PILDYSH
TECHNOLOGIES INC.

Hard-Cem™ Concrete:
Surface Chipping Impact Resistance

Submitted to: Cementec Industries Inc.

March 6, 2009.

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DISCLAIMER

This evaluation was undertaken with the sole intent of assessing relative Hard-Cem™ concrete surface chipping impact resistance performance within the context of its market application: hardened commercial and industrial concrete. With respect to impact resistance, this evaluation was undertaken from the perspective of concrete surface chipping such as that which may occur during "wear and tear" use of commercial and industrial concrete. This bench scale evaluation was conducted under controlled laboratory test conditions.

Hard-Cem™ is not intended to replace or reduce the need for engineering design, products or construction practices specifically intended to mitigate concrete impact, such as, for example, reinforced concrete design, steel concrete surface plates or rails, polymeric or elastomeric pads, etc. With respect to concrete flatwork joints and edges, Hard-Cem™ is not intended to replace joint fillers or joint/edge armoring products and technologies.

This evaluation is not intended to:

- Assess the claims of any competing products in absolute terms.
- Serve as a product usage guide for Hard-Cem™.
- Recommend concrete mix designs and/or concrete installation practices.

Product performance is affected by many factors including storage, method and conditions of application and use. User testing is essential to determine suitability of product for intended method of application and use. Seller's sole warranty is that the product has been manufactured to specifications. No oral or written information or advice shall increase this warranty or create new warranties. Seller's sole liability is to replace product proved defective. In no event shall Seller be liable for any consequential, indirect or other damages whether arising from negligence or otherwise.

Cementec Industries Inc. manufactures Hard-Cem™ an integral concrete hardener. At Cementec's request, Pildysh Technologies Inc. conducted an evaluation of Hard-Cem™ concrete with respect to surface chipping impact resistance.

1.0 Concrete Surface Chipping Impact Resistance Test Program:

A control (unhardened) concrete mix design was batched as follows:

Table 1: Control Concrete Mix Design & Mix Properties	
Material	**Amount**
20 mm aggregate	420 kg/m^3
14 mm aggregate	620 kg/m^3
Sand	920 kg/m^3
Cement	235 kg/m^3
Fly Ash	40 kg/m^3
Water	150 kg/m^3
LRWR	290 ml/m^3
Mix Properties:	
Entrained Air Content	No air mix
Plastic concrete slump	80 mm
28 day Strength	25 MPa (approximately)

Chipping impact resistance test specimens (discussed below) were cast from the above control concrete mix. In addition to the control concrete test specimens, chipping impact resistance test specimens were cast from hardened concrete test specimens as follows:

- **Dry shake hardened concrete test specimens:** a metallic dry shake on hardener was applied to two, steel trowel finished faces of the sawcut test specimens at an application rate of approximately 7.3 kg/m^2 (1.5 lbs/ft^2) of concrete surface area to each finished face (the median recommended manufacturer dosage.) The dry shake hardener was applied as per manufacturer instructions.

- **Hard-Cem™ concrete test specimens:** Hard-Cem™ integral concrete hardener was incorporated into the mix design shown in Table 1 at 40 kg/m^3 (67 lbs/yd^3) of concrete mix volume (an equivalent volume of concrete mix sand was removed to accommodate Hard-Cem™ volumetrically.)

Test block specimens consisting of control (unhardened) concrete, metallic dry shake hardened concrete and Hard-Cem™ hardened concrete were subject to a chipping impact resistance evaluation as discussed below.

2.0 Test Methodology:

- Lab batched concrete was cast into large beam panels and the top and bottom of the panels were steel trowel finished by hand. Some additional finishing effort was required to work the dry shake product into the concrete surface. After 28 days of wet curing the beam panels were sawcut into test block specimens with dimensions of approximately 4-inch wide x 4-inch long x 3 inch thick and weighing approximately 1.9 kg each.

- For each of the 3 tests (control, dry shake hardened and Hard-Cem™ hardened concrete), 3 test block specimens were combined to form a test sample set with a total initial cumulative sample set mass of approximately 5.7 kg. The test specimen sets were provided to a third party testing laboratory (Amec – Calgary) for chipping impact resistance testing as per ASTM C 131 and C 535: Standard Test Methods for Resistance to Degradation of Small-Size and Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine, respectively. The ASTM C 131 and C 535 methodologies were modified with respect to a.) the test sample material type, b.) test sample size, c.) steel charge volume and d.) length of the test

- The concrete test specimens were tumbled in the Los Angeles Machine – a rotating steel drum (approximately 30 revolutions per minute) with a test specimen lifting shelf and charged with steel balls approximately 47 mm in diameter and weighing approximately 400g each. The LA Machine imparts impact in the form of tumbling/striking/chipping the concrete test specimen surfaces against a.) each other, b.) the steel charge and c.) the LA machine steel drum wall and lifting shelf. 9 steel balls were utilized during specimen tumbling. The length of the test was 500 revolutions.

- After tumbling in the LA Machine, the test blocks were hand brushed to remove any loose surface specimen debris dislodged during the tumbling and the final, cumulative sample set mass loss is measured. The cumulative % mass loss of each respective sample set was calculated as a percentage of the initial cumulative sample set mass. Those specimen sets exhibiting a relatively lower cumulative % mass loss are deemed to have higher impact surface chipping resistance.

