# CHEM CONCRETE™

- *Manufacturer & Supplier of ChemConcrete Hybrid Admixture*
- *NATA (ISO/IEC 170225)-Accredited Concrete Laboratory*

*Operating in over 30 countries through a network of trusted partners &distributors*

**Website:** www.chemconcrete.com.au **E-mail:** sales@chemconcrete.com.au
**Phone:** +61-4-2-388-1091 | +61-4-8-1-69-1552 | +61-4-0-1-33-5611
**Headquarter office:** 16 Caird Place, Seven Hills, NSW 2147, Australia.
**Distribution warehouse:** 27, 45 Powers Rd, Seven Hills Business Park, Seven Hills, NSW, 2147.


28.01.2026

# "Independent Testing of ChemConcrete™ Hybrid Admixture"

## SUMMARY


CHEM CONCRETE™ is a rapidly growing company comprising a team of globally-recognized professors, PhD holders, and engineers, specializing in concrete technology, testing, durability, and waterproofing. CHEM CONCRETE™ is the sole IP-holder and manufacturer of "*ChemConcrete™ Hybrid Admixture*", a multifunctional waterproofing, durability-enhancing, and strengthening admixture — also known as a "*Complete Concrete Enhancement System*.

ChemConcrete™ Hybrid Admixture (Patent No. 2023902368) is the most researched, independently tested, and proven admixture on the global market, validated by over 200 well-known laboratories and universities worldwide. Concrete treated with ChemConcrete exhibits significantly enhanced durability, waterproofing, and strength properties compared to the traditional waterproofing admixtures. A summary of the main findings is provided below.

**ChemConcrete™ Hybrid Admixture:**

- Has full compliance certificates with national and international standards, such as ASTM C494 (USA), AASHTO M194 (USA), and AS1478 (Australia) standards (Type S).
- Eliminates the need for simultaneous use of several additives and admixtures.
- Is the most researched, independently tested, and proven admixture on the market, validated by 200+ independent labs & universities worldwide.
- Drastically reduces water absorption and permeability (under both static & hydrostatic pressure) and meets the requirements of all existing standards for waterproof and durable concrete.
- Improves 1-day & 28-day compressive strengths by up to 70% & 50%, respectively.
- Allows up 20 to 32% cement reduction without compromising strength (cost saving on cement often exceed the price of the product itself).
- Significantly reduces costs by cutting cement and eliminating the need for most traditional additives.
- Is a cost-effective and high-performance replacement for silica fume.
- Provides 2-3 times longer service life and up to 85% lower $CO_2$ footprint over a given service life.
- Provides excellent self-healing of microcracks.
- Lowers drying and chemical shrinkage and significantly improves crack resistance.
- Improves cohesion, rheology, workability, finishability and pumpability of concrete.
- Significantly enhances resistance to cracking, abrasion, spalling, corrosion, delamination, acid, sulfate, chloride, deicing salts, ASR, efflorescence, freezing-thawing, etc.
- Is compatible with all types of cements, SCMs, and all concrete types including alkali-activated geopolymers.
- Has been successfully used in numerous projects worldwide. Is suitable for both cold and hot climates.
- Is highly user-friendly (liquid) and cost-effective—everyone can afford!


## TESTING PROTOCOL

Samples of ChemConcrete™ Admixture were distributed to various laboratories, companies, and universities worldwide. The samples were typically supplied in 20-litre pails, and tests were conducted independently, without supervision from CHEM CONCRETE's technical team. The admixture was tested at various dosages, ranging from 4 - 20 liters per cubic meter of concrete (1 to 4 gallons per cubic yard). A selection of the independent testing reports is provided in the following sections.

Concrete Testing Services (Pty) Ltd.
(Reg. No. 2016/109154/07
20 THORA CRESCENT WYNBERG
2090
PO BOX 1963, KELVIN, 2054
(011) 444 9280/2
www.concretetesting.co.za

# CONCRETE REPORT

**Client:** CLF Flooring
**Contract:** ChemConcrete Hybrid Admixture- Independent Testing

**Report Date:** 19/12/2025
**Contract No:** CD440

**Table 1:** Compressive strength at **fixed cement content and slump (site condition)**.

| Mix ID | Mix 1: Control | Mix 2: 5 Litre | Mix 3: 10 Litre | Mix 4: 20 Litre |
|---|---|---|---|---|
| W/C Ratio | 0.70 | 0.58 | 0.54 | 0.55 |
| Water (kg) | 210 | 169.55 | 159.10 | 160.20 |
| Cement (kg) | 296 | 296 | 296 | 296 |
| 22mm Jukskei Stone (kg) | 780 | 780 | 780 | 780 |
| 13mm Jukskei Stone (kg) | 170 | 170 | 170 | 170 |
| Jukskei Crusher Sand (kg) | 883 | 883 | 883 | 883 |
| ChemConcrete Admix (Litre) | - | 5 | 10 | 20 |
| Slump (mm) | 170 | 160 | 190 | 180 |
| 1 Day Strength (MPa) | 9.5 | 15.4 | 17.0 | 11.5 |
| 7 Day Strength (MPa) | 19.0 | 22.0 | 30.5 | 35.5 |
| 28 Day Strength (MPa) | 28.0 | 42.5 | 50.5 | 51.0 |

**Table 2:** Compressive strength at **reduced cement and increased W/C ratio.**

| Mix ID | Mix 1: Control | Mix 5: 5 Litre | Mix 6: 10 Litre | Mix 7: 20 Litre |
|---|---|---|---|---|
| W/C Ratio | **0.70** | **0.73** | **0.76** | **0.81** |
| Water (kg) | 210 | 169.55 | 157.10 | 157.20 |
| Cement (kg) | **296** | **233** | **209** | **196** |
| 22mm Jukskei Stone (kg) | 780 | 780 | 780 | 780 |
| 13mm Jukskei Stone (kg) | 170 | 170 | 170 | 170 |
| Jukskei Crusher Sand (kg) | 883 | 1056 | 1120 | 1156 |
| ChemConcrete Admix (Litre) | - | 5 | 10 | 20 |
| Slump (mm) | 170 | 140 | 160 | - |
| 1 Day Strength (MPa) | 9.5 | 10.5 | 12.0 | - |
| 7 Day Strength (MPa) | 19.0 | 22.5 | 27.5 | 19.5 |
| 28 Day Strength (MPa) | 28.0 | 38.5 | 49.0 | 29.0 |

Yours truly,
CONCRETE TESTING SERVICES PTY LTD

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234 0088

Opinions and interpretations expressed herein are outside the scope of SANAS accreditation.

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ENGINEERING & THE BUILT ENVIRONMENT

CoMSIRU

## Test report

# Fresh and hardened concrete properties tests

**Report prepared for:** **Peter Norton, Concrete Laser Flooring**


**Prepared by:** **Nicholas Jarratt**
Email: jrrnic001@myuct.ac.za

**Reviewed by:** **Prof. Hans Beushausen**
Email: hans.beushausen@uct.ac.za
Phone: +27 (0)21 650 5181


Report number: 2527

Reference number: ChemConcrete Hybrid Admixture

Testing conducted by: Thato Mile, Lonwabo Lubobo, Christopher Caesar, and Pitsi Mamabolo

Date: 04/09/2025

# 1 Introduction

The Concrete Materials and Structural Integrity Research Unit (CoMSIRU) of the University of Cape Town (UCT) was commissioned by Concrete Laser Flooring (Client) to carry out various fresh and hardened concrete tests on different concrete mixes (Reference concrete mix, Reference + Crystalline Admixture, and Reference+ChemConcrete Admixture). All the three concrete mixing and testing were conducted at the UCT concrete laboratory. The various constituent materials used to fabricate the concrete mixes were procured and delivered by the Client, except for the water, which was taken from the laboratories municipal tap.

# 2 Mix design

A total of three concrete mixes were cast and tested. The aim was to assess the performance of two concrete mixes containing different admixtures (Crystalline Admix-X and ChemConcrete Admix) against a Reference concrete mix (Ref). The supplier of the constituent materials supplied the mix designs of the reference and Admix concrete mixes. All mixing and slump tests were performed in accordance with SANS 5861-1 and SANS 5862-1, respectively, and samples were demoulded the day after being cast and placed in a water-curing tank maintained at 22 ± 1°C until testing.

The mix design of the three concrete mixes cast is provided in Table 2.1, and shows the volume of concrete mixed. Mix ChemConcrete followed the same mix design as the Ref mix but had a lower water content to compensate for the addition of the existing water inside the ChemConcrete admixture.

- The ChemConcrete Admixture was mixed with 40% of the water content in mix Ref using a drill and paint mixing paddle.
- This liquid mixture was then added to the mixed dry materials in a pan mixer and mixed for 2 – 3 minutes, in accordance with SANS 5861-1.
- A slump test of then conducted on the freshly mixed concrete.
- If the recorded slump did not meet the target slump, additional water was gradually added, and the concrete mixed for one additional minute before conducting another slump test. This process was repeated until a reasonable slump was attained and the amount of additional water added to the concrete mix recorded.

[1] The authors note that while it was ideal to have an exact slump of 125 mm for all mixes, the small quantity of the admixtures made it difficult to repeat the mixes. Instead, a prescribed slump tolerance of ±50 mm was set based on the experience of the lab staff.

Following the above, and noting the solid content of the ChemConcrete admixture, the volumetric volume, the equation below (Equation 2) was used to determine the total water content ($w_{ChemConcrete\ total}$, kg/m$^3$) of the ChemConcrete mix. Note the density of water was assumed to be 1000 kg/m$^3$.

$$w_{ChemConcrete\ total} = w_{Ref} \times 0.4 + 0.7 \times H + w_{added}/V_{cast} \quad (2)$$

where:

$w_{Ref}$ is the water content (kg/m$^3$) of the reference concrete mix, Ref;

$H$ is the volumetric ChemConcrete admixture content (L/m$^3$); $w_{added}$ is the mass of additional water added (g); and

$V_{cast}$ is volume of concrete cast (L).

*Table 2.1: Concrete mix design of concrete cast and tested.*

| Material | Type | Unit | QTY/m$^3$ | | |
|---|---|---|---|---|---|
| | | | Ref | Crystalline | ChemConcrete |
| Cement | Afrisam HSC CEM I 52.5 | kg | 269 | 269 | 269 |
| Stone | 20 mm Afrisam Peninsula Quarry | kg | 709 | 709 | 709 |
| Stone | 14 mm Afrisam Peninsula Quarry | kg | 236 | 236 | 236 |
| Crusher sand | Crusher Afrisam Peninsula Quarry | kg | 469 | 469 | 469 |
| Fine sand | SSB Mac sand | kg | 524 | 524 | 524 |
| Water | | kg | 180 | 180 | 160 |
| Superplasticiser | Omega 174 | kg | 2.69 | 2.69 | 2.69 |
| Admixture 1 | Crystalline Admixture (X) | kg | 0 | 3.00 | 0 |
| Admixture 2 | ChemConcrete Admixture | L | 0 | 0 | 20 |
| | w/b ratio | - | 0.67 | 0.67 | 0.60 |
| | Date cast | - | 2025/06/26 | 2025/06/30 | 2025/07/01 |
| | Quantity cast | L | 30 | 50 | 40 |
| | **Slump** | **mm** | **115** | **115** | **155** |

Note that the slump of the ChemConcrete mix exceeded the target slump of 115 mm. While water was gradually added during mixing (as per the instructions laid out), the concrete mix achieved higher slump (155 mm). Trial mixes could not be repeated due to the limited amount of ChemConcrete admixture available. This factor thus made it difficult to repeat the test and achieve the target slump.

# 3 Test procedures

## 3.1 Compressive strength

Compressive strength testing was done at 1, 7, and 28 days using a compression testing machine, in accordance with SANS 5863:2006. A uniform loading rate of 0.03 ± 0.01 MPa/s was applied to the concrete specimen, until failure occurred, and the load at failure used to determine the compressive strength.

## 3.2 Flexural strength

Flexural strength was determined at 28 days using the two-point loading method on 100 x 100 x 500 mm prism specimens, with a nominal load rate between 0.07 and 0.14 kN/s, per SANS 5864.

## 3.3 Absorption of water

The water absorption was measured using the absorption after immersion method according to ASTM C642-21. Three 100 mm cube samples were initially oven-dried at 28 days of age in a 110°C ± 5°C oven until they reached a constant mass, following the ASTM procedure. After drying and cooling, the samples were submerged in water at 22 ± 1°C until the change in mass over 24 hours was less than 0.5% of the larger value.

## 3.4 Durability index

The durability index test encompasses the Oxygen Permeability Index (OPI), Water Sorptivity Index (WSI), and Chloride Conductivity (CCI). Four specimens were used, each consisting of a 70 ± 2 mm diameter concrete disc with a thickness of 30 ± 2 mm. These specimens were cored and cut from the cubic samples at 28 days of age, following standard procedures for the preparation of test specimens for concrete Durability Index testing (SANS 3001-CO3-1). The specimens were oven-dried at 50°C for 7 days before testing. OPI, CCI and WSI tests were performed on these concrete discs, following SANS 3001-CO3-2, SANS 3001-CO3-3 (SABS, 2015) and the DI test manual (UCT, 2017), respectively. The water Sorptivity tests shall be repeated due to the inconsistencies between the individual results.

# 4 Test results

A summary of the tests results comparing ChemConcrete Admix vs. Crystalline admix is provided in Table A.

*Table A. ChemConcrete Admixture vs Crystalline Admixture.*

| Test Type | | ChemConcrete Admix vs Crystalline Admix (X) | Notes |
|---|---|---|---|
| Compressive Strength- 1 Day | | 69% higher | Higher is better |
| Compressive Strength- 7 Day | | 8% higher | Higher is better |
| Compressive Strength- 28 Day | | 26% higher | Higher is better |
| Flexural Strength | | 33% higher | Higher is better |
| Water Absorption Rate | | 55% lower | Lower is better |
| Oxygen Permeability Index (OPI) | Coefficient of Permeability | 83% lower | Lower is better |
| | OPI (log scale) | 8% higher | Higher is better |
| Water Sorptivity Index (WSI) | Sorptivity | xx% lower | Lower is better |
| | Porosity | 73% lower | Lower is better |
| Chloride Conductivity Index (CCI) | Conductivity | 87% lower | Lower is better |
| | Porosity | 31% lower | Lower is better |

## 4.1 Compressive strength

A summary of the compressive strength results of each mix at their respective ages are presented in Table 4.1. Note that the individual results of Ref mix at 28 days of age exceeded 15% of the average result shown. In the interpretation of SANS 5863, these set of results are regarded as unreliable. Inspection of the specimens after testing showed no unsatisfactory failure. The detailed results for individual specimens are provided in Appendix A.

