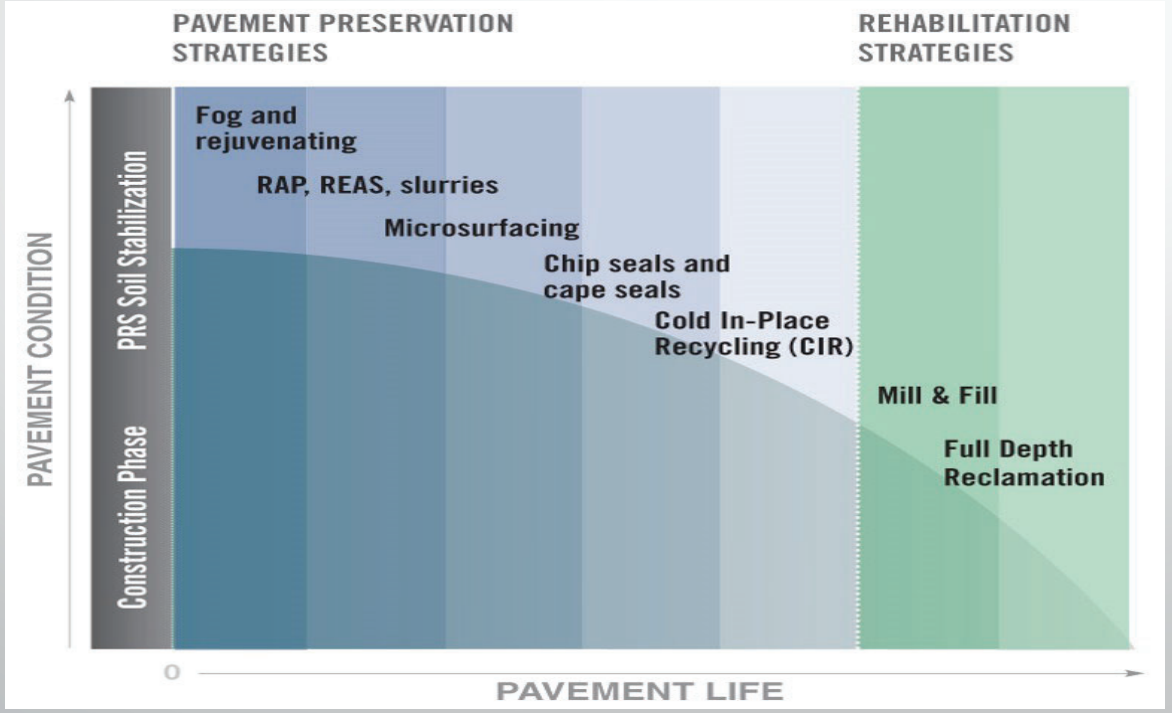
Today's Takeaway

Cold Recycling (CIR/CCPR) and Full Depth Reclamation (FDR) are proven processes that need to be part of every Pavement Manager's toolbox.

Where does CIR/FDR fit on Pavement Life Curve?



Cold In Place Recycling (CIR)

- CR is a pavement maintenance/rehabilitation technique that involves the processing and treatment of the existing asphalt pavement with a bituminous recycling agent (emulsified asphalt or foamed asphalt) and additives, as required, such as lime, cement, or corrective aggregate.
- Cold In-Place Recycling (CIR) is one subcategory – typically utilizing single and/or multi unit trains.
- Cold Central Plant Recycling (CCPR) is the second subcategory where RAP in existing stockpiles or milled from a roadway is processed in a central plant.

Evolution of the Process

- Process began in early ‘80’s.
- Thought to be a low volume road treatment only.
- Traditional emulsions and/or rejuvenators used.
- Traffic kept off the recycled material for period of time.
- No mix design utilized.
- In late ‘80’s/early 90’s, lime slurry and/or fly ash utilized.
- Late ‘90’s/early 2000’s, engineered emulsions as well as a mix design procedure begin to be used.
- Multi-unit, single unit trains utilized.

CIR Evolution (Continued)

- With the advent of engineered emulsions and a workable mix design method, the end quality of the recycled product continued to improve.
- With higher early strengths, the application of the process spread beyond low volume roads to higher volume roads as well as Interstate highways.
- Along with the improved end product, final surfacing was not limited to HMA. On lower volume roads it is now very common to see chip seals or microsurfacing applied to cold recycled material.
- Recent research has shown the layer coefficient for cold recycled material may well be much closer to HMA than originally thought.

