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COLD IN-PLACE RECYCLING (CIR)

Oregon's initial (1984-1985) success of cold in-place recycling (CIR) of asphalt concrete pavement prompted a joint research effort between the Oregon State Highway Division (OSHD) and Oregon State University (OSU). In 1986, this joint research effort between OSHD and OSU resulted in a recommended CIR mix design procedure for asphalt concrete pavements.

The CIR mix design procedure involves using a 16-inch mill to gather preliminary milling samples from the pavement to be recycled. These millings are tested for gradation, asphalt content, penetration and viscosity. Based on the results, an initial emulsion content is estimated for the mix design. Laboratory specimens are then prepared with the millings, varying the emulsion content around this initial emulsion. Each is tested for mechanical properties (e.g. Hveem and Marshall stability, resilient modulus, fatigue, etc.) and a design emulsion content is selected.

Recent research focused on verifying and/or modifying this mix design procedure. A research study was conducted based on projects constructed during the 1988 and 1989 construction seasons. Findings from the study have been published by the OSHD in a final report titled, "In-Depth Study of Cold In-Place Recycled Pavement Performance," Volumes I and II, December 1990.

Volume I of the report includes OSHD's CIR mix design procedure. It presents lab results that show how difficult it is to choose an emulsion content based on Hveem and Marshall stability. Data comparing design emulsion content with actual emulsion contents used in the field are presented. Selection of water content is discussed. Test results of mix properties monitored over time are presented, demonstrating the curing of the emulsion. Performance data for CIR pavements constructed from 1984 through 1988 are included as well as initial results of an attempt to use lime during recycling to correct a stripped pavement.

Significant findings as a result of this study include the following:

1. Field performance of CIR has been good, with a few exceptions. Proper project selection is extremely important.

2. Estimation procedures for determining emulsion content serve as a good starting point for field operations. Continual monitoring and adjustment of emulsion content is required in the field.
3. It is difficult to relate Hveem and Marshall stability, resilient modulus, fatigue and Index of Retained Modulus (IRM) laboratory testing to field construction conditions for CIR.
4. Mix property test results indicate that the stiffness and fatigue properties of recycled mixtures increase over a period of years.
5. Addition of 1% and 2% lime to recycled asphalt pavement (RAP) from badly stripped pavement produced better IRM results than the RAP without lime.
6. Review of existing projects suggests service lives for low volume roads of 6 to 8 years for CIR with a chip seal surface when projects are properly selected.

Volume II, "Construction and Inspection Manual," is a manual that provides the user with a general explanation of the project selection, design, construction and quality control considerations used by OSHD to help insure a successful cold in-place recycling project. Information assembled in this manual is based on CIR design and construction as practiced by OSHD in 1990 using CMS-2S or HFE-150 as recycling agents.

Included in the manual are handy, easy to read, tables and flow diagrams that outline the CIR process. For example, you will find a table that lists the considerations for when CIR is recommended and for when CIR is not recommended. Another table gives the reader a list of field quality control tests with frequency and purpose behind the test. Still another table identifies some pavement problems, in CIR mixes and gives their causes and/or solutions.

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