*Table 4.1: Summary of compressive strength results.*

| Mix ID | Age | Density ($kg/m^3$) | Compressive strength (MPa) |
|---|---|---|---|
| Ref | 1 | 2353 ± 15 | 6.5 ± 0.8 |
| | 7 | 2438 ± 22 | 39.5 ± 1.0 |
| | 28 | 2435 ± 38 | 45.0 ± 7.8[2] |
| Crystalline (X) | 1 | 2457 ± 9 | 11.0 ± 0.5 |
| | 7 | 2425 ± 18 | 40.5 ± 1.2 |
| | 28 | 2447 ± 14 | 51 ± 1.5 |
| ChemConcrete | 1 | 2454 ± 18 | 18.5 ± 1 |
| | 7 | 2480 ± 20 | 43.5 ± 3.5 |
| | 28 | 2515 ± 20 | 64 ± 4.7 |

## 4.2 Flexural strength

The 28-day flexural strength test results on the respective concrete mixes are summarized in Table 4.2.

*Table 4.2: Summary of 28-day flexural strength results.*

| Mix ID | Flexural Load (kN) | Flexural Strength (MPa) |
|---|---|---|
| Ref. | 19.8 ± 1.5 | 5.90 ± 0.5 |
| Crystalline Admix (X) | 18.8 ± 0.8 | 5.65 ± 0.2 |
| ChemConcrete Admix | 25 ± 1 | 7.5 ± 0.3 |

[2] The range in individual strength results exceed 15% of the average. The reason for this is unknown.

## 4.3 Absorption of water

The water absorption results of each mix is summarized in Table 4.4. The detailed results for individual specimens, including the drying and immersion periods, are provided in Appendix C.

*Table 4.4: Summary of water absorption test results.*

| Mix ID | Absorption after immersion (%) |
|---|---|
| Ref. | 5.0 ± 0.24 |
| Crystalline Admix X | 5.0 ± 0.12 |
| ChemConcrete Admix | 2.3 ± 0.12 |

## 4.5. Durability index

The averaged results from the Oxygen Permeability Index (OPI), Water Sorptivity Index (WSI), and Chloride Conductivity Index (CCI) test are summarized in Table 4.5. Some test results reported are based on the average of three results due to the correlation coefficient being lower than 0.98, making that result invalid. However, each of the test methods permits taking the average of three results. The results for individual specimens are provided in Appendix D.

*Table 4.5: Summary OPI, WSI, and CCI test results [3].*

| Mix ID | OPI (average) | | WSI (average) | | CCI (average) | |
|---|---|---|---|---|---|---|
| | Coefficient of permeability (k/ms-1) | OPI (log scale) | Sorptivity (mm/hr0.5) | Porosity (%) | Conductivity (mS/cm) | Porosity (%) |
| Ref. | $1.418E^{-11}$ | 10.85 | xx | 11.09 | 1.00 | 9.44 |
| Crystalline (X) | $2.665E^{-11}$ | 10.58 | xx | 12.08 | 1.13 | 9.22 |
| ChemConcrete | $0.4673E^{-11}$ | 11.35 | xx | 3.37 | 0.15 | 6.41 |

We trust the above fulfils your requirements.

Regards,

**Nicholas Jarratt**

MSc, BSc. Eng (University of Cape Town)

**Professor Hans Beushausen**

PhD, MSc, Dipl.-Ing (HAW Hamburg, Germany)

Result are based on average of 3 results

# 4. References


- South African Bureau of Standards (SABS). 2006. South African National Standard (SANS): *Concrete tests – Part 1: Mixing fresh concrete in the laboratory (SANS 5861-1:2006). Pretoria. SABS Standards Division.*
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- South African Bureau of Standards (SABS). 2015. South African National Standard (SANS): *Civil engineering test methods Part CO3-3: Concrete durability index testing – Chloride conductivity test (SANS 3001-CO3:2015).* Pretoria. SABS Standards Division.
- University of Cape Town (UCT). 2017. *Durability Index Testing Procedure Manual.* Department of Civil Engineering

# Appendix A – Detailed compressive strength results

*Table A.1: Compressive strength of Ref mix.*

| Mix ID | Cube No. / ID | Day | Ave. height (mm) | Ave. breadth (mm) | Ave. width (mm) | Mass (g) | Density (kg/m$^3$) | Load (kN) | Compressive strength (MPa) | Average Compressive strength (MPa) |
|---|---|---|---|---|---|---|---|---|---|---|
| Ref. | 1 | 1 | 102 | 101 | 101 | 2455 | 2359 | 55 | 5.5 | 6.5 |
| | 2 | 1 | 103 | 100 | 101 | 2430 | 2336 | 67 | 6.5 | |
| | 3 | 1 | 100 | 100 | 100 | 2365 | 2365 | 68 | 7.0 | |
| | 4 | 7 | 100 | 100 | 100 | 2428 | 2428 | 392 | 39.0 | 39.5 |
| | 5 | 7 | 100 | 100 | 100 | 2423 | 2423 | 387 | 38.5 | |
| | 6 | 7 | 100 | 99 | 100 | 2438 | 2463 | 403 | 40.5 | |
| | 7 | 28 | 100 | 100 | 100 | 2423 | 2423 | 474 | 47.5 | 45.0 |
| | 8 | 28 | 100 | 101 | 100 | 2429 | 2405 | 509 | 51.0 | |
| | 9 | 28 | 100 | 100 | 100 | 2477 | 2477 | 360 | 36.0 | |

*Table A.2: Compressive strength of Crystalline mix and ChemConcrete mix*

| Mix ID | Cube No. / ID | Day | Ave. height (mm) | Ave. breadth (mm) | Ave. width (mm) | Mass (g) | Density (kg/m$^3$) | Load (kN) | Compressive strength (MPa) | Average Compressive strength (MPa) |
|---|---|---|---|---|---|---|---|---|---|---|
| Crystalline (X) | 1 | 1 | 100 | 100 | 100 | 2455 | 2455 | 115 | 11.5 | 11.0 |
| | 2 | 1 | 101 | 100 | 100 | 2492 | 2467 | 107 | 10.5 | |
| | 3 | 1 | 100 | 100 | 100 | 2449 | 2449 | 110 | 11.0 | |
| | 4 | 7 | 100 | 100 | 100 | 2430 | 2430 | 420 | 42.0 | 40.5 |
| | 5 | 7 | 100 | 100 | 100 | 2440 | 2440 | 402 | 40.0 | |
| | 6 | 7 | 100 | 100 | 100 | 2405 | 2405 | 400 | 40.0 | |
| | 7 | 28 | 100 | 100 | 100 | 2430 | 2430 | 495 | 49.5 | 51.0 |
| | 8 | 28 | 100 | 100 | 100 | 2455 | 2455 | 517 | 51.5 | |
| | 9 | 28 | 100 | 100 | 100 | 2455 | 2455 | 527 | 52.5 | |
| ChemConcrete | 1 | 1 | 100 | 100 | 100 | 2438 | 2438 | 187 | 18.5 | 18.5 |
| | 2 | 1 | 101 | 100 | 100 | 2499 | 2474 | 177 | 17.5 | |
| | 3 | 1 | 101 | 100 | 100 | 2473 | 2449 | 195 | 19.5 | |
| | 4 | 7 | 101 | 101 | 101 | 2552 | 2477 | 475 | 46.5 | 43.5 |
| | 5 | 7 | 101 | 100 | 100 | 2526 | 2501 | 400 | 39.5 | |
| | 6 | 7 | 101 | 100 | 100 | 2486 | 2461 | 443 | 44.0 | |
| | 7 | 28 | 100 | 100 | 100 | 2537 | 2537 | 586 | 58.5 | 64.0 |
| | 8 | 28 | 100 | 100 | 100 | 2507 | 2507 | 673 | 67.5 | |
| | 9 | 28 | 100 | 100 | 100 | 2500 | 2500 | 657 | 65.5 | |

## Appendix B – Detailed flexural strength results

| Mix ID | Sample ID | Dimensions (mm) | Failure Load (kN) | Flexural strength (MPa) | Average Flexural strength (nearest 0.05 MPa) |
|---|---|---|---|---|---|
| Ref | 1 | 100x100x500 | 18.0 | 5.40 | 5.90 |
| | 2 | 100x100x500 | 20.7 | 6.21 | |
| | 3 | 100x100x500 | 20.5 | 6.15 | |
| Crystalline (X) | 1 | 100x100x500 | 19.7 | 5.91 | 5.65 |
| | 2 | 100x100x500 | 18.2 | 5.46 | |
| | 3 | 100x100x500 | 18.5 | 5.55 | |
| ChemConcrete | 1 | 100x100x500 | 23.8 | 7.14 | 7.50 |
| | 2 | 100x100x500 | 25.7 | 7.71 | |
| | 3 | 100x100x500 | 25.5 | 7.65 | |

## Appendix C – Detailed results of water absorption test

| Mix ID | Cube ID | Drying period (hours) | | | | Saturation period (hours) | | | Absorption after immersion (%) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 0 | 24 | 48 | 72 | 0 | 48 | 60 | Individual | Average |
| Ref | 1 | 2455.90 | 2326.30 | 2318.52 | 2317.29 | 2317.29 | 2318.49 | 2437.41 | 5.2 | 5.0 |
| | 2 | 2530.83 | 2405.32 | 2399.5 | 2398.57 | 2398.57 | 2400.07 | 2511.92 | 4.7 | |
| | 3 | 2476.67 | 2346.22 | 2338.92 | 2338.42 | 2338.42 | 2340.76 | 2456.61 | 5.1 | |
| Crystalline | 1 | 2380.00 | 2356.10 | 2340.70 | 2328.44 | 2328.44 | 2325.17 | 2445.05 | 5.0 | 5.0 |
| | 2 | 2472.00 | 2400 | 2307.34 | 2294.27 | 2294.27 | 2290.81 | 2410.05 | 5.0 | |
| | 3 | 2325 | 2296.1 | 2289.03 | 2277.26 | 2277.26 | 2273.33 | 2387.15 | 4.8 | |
| ChemConcrete | 1 | 2468.02 | 2464.26 | 2457.50 | 2456.71 | 2456.71 | 2510.30 | 2511.20 | 2.2 | 2.3 |
| | 2 | 2504.87 | 2463.71 | 2458.9 | 2457.73 | 2457.73 | 2510 | 2510.99 | 2.2 | |
| | 3 | 2455.41 | 2464.82 | 2456.7 | 2456.01 | 2456.01 | 2514.1 | 2514.9 | 2.4 | |

# Appendix D – Individual results of OPI, WSI, and CCI tests

*Table D.1: OPI, WSI and CCI results of Ref mix*

| Disc Number | k (m/s) | OPI | Porosity (%) | Conductivity (mS/cm) | Porosity (%) |
|---|---|---|---|---|---|
| 1 | 1.392E-11 | 10.86 | 9.63 | 1.09 | 9.96 |
| 2 | 1.197E-11 | 10.92 | 10.14 | 1.06 | 9.47 |
| 3 | 1.618E-11 | 10.79 | 12.28 | 0.87 | 8.93 |
| 4 | 1.464E-11 | 10.83 | 12.31 | 0.99 | 9.41 |
| **Mean** | **1.418E-11** | **10.85** | **11.09** | **1.00** | **9.44** |
| **COV (%)** | 12 | 0.50 | 12.67 | 9.82 | 4.45 |

*Table D.2: OPI, WSI and CCI results of Crystalline mix*

| Disc Number | k (m/s) | OPI | Porosity (%) | Conductivity (mS/cm) | Porosity (%) |
|---|---|---|---|---|---|
| 1 | 2.804E-11 | 10.55 | 11.86 | 0.99 | 8.91 |
| 2 | 3.044E-11 | 10.52 | 11.29 | 1.07 | 9.17 |
| 3 | 2.148E-11 | 10.67 | 11.91 | 1.18 | 8.77 |
| 4 | Invalid* | Invalid* | 13.25 | 1.27 | 10.02 |
| **Mean** | **2.665E-11** | **10.58** | **12.08** | **1.13** | **9.22** |
| **COV (%)** | 17 | 0.75 | 6.86 | 10.71 | 6.09 |

*The coefficient of correlation in disc 3 of the OPI test was less than 0.98. According to the SANS test method, the result is considered invalid. The result is based on 3 samples, which the DI manual permits.

*Table D.3: OPI, WSI and CCI results of ChemConcrete mix*

| Disc Number | k (m/s) | OPI | Porosity (%) | Conductivity (mS/cm) | Porosity (%) |
|---|---|---|---|---|---|
| 1 | 4.560E-12 | 11.34 | Invalid* | 0.18 | 6.26 |
| 2 | 6.324E-12 | 11.20 | 3.54 | 0.13 | 6.45 |
| 3 | Invalid* | Invalid* | 3.33 | 0.15 | 6.68 |
| 4 | 3.044E-12 | 11.52 | 3.24 | 0.16 | 6.26 |
| **Mean** | **4.643E-12** | **11.35** | **3.37** | **0.15** | **6.41** |
| **COV (%)** | 35 | 1.40 | 4.64 | 11.48 | 3.11 |

*The coefficient of correlation in disc 3 and 1 of the OPI and WSI test was less than 0.98, respectively. According to the SANS test method and DI test manual, the result is considered invalid. The result is based on 3 samples, which both documents permit.

SGS TEC SERVICES
Testing • Engineering • Consulting

September 26, 2025

Mr. Jim Kaylor
Durability Consultants
19441 Citronia Street
Northridge, CA 91324

Phone: (310) 650-4263
Email: jim@durabilityconsultants.com

Subject: **Interim Report for ChemConcrete Waterproofing Admixture Compliance Verification for Type S Admixture**
**ASTM C494/C494M-19-** ***Standard Specification for Chemical Admixtures for Concrete***
**AASHTO M194-23-** ***Standard Specifications for Chemical Admixtures for Concrete***
**SGS TEC Services Laboratory No: 24-1302**

Dear Mr. Kaylor:

SGS TEC Services is an AASHTO R18 (Lab #100142), ANS/ISO/IEC 17025:2017 and Army Corps of Engineers accredited laboratory. SGS TEC Services is pleased to present this report of our compliance verification testing of ChemConcrete Waterproofing Admixture an ASTM C494/C494M-19- *Standard Specification for Chemical Admixtures for Concrete* (ASTM C494), Type S *(Specific Performance)* admixture. Our services were performed in accordance with our service agreement date July 23, 2024.

Sample preparation and testing was performed in accordance with applicable sections of ASTM C494, and documents referenced therein. Material and procedures outlined in ASTM C494 were used. Based on our results to date, ChemConcrete Waterproofing Admixture complies with the requirements in Table 1 of ASTM C494. These test results pertain only to the samples tested.

