Pavement & Materials Partnering Committee
Work Product Scoping Document
New
Impact of Portland Limestone Cement (PLC) on Concrete Performance
May 21, 2020

Task Group

Concrete Task Group

Problem Process

☒ Annual
☐ Expedited
☐ Emerging Initiative

Title

Impact of Portland Limestone Cement (PLC) on Concrete Performance

Statement of Effort/Improvement

Type IL cements, commonly referred to as Portland Limestone Cement (PLC), are currently not allowed by Caltrans specifications, though industry partners continue to seek the consideration for their inclusion as a tool to help Caltrans improve sustainability and reduce greenhouse gas (GHG) emissions. ASTM C150 allows up to 5% interground limestone in portland cement, whereas type IL in ASTM C595 (AASHTO M240) allows between 5% to 15% limestone in blended cements. Caltrans 2018 Standard Specifications allows ASTM C150 and only allows ASTM C595 (AASHTO M240) type IS and type IP cements with additional requirements. Additional utilization of ground limestone in hydraulic cement can enhance sustainability, lower GHG emissions and reduce the energy consumption associated with cement while maintaining equivalent quality and performance of the concrete produced.

There has been discussion of inclusion of type IT ternary blended cements into this scoping document, however, there is concern that incorporating this additional work item would slow progress of incorporating type IL milestones. As a compromise, it is suggested that a review of type IT information available be reviewed concurrently with the type IL work to determine if type IT could be incorporated without additional efforts that would delay milestones of type IL scope. After review if it is determined that type IT would need further testing or research that would delay the scope of type IL, a separate scoping document would be developed. Conversely, if it is found that type IT could be included without additional efforts or delay, it would be included into this work.

Purpose

The manufacture of ordinary portland cement (OPC) is a complex and highly energy intensive process, which is responsible for approximately 7% of the total global GHG emissions every year. PLC is designed to significantly reduce the energy consumption and GHG emissions associated with cement production. Allowance of PLC has the potential to significantly reduce the CO2 and energy that is embodied in transportation infrastructure, which is in line with Caltrans' values and mission.

Background

Despite the environmental benefits, inadequate studies on the use of PLC with typical California Supplementary Cementitious Materials (SCMs) and material resources remains as one of the barriers to their inclusion into Caltrans Standard Specifications. To confidently adopt the use of PLC in Caltrans, Oregon State University (OSU) has been tasked with conducting a three-phase comprehensive research project for Caltrans to address whether PLC would negatively impact the performance of concrete materials that are specific to California. This working group seeks to review the research findings from the OSU team and address how these findings would apply to Caltrans Standard Specifications with the use of PLC.

This effort's main objectives are to draft a revised Standard Specification incorporating the use of PLC and create an implementation plan with the additional information provided by OSU's report.

Approach

1. Street Ready Assurance

   The adoption of an option to use PLC in concrete will be made depending on the findings and recommendations from OSU's research. If the results and conclusions are favorable, specification revisions and an implementation plan will be developed for adoption of the PLC in Caltrans projects.

2. Performance Tracking/Management

The performance and properties of PLC concrete are being evaluated by the OSU team. The working group will review interim reports provided by OSU, ongoing test results of the research, as well as any recommendations from the associated Caltrans-Industry Research Steering Committee to understand the performance of PLC concrete and potential implications from its adoption into specifications. The OSU research project is scheduled to be fully complete by Spring 2021.

3. Consistently Implemented

   Based on the findings from the research, specifications revisions and an implementation plan will be developed which will initiate an option of PLC statewide. The supporting documents that may be impacted and will need to be identified and addressed include but are not limited to the Caltrans Construction Manual, Concrete Technology Manual, Authorized Materials List Criteria, California Test Methods, etc.

4. Pilot Projects (if anticipated)

   Pilot Projects are not necessary for this project.

5. Research Needs (if necessary)

   In 2018, Caltrans initiated a three-year comprehensive research project with OSU to evaluate whether the use of PLC would have any detrimental impacts on the properties and performance of concrete while using California's representative concrete materials. The anticipated conclusions and recommendations from the research will be provided by April 2021. An interim report on findings thus far is expected in March 2020.

Team Members (Indicate CT Chair and Industry Lead)

CT/Industry	Division/Firm Name	Member Name
CT Chair	METS	Zihui (Lance) Li
CT	Pavement Program	David Lim
CT	SP&I	Craig Knapp

CT	SP&I Structures Specification Research and Development (SSRD)	Jeff Goronea/Eric Fornera(A)
Industry Lead	CalPortland	Kirk McDonald
Industry	NCE	Tom Van Dam
Industry	Lehigh Hanson	Morgan Johnson
Industry	Cemex	Hernan Jose Perez Rodriguez

Team should not include more than four Caltrans staff and four members from Industry. See PMPC Standard Operating Procedures for more information. It is anticipated that experts from academia, industry or other specialized areas will provide input on a needed basis.

