

FULL DEPTH RECLAMATION

PROCESS DESIGN OVERVIEW

1 SCOPE

Full Depth Reclamation (FDR) is a rehabilitation process whereby the existing asphalt pavement and a predetermined portion of the underlying materials (base, subbase and/or subgrade) is pulverized and mixed into a homogeneous base material without the presence of heat during the recycling process.

The advantages of FDR are as follows:

- Conserve resources by reusing aggregates and asphalt in the existing pavement
- Energy conservation
- Pavement materials disposal reduced or eliminated
- Elimination of bumps, dips, cracks, rutting, potholes and patches.
- Subgrade deficiencies corrected.
- Structural improvements
- Improvement of crown or slope
- Pavement maintenance costs are reduced
- Economic savings

1.1 DEFINITIONS

Full Depth Reclamation:

Full depth reclamation (FDR) is a rehabilitation treatment consisting of pulverizing the existing pavement surface with a portion of the underlying material, mixing and blending this material into a homogeneous base material. This blended material can be further processed in different ways. There are three different types of stabilization that can be used;

- Mechanical
- Chemical
- Bituminous

Mechanical stabilization is achieved by adding virgin aggregate or recycled materials such as recycled asphalt pavement (RAP) or recycled concrete. Chemical stabilization is done by adding lime, Portland cement, Fly ash, lime or cement kiln dust or various proprietary chemical products. Bituminous stabilization is achieved by adding, liquid asphalt, asphalt emulsion or foamed (expanded) asphalt. Combinations of all three types can be done as well if needed for increased requirements.

FULL DEPTH RECLAMATION

PROCESS DESIGN OVERVIEW

2 MATERIALS

2.1 Recycling Additives:

2.1.1 Asphalt Emulsions:

A number of different types and grades of asphalt emulsions can be used in Full Depth Reclamation. The proper emulsion to be used is based on a number of factors; environmental conditions (temperature and humidity), time of year, and the existing road conditions. All these conditions affect the emulsion to be used. Typically the most common emulsions used are CSS-1, CMS-2 (polymer versions included) as well as proprietary products. Compatibility between the emulsion and the reclaimed material is critical to make the system work.

2.1.2 Expanded (Foam) Asphalt:

The asphalt cement typically used in expanded FDR is PG58-28. Softer grades can be used if the specification requirements for tensile strength can be met. To create the foam 2-3% water is injected into the hot (150-170°C) asphalt.

2.2 Recycled Blended Material:

The recycled blended material is created by the pulverization the existing pavement and underlying granular materials into a homogeneous mixture. Virgin aggregate, RAP material, or crushed concrete can be added to improve overall strength. Typically the maximum particle size is 37 mm. The pulverizing machine can control the gradation of the RAP through speed, milling head direction as well as the existing pavement condition.

2.3 Modifiers:

There are different modifiers that can be used in the FDR process. Besides the asphalt emulsion or Expanded (Foam) Asphalt, virgin aggregate may be added to improve gradation, stability or cross slope. Portland cement or lime in dry or slurry form as well as Type C Fly ash can be used to improve early strength, cohesion and resistance to moisture damage.

2.4 Aggregate:

Aggregates used to improve the gradation or give extra strength can be virgin crusher run, recycled crushed concrete or recycled asphalt pavement (RAP). The virgin aggregate can also be coarse aggregate if the gradation needs to be corrected due to the fine nature of the pulverized material.



McASPHALT INDUSTRIES LIMITED

8800 Sheppard Avenue East T 416.281.8181 TF 1.800.268.4238
Toronto, ON M1B 5R4 F 416.281.8842 E info@mcasphalt.com

mcasphalt.com
ISO 9001/14001/45001

FULL DEPTH RECLAMATION

PROCESS DESIGN OVERVIEW

3 DESIGN CRITERIA

In order to design a mix to satisfy the objectives of the project the existing pavement must be investigated for structural adequacy, thickness, slope and cross-fall as well as the visual appearance. Based on these criteria a proper design can be developed. In most instances the design procedure developed by Wirtgen is the accepted method of design. This design procedure is well laid out in the Wirtgen Cold Recycling Technology Manual.

The following is a guide to the design procedure:

- Obtain representative samples of RAP and underlying materials from field
- Determine RAP gradation, binder content, gradation of extracted aggregate, and aged binder
- Determine gradation and physical properties of underlying granular.
- Select amount and type of additional aggregate if required
- Select type and grade of recycling additive
- Estimate recycling, additive demand
- Determine pre-mix moisture content for coating
- Test trial mixtures, initial curing properties, final curing properties, and moisture sensitivity
- Establish job mix formula
- Make adjustments in field

4 RECOMMENDED PERFORMANCE GUIDELINES

In order to construct a proper well designed FDR Mix the following guidelines should be followed:

- Ensure the existing pavement structure is adequate to support expected traffic.
- Evaluate existing pavement for distresses and make sure repairs completed prior to construction
- Ensure that the FDR process is the proper process to be used.
- Determine if a corrective aggregate or other modifiers such as cement are needed.
- The existing pavement should have the recovered asphalt cement evaluated.
- Ensure a proper mix design is done. Use mix design as a guide only
- Field adjustments may have to be made to water content or recycling additive to achieve good coating and workability.
- Proper equipment needed (reclaimer, grader, water truck, compactors).
- Use of vibratory footpad, pneumatic ,vibratory rollers and static steel rollers used.
- If modifier used compaction begins as soon as mix is placed.
- Breakdown rolling following by shaping and final compaction.
- Rolling patterns should be established at start with use of nuclear gauge.
- Curing of finished mat is required before placement of wearing surface.
- Curing can vary depending on environmental conditions and type of additive used. Typically 2 to 4 days for foam and 10-14 days for emulsions.
- A light fog seal may be needed to prevent surface raveling.
- Typically a HMA wearing surface is placed over FDR. Mix type governed by structural requirements.



McASPHALT INDUSTRIES LIMITED

8800 Sheppard Avenue East T 416.281.8181 TF 1.800.268.4238
 Toronto, ON M1B 5R4 F 416.281.8842 E info@mcasphalt.com

mcasphalt.com
 ISO 9001/14001/45001

FULL DEPTH RECLAMATION

PROCESS DESIGN OVERVIEW

5 RESOURCES

1. "Basic Asphalt Emulsion Manual", Fourth Edition, Asphalt Institute and Asphalt Emulsion Manufacturers Association, 2008
2. "Basic Asphalt Recycling manual", Asphalt Recycling and Reclaiming Association, Annapolis Maryland, 2001
3. "Wirtgen Cold Recycling Technology", 2012 Edition, Wirtgen GmbH,
4. "Report on Cold Recycling of Asphalt Pavements", Task Force 38, AASHTO/AGC/ARTBA, March 1998



McASPALT INDUSTRIES LIMITED

8800 Sheppard Avenue East T 416.281.8181 TF 1.800.268.4238
Toronto, ON M1B 5R4 F 416.281.8842 E info@mcasphalt.com

mcasphalt.com
ISO 9001/14001/45001