The compliance verification was performed by SGS TEC Services in Lawrenceville, Georgia. Concrete batching was performed on three different days in September of 2024. One control mixture and one test mixture containing ChemConcrete Waterproofing Admixture both meeting the requirements of ASTM C494 for fresh concrete properties were produced each day. One 5-gallon sample of ChemConcrete Waterproofing Admixture was supplied to SGS TEC Services by ChemConcrete Pty Ltd. The air-entraining agent used in this testing was a vinsol resin, meeting the requirements of ASTM C260/C260M-10a (2016) *Standard Specification for Air-Entraining Admixtures for Concrete*.

Testing of the concrete's plastic properties, time of setting, compressive strengths, flexural strengths, length change, and freeze thaw resistance were performed by SGS TEC Services. Mixture proportions and results of our testing are given in Tables 1 to 3. Information and test data on fine and coarse aggregates are listed in Tables 4 to 6. Table 7 contains information on ChemConcrete Waterproofing Admixture. Product information and test data on the Type I/II cement is included in Table 8. Test results for each of the six batches prepared for this report are included in Tables 9 thru 12.

Table 1: ChemConcrete Waterproofing Admixture performance and ASTM C494 requirements for a Type S admixture.

| Test Results | ChemConcrete Admixture | Specification Requirements |
|---|---|---|
| Time of setting, deviation of control | | |
| Initial (hr:min) | -0:32 | -1:00 to +1:30 |
| Final (hr:min) | -0:45 | -1:00 to +1:30 |
| Compressive strength (percent of control) | | |
| 3 days | 171 | 90 (min) |
| 7 days | 142 | 90 (min) |
| 28 days | 130 | 90 (min) |
| 56 days | 135 | 90 (min) |
| 90 days | 130 | n/a |
| 6 months | 131 | 90 (min) |
| 1 year | 134 | 90 (min) |
| Flexural strength (percent of control) | | |
| 3 days | 124 | 90 (min) |
| 7 days | 115 | 90 (min) |
| 28 days | 120 | 90 (min) |
| 56 days | 117 | 90 (min) |
| Length change (increase over control) | +0.001 | +0.010 (max) |
| Relative durability factor | 101 | 80 (min) |

Table 2: Mixture proportions, fresh concrete properties, and ASTM C494 requirements for Type S admixture

| Average of Three Separate Tests | Control Mixture | ChemConcrete Admixture | Specification Requirements |
|---|---|---|---|
| Cement factor (lb/yd$^3$) | 515 | 516 | 517 ± 5 |
| Water (lb/yd$^3$) | 286 | 240 | |
| Water-cement ratio | 0.554 | 0.465 | |
| Coarse aggregate | 1844 | 1848 | |
| Fine aggregate | 1160 | 1285 | |
| Fine aggregate-total aggregate ratio | 0.39 | 0.41 | |
| ChemConcrete Admixture (lbs) | 0.00 | 10.33 | |
| Vinsol Resin (oz/cwt) | 0.52 | 0.56 | |
| Slump (in.) | 4.00 | 3.50 | 3 ½ ± ½ |
| Air content (%) | 5.8 | 5.6 | 5-7 (± 0.5 of control) |
| Density (lb/ft$^3$) | 140.9 | 144.1 | |
| Time of setting | | | |
| Initial (hr:min) | 4:29 | 3:57 | |
| dev. of control (hr:min) | | -0:32 | -1:00 to +1:30 |
| Final (hr:min) | 6:16 | 5:31 | |
| dev. of control (hr:min) | | -0:45 | -1:00 to +1:30 |

Table 3: Properties of hardened concrete

| Test Performed | Control Mixture | ChemConcrete Admixture |
|---|---|---|
| Compressive strength (psi) | | |
| 3 days | 2210 | 3770 |
| 7 days | 3080 | 4370 |
| 28 days | 4290 | 5570 |
| 56 days | 4630 | 6240 |
| 90 days | 4830 | 6290 |
| 6 months | 5050 | 6610 |
| 1 year | 5110 | 6840 |
| Flexural strength (psi) | | |
| 3 days | 475 | 590 |
| 7 days | 555 | 640 |
| 28 days | 675 | 810 |
| 56 days | 680 | 795 |
| Length change (%) | -0.021 | -0.022 |
| Durability factor (%) | 92 | 93 |

Table 4: Properties of fine and coarse aggregates

| Aggregate Information | Fine aggregate | Coarse aggregate |
|---|---|---|
| Manufacturer | **Lambert Sand, Shorter** | **Vulcan, Lithonia** |
| Aggregate Type | Natural sand | Crushed Granite |
| Specific Gravity $_{SSD}$ | 2.630 | 2.648 |
| Absorption (%) | 0.76 | 0.43 |

Table 5: Gradation of fine aggregate and ASTM C494 requirements

| Percent passing | | |
|---|---|---|
| **Sieve** | **Fine Aggregate** | **Specifications Requirements** |
| No. 4 (4.75 mm) | 100 | 100 |
| No. 16 (1.18 mm) | 71 | 65 to 75 |
| No. 50 (300 µm) | 19 | 12 to 20 |
| No. 100 (150 µm) | 4 | 2 to 5 |

Table 6: Gradation of coarse aggregate and ASTM C494 requirements

| Percent passing | | |
|---|---|---|
| **Sieve** | **Coarse Aggregate** | **Specifications Requirements** |
| 1.5 in. (37.5 mm) | 100 | 100 |
| 1.0 in. (25.4 mm) | 98 | 95 to 100 |
| 0.5 in. (12.5 mm) | 34 | 25 to 60 |
| No. 4 (4.75 mm) | 3 | 0 to 10 |
| No. 8 (2.36 mm) | 3 | 0 to 5 |

Table 7: Admixture information

| **Information** | **Admixture Information** |
|---|---|
| Brand Name | ChemConcrete Waterproofing Admixture |
| Manufacturer | ChemConcrete Pty Ltd. |
| Lot Size | 500 lbs |
| Solid content (%) | 57.914 |
| pH | 5.51 |
| Chloride Content (% per BS EN 480-10:2009) | 0.001 |

Table 8: Cement information and test data

| **ASTM C 150 Type I/II cement** | | | |
|---|---|---|---|
| Brand name | | Portland Type I/II | |
| Manufacturer | | Cemex Clinchfield Plant | |
| ***Chemical Analyses by Mass (%)*** | | | |
| Silicon dioxide ($SiO_2$) | 20.2 | Sulfur trioxide ($SO_3$) | 3.3 |
| Aluminum oxide ($Al_2O_3$) | 4.8 | Loss on ignition (950ºC) | 2.8 |
| Iron oxide ($Fe_2O_3$) | 3.3 | Insoluble residue | 0.34 |
| Calcium oxide (CaO) | 65.4 | Alkalies as $Na_2O$ | 0.26 |
| Magnesium oxide (MgO) | 1.0 | | |
| ***Calculated Potential Compounds as per ASTM C 150-05 (%)*** | | | |
| Tricalcium silicate ($C_3S$) | 65 | Tricalcium aluminate ($C_3A$) | 7.0 |
| Dicalcium silicate ($C_2S$) | 8 | Tetracalcium aluminoferrite ($C_4AF$) | 10 |
| ***Physical Testing and Results*** | | | |
| Fineness Specific Surface (Blaine) | 472 $m^2$/Kg | Air Content (%) | 4.9 |
| Setting Times (Vicat) Initial | 79 minutes | Autoclave Expansion (%) | 0.01 |
| Compressive 3 Day Strength (psi) | 3830 | Compressive 7 Day Strength (psi) | 4650 |
| C1038 Expansion @ 3.39% $SO_3$ (%) | 0.006 | Density of Hydraulic Cement ($g/cm^3$) | 3.13 |

*Provided by Cemex

Table 9: Yield adjusted mixture proportions, fresh concrete properties, and time of set for three control batches.

| Materials & Plastic Properties | Control 1 | Control 2 | Control 3 | Average |
|---|---|---|---|---|
| Cement factor (lb/yd$^3$) | 515 | 514 | 517 | **515** |
| Water (lb/yd$^3$) | 288 | 284 | 285 | **286** |
| Water-cement ratio | 0.559 | 0.552 | 0.552 | **0.554** |
| Coarse aggregate (lb/yd$^3$) | 1842 | 1839 | 1851 | **1844** |
| Fine aggregate (lb/yd$^3$) | 1152 | 1160 | 1167 | **1160** |
| Fine aggregate-total aggregate ratio | 0.385 | 0.387 | 0.387 | **0.39** |
| ChemConcrete Admixture (lbs) | 0.00 | 0.00 | 0.00 | **0.00** |
| Vinsol Resin (oz/cwt) | 0.57 | 0.53 | 0.45 | **0.52** |
| Slump (in.) | 4.00 | 4.00 | 4.00 | **4.00** |
| Air content (%) | 5.9 | 6.1 | 5.5 | **5.8** |
| Density (lb/ft$^3$) | 140.6 | 140.6 | 141.5 | **140.9** |
| Time of setting | | | | |
| Initial (hr:min) | 4:34 | 4:21 | 4:31 | **4:29** |
| Final (hr:min) | 6:11 | 6:04 | 6:32 | **6:16** |

Table 10: Yield adjusted mixture proportions, fresh concrete properties, and time of set for three test batches containing ChemConcrete Waterproofing Admixture.

| Materials & Plastic Properties | Test 1 | Test 2 | Test 3 | Average |
|---|---|---|---|---|
| Cement factor (lb/yd$^3$) | 516 | 517 | 516 | **516** |
| Water (lb/yd$^3$) | 239 | 241 | 241 | **240** |
| Water-cement ratio | 0.464 | 0.466 | 0.466 | **0.465** |
| Coarse aggregate (lb/yd$^3$) | 1847 | 1850 | 1848 | **1848** |
| Fine aggregate (lb/yd$^3$) | 1286 | 1285 | 1283 | **1285** |
| Fine aggregate-total aggregate ratio | 0.410 | 0.410 | 0.410 | **0.41** |
| ChemConcrete Admixture (lbs) | 10.32 | 10.34 | 10.32 | **10.33** |
| Vinsol Resin (oz/cwt) | 0.55 | 0.55 | 0.58 | **0.56** |
| Slump (in.) | 3.25 | 3.50 | 3.50 | **3.50** |
| Air content (%) | 5.6 | 5.5 | 5.6 | **5.6** |
| Density (lb/ft$^3$) | 144.0 | 144.2 | 144.0 | **144.1** |
| Time of setting | | | | |
| Initial (hr:min) | 3:52 | 3:57 | 4:03 | **3:57** |
| Final (hr:min) | 5:15 | 5:32 | 5:47 | **5:31** |

Table 11: Properties of hardened concrete from three control test batches

| **Test Age** | **Control 1** | **Control 2** | **Control 3** | **Average** |
|---|---|---|---|---|
| Compressive strength (psi) | | | | |
| 3 days | 2000 | 2160 | 2470 | **2210** |
| 7 days | 3030 | 3040 | 3180 | **3080** |
| 28 days | 4390 | 4140 | 4340 | **4290** |
| 56 days | 4370 | 4540 | 4970 | **4630** |
| 90 days | 4840 | 4730 | 4920 | **4830** |
| 6 months | 4960 | 4680 | 5500 | **5050** |
| 1 year | 5160 | 4800 | 5360 | **5110** |
| Flexural strength (psi) | | | | |
| 3 days | 495 | 440 | 495 | **475** |
| 7 days | 565 | 545 | 560 | **555** |
| 28 days | 650 | 665 | 710 | **675** |
| 56 days | 705 | 685 | 645 | **680** |
| Length change (%) | -0.021 | -0.020 | -0.022 | **-0.021** |
| Durability Factor (%) | 92 | 92 | 92 | **92** |

| Approximate Total Cycles Completed | Fundamental Transverse Frequency, kHz | | | Relative Dynamic Modulus, (%) Average of 2 Beams per Mix | | | Average |
|---|---|---|---|---|---|---|---|
| | Control 1 | Control 2 | Control 3 | Control 1 | Control 2 | Control 3 | |
| 0 cycles | 2.086 | 2.086 | 2.041 | NA | NA | NA | NA |
| 32 cycles | 2.086 | 2.086 | 2.041 | 100 | 100 | 100 | 100 |
| 66 cycles | 2.041 | 2.041 | 2.041 | 96 | 96 | 100 | 97 |
| 96 cycles | 2.041 | 2.041 | 1.997 | 96 | 96 | 96 | 96 |
| 128 cycles | 2.041 | 2.041 | 1.997 | 96 | 96 | 96 | 96 |
| 162 cycles | 1.997 | 1.997 | 1.953 | 92 | 92 | 92 | 92 |
| 192 cycles | 1.997 | 1.997 | 1.953 | 92 | 92 | 92 | 92 |
| 220 cycles | 1.997 | 1.997 | 1.953 | 92 | 92 | 92 | 92 |
| 253 cycles | 1.997 | 1.997 | 1.953 | 92 | 92 | 92 | 92 |
| 287 cycles | 1.997 | 1.997 | 1.953 | 92 | 92 | 92 | 92 |
| 300 cycles | 1.997 | 1.997 | 1.953 | 92 | 92 | 92 | 92 |

Table 12: Properties of hardened concrete from three batches containing ChemConcrete Waterproofing Admixture.

| Test Age | Test 1 | Test 2 | Test 3 | Average |
|---|---|---|---|---|
| Compressive strength (psi) | | | | |
| 3 days | 3650 | 3800 | 3870 | **3770** |
| 7 days | 4370 | 4360 | 4370 | **4370** |
| 28 days | 5610 | 5520 | 5590 | **5570** |
| 56 days | 6250 | 6420 | 6060 | **6240** |
| 90 days | 6300 | 6080 | 6490 | **6290** |
| 6 months | 6500 | 6450 | 6880 | **6610** |
| 1 year | 6860 | 6620 | 7030 | **6840** |
| Flexural strength (psi) | | | | |
| 3 days | 630 | 575 | 570 | **590** |
| 7 days | 670 | 610 | 640 | **640** |
| 28 days | 840 | 800 | 795 | **810** |
| 56 days | 810 | 805 | 765 | **795** |
| Length change (%) | -0.027 | -0.020 | -0.020 | **-0.022** |
| Durability Factor (%) | 96 | 92 | 92 | **93** |

| Approximate Total Cycles Completed | Fundamental Transverse Frequency, kHz | | | Relative Dynamic Modulus, (%) Average of 2 Beams per Mix | | | Average |
|---|---|---|---|---|---|---|---|
| | Test 1 | Test 2 | Test 3 | Test 1 | Test 2 | Test 3 | |
| 0 cycles | 2.175 | 2.175 | 2.175 | NA | NA | NA | NA |
| 32 cycles | 2.175 | 2.175 | 2.175 | 100 | 100 | 100 | 100 |
| 66 cycles | 2.175 | 2.175 | 2.130 | 100 | 100 | 96 | 99 |
| 96 cycles | 2.175 | 2.130 | 2.130 | 100 | 96 | 96 | 97 |
| 128 cycles | 2.130 | 2.130 | 2.130 | 96 | 96 | 96 | 96 |
| 162 cycles | 2.130 | 2.130 | 2.086 | 96 | 96 | 92 | 95 |
| 192 cycles | 2.130 | 2.086 | 2.086 | 96 | 92 | 92 | 93 |
| 220 cycles | 2.130 | 2.086 | 2.086 | 96 | 92 | 92 | 93 |
| 253 cycles | 2.130 | 2.086 | 2.086 | 96 | 92 | 92 | 93 |
| 287 cycles | 2.130 | 2.086 | 2.086 | 96 | 92 | 92 | 93 |
| 300 cycles | 2.130 | 2.086 | 2.086 | 96 | 92 | 92 | 93 |

We appreciate the opportunity to provide our services to you on this project. Should you have any questions or comments regarding this report, please feel free to contact us at your convenience.