Objectives/Deliverables/Due Dates

Description: The working group seeks to review the research findings from OSU and address how these conclusions and recommendations will apply to Caltrans Specifications when PLC is adopted. Additionally, the impacts of the potential PLC specifications to other sections will be identified and any inconsistency in supporting documentation will be identified so that they may be addressed. The main objectives of this project are to develop the specification draft and propose an implementation plan for use of PLC as per OSU's findings. The following deliverables are necessary to meet the objective:

1. Identify where PLC adoption would need to be specified in specifications
2. Identify the assets or specification sections that it would impact (e.g. pavements, culverts, bridges, etc.).
3. Develop any necessary specification revisions due to this adoption.
4. Identify impacted supporting documents that will require updates. (Implementation plan)
    - Construction Manual
    - Authorized Materials List for Cementitious Materials
    - California Test Methods
    - Concrete Technology Manual

- Other related documents

5. Final summary report.

Document and summarize all work that the working group has been done.

Schedule:

Milestones	**Name - Responsible Party**	**Due Date (Start/Complete)**
1a. Identify where PLC adoption would need to be specified in specifications	Lance Li/Kirk McDonald	July 2020/September 2020
1b. Review research (OSU & other) or perform additional tests to determine if there is enough information to include ASTM C595 type IT in project or if further work is necessary. Submit report summarizing suggestion.	Craig Knapp/Tom Van Dam	July 2020/November 2020
2a. Identify the assets or specification sections that it would impact (e.g. pavements, culverts, bridges, etc.).	Craig Knapp/Kirk McDonald	September 2020/January 2021
2b. Finalize decision to either include type IT or suggest separate scoping document.	Lance Li/Kirk McDonald	December 2020
3. Develop any necessary specification revisions due to this adoption	Jeff Goronea/Kirk McDonald	January 2021/May 2021
4. Identify impacted supporting documents that will require updates. (Implementation plan)	Tom Collins/Lance Li	April 2021/September 2021
5. Final summary report	Lance Li/ Kirk McDonald	July 2021/ October 2021

Resources To Develop and Implement

	Caltrans Hours	Industry Hours
Development	1200	800
Other Resources (Labs and Districts)	120	0

Benefits

- Reduce amount of portland cement necessary for concrete production, along with ability to maintain usage of current levels of SCM, results in significant reduction in CO2 emissions.
- Extend the life of limestone quarries and preserve natural resources. This is mainly because limestone used directly in cement without being calcined.

Estimated Impact to Caltrans and Contractor

- Increase awareness of sustainable materials and reduce portland cement usage for Caltrans projects.
- Significantly reduce the GHG emissions and energy that is embodied in the transportation infrastructure.

Impediments to Completion of Deliverables

1. Delay of the OSU's ongoing research project.

   The working group chair is a member of the steering committee for the research project and the chair will communicate with the research team regularly to determine whether the working group schedule should be revised based on the progress of the research.

2. Lack of communication and contribution from group members.

   Regular meetings/conference calls will be scheduled to maintain communication within the group and ensure everyone is on the same page. The group chair and industry lead will ensure all the literature and meeting documentation are available to members, and the working tasks will be assigned to individual members as action items in each meeting.

3. Scope Creep

Any changes to specifications by this working group must be limited to those impacted by the adoption and use of PLC.

Recommendation and Approval

This scoping document for Impact of Portland Limestone Cement (PLC) on Concrete Performance was prepared by the Concrete Task Group to address a priority issue with statewide significance and is within the Pavement and Materials Partnering Committee mission as described in the Pavement and Materials Partnering Committee Charter. The Subtask Group members have determined the scope, resources required and timeline for delivery of this project to attempt to ensure that the deliverables are achievable. A signature here indicates that each Task Group and PMPC Executive Committee is committed to providing the resources to support this effort within the prescribed timeframes.

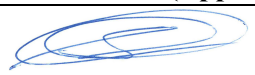
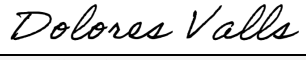
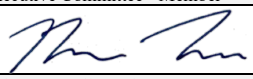
Furthermore, it is everyone's responsibility to ensure that the final effort/improvement will be:

1) Street-Ready,
2) Monitored and reported for performance,
3) Successfully implemented statewide as appropriate.

Scoping Document Recommendation and Industry Concurrence by (name and date):

Caltrans Name (Recommendation)	**Date**	**Industry Name (Concurrence)**	**Date**
	6/10/20	Kirk McDonald	6/10/20
Keith Hoffman, Caltrans Task Group Chair		Kirk McDonald, Industry Task Group Lead	
Kuo-Wei Lee	6/15/20	Mark Hill	6/10/20
Kuo-Wei Lee, Caltrans Task Group Member		Mark Hill, Industry Task Group Co-Member	
Ken Solak	6/15/20		
Ken Solak, Caltrans Task Group Member			

Scoping Document Approval and Industry Concurrence by (name and date):

Caltrans Name (Approval)	Date	Industry Name (Concurrence)	Date
	6/18/20		6/18/20
Sergio Aceves, Caltrans PMPC Executive Committee – Chair		Brandon Milar, Industry PMPC Executive Committee - Member	
	6/18/20		6/18/20
Ray Hopkins, Caltrans PMPC Executive Committee - Member		Charley Rea, Industry PMPC Executive Committee - Member	
	6/18/20		
Dolores Valls, Caltrans PMPC Executive Committee - Member			
	6/18/20		
Roberto Lacalle, Caltrans PMPC Executive Committee – Member			

Approval Date: 6/18/20