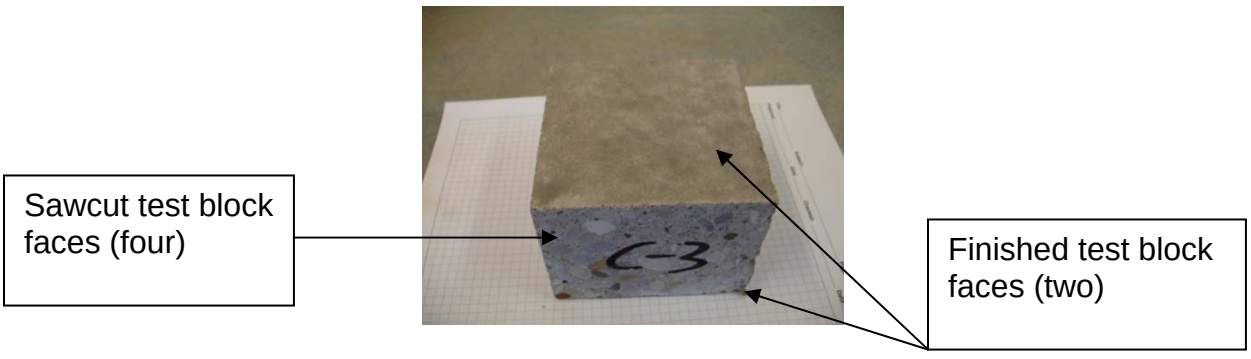
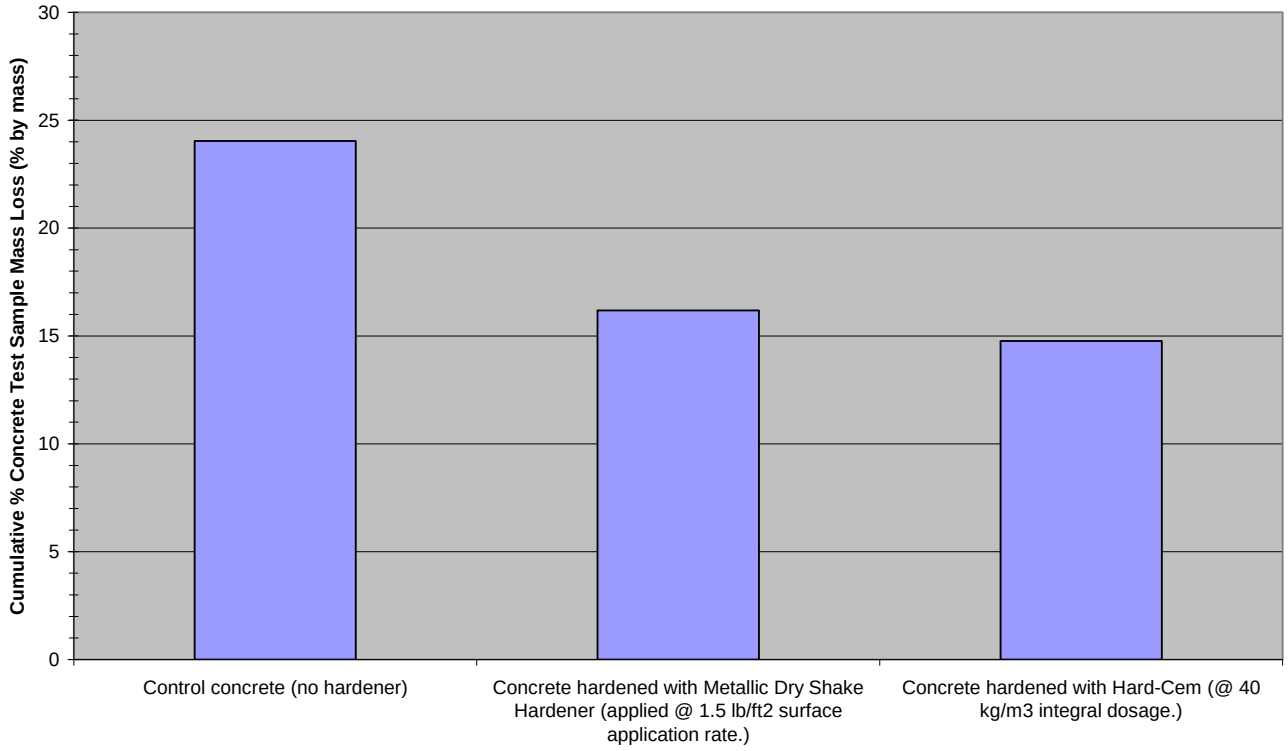


Fig. 1: Sawcut chipping impact resistance test block

3.0 Test Results:

GRAPH 1: Hardened Concrete Chipping Impact Resistance as Measured by the LA Machine (ASTM C 131/535)



4.0 Findings and Conclusions:

1. Relative to the unhardened control concrete, under the conditions of this test methodology, both sets of hardened concrete test specimens exhibited increased resistance to surface chipping impact.

2. Under the conditions of this test methodology, the relative surface chipping impact resistance of the concrete test specimens hardened with Hard-Cem™ and the metallic dry shake hardener were on the same order.