Sincerely,

**SGS TEC Services, Inc.**

James G. McCants III
General Manager, Chemist

Alexander Fairley
Project Manager

**Boral Construction Materials**
**Materials Technical Services**

Unit 4, 3-5 Gibbon Road
Baulkham Hills NSW 2153 Australia
PO Box 400, Winston Hills NSW 2153

T: +61 (02) 9624 9900
F: +61 (02) 9624 9999

www.boral.com.au

21-January-2025

**Dr. Sam Soheil Jahandari, Dr Saeed Karimian, Professor Adam Ahmad Dalvand**

**Chem Concrete Pty Ltd and Perchinz Developments Limited**

**Re: Report for ChemConcrete-$^{WP}$ Waterproffing Admixture Compliance Certificate for Type SN AS 1478.1-2000 Chemical admixtures for concrete, mortar and grout, Part 1: Admixtures for concrete**

**Dear Dr. Sam Soheil Jahandari, Dr Saeed Karimian, Professor Adam Ahmad Dalvand**

Boral is proud to operate the largest construction materials research and testing facility of its kind in the southern hemisphere at Baulkham Hills, Sydney. This facility plays a key role in maintaining the high standards Boral customers have come to expect and its accredited by NATA (ISO/IEC 17025) and certified by NCSI (ISO 9001) to conduct an extensive range of compliance testing on cement, aggregates, soil, pavement materials, concrete, and asphalt.

The Boral MTS Lab. conducts construction materials testing and chemical testing under NATA accreditation numbers 547 and 9968, respectively. Our full scope of accreditation can be viewed at the NATA website https://nata.com.au/

Four concrete trials were performed in accordance with applicable sections of AS 1478.1 - two trials for the concrete and two trials for ChemConcrete-WP admixture. One 20-litre pail of ChemConcrete Waterproofing Admixture was supplied to Boral by Chem Concrete Pty Ltd. All materials were homogenised and batched on the same day before mixing date. All four trials were performed on the same day in the order of control mix, control mix duplicate, concrete with ChemConcrete-WP and concrete with ChemConcrete-WP duplicate. The dosage of ChemConcrete-WP is at 2% of cement by weight. Each trial was carried out as per AS 1012.2. The fresh properties include slump AS 1012.3.1, air content AS 1012.4.2, fresh density AS 1012.5, bleed AS 1012.6, and setting time AS 1012.18. A total of 12 concrete cylinders were cast and cured as per AS 1012.8.1 and tested for compressive strength as per AS 1012.9 at 1x1d, 2x3d, 3x7d, 3x28d and 3x90d. One set of shrinkage prisms were cast and cured as per AS 1012.8.4 and tested for the drying shrinkage as per AS 1012.13 up to 56d drying.

All results from above tests can be read from NATA reports and summarised on page 3. They were compared with the requirements in Table 2.1 AS 1478.1 (column SN) for the compliance or not. The comparison report is presented on page 2.

In conclusion, we confirm that ChemConcrete-WP Admixture complies with the requirements as per AS1478.1-2000 for Type SN admixture.

Sincerely

Tony Songaini 21.01.2025

**Tony Song**
Senior Laboratory Engineer - Concrete

**Boral Construction Materials**
**Materials Technical Services**
Unit 4, 3-5 Gibbon Road
Baulkham Hills NSW 2153 Australia
PO Box 400, Winston Hills NSW 2153
T: +61 (02) 9624 9900
F: +61 (02) 9624 9999
www.boral.com.au

# CONCRETE TEST SUMMARY

## ChemConcrete-WP Admixture, Type SN, AS1478.1 AT 2.0% BY WEGHT OF CEMENT

**CLIENT: Chem Concrete Pty Ltd and Perchinz Developments Limited**

**PROJECT: AS1478 Compliance Test for ChemConcrete-WP**

**Client No: 911/24**

**REQUEST No: 115259**

**LAB SAMPLE No: 311691 & 311692 (control), 311693 & 311694 (ChemConcrete-WP)**

**Standard AS 1478.1-2000: Chemical admixtures for concrete, mortar and grout, part 1: admixtures for concrete**

**Cement:** Bulk Type GP ex Berrima 2402496 BTSL **Date of Test**: 16.10.2024

| PARAMETERS | Control | ChemConcrete -WP at 2% | Comparison | AS1478.1 REQUIREMENTS | Pass or Fail |
|---|---|---|---|---|---|
| Cement Content | 305 | 305 | same | (cement 300 ± 15 kg/ m$^3$) | Pass |
| Slump | 80 | 80 | same | 80 ± 10 mm | Pass |
| Time of Setting | 4:00<br>5:50 | 4:20<br>6:00 | +20min<br>+10min | Initial: ± 1 hour<br>Final: ± 1 hour | Pass |
| Water Content | 206 | 183 | -23kg | Test and report | Pass |
| Bleeding (%) | 1.7 | 0.4 | -1.3% | Not exceed that of the control by more than 2% | Pass |
| Air Content (%) | 2.0 | 2.2 | +0.2% | Test and report | Pass |

**COMPRESSIVE STRENGTH:**

| Age | Min. of Control | Control (MPa) | ChemConcrete WP at 2% (MPa) | Comparison | Pass/Fail |
|---|---|---|---|---|---|
| 1 | No limit | 9.5 | 12.8 | 133% | Pass |
| 3 | 90% | 20.6 | 26.1 | 127% | Pass |
| 7 | 90% | 29.5 | 35.4 | 120% | Pass |
| 28 | 90% | 34.2 | 40.4 | 118% | Pass |
| 90 | 90% | 34.3 | 41.0 | 119% | Pass |

**DRYING SHRINKAGE:** (Microstrain)

| Age | Min. of Control | Control | ChemConcrete-WP at 2% | Difference |
|---|---|---|---|---|
| 7 | Test and report no limit established | 215 | 195 | -20 |
| 14 | Test and report no limit established | 335 | 295 | -40 |
| 21 | Test and report no limit established | 425 | 370 | -55 |
| 28 | Test and report no limit established | 505 | 445 | -60 |
| 56 | Test and report no limit established | 615 | 555 | -60 |

**Note:** All samples were prepared, cured and tested at this Laboratory as per AS 1012.2,.3,.4,.5,.6,.8,.9,.13,.18 respectively.

**Remarks:** ***This admixture (ChemConcrete-WP at 2%) complies with the requirements as per AS1478.1 2000, type SN admixture.***

**Dr. Sam Soheil Jahandari, Dr Saeed Karimian, Professor Adam Ahmad Dalvand, File 911, File 8477, Ref 115259SD**

Tony Song 21. 01. 2025

**Tony Song**
**Senior Laboratory Engineer - Concrete**

**Boral Construction Materials**
**Materials Technical Services**

Unit 4, 3-5 Gibbon Road
Baulkham Hills NSW 2153 Australia
PO Box 400, Winston Hills NSW 2153

T: +61 (02) 9624 9900
F: +61 (02) 9624 9999

www.boral.com.au

Project: AS 1478 Compliance Tests for ChemConcrete-WP
Attention: Dr. Sam Soheil Jahandari, Dr Saeed Karimian, Professor Adam Ahmad Dalvand
Client: : Chem Concrete Pty Ltd and Perchinz Developments Limited
Request: 115259
Client: 911/24
Concrete section: 8477

**Re: AS 1478 Compliance Tests for ChemConcrete-WP**

| MTS Concrete Trials No. | | T13575 | T13576 | T13577 | T13578 |
|---|---|---|---|---|---|
| **Cementitious ID** | | Control | Control duplicate | ChemConcrete-WP Admix | ChemConcrete-WP Admix duplicate |
| MTS LSN for concrete trials | | 311691 | 311692 | 311693 | 311694 |
| **MIX DATE:** | | 16.10.2024 | | | |
| Boral Cement SL | kg/m$^3$ | 305 | 305 | 305 | 305 |
| ChemConcrete-WP (liquid class SN | ml/m$^3$ | 0 | 0 | 6000 | 6000 |
| 20mm Peppertree | kg/m$^3$ | 730 | 730 | 730 | 730 |
| 10mm Peppertree | kg/m$^3$ | 280 | 280 | 280 | 280 |
| Peppertree Man Sand | kg/m$^3$ | 460 | 460 | 460 | 460 |
| Dunmore washed fine sand | kg/m$^3$ | 390 | 390 | 390 | 390 |
| **Water** | kg/m$^3$ | 206 | 206 | 184 | 182 |
| **Slump AS 1012.3.1** | mm | **85** | **80** | **80** | **80** |
| Fresh concrete density AS 1012.5 | kg/m$^3$ | 2370 | 2360 | 2360 | 2360 |
| **Water / Cement** | ratio | 0.68 | 0.68 | 0.60 | 0.60 |
| **Air content AS 1012.4.2** | % | 2.0 | 2.0 | 2.2 | 2.2 |
| **Bleeding AS 1012.6** | % | 1.7 | 1.6 | 0.3 | 0.4 |
| **Setting time AS 1012.18 (initial)** | hr:mm | 4:00 | 4:00 | 4:20 | 4:20 |
| **Setting time AS 1012.18 (final)** | hr:mm | 5:50 | 5:50 | 5:50 | 6:10 |
| **AS1012.9 Compressive strength (MPa @ days)** | 1 | 10.0 | 9.2 | 12.5 | 13.0 |
| | 3 | 21.0 | 20.5 | 26.0 | 27.0 |
| | 3 | 20.5 | 20.5 | 25.5 | 26.0 |
| | 7 | 29.5 | 30.0 | 35.0 | 36.5 |
| | 7 | 29.0 | 29.5 | 34.5 | 35.5 |
| | 7 | 30.0 | 29.0 | 35.5 | 35.5 |
| | 28 | 35.5 | 33.0 | 40.0 | 39.5 |
| | 28 | 35.5 | 33.5 | 41.5 | 40.0 |
| | 28 | 34.0 | 33.5 | 40.0 | 41.5 |
| | 90 | 34.0 | 35.5 | 39.5 | 42.5 |
| | 90 | 33.5 | 35.5 | 39.5 | 42.0 |
| | 90 | 34.0 | 33.5 | 40.5 | 42.0 |
| AS1012.13 Drying shrinkage (micro-strains @ days) | 7 | 220 | 210 | 200 | 190 |
| | 14 | 340 | 330 | 290 | 300 |
| | 21 | 430 | 420 | 370 | 370 |
| | 28 | 510 | 500 | 440 | 450 |
| | 56 | 630 | 600 | 550 | 560 |

TS updated 20.01.2025

Tony Songatimi 21.01.2025

Tony Song
Boral MTS file

**Hy-Tec Industries (New South Wales) Pty Ltd**
**ABN: 90 070 100 702**
Unit 7/85-115 Alfred Road
Chipping Norton
New South Wales 2170
Ph : (02) 9822 6842
Fax: (02) 9601 7446

**Report No: CON:CPN24/2828**
**Issue No: 2**
*This report replaces all previous issues of report no 'CON:CPN24/2828'.*

# Concrete Test Report

**Client:** HY TEC INDUSTRIES P/L

NSW 2144

**Project:** QUALITY CONTROL

Accredited for compliance with ISO/IEC 17025 - Testing

NATA Accredited Laboratory No.: 18082

Approved By: KHUZAIMA KHAN (TECHNICAL SUPERVISOR)
Date of Issue: 30/07/2024



## COMPRESSIVE STRENGTH OF CONCRETE CYLINDERS

### Details of Sampled Concrete

### Concrete Specimens and Results

| Date & Time Batched / Truck No / Load | Time Sampled / Time Moulded / Prog. Load | Plant Code / Docket No / Mix Code / MPUV(kg/m³) | Grade(MPa) / Agg(mm) / Design | App Air(%) / Compact / Slump(mm) / Measured | Specimen Ident. | Dimensions (mm) Avg. Diameter | Dimensions (mm) Height | Density (kg/m³) | Curing Initial (hrs) | Curing Std (days) | Prep or Cap Type | Date of Test | Age (days) | Strength (MPa) | Marks | Fail Mode | Location & Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01/07/24 | 11:28 | 232 | S50 | 1.8 | CPN68923A | 100.1 | 199 | 2320 | 22 | 0 | S | 02/07/24 | 1 | 6.8 | | N | Concrete Temp. (°C): 16 |
| 11:20 | 11:50 | | 20 | EXT VIB | CPN68923B | 100.1 | 197 | 2360 | | 3 | G | 05/07/24 | 4 | 32.0 | | N | CONTROL MIX |
| | | N502B80C | 100 | 85 | CPN68923C | 100.2 | 196 | 2320 | | 6 | G | 08/07/24 | 7 | 41.5 | | N | |
| | | 2320 | | | CPN68923D | 99.8 | 197 | 2360 | | 13 | G | 15/07/24 | 14 | 57.5 | | N | |
| | | | | | CPN68923E | 100.2 | 197 | 2360 | | 27 | G | 29/07/24 | 28 | 64.5 | | N | |
| | | | | | CPN68923F | 100.1 | 199 | 2340 | | 27 | G | 29/07/24 | 28 | 66.0 | | N | |
| | | | | | CPN68923G | | | | | 55 | G | 26/08/24 | 56 | | | | |
| | | | | | CPN68923H | | | | | 90 | G | 30/09/24 | 91 | | | | |
| 01/07/24 | 09:40 | 232 | S50 | 1.8 | CPN68924A | 100.1 | 200 | 2340 | 24 | 0 | S | 02/07/24 | 1 | 12.5 | | N | Sampling AS 1012.2 |
| 09:30 | 10:20 | | 20 | EXT VIB | CPN68924B | 100.2 | 198 | 2360 | | 3 | G | 05/07/24 | 4 | 43.0 | | N | Pan Mixer |
| | | N502B80C | 100 | 80 | CPN68924C | 100.2 | 198 | 2360 | | 6 | G | 08/07/24 | 7 | 53.5 | | N | CHEMCONCRETE-WP |
| | | 2360 | | | CPN68924D | 100.1 | 198 | 2360 | | 13 | G | 15/07/24 | 14 | 66.5 | | N | ADMIXTURE |
| | | | | | CPN68924E | 100.0 | 200 | 2380 | | 27 | G | 29/07/24 | 28 | 81.5 | | N | |
| | | | | | CPN68924F | 100.2 | 199 | 2360 | | 27 | G | 29/07/24 | 28 | 83.0 | | N | |
| | | | | | CPN68924G | | | | | 55 | G | 26/08/24 | 56 | | | | |
| | | | | | CPN68924H | | | | | 90 | G | 30/09/24 | 91 | | | | |

