CP Road Map E-News December 2014

The ***CP Road Map E-News*** is the newsletter of the Long-Term Plan for Concrete Pavement Research and Technology (CP Road Map), a national research plan developed and jointly implemented by the concrete pavement stakeholder community. To find out more about the CP Road Map, or to get involved, contact Steve Klocke, 515-964-2020.

New Moving Advancements into Practice (MAP) Brief

Moving Advancements into Practice (MAP) Briefs describe promising research and technologies that can be used now to enhance concrete paving practices.

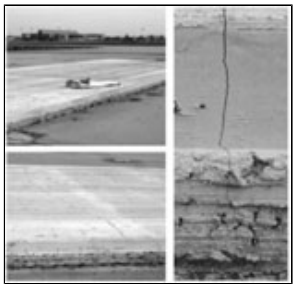
The December 2014 MAP Brief, "Relating Transport Properties to Performance" describes ongoing research into concrete permeability.

Download the December 2014 MAP Brief.

News from the Road

News from the Road highlights research around the country that is helping the concrete pavement community meet the research objectives outlined in the CP Road Map.

Substrate Restraint of Bonded Concrete Overlays



When new concrete is placed, it undergoes volume changes due to drying shrinkage and changes in temperature and humidity. When new concrete is placed as part of a bonded concrete overlay, the existing concrete substrate, which is relatively stable, resists these changes, creating stresses in the new pavement that can lead to early age failures of the new surface.

This study considers three different methods for calculating stresses inside the overlay concrete. The study also provides recommendations on how to minimize cracking due to substrate restraint, including selecting a proper water to cement ratio, careful use of admixtures, use of supplemental cementitious materials, selection of cement type, timing of overlay placement, and proper curing.

This report was completed by Alex Hak-Chul Shin (Louisiana State University) and David Lange (University of Illinois at Urbana-Champaign) and published by the International Journal of Pavement Research and Technology. Click here to read the full report.

This research is contributing to objectives identified in CP Road Map Track 8: Concrete Pavement Construction, Reconstruction, and Overlays.

Potential Use of Waste Paper Sludge as a Pozzolan

Natural pozzolans are defined as either raw (volcanic material, limestone) or calcined natural materials (burnt shale, calcined kaolinite) with pozzolanic properties. Historically, they are among the oldest materials that have been used in combination with lime for construction purposes. For example, Santorin earth is a

natural pozzolan from a volcanic eruption around 1500 BCE on an island of the same name in Greece. Over the last decades, research into cement matrices has been changing direction, owing to deeper environmental concerns over the impact of the cement industry and its consequences for climate change. Global environmental policies are increasingly strict, prioritizing the reuse rather than the disposal of industrial wastes. In this context, one of the biggest challenges is the search for strategies that promote the industrial rotation of high volumes of wastes in their productive cycles.

The main purpose of this research is to widen the existing knowledge base on the behavior of new mineral pozzolans of high added value in the cement sector, lending special attention to paper sludge wastes generated in the process of paper manufacture, in which recycled paper is used as a raw material. The results to date show that, once thermally activated (in the range of 1200°F –1300°F), paper sludge turns out to be an alternative source of recycled metakaolin. This product is characterized by its high pozzolanic activity and improved performance with regard to the benefits of certain binary cements. The possibility of incorporating this industrial waste in cements along with other already standard pozzolans focuses on the notable increase in the production of these types of cements. At present, this is due to the extensive constructive applications for type-II cements (single additive) and to their lower economic and energetic costs, which also makes them more suitable in times of economic crisis.

In this report, the influence that pozzolan blends (activated paper sludge and fly ash) have on the reaction kinetics of ternary blended cements (6 and 21% of replacement) is evaluated, paying special attention to the identification and evolution of hydrated phases with increasing reaction times. The results obtained represent a pioneering research line at a global level and a starting point for future investigations because, in the case of using paper sludge, release of CO2 from organic matter is very low and is listed as zero release.

This report was completed by Rosario García Giménez, et al. and published in the ASCE Journal of Materials in Civil Engineering, 2014. A full transcript of the report is available by clicking here.

This project is contributing to research objectives identified in CP Road Map Track 12: Concrete Pavement Sustainability.

