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EXPLORATORY STUDY OF HOT-IN-PLACE RECYCLING OF ASPHALT PAVEMENTS

In 1992, the Oregon Department of Transportation (ODOT) contracted for six hot in-place recycling (HIR) projects for rehabilitation of asphalt concrete pavements. Five projects were constructed in 1992; the sixth was constructed in 1993.

In September, 1992, ODOT contracted with Oregon State University (OSU) to

1. synthesize existing information regarding HIR,
2. evaluate the effectiveness of ODOT HIR projects,
3. refine the HIR mix design process in light of ODOT experience,
4. determine the most critical design inputs,
5. and develop guidelines for HIR use in Oregon.

Research efforts included an extensive literature review, organization and analysis of available field data from the six ODOT HIR projects, limited field observation of the HIR process, and a laboratory testing program. The information was compiled in a final report where HIR equipment and process are discussed. Construction challenges for each project and results achieved are reported and discussed. A flow chart for selection of HIR candidate projects is presented and discussed. A flow chart for HIR mix design for selected candidates is presented and discussed.

Challenges sometimes faced during HIR construction were

1. stripped pavements,
2. pavements with extensive delaminations, sometimes with water present,
3. very severely aged RAP,
4. heavily patched and highly variable pavements,
5. marginal, non state-of-the-art equipment,
6. smoke control, and
7. night paving requirements.

For three of six projects the challenges were too severe to provide fair evaluation of HIR equipment and methods.

One of ODOT's four wearing course HIR projects illustrated that if a suitable HIR candidate is chosen and a competent recycling contractor with state-of-the-art equipment is utilized, the HIR process can produce acceptable pavements. Three of ODOT's four wearing course HIR projects showed that pavements with stripping, extensive delaminations, or free water present in the pavement are not good HIR candidates.

Two of the HIR projects were designed to be base course for overlays. These projects show no signs of distress after HIR, but data indicate that rejuvenation of binder may have been spotty on one project, and that binder was actually hardened on the other. The project with apparent spotty rejuvenation had an average recycling agent (RA) add rate of about 0.2% compared to a design recommendation of 1.0%. The reasons for this difference are not fully understood -- fear of instability and metering equipment difficulties were factors. The project where binder was hardened experienced out-of-specification rejuvenating agent in less than design amounts, and probably over-heating.

Twenty conclusions and five recommendations for implementation are presented. Among the most significant of these are the following:

1. ODOT should continue to consider HIR as a rehabilitation option for asphalt pavements on carefully selected projects.
2. HIR for stripped pavements or for RAP which shows stripping potential is not recommended at the current stage of development of HIR technology.
3. If RAP binder absolute viscosity is greater than 200,000 poises, HIR to serve as a wearing course without addition of coated aggregate or virgin hot mix is not recommended.
4. ODOT should consider implementation of the HIR selection procedure presented in the report.
5. Critical inputs for HIR design come from testing RAP properties and from testing remolded specimens with RA added. These test properties are presented below:
 - a) For RAP, properties are
 - i) % asphalt,
 - ii) penetration (25°C) of recovered asphalt,
 - iii) absolute viscosity (60°C) of recovered asphalt, and
 - iv) RAP gradation.
 - b) For remolded specimens with RA added, properties are
 - i) % air,
 - ii) stability (Hveem or Marshall), and
 - iii) Index of retained resilient modulus (or other stripping indicator).
6. ODOT should consider implementation of the HIR mix design procedure presented in the report.

Copies of the recently published final report for this research are now available. If you want additional information regarding this project or a copy of the report, please contact:

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SUMMARIES OF CURRENT TRANSPORTATION RESEARCH