### Notes

1. Sampling in accordance with AS 1012.1
2. Slump test in accordance with AS 1012.3.1
3. Apparent air content in accordance with AS 1012.4.2
4. Mass per unit volume (MPUV) of fresh concrete in accordance with AS 1012.5
5. Compression specimen compaction by vibration, in accordance with AS 1012.8.1 Clause 7.4
6. Initial curing in accordance with AS 1012.8.1 Clause 9.2.2
7. Standard curing in accordance with AS 1012.8.1 Clause 9.3(a)
8. Prep/Cap Type: G = Ground
9. Prep/Cap Type: S = Filled sulphur mixture
10. Compressive strength in accordance with AS 1012.9
11. Density in accordance with AS 1012.12.1
12. Moisture condition SSD in accordance with AS 1012.12.1, unless otherwise stated

### Remarks

FailureMode: N = Normal
Compaction: EXT VIB = External Vibrating

**Interim Report**

**MAHAFFEY ASSOCIATES PTY LTD**
Unit 9/108-110 Percival Rd (PO Box 2162) Smithfield NSW 2164
Ph: (02) 9756 4003 Email: admin@mahaffey.com.au
ABN: 90 001 629 036

NATA
WORLD RECOGNISED ACCREDITATION

***Client:*** Hy Tec
***Project:*** Quality Control
***Section:*** -
***Mix Identification:*** 68923
***Mix Design:*** N502B80C-S50MPa Control
***Test Type:*** Determination of the Drying Shrinkage of Concrete

***Job No:*** 20401
***Date Cast:*** 1/07/2024
***Date Received:*** 2/07/2024
***Date Curing Commenced:*** 2/07/2024
***Date of Initial Measurement:*** 8/07/2024
***Duration of Standard Moist Curing (Days):*** 6

| ***Specimen*** | ***Drying Shrinkage (Microstrain)*** | | | | |
|---|---|---|---|---|---|
| | ***7 Days*** | ***14 Days*** | ***21 Days*** | ***28 Days*** | ***56 Days*** |
| I | 260 | 350 | 400 | 440 | 510 |
| J | 250 | 340 | 390 | 430 | 500 |
| K | 260 | 360 | 410 | 450 | 530 |
| ***Average*** | **260** | **350** | **400** | **440** | **510** |

Note: "*" denotes information not suplied by the client
Samples cast by: Others
Tested in accordance with AS 1012 Part 13 - 2015
The average drying shrinkage results are based on individual results within 40 microstrain of the median, as required by the standard.

David Wilmshurst
Approved Signatory
Date of Issue: 04/09/2024

**Accredited for compliance with ISO/IEC 17025 - Testing**

**MAHAFFEY ASSOCIATES PTY LTD**
Unit 9/108-110 Percival Rd (PO Box 2162) Smithfield NSW 2164
Ph: (02) 9756 4003 Email: admin@mahaffey.com.au
ABN: 90 001 629 036

NATA
WORLD RECOGNISED ACCREDITATION

***Client:*** Hy Tec ***Job No:*** 20401
***Project:*** Quality Control ***Date Cast:*** 1/07/2024
***Section:*** - ***Date Received:*** 2/07/2024
***Mix Identification:*** 68924 ***Date Curing Commenced:*** 2/07/2024
***Mix Design:*** N502B80C-S50MPa Waterproofing ***Date of Initial Measurement:*** 8/07/2024
***Duration of Standard Moist Curing (Days):*** 6
***Test Type:*** Determination of the Drying Shrinkage of Concrete

| ***Specimen*** | ***Drying Shrinkage (Microstrain)*** | | | | |
|---|---|---|---|---|---|
| | ***7 Days*** | ***14 Days*** | ***21 Days*** | ***28 Days*** | ***56 Days*** |
| I | 180 | 260 | 290 | 310 | 370 |
| J | 200 | 270 | 320 | 330 | 390 |
| K | 190 | 260 | 300 | 330 | 380 |
| ***Average*** | **190** | **260** | **300** | **320** | **380** |

Note: "*" denotes information not suplied by the client
Samples cast by: Others
Tested in accordance with AS 1012 Part 13 - 2015
The average drying shrinkage results are based on individual results within 40 microstrain of the median, as required by the standard.

David Wilmshurst
Approved Signatory
Date of Issue: 04/09/2024

**Accredited for compliance with ISO/IEC 17025 - Testing**

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Unit 9/108-110 Percival Rd (PO Box 2162) Smithfield NSW 2164
Ph: (02) 9756 4003 Email: admin@mahaffey.com.au
ABN: 90 001 629 036

**Client:** Hy Tec
**Job Number:** 20401
**Project:** Quality Control N502B80C-S50MPa Control
**Cast Date:** 1/07/2024
**Test Type:** Sorptivity
**Received Date:** 2/07/2024
**Test Method:** RMS T362
**Exposure Category** C
**Mix ID:** 68923
**Curing Regime:** Water
**Test Date (Completed):** 14/08/2024

| *Beam* | *Curing Regime* | *Curing Period (Days)* | *Average Water Penetration (mm)* |
|---|---|---|---|
| S | Water | 7 | 6.0 |
| T | Water | 7 | 6.3 |
| **Average of Mix** | | | **6.2** |

**Notes:** Values quoted as 0.5mm are at the lower limit of measurement and the actual value may be less than 0.5mm

David Wilmshurst
Approved Signatory
Date of Issue: 15/08/2024

**MAHAFFEY ASSOCIATES PTY LTD**
Unit 9/108-110 Percival Rd (PO Box 2162) Smithfield NSW 2164
Ph: (02) 9756 4003 Email: admin@mahaffey.com.au
ABN: 90 001 629 036

**Client:** Hy Tec
**Job Number:** 20401
**Project:** Quality Control N502B80C-S50MPa Waterproofing
**Cast Date:** 1/07/2024
**Test Type:** Sorptivity
**Received Date:** 2/07/2024
**Test Method:** RMS T362
**Exposure Category** C
**Mix ID:** 68924
**Curing Regime:** Water
**Test Date (Completed):** 14/08/2024

| *Beam* | *Curing Regime* | *Curing Period (Days)* | *Average Water Penetration (mm)* |
|---|---|---|---|
| S | Water | 7 | 0.0 |
| T | Water | 7 | 0.0 |
| **Average of Mix** | | | **0.0** |

**Notes:** Values quoted as 0.5mm are at the lower limit of measurement and the actual value may be less than 0.5mm

David Wilmshurst
Approved Signatory
Date of Issue: 15/08/2024

**MAHAFFEY ASSOCIATES PTY LTD**
Unit 9/108-110 Percival Rd (PO Box 2162) Smithfield NSW 2164
Ph: (02) 9756 4003 Email: admin@mahaffey.com.au
ABN: 90 001 629 036

NATA
WORLD RECOGNISED ACCREDITATION

***Client:*** Hy Tec
***Job Number:*** 20401

***Details:*** 68923
N502B80C-S50 MPa Control

***Test Method:*** Determination of chloride and sulfate in hardened concrete and aggregates Nitric acid extraction method AS 1012.20.1

***Cast Date:*** 1/07/2024
***Received Date:*** 2/07/2024
***Test Date:*** 24/07/2024

## ***Sulfate Test Report***

| ***Specimen*** | ***Depth (mm)*** | | ***$SO_3^=$ (% w/w Specimen)*** |
|---|---|---|---|
| | ***From*** | ***To*** | |
| 68923 | - | - | 0.480 |

Notes: Samples prepared in this laboratory using AS1012 Method 20.1 – 2016 Section 6
Work covered by Clause 7 of the standard by NATA accredited facility no. 1884

Signed: _____

David Wilmshurst
Approved Signatory
Date of Issue: 24/07/2024

**Accredited for compliance with ISO/IEC 17025 - Testing**

**MAHAFFEY ASSOCIATES PTY LTD**
Unit 9/108-110 Percival Rd (PO Box 2162) Smithfield NSW 2164
Ph: (02) 9756 4003 Email: admin@mahaffey.com.au
ABN: 90 001 629 036

NATA
WORLD RECOGNISED ACCREDITATION

***Client:*** Hy Tec
***Job Number:*** 20401

***Details:*** 68924
N502B80C-S50 MPa Waterproofing

***Test Method:*** Determination of chloride and sulfate in hardened concrete and aggregates Nitric acid extraction method AS 1012.20.1

***Cast Date:*** 1/07/2024
***Received Date:*** 2/07/2024
***Test Date:*** 24/07/2024

## ***Sulfate Test Report***

| ***Specimen*** | ***Depth (mm)*** | | ***$SO_3^=$ (% w/w Specimen)*** |
|---|---|---|---|
| | ***From*** | ***To*** | |
| 68924 | - | - | 0.350 |

Notes: Samples prepared in this laboratory using AS1012 Method 20.1 – 2016 Section 6
Work covered by Clause 7 of the standard by NATA accredited facility no. 1884

Signed: _____

David Wilmshurst
Approved Signatory
Date of Issue: 24/07/2024

**Accredited for compliance with ISO/IEC 17025 - Testing**

**Hy-Tec Industries (New South Wales) Pty Ltd**
**ABN: 90 070 100 702**
Unit 7/85-115 Alfred Road
Chipping Norton
New South Wales 2170
Ph : (02) 9822 6842
Fax: (02) 9601 7446

# Concrete Test Report

**Report No: CON:MOO23/5880**
**Issue No: 6**
*This report replaces all previous issues of report no 'CON:MOO23/5880'.*

**Client:** HY TEC INDUSTRIES P/L

NSW 2144

**Project:** QUALITY CONTROL

Accredited for compliance with ISO/IEC 17025 - Testing

NATA Accredited Laboratory No.: 18082

Approved By: Edgar Hernandez
(Lab Manager)
Date of Issue: 28/02/2024



## COMPRESSIVE STRENGTH OF CONCRETE CYLINDERS

### Details of Sampled Concrete — Concrete Specimens and Results

| Date & Time Batched / Truck No / Load / Prog. Load | Time Sampled | Time Moulded | Plant Code / Docket No / Mix Code | Grade(MPa) | Agg(mm) | Slump(mm) | Air(%) | Compact | Specimen Ident. | Dimensions (mm) Avg. Diameter | Height | Density (kg/m³) | Curing Initial (hrs) | Curing Std (days) | Prep or Cap Type | Date of Test | Age (days) | Strength (MPa) | Marks | Fail Mode | Location & Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 29/11/23 | 11:13 | | | S50 | | | 1.8 | | MOO62429A | 100.1 | 200 | 2340 | 19 | 0 | S | 30/11/23 | 1 | 14.0 | | N | Sampling AS 1012.2 |
| 11:13 | 11:33 | | | | | | 25H | | MOO62429B | 100.3 | 198 | 2340 | | 4 | G | 04/12/23 | 5 | 38.0 | | N | Pan Mixer |
| | | | N502B80C | 100 | | 100 | | | MOO62429C | 100.3 | 198 | 2340 | | 6 | G | 06/12/23 | 7 | 45.0 | | N | Concrete Temp. (°C): 25 SL CONTROL MIX |
| | 0.1 | | | | | | | | MOO62429D | 100.6 | 197 | 2320 | | 13 | G | 13/12/23 | 14 | 55.5 | | N | |
| | | | | | | | | | MOO62429E | 100.1 | 197 | 2360 | | 33 | G | 02/01/24 | 34 | 64.0 | E | S | |
| | | | | | | | | | MOO62429F | 100.1 | 197 | 2360 | | 33 | G | 02/01/24 | 34 | 67.0 | | N | |
| | | | | | | | | | MOO62429G | 100.0 | 198 | 2360 | | 55 | G | 24/01/24 | 56 | 68.0 | | N | |
| | | | | | | | | | MOO62429H | 100.5 | 197 | 2360 | | 90 | G | 28/02/24 | 91 | 74.5 | | N | |
| 29/11/23 | 12:28 | | | S50 | | | 1.4 | | MOO62430A | 100.1 | 201 | 2420 | 18 | 0 | S | 30/11/23 | 1 | 25.0 | | N | Sampling AS 1012.2 |
| 12:15 | 12:48 | | | | | | 25H | | MOO62430B | 100.2 | 200 | 2420 | | 4 | G | 04/12/23 | 5 | 73.5 | | N | Pan Mixer |
| | | | N502B80C | 100 | | 100 | | | MOO62430C | 100.1 | 200 | 2440 | | 6 | G | 06/12/23 | 7 | 79.5 | | N | Concrete Temp. (°C): 25 Hybrid Integral |
| | 0.1 | | | | | | | | MOO62430D | 100.3 | 198 | 2440 | | 13 | G | 13/12/23 | 14 | 97.0 | | N | Waterproofing |
| | | | | | | | | | MOO62430E | 100.2 | 196 | 2460 | | 33 | G | 02/01/24 | 34 | 103.0 | E | S | |
| | | | | | | | | | MOO62430F | 100.1 | 199 | 2440 | | 33 | G | 02/01/24 | 34 | 107.5 | | N | |
| | | | | | | | | | MOO62430G | 100.0 | 198 | 2440 | | 55 | G | 24/01/24 | 56 | 104.0 | | N | |
| | | | | | | | | | MOO62430H | 100.1 | 197 | 2460 | | 90 | G | 28/02/24 | 91 | 113.5 | | N | |

## Notes

1. Sampling in accordance with AS 1012.1
2. Slump test in accordance with AS 1012.3.1
3. Air content in accordance with AS 1012.4.2
4. Compression specimen compaction by rodding, in accordance with AS 1012.8.1 Clause 7.3
5. Initial curing in accordance with AS 1012.8.1 Clause 9.2.2
6. Standard curing in accordance with AS 1012.8.1 Clause 9.3(a)
7. Prep/Cap Type: G = Ground
8. Prep/Cap Type: S = Filled sulphur mixture
9. Compressive strength in accordance with AS 1012.9
10. Density in accordance with AS 1012.12.1
11. Moisture condition SSD in accordance with AS 1012.12.1, unless otherwise stated

## Remarks

Marks: E = Exclude from AS1379
FailureMode: N = Normal, S = Shear
Compaction: 25H = 25 rods per layer

The 9th International Congress on Civil Engineering, Architecture and Urban Development / 19-21 September, 2023, Tehran, in cooperation with Shiraz University, Maraghe University And University of Science and Technology

# Performance of Commercial Concrete Modified with Hybrid ChemConcrete-WP Waterproofing Admixture

M.R. Rezaeian [1*], F. Zivari [2]

[1] Associate Professor, Department of Civil, Environmental and Geomatic Engineering, University College London, London, UK.