Shrinkage Behavior of Sustainable Concrete with Crushed Returned Concrete Aggregate

In the current trend of sustainability, the concrete community has been aggressively looking into adopting green construction material practices and at the same time improving concrete quality and performance for extensive service life and adaptive reuse. Concrete is the construction material used most in the world, with an estimated yearly production of 2.35 billion tons worldwide. In the United States, it is estimated that approximately 5% of the ready-mix concrete produced is unused and returned to the plant, with only a small portion reused. Such material, when further processed and identified as crushed returned concrete aggregate (CCA), has a significant residual value because, among other things, it is free of contaminants and has better quality than recycled concrete aggregate (RCA).

The objective of this study was to assess the shrinkage behavior of CCA concrete mixtures produced with aggregate from returned concrete. The aggregate was prepared from concrete of different strengths. The virgin aggregate (stone) was replaced either partially or at 100% level in the concrete mixtures. The response of the hyperbolic shrinkage prediction model was examined, and based on the experimental results, an alternative model is proposed. The proposed model and methodology can be used to estimate the drying shrinkage of CCA mixtures, and eventually can be adopted for assessing the shrinkage behavior of these concrete mixtures in other regions.

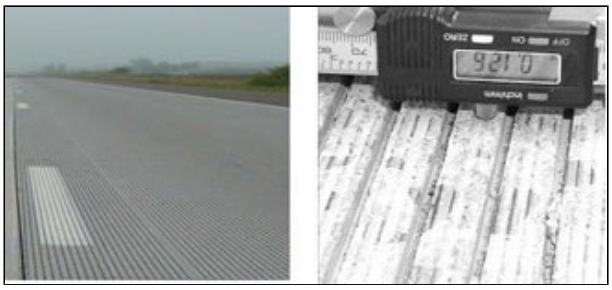
This work was completed by Kim, H. and Goulias, D. and was published in the ASCE *Journal of Materials in Civil Engineering*, 2014. A full transcript of the report is available by clicking here.

This project is contributing to research objectives identified in CP Road Map Track 12: Concrete Pavement Sustainability.

MnRoad: A Quiet and Durable Surface Experience

The current quiet diamond grinding configuration popularly known as Next Generation Concrete Surface (NGCS) was progressively researched, enhanced, and ultimately deployed between 2007 and 2013 at the MnROAD research facility. MnDOT, TXDOT, and FHWA collaborated with Industry partners IGGA and ACPA in a pooled fund study, TPF 5-(134), towards the successful completion of this research after the prior laboratory work had been performed at the Herrick Laboratories at Purdue University.

Multifaceted benefits explain why NGCS is currently being deployed nationwide. Its acoustic advantage of being 6 decibels quieter than pre-existing transverse tining and 3 decibels lower than the traditional grind while maintaining comparable skid resistance is evident. It also provides better and more durable skid resistance than the longitudinally dragged and tined textures while providing an acoustic advantage of being 3 -5 decibels quieter. A 3 decibels reduction is tantamount to 50% reduction of the tire-pavement source strength. The robust configurations also provide better acoustic durability and lower rolling resistance than the traditional grinding. The final study report is available here and a summarized factsheet here.



Since MnROAD facilitated real-time research toward this innovation, it has been deployed in many projects including the $66 million 2010 Interstate Highway 35 rehabilitation project in Duluth, Minnesota.

For more information, please contact Bernard Izevbekhai at MnROAD.

This research is contributing to objectives identified in CP Road Map Track 4: Optimized Surface Characteristics for Safe, Quiet, and Smooth Concrete Pavements.

Updates from the States: Oklahoma

In the State of Oklahoma, concrete pavement research is coordinated through the Oklahoma Department of Transportation (ODOT) Research, Development, and Technology Transfer (RDTT) Program. This program identifies research needs, arranges for the conduct of research, and secures appropriate funding for research projects with specific objectives and prescribed timeframes. Research projects with well-defined objectives are selected by Department personnel with the aim of providing a coordinated and balanced effort among the various technical, socioeconomic, and environmental subject areas. Furthermore, research results are implemented through new specifications, standard plans, test methods, new or revised procedures, computer programs, manual changes, or policy and procedure directives.

Although the RDTT Program conducts work through in-house research, the majority of projects are conducted for the ODOT under contract by universities, other governmental agencies, or private organizations. Collaborative research also offers the Department the ability to further leverage State funds and includes partners such as the Transportation Research Board (TRB), Transportation Pooled Fund (TPF) Program, state highway agencies, and the Oklahoma Transportation Center (OkTC).

Read on for more information about concrete pavement research in Oklahoma...

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