CIR Evolution (Continued)

- NCAT and Auburn University's research has indicated a structural coefficient of 0.35 and perhaps higher as compared to 0.44 for HMA.
- Typical existing structural coefficients range for most Owners range from 0.28 – 0.32.
- This higher structural coefficient translates to even bigger potential cost savings for Owners meaning more miles of their system can be affected every year.

The Process - Multi Unit Train

The Process - Single Unit Train

Cold Central Plant Recycling

- CR is a pavement maintenance/rehabilitation technique that involves the processing and treatment of the existing asphalt pavement with a bituminous recycling agent (emulsified asphalt or foamed asphalt) and additives, as required, such as lime, cement, or corrective aggregate.
- Cold In-Place Recycling (CIR) is one subcategory – typically utilizing single unit trains.
- Cold Central Plant Recycling (CCPR) is the second subcategory where RAP in existing stockpiles or milled from a roadway is processed in a central plant.

CCPR Process

- RAP is stockpiled – either an existing stockpile or from an existing roadway.
- Existing rap is processed to a maximum size (typically 1”). The sized material is then mixed with specified additives – these additives can be an engineered emulsion or foamed asphalt along with a mineral binder such as cement or lime (typically 0.5-1.0% by weight of material).
- The mixed material can either be loaded directly into trucks or from a stockpile, hauled to the project site, deposited in a windrow or directly in the paver hopper, laid, and compacted.

CCPR – Emulsion or Foamed Asphalt

CCPR Materials

- Engineered emulsion – typically in the 2-3% by weight range of application.
- Cement – typically in the 0.5-0.75% by weight range.
- Foamed Asphalt – PG grade oil – mixed with water to create the foaming action to enhance coating. Haul length for oil can create issues – material needs to be 325-350 degrees at the plant.

CCPR Project Selection Criteria

- CCPR material can be used in 2 major areas –

  1 – The stockpiled rap can be processed, mixed, hauled, laid, and compacted as an overlay on an existing roadway. This overlay can then be capped with some type of surface treatment based on overall traffic volume, heavy truck volume, etc.

  2 – Material from an existing roadway can be removed, stockpiled, mixed, hauled back to the original roadway, laid, and compacted.
- Recent studies (NCAT, Virginia DOT) are indicating a higher layer coefficient than traditionally thought – 0.32-0.35 as opposed to 0.28-0.32 that many agencies use. This translates to additional cost savings utilizing these processes.

CIR and CCPR Laydown and Compaction - Both Processes Utilize Conventional Asphalt Paving Machines and Asphalt Compaction (Steel Wheel Vibratory/Static and Pneumatic (25 Ton plus)

Full Depth Reclamation

- An engineered pavement recycling process in which existing pavement and underlying base materials are incorporated into a structural pavement section through the pulverization and/or soil stabilization process.
- The pulverized material can be mixed with a variety of materials (cement, lime, emulsion, foamed asphalt) to create a stabilized base material.

FDR Process – Initial Pulverizing

FDR Process – After Initial Pulverizing - Spreading Cement

FDR Process – Mixing Cement

FDR Process – Mixing Foamed Asphalt

FDR Process - Grading and Compaction

FDR Process - Grading and Compaction

FDR Materials

- Cement

  - Has been used extensively in the West. Advantages – cost. Disadvantages – availability, danger of making the base too rigid, creating problems for surfacing material.

- Lime

  - Typically not used in FDR unless soils dictate the use of lime (high PI).

- Emulsion

  - Engineered emulsions provides good flexible base with higher early strength than conventional emulsions and is relatively easy to mix into pulverized material.

- Foamed Asphalt

  - PG grade asphalt is mixed with water to create a foaming action which provides improved coating of material. Advantages - better dispersion of material. Disadvantages - dependent on distance from oil supplier to job site/ keeping oil in correct temperature range for optimum mixing.

- Typically cement is specified in addition to emulsion or foamed asphalt – usually in the 0.5-1.0% by weight of material range.

Project Selection Criteria

- FDR is typically utilized if the existing roadway is past the point of pavement preservation or rehabilitation.
- Are there base or sub grade issues that won't be addressed by mill and fill, or overlay?
- Is the asphalt surfacing thickness too thin (less than 3") to accommodate the CIR process?
- Are there large rocks just below the existing asphalt section?
- Depth of treatment is typically 6-12" – beyond 12" deep, adequate compaction is more difficult to achieve.
- Do your homework! Don't remove and replace!

References

- NCAT studies on CIR, CCPR, and FDR
- Basic Asphalt Recycling Manual (BARM)
- Asphalt Recycling and Reclaiming Association
- State DOT reports on CIR (Washington, Montana)
- University research – UNR, Michigan State, Auburn University (NCAT)
- Road resource.org

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