[2] Department of Building, Civil and Environmental Engineering, Concordia University, Montreal, Canada.

## ABSTRACT

A significant research program was undertaken to evaluate the effectiveness of a waterproofing (also known as water-resisting and permeability-reducing) admixture, with the commercial name of Hybrid ChemConcrete-WP Waterproofing Admixture, to improve water-tightness and durability of commercial concrete mixes in corrosive environments. The waterproofing performance of the admixture was compared with a few other widely used waterproofing admixtures available on the market through water absorption test results. For each type of concrete, a control batch was produced without waterproofing admixtures, and other batches included waterproofing admixtures at the recommended dose rates by the manufacturers. This report provides the tests results of slump, air content, water contact angle, compressive and flexural strengths, and chloride resistance of concrete mixes. Assessment of these test results indicates that, whilst concrete performance was influenced by cement type, these permeability reducing admixtures can also significantly improve the durability of concrete. The findings show that Hybrid ChemConcrete-WP Admixture has significant impact on enhancing the water-tightness and durability of concrete.

**Key words:** Concrete waterproofing admixtures; waterproof concrete; water absorption; durability; chloride resistance; ChemConcrete-WP.

## 1. Introduction

Penetration of water is the main cause of all the major chemical and physical deterioration processes affecting concrete structures and pavements. Water may be the agent causingdistress or it may allow the penetration of aggressive species that cause damage. Excessive penetration of water can also compromise the functionality of many structures such as water tanks, basements, and liquid-retaining structures [1]. Commonly used methods to achieve durable and waterproof concrete include using supplementary cementitious materials, adopting low water to cement ratio, limiting cracks by using reinforcing elements or using surface coatings or membranes [1, 2]. Nevertheless, it is very hard to eliminate water penetration because concrete is naturally micro-cracked and porous, it is often exposed to corrosive environments, and it is prepared using variable site practices [1-3].

Another approach to reduce water penetration is using integral waterproofing admixtures (also known as water-resisting admixtures) [4]. These admixtures are often available in liquid or powder forms and could be generally classified as: 1) hydrophobic or water repelling admixtures, 2) crystalline admixtures, 3) densifying or pore blocking admixtures, and 4) hybrid admixtures [4]. Among these, the first three groups are very well-known. However, thelast group (hybrid admixtures) is considered as the new generation of waterproofing admixtures in which some chemicals with quite different waterproofing mechanisms (i.e., water repelling, pore blocking, crystalline/self-healing, etc.) are used. ChemConcrete$^{-WP}$ waterproofing admixture, developed by Chem Concrete Pty Ltd may be considered as a new generation or the first hybrid waterproofing admixture in the market .

German Committee on Reinforced Concrete [5] limits the water absorption of waterproof concrete to below 50% in comparison to untreated concrete. However, waterproof concrete should have a water absorption rate of below 2.5% based on National Corporation of Highway Research Program in the USA [6]. In BS EN 14695 [7], it is stated that waterproof concrete should have the ability to prevent the movement of moisture from one place to another. Despite the definitions, it is obvious that waterproof concrete should have a very low water absorption [4].

Hydrophobic admixtures alter the surface energy or surface tension within cracks and pores to increase water/liquid contact angle and resist absorption. These admixtures usually consist of vegetable oils, fatty acids, wax emulsions, hydrocarbons, animal fats, silanes and siloxanes [1, 8]. Crystalline admixtures are reported to increase the resistance to water ingress by the deposition of solids via chemical reactions or removal from suspension [4]. The most widely used densifiers are nanomaterials and supplementary cementitious materials such asfly ash, slag, and silica fume. The effects of these agents in reducing the water absorption of concrete are well-understood. However, the effects of these agents on the water absorption reduction are limited to below 20%, which is far beyond the limitations specified by standardsfor waterproof concrete [4]. The use of integral waterproofing admixtures has many benefits over surface protection because they do not require regular maintenance, are not vulnerable todeterioration, and can be used where membranes or surface coatings are impossible or too complex to apply [1]. However, a more promising method to minimize water penetration into concrete is using hybrid integral waterproofing admixtures in concrete because these admixtures provide both hydrophobic and self-healing properties simultaneously .

A wide range of integral waterproofing admixtures are available in the market. The manufacturers have made many claims on the effectiveness of these products, such as providing an exceptional resistance to corrosion, permanent reduction in water absorption,and extended life span [1, 9]. However, a latest independent review by the Concrete Society

in the UK [9] found a distinct lack of independent data to substantiate the claims made by the manufacturers. Much of the existing data are provided by the manufacturers, and most of the current research has investigated generic materials rather than proprietary products. The ingredients in these commercial waterproofing admixtures and the mechanisms by which these admixtures provide waterproof concrete are often not reported [1]. This is specifically true when the admixture is prepared by mixing several different agents [1]. Some waterproofingadmixtures decrease water absorption in concretes with a high w/c ratio and restricted curing (low-grade porous concrete) but have minor effect on normal grade concrete [1, 4]. Therefore, these admixtures can do little to improve the waterproofing performance of concrete beyond what could be achieved by adopting a good mix design [1].

A comprehensive review conducted by the Concrete Society in the UK demonstrated that most of the current commercial waterproofing admixtures have limited impact on developing waterproof concrete [9]. However, ChemConcrete-WP waterproofing admixture, classified as a new generation of hybrid waterproofing admixtures, has not yet been examined by researchers and/or Concrete Society in the UK. Therefore, the aim of the current research has been to evaluate the effects of this commercial admixture on the water absorption, strength properties, and chloride resistance of concrete and compare the results with similar researchon other commercial waterproofing admixtures.

## 2 .Experimental program

### 2.1 . Materials

Type II ordinary Portland cement (OPC) was used in this research. Natural river sand(with maximum particle size below 3 mm) and coarse aggregates (with a nominal maximum size of 10 mm) were used in this study. Before using the fine and coarse aggregates in the mixtures, all the aggregates were dried in an oven for 48 hours at a temperature of 105 ºC. Some previous researchers have reported that the quality of water can affect the mechanical properties of concrete [10]. Therefore, in this research, tap water was used to prepare the specimens. Sodium chloride in powder form with over 96% purity was purchased from Alibaba in China. ChemConcrete-WP waterproofing admixture in white liquid form (Figure 1) was supplied by Chem Concrete Pty Ltd, Australia. Experiments were carried out accordingto the relevant standards and the manufacturer's instructions.

Figure 1: ChemConcrete admixture in liquid form (original photos were replaced by CHEM CONCRETE as they were showing the concentrated version).

### 2.2. Mix design

The amount of cement in all the mixes were kept constant at 385 kg/m$^3$ of concrete. Moreover, the amount of coarse and fine aggregates in the control concrete were 1075 and 667 kg/m$^3$, respectively. To make the results comparable to those provided in [8], similar amounts of materials were used in this research. Similarly, the amount of water was determined after conducting some trial tests in a way that both the treated and untreated (control) concrete mixtures could achieve a target slump of 100 mm. The amount of ChemConcrete$^{-WP}$ waterproofing admixtures used in the mix design were set at 2.2% (by weight) of total cementitious materials as recommended by the supplier.

### 2.3. Specimen preparation and curing

To prepare the untreated concrete, coarse and fine aggregates were mixes well in a 30-litre automatic mixer for about 2 minute. Then, cement was added to the mixture and the mixing was resumed for 2 minutes before adding the required water. To prepare the treated concrete, ChemConcrete$^{-WP}$ waterproofing admixture was added to 30% of mixing water and stirred for 2 minutes. Then, this mixture was added to dry materials (mixture of basalt, sand, and cement). The mixing was further continued for 3 minutes until a homogeneous mixture was attained. The rest of the mixing water was then gradually added during the mixing process to achieve a target slump of 100 mm. Fresh concrete was then poured into cylindrical steel moulds with 100 mm diameter and 200 mm height (for water absorption and compressive strength tests), in steel moulds with the dimensions of 100×100×300 mm (for flexural strengthtests), and in cubic moulds with the dimensions of 100×100×100 mm (for chloride resistance tests) without using demoulding agents or oils. Demoulding agents or oils were not used inthis study as they can affect the water absorption rate or hydrophobic behaviour of concrete. After 24 hours of casting, the specimens were stripped and wrapped with plastic sheets to avoid significant moisture variations during their curing process. The concrete specimenswere then cured in an ambient chamber at 25 ± 1 ºC for 28 days. Afterwards, some of the specimens were cut by a saw cutter to the specified sizes by ASTM C 642 standard for the water absorption tests.

### 2.4. Testing

In this research, the workability of the fresh concrete was measured through slump tests based on ASTM C143. The hydrophobic behaviour of the treated concrete specimens was measured using a water contact angle measurement equipment. The water absorption tests were carried out on the hardened concrete specimens following ASTM C 642. The flexural and compressive strengths tests were carried out on the concrete specimens following ASTM C78 and ASTM C39 standards, respectively. To measure the chloride resistance, concrete specimens were immersed in sodium chloride solutions for 90 days. The concentration of the chloride solution was 5%. Weight change and compressive strength reduction of the treated and untreated specimens were measured and reported.

# 3. Results and discussion

The tests results of the treated and untreated concrete, including fresh, mechanical and durability tests results, are presented and discussed in this section. The water absorption tests results are compared to the similar results from the literature.

## 3.1 Water absorption

In Figure 2, the waterproofing performance (water absorption tests results) of six commercial waterproofing admixtures, untreated (control) concrete, and concrete treated with ChemConcrete$^{-WP}$ is presented. The test results of the untreated control concrete were necessary for comparison purposes. It should be noted that the results of the commercial products were carefully extracted from literature for the 28-day cured specimens. The reason behind selecting the results of 28-day cured specimens is because concrete is often considered mature after 28 days of curing. The results are comparable with those provided in the literature because the amount of materials used to prepare the specimens were kept constant. Based on relevant standards and manufacturers' instructions three replicate specimens were prepared and tested to ensure the accuracy of the test results. It is generally expected that a good waterproofing admixture should decrease the water absorption rate of concrete to below 2.5% or less than 50% of that of untreated (control) concrete, based on [5,6, 8]. The results demonstrate that Product-1 had even a slightly negative impact on the water absorption of concrete and increased the water absorption rate of concrete from 6.38% to 6.69%.

Other commercial admixtures (apart from ChemConcrete$^{-WP}$) decreased the water absorption rate of concrete, but the reduction is not significant and none of them could meet the limits specified in [5, 6]. These results are in line with the findings reported in similar studies [1, 4, 8]. The best results were achieved while using ChemConcrete$^{-WP}$, which reduced the water absorption rate of concrete from 6.38% to below 1%, meeting the water absorption limits specified in [5, 6]. However, it is difficult to provide reasons for the results received because the ingredients of these commercial waterproofing admixtures are unknown [1]. Nevertheless, based on the current available information, ChemConcrete$^{-WP}$ is reported to provide a waterproof concrete by benefiting from different waterproofing mechanisms such as water repelling, pore blocking, self-healing, densifying, etc. Therefore, ChemConcrete$^{-WP}$ is reportedly known as the first generation of "hybrid" waterproofing admixtures. The other commercial admixtures are reportedly found to provide water-resistant concrete typically by only following one waterproofing mechanism such as crystalline or hydrophobing technologies. Therefore, the superior waterproofing performance of ChemConcrete$^{-WP}$ (in comparison to the other six commercial admixtures) could be because of the simultaneous use of different ingredients with different waterproofing mechanisms.

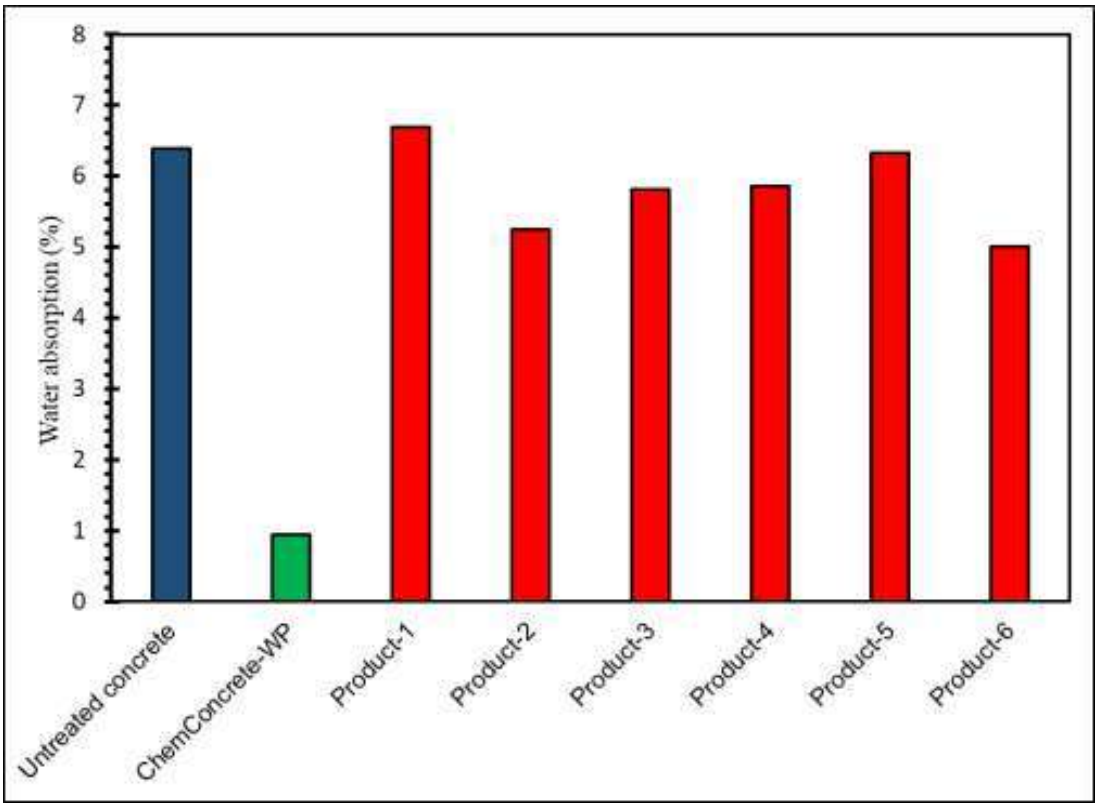


Figure 2: Waterproofing performance of untreated concrete and concrete treated with seven commercial admixtures.

### 3.2. Slump, water contact angle, and strength properties

If the water contact angle of a surface is between 0 º to 90 º, it is called hydrophilic (also known as water lover). However, the water contact angle of a hydrophobic surface must be between 90 º to 150 º. Slump and water contact angle measurement tests results on the cut surface of untreated (control) concrete and the concrete treated by ChemConcrete$^{-WP}$ are presented in Table 1. As can be seen in this table, the water contact angle increased from 0 º to 93 º because of using ChemConcrete$^{-WP}$ waterproofing admixture. Therefore, the treated concrete can be considered as a hydrophobic concrete. It could be concluded that the water repellent agents used in this admixture have turned the normal concrete into a water repellent/hydrophobic concrete. Through conducting some trial tests, the slump of both untreated and treated concretes were kept at 100 mm to make the results more comparable for similar applications.

The compressive and flexural strengths tests results of untreated (control) concrete and concrete treated with ChemConcrete$^{-WP}$ waterproofing admixture are summarized in Table 1. As can be observed in this table, the compressive strength of 28-day cured concrete specimens increased from 41 MPa (for control/untreated concrete) to 48 MPa (for treated concrete). Similarly, the flexural strength of 28-day cured concrete specimens increased from 5.50 MPa (for control/untreated concrete) to 6.30 MPa (for treated concrete). The improvement in the compressive and flexural strengths of concrete could be due to the different ingredients in ChemConcrete$^{-WP}$ waterproofing admixture that act as densifying, pore blocking, or self-healing agents. However, it should be noted that it is hard to further interpret these findings because the ingredients of this product are unknown [1], and there is currently no much information published on this product.

Table 1: Properties of control concrete and concrete treated with ChemConcrete-WP.

| Test | Untreated (control) concrete | Treated with ChemConcrete-WP |
|---|---|---|
| **Air content (%)** | 1.9 | 1.4 |
| **Slump (mm)** | 100 | 100 |
| **Water contact angle (º)** | 0 | 93 |
| **Compressive strength (MPa)** | 41 | 48 |
| **Flexural strength (MPa)** | 5.50 | 6.30 |

### 3.3. Chloride resistance

Corrosion of steel rebars in concrete is the most challenging problem when it comes to concrete durability [11]. Rebar corrosion shortens the life span of concrete structures, infrastructures, and pavements. Chloride-induced corrosion is one of the main mechanisms of degradation affecting the long-term durability performance of concrete structures, especially in marine environments [2, 12].

Mass change and strength reduction of the untreated (control) concrete and concrete treated with ChemConcrete-WP waterproofing admixture is presented in Table 2. It should be noted that the specimens were immersed in the solutions (for 90 days) after 28 days of curing. The results were compared with the strength of similar specimens that were cured for thesame age (118 days) and were not exposed to NaCl solution solution. Results of strength reduction (presented in Table 2) show that the chloride resistance of concrete treated by ChemConcrete- WP was significantly more than the untreated control concrete. Untreated (control) concrete specimens experienced a strength reduction of 12%, whereas the treated concrete specimens with ChemConcrete-WP experienced a strength reduction of 2%. The mass of both untreated and treated specimens increased by 2.44% and 0.06%, respectively. This increase in the mass of the specimens is due to the water (and maybe chemicals) absorption of the specimens because the specimens were not fully saturated before exposure to NaCl. However, the higher mass gain of untreated specimens could be because of tendency to absorb more water. On the contrary, the treated specimens experienced a small mass gain, which could be due to the lower water absorption rate because of employing the waterproofing admixture.

**Table 2: Mass change and strength reduction of treated and untreated concrete.**

| Test | Untreated (control) concrete | Treated with ChemConcrete-WP |
|---|---|---|
| **Mass change (%)** | 2.44 | 0.06 |
| **Strength reduction (%)** | 13.00 | 2.00 |

## 4. Conclusions

This research evaluated the effect of Hybrid ChemConcrete-WP (a commercially available, hybrid integral waterproofing admixture) on the air content, water absorption, water contact angle, compressive strength, flexural strength, and chloride resistance of conventional OPC concrete. The water absorption tests results were also compared with the existing literature on similar waterproofing admixtures. The main finding of this technical research is summarized below.

Water absorption rate of 28-day cured concrete treated by H y b r i d ChemConcrete-WP waterproofing admixture reduced from 6.38% to below 1%, and the developed concrete met the requirements of waterproof concrete. The comparison showed that the second most effective commercial waterproofing admixture (among six other waterproofing admixtures) reduced the water absorption rate of concrete from 6.38% to 5.01% and did not meet the requirements of waterproof concrete.

Hybrid ChemConcrete-WP waterproofing admixture increased the water contact angle of concrete from 0 º to 93 º and developed a hydrophobic concrete. Compressive and flexural strengths of concrete increased from 41 MPa to 48 MPa and from 5.50 MPa to 6.30 MPa, respectively, when ChemConcrete-WP was used.

Chloride resistance of concrete treated by ChemConcrete-WP was significantly increased in comparison to the untreated control concrete. After 90 days of immersing the specimens inside 5% NaCl solution, the untreated and treated concrete with ChemConcrete-WP experienced a strength reduction of 13% and 2%, respectively.

It is concluded that ChemConcrete-WP waterproofing admixture has substantial impact on reducing the water absorption rate and developing a waterproof and durable concrete while simultaneously improving the strength properties of concrete. The findings of this research are in line with the claims made by ChemConcrete-WP manufacturer.

## Funding

Authors confirm that this research received no substantial funding or grant.

## Acknowledgement

The authors wish to express their gratitude to Chem Concrete Pty Ltd in Australia for their materials supply and technical assistance throughout the research project.

## References

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| BFRM<br>BIN FADEL AL HAZROUEI READY MIX - Sole P. L.L.C. | QHSE FORMS | BFRM-F QHSE 119 |
|---|---|---|
| | | Version: 01 |
| | MIX DESIGN REVIEW FORM | Page 1 of 1 |
| | | Approval Date: 03-11-2021 |

**Trial Mix Worksheet**

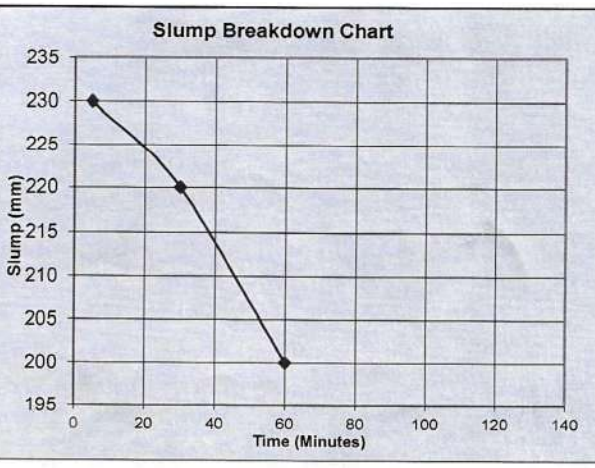
| | | | | |
|---|---|---|---|---|
| **Date :** | 21-Sep-23 | **TIME:** 12:15 PM | **Mix Code:** | **LTM:** 232 |
| **Customer :** | Bin Fadel Ready Mix | | | |
| **Client :** | Na | | | |
| **Project :** | Lab Trial Mix | | | |
| **Consultant :** | Na | | | |
| **Grade :** | C40/50 OPC+60%GGBS+5%MS+WP | | | **W/C =** 0.35 |
| **Trial Purpose:** | Internal Lab Trial Mix - To Verify The Strength & Workability of Mix Design | | | |

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Material** | **Source** | **Type** | **SSD** | **Moisture %** | **Absorption %** | **Net Water (4-5) %** | **Excess Wt. (6x8)/100 Kg/M$^3$** | **SSD Wt. Design Mix Kg/M$^3$** | **Corrective Design Mix Kg/M$^3$** | **Trial Mix For Plant (0.03 M$^3$)** |
| **Cement** | Emirates | OPC | **20mm** | **33.95%** | | **5mm** | **30.50%** | 290 | 290 | 8.70 |
| **GGBS** | Emirates Cement | Slag | **10mm** | **18.04%** | | **5mm** | **0.00%** | 110 | 110 | 3.30 |
| **MS** | Silica Trading | S.Fumes | **DS** | **17.51%** | | **Tot. Agg** | **1885** | 10 | 10 | 0.30 |
| **20.0mm** | Riyad Dhank - Oman | Crushed | 2.72 | 0.00 | 0.90 | -0.90 | -5.76 | 640 | 634.24 | 19.03 |
| **10.0mm** | Riyad Dhank - Oman | Crushed | 2.70 | 0.00 | 0.90 | -0.90 | -3.06 | 340 | 336.94 | 10.11 |
| **5.0mm** | W.B.G Crusher | Crushed (limestone) | 2.69 | 0.70 | 1.30 | -0.60 | -3.45 | 575 | 571.55 | 17.15 |
| **5.0mm Wash** | | | | | | | | | | |
| **Dune Sand** | Al Ain Municipality | Natural | 2.64 | 0.90 | 0.90 | 0.00 | 0.00 | 330 | 330.00 | 9.90 |
| | | | | | | | | | | |
| Total Excess Water Due To Moisture | | | | | | | * | -12.27 | | |
| Note: * If The Value is Negative then Add To Free Water, Else Subtract From Free Water | | | | | | | | | | |
| Free Water | | | | | | | | 145.0 | | |
| Net Water | | | | | | | | | 157.27 | 4.72 |
| Admix 1 - **Sika Plast 750** | | | | | | | | 4.00 | 4.0 | 0.120 |
| Admix 2 - **Sample 182 N (waterproofer)** (Australia) Chem - 1000 | | | | | | | | 4.00 | 4.0 | 0.120 |
| Admix 3 - | | | | | | | | 0.00 | 0.0 | 0.00 |
| Theoretical Density | | | | | | | | 2448 | 2448 | |

| BFRM<br>BIN FADEL AL MAZROUEI READY MIX - Sole P. L.L.C. | QHSE FORMS | BFRM-F QHSE 119 |
|---|---|---|
| | | Version: 01 |
| | MIX DESIGN REVIEW FORM | Page 1 of 1 |
| | | Approval Date: 03-11-2021 |

## Slump Breakdown

| Frequency | Checking Time | Slump mm |
|---|---|---|
| @ 5 Initial Slump | 12:20 PM | 230 |
| @ 30 minutes | 12:45 PM | 220 |
| @ 60 minutes | 1:15 PM | 200 |
| @ 90 minutes | | |
| @ 120 minutes | | |
| | | |
| | | |
| | | |
| | | |




| Additional Information | | Compressive Strength | | |
|---|---|---|---|---|
| Slump Required at Site | 150±25 | Age | No. of Cubes- 14 | Due Date |
| Actual Wet Density (Yield) | 2440 Kg/M$^3$ | 1 day | - | 22-Sep-23 |
| Humidity | % | 3 days | 2 | 24-Sep-23 |
| Air Voids | 3.0 % | 7 days | 2 | 28-Sep-23 |
| Water Temperature | °C | 14 days | - | 5-Oct-23 |
| Concrete Temperature | °C | 28 days | 2 | 19-Oct-23 |
| | | 56 days | - | 16-Nov-23 |
| | | | | |
| | | | | |
| Ambient Temperature | °C | | | |
| Trial Mix Evaluation: | | | | |
| Setting Time: | | | | |
| Remarks : | | | | |

## Additional Tests Required

| Purpose | Test | Standard | DATE | Age | No. of Cubes | Client Specification | Cube Size (mm) |
|---|---|---|---|---|---|---|---|
| Durability Test | Water Penetration (mm) | DIN 1048 | 19-Oct-23 | 28 | 2 | NA | 150x150x150 |
| | Water Absorption (%) | BS 1881 Part 122 | 19-Oct-23 | 28 | 2 | NA | 150x150x150 |
| | Rapid Chloride Permeability (Coulombs) | ASTM:C1202 | 19-Oct-23 | 28 | 2 | NA | 150x150x150 |
| | Chloride Migration | --- | - | - | - | - | - |
| | Porosity | CPC 11.1 | - | - | - | - | - |
| | Chloride (%) | BS 1881 Part 124 | - | - | - | - | - |
| | Sulphate (%) | BS 1881 Part 124 | | | | | |
| | ISAT (ml/m$^2$/s) | BS1881:PART 208 | 19-Sep-23 | 28 | 2 | NA | 150x150x150 |

Lab Technician
Nihas N

Verified By: Q.C.Engineer
Abdul Rahoof

Reviewed By: Tech. Manager
Pradeep Kumar

| BFRM | QHSE FORMS | BFRM-F.QHSE 187 |
|---|---|---|
| | WORKSHEET FOR COMPRESSIVE STRENGTH OF CONCRETE CUBES | Version : 04 |
| | | Page 1 of 1 |
| | | Approved Date : 29/03/2023 |

Customer Name : BFRM

Project Name : LAB TRIAL MIX

Delivery Note No. : NA

Casting Date : 21-9-23

Batch Time(hh:mm) : 12:15PM

Slump / Flow(mm) : 200

Nominal Size of Specimen (mm): 150

Class of Concrete : 40/50 OPC + GGBS + PFA + MS + WP

Load Applied Direction : Perpendicular to Casting Face

Element Cast : Inhouse cube LTM

Removal of Grift / Extraneous Material : NO FINES

No.of Specimen : 6

Condition of the Specimen : Satisfactory / Unsatisfactory ✓

Curing Condition : BS EN 12390 - 2 :2019

Volume Determination : Calculation (using actual measurements) / Calculation (checked,designed size)

| Cube No. | Test Date | Age of Test (Days) | Average Dimensions (mm) | | | Weight (kg) | Cross Sectional Area ($mm^2$) | Volume of Specimen ($m^3$) | Density ($kg/m^3$) | Max. Load at Failure (KN) | Compressive Strength ($N/mm^2$) | Type of Failure |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Length | Width | Height | | | | | | | |
| 1 | 24-9-23 | 3 | 150<br>150<br>150 | 150<br>150<br>150 | 150<br>150<br>150 | 8.318 | 22500 | 0.003375 | 2463 | 877 | 38.67 | S |
| 2 | " | 3 | 150<br>150<br>150 | 150<br>150<br>150 | 150<br>150<br>150 | 8.298 | 22500 | 0.003375 | 2459 | 910 | 40.44 | S |
| 3 | 28-9-23 | 7 | 150<br>150<br>150 | 150<br>150<br>150 | 150<br>150<br>150 | 8.324 | 22500 | 0.003375 | 2466 | 996 | 44.28 | S |
| 4 | " | " | 150<br>150<br>150 | 150<br>150<br>150 | 150<br>150<br>150 | 8.337 | 22500 | 0.003375 | 2470 | 1018 | 45.26 | S |
| 5 | 11-10-23 | 20 | 150<br>150<br>150 | 150<br>150<br>150 | 150<br>150<br>150 | 8.329 | 22500 | 0.003375 | 2468 | 1011 | 44.92 | S |
| 6 | | " | 150<br>150<br>150 | 150<br>150<br>150 | 150<br>150<br>150 | 8.341 | 22500 | 0.003375 | 2471 | 915 | 40.67 | S |

* S - satisfactory

Sampling Method : BS EN 12350 - 1 :2019

Test Specimen Preparation : BS EN 12390 Part - 2 :2019 Cls.6

Test Method : BS EN 12390 - 1 :2021 / BS EN 12390 - 3 :2019/ BS EN 12390 - 7 :2019

Test Method Variation : None

Remarks : None

Equipment Ref No. : 1) BF-CM-02
2) 1420130286
3) C1006081258
4) QTS-0027-22-TH

Calibration Status : ☑ Yes / ☐ No

Room Temp. ($^0$c) :

**Tested by:**
Laboratory Technician

**Checked by**
Lab Engineer/ Lab Supervisor

| BFRM | QHSE FORMS | BFRM-F.QHSE 187 |
|---|---|---|
| | WORKSHEET FOR COMPRESSIVE STRENGTH OF CONCRETE CUBES | Version : 04 |
| | | Page 1 of 1 |
| | | Approved Date : 29/03/2023 |

Customer Name : BFRM

Project Name : LAB TRIAL MIX (LTM-23.1)

Delivery Note No. : NA

Casting Date : 21-9-23

Batch Time(hh:mm) :

Slump / Flow(mm) :

Nominal Size of Specimen (mm): 150

Class of Concrete : 40/20 OPC + WP

Load Applied Direction : Perpendicular to Casting Face

Element Cast : (LTM) INHOUSE CUBE

Removal of Grift / Extraneous Material : NO FINS

No.of Specimen :

Condition of the Specimen : Satisfactory ✓ / Unsatisfactory

Curing Condition : BS EN 12390 - 2 :2019

Volume Determination : Calculation (using actual measurements) / Calculation (checked,designed size)

| Cube No. | Test Date | Age of Test (Days) | Average Dimensions (mm) | | | Weight (kg) | Cross Sectional Area ($mm^2$) | Volume of Specimen ($m^3$) | Density ($kg/m^3$) | Max. Load at Failure (KN) | Compressive Strength ($N/mm^2$) | Type of Failure |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Length | Width | Height | | | | | | | |
| 1 | 20-10-23 | 29 | 150 | 150 | 150 | 8.296 | 22500 | 0.003375 | 2458 | 1221 | 54.31 | S |
| | | | 150 | 150 | 150 | | | | | | | |
| | | | 150 | 150 | 150 | | | | | | | |
| 2 | " | 11 | 150 | 150 | 150 | 8.292 | 22500 | 0.003375 | 2456 | 1100 | 48.91 | S |
| | | | 150 | 150 | 150 | | | | | | | |
| | | | 150 | 150 | 150 | | | | | | | |
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* S - satisfactory

Sampling Method : BS EN 12350 - 1 :2019

Test Specimen Preparation : BS EN 12390 Part - 2 :2019 Cls.6

Test Method : BS EN 12390 - 1 :2021 / BS EN 12390 - 3 :2019/ BS EN 12390 - 7 :2019

Test Method Variation :

Remarks :

Equipment Ref No. : 1) BF-CM-02
2) 1420130286
3) C1006081258
4) QTS-0027-22-TH

Calibration Status : ☐Yes / ☐No

Room Temp. ($^0$c) :

**Tested by:**
Laboratory Technician

**Checked by**
Lab Engineer/ Lab Supervisor

| BFRM | QHSE FORMS | BFRM-F.QHSE 185 |
|---|---|---|
| | | Version 04 |
| | WORKSHEET FOR DETERMINATION OF INITIAL SURFACE ABSORPTION OF CONCRETE | page 1 of 1 |
| | | Approval Date 29/03/2023 |

Sample No : NA Sampling Date : 21-09-23

Class of Concrete : C 40/50 OPC + 60% GGBS + 5% MS + WP (4kg/m³)

Casting Date : 21-09-23 Date / Time of Test : 20-10-23 (4:35PM)

Place of Test : BFRM LAB Age of Test : 28

Description of the Surface of concrete : SATISFACTORY Area of Water Contact (mm²) : 5408

Orientaion of the test suface : HORIZONTAL Dimention of the cap (mm) : 83

Details about the conditioing of specimen : BSEN 12390-3-2019 Length of Capillary tube (mm) : 460

Method of Sealing the Cap : CLAMPED

Date /Time Conditioning Started : 20-10-23 (4:20 PM) Conditioning temperature (°C) : 21.2

Date / Time Conditioning Completed : 20-10-23 (4:35 PM) Water temperature (°C) : 21.8

| Specimen Id | Time of Test | Temperature of concrete surface(°C) | Elapsed Time (min) | No of Scale Divisons in 5 sec. | Period During Which Movement Measured | No of Scale Divisons Moved | No of Scale Divisons in 1 min. | Initial Surface Absorption | Absorption Corrected to Equivalent 20 °C |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 4:35PM | 21.2 | 10 | < 3 | 2 min | 02 | 01 | 0.01 | 0.01 ✓ |
| | | | 30 | | | | | | |
| | | | 60 | | | | | | |
| 2 | 4:50 PM | 21.3 | 10 | < 3 | 2 min | 01 | 0.5 | 0.005 | 0.005 ✓ |
| | | | 30 | | | | | | |
| | | | 60 | | | | | | |
| | | | 10 | | | | | | |
| | | | 30 | | | | | | |
| | | | 60 | | | | | | |

Sampling Method : BS EN 12350 Part - 1 :2019 Calibration Status : ☑Yes / ☐No

Test Specimen Preparation : BS 1881 Part 208: 1996 Cls 8.1.3 Equipment Ref. No : 1) ISAT2016BF 01

Test Method : BS 1881 Part 208: 1996 Cls 8.1.3 2)

Test Method Variation : None 3)

Remarks : NONE

**Tested By**
Laboratory Technician

**Checked By**
Lab . Engineer /Lab. Supervisor

**Testing Date:** 20-10-23

| BFRM | QHSE FORMS | BFRM-F.QHSE 245 |
|---|---|---|
| | | Version: 00 |
| | REPORT ON INITIAL SURFACE ABSORPTION TEST | Page 1 of 1 |
| | | Approval Date:29/03/2023 |

Report No : NA

Sample No. : NA

Project Name : LAB TRIAL MIX (LTM 232)

Sampled By : BFRM Rep.

Client Name : NA

Consultant : NA

Customer : BFRM

Sample Description : Concrete Cubes

Source : Bin Fadel Ready Mix

Class of Concrete : 40/50 OPC + 601.6 GGBS + 51.ms + (W.P 4kg/m³)

Location : BFRM LAB

Method of Compaction : By Hand

Date of Casting : 21-9-23

Curing Condition : BSEN 12390 Part 2 :2019

Date Specimen Received : 21-9-23

Place of Test : BFRM LAB

Date Test Required : 20-10-23

Specimen Condition Prior to Test : Done

Date of Test : 20-10-23

Orientation of Test Surface : Horizontal

Age of Test : 28 Days

Area of Water Contact of Cap($mm^2$) : 5408

Diameter of Cap(mm) : 83

Length of Capillary Tube(mm) : 460

Method of Sealing the Cap : Clamped

Description of the Concrete Surface Under Test : Cast surface of the cube having smooth finish without cracks, voids & honey combing.

| Specimen id | 1 | | 2 | | 3 | |
|---|---|---|---|---|---|---|
| Time of Test | 4:35 | | 4:50 PM | | | |
| Temp. of Concrete Surface(°C) | 21.2 | | 21.3 | | | |
| Initaial Surface Absorption(ml/$m^2$-sec) | Actual | Corrected to 20°C | Actual | Corrected to 20°C | Actual | Corrected to 20°C |
| @ 10 mins | 0.01 | 0.01 | 0.005 | 0.005 | | |
| @ 30 mins | This concrete is too impermeable to be sensitive for a longer term test. | | | | | |
| @ 60 mins | | | | | | |

Testing Date : 20/10/23 - 20/10/20

Certificate of Sampling, Specimen Preperation & Site Curing : Not Given

Sampling Method : BSEN 12350 Part 1 :2019

Test Specimen Preparation : BS 1881 Part 208 :1996 Cls8.1.3

Test Method : BS 1881 Part 208 :1996 Cls8.1.3

Test Method Variation : None

Remarks : Report Shall Not be Reproduced Without Written Approval of Laboratory .

**Tested By**

Lab Technician

**Checked by**

Lab Engineer/Lab Supervisor

| BFRM – شركة بن فاضل المزروعي للخرسانة الجاهزة ذ.م.م BIN FADEL AL MAZROUEI READY MIX - Sole P. L.L.C. | QHSE FORMS | BFRM-F.QHSE 184 |
|---|---|---|
| | | Version : 04 |
| | WORKSHEET FOR DETERMINATION OF WATER PERMEABILITY TEST (DIN) | Page 1 of 1 |
| | | Approval Date 29/03/2023 |

Sample No : NA Age of Test : 28

Class of Concrete : 40/50 OPC +GGBS 51.MS + (W.P 4kg) Casting Date : 21-9-23

Appearance of Specimen When Received : SATISFACTORY

Condition of storage & curing until testing : BSEN 12390 - 2 - 2019

Direction of application of water pressure with respect to casting direction : PERPENDICULAR

Surface Treatment : DONE BY BFRM

Date/ time pressure application started : 19-10-23 (7:00 PM)

Date/ time pressure application completed : 22-10-23 (7:10 PM)

Applied pressure, bar : 5 NO's

| Specimen ID | 1 | 2 | 3 |
|---|---|---|---|
| Dimensions (mm) | 150 x 150 x 150 | 150 x 150 x 150 | 150 x 150 x 150 |
| Maximum Depth of Penetration (mm) | 4 | 3 | |
| Average Penetration (mm) | 3.5 | | |

Sampling Method : BSEN 12350 Part -1 :2019 Equipment Ref. No : 1) BF-AVC-01

Test Specimen Preparation : DIN 1048 Part 5 : 1991 Cls 6.4 Calibration Status : ☑ Yes / ☐ No

Test Method : DIN 1048 Part 5 : 1991 Cls 7.6

Test Method Variation : NONE

Remarks : NONE

**Tested By**
Laboratory Technician

**Checked By**
Lab. Engineer /Lab. Supervisor

**Testing Date:** 22-10-23

BFRM
BIN FADEL READY MIX - SOLE P.L.L.C.

# QHSE FORMS

Reference No.

## DETERMINATION OF WATER ABSORPTION OF CONCRETE

Test Method : BS 1881 Part 122 : 2011+A1:2020

| Date (dd/mm/yy) | |
|---|---|
| Start | Finish |
| 25-10-23 | 29-10-23 |

**Customer:** BIN FADEL READY MIX

**Project Name:** LAB TRIAL MIX (LTM-232) USING SAMPLE 182 N (WATER PROOFER) 4 Kg /m³ [CHEM 1000]

**Type of Specimen:** ☐ Core from structure ☑ Core from casted cube ☐ Casted Cube ☐ Casted Cylinder

| Spec. Id | Dimensions (nearest 1mm) Diameter (75 ± 3) 00 | Dimensions (nearest 1mm) Length (32 to 150) 000 | Orientation Relative to Structure | Condition of Specimen when received (compaction, voids and honeycombing) | Volume (mm³) | Surface Area (mm²) | Specimen Weight (g) After Drying & Cooling | Specimen Weight (g) After 30 ± 0.5min immersing | Oven Dry Density (kg/m³) Nearest 10 | Measured absorption (%) 0.0 | Correction factor 0.00 | Corrected Absorption (%) 0.0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 73.0 | 151.0 | - | SATISFACTORY | 631993 | 43000/ | 1499.4 | 1509.4 | - | 0.67 | 1.17/ | 0.78 |
| 2 | 73.0 | 150.3 | - | SATISFACTORY | 629064 | 42840 | 14762 | 1486.6 | - | 0.70 | 1.17 | 0.82 |
| | | | | | | | | | | | Average | 0.8 % |

**Details of reinforcement (if any.):**

$$\text{Correction factor} = \frac{\text{Volume}(mm^3)}{12.5 \times \text{surface area}(mm^2)}$$

**Condition of Storage & Curing until test date**

Curing Method: ☑ Water ☐ Moist Air

Temperature: 20±2 °c

**Date Concrete Produced (dd/mm/yy):** 21-10-2023

**Age at start of Absorption Test (days):** 24 (28 to 32)

| Preparation prior to Immersion Test | Date & Time Start | Date & Time Finish | Duration (hr) |
|---|---|---|---|
| Drying (72 ± 2hr) | 25-10-23 (11:30 AM) | 28-10-23 (11:30 AM) | 72 HRS |
| Cooling (24 ± 0.5hr) | 28-10-23 (11:30 AM) | 29-10-23 (11:30 AM) | 24 HRS |

**Density is determined according to BS EN 12390-7 & Dimension is determined According to BS EN 12390-1**

**Volume determined by :** ☑ Measurement ☐ Water Displacement

**Apparatus**

Caliper : ✓

Balance : ✓

Oven : ✓

**REMARKS:**

| Tested By | | Checked By | | Witnessee | | |
|---|---|---|---|---|---|---|
| Date | 29-10-23 | Date | | Name | | |
| | | | | Initial | | |

RMIT UNIVERSITY

**School of Engineering**
**STEM College**
GPO Box 2476
Melbourne VIC 3001
Australia
Tel. +61 3 9925 5776

5th May 2024

**Re: Testing for of ChemConcrete Hybrid Admixture**

Acid, chloride, and sulphate resistance tests were performed on Portland cement-based concrete specimens (untreated and treated mixes with ChemConcrete Waterproofing Admixture) per ChemConcrete Pty Ltd request. The test results are presented in Table 1. Please contact me if you require additional information.

Yours sincerely,

**Dr Mohammad Saberian**

***B.Eng, M.Eng, PhD***
**Lecturer at School of Engineering**
**RMIT University**
**T: +613 9925 5776**
**E: mohammad.saberian@rmit.edu.au**

Table 1. Acid, sulphate, and chloride resistance of concrete with and without ChemConcrete WP Admixture (Conducted at RMIT University).

| **Designation** | | **Mass loss (%)** | **Compressive strength reduction (%)** |
|---|---|---|---|
| **2% Acid ($H_2SO_4$)** | Untreated concrete | 8.77 | 61 |
| | ChemConcrete | 2.42 | 22 |
| **5% Sulphate ($Na_2SO_4$)** | Untreated concrete | 0.530 | 12 |
| | ChemConcrete | 0.083 | 3 |
| **5% Chloride (NaCl)** | Untreated concrete | 0.51 | 13 |
| | ChemConcrete | 0.094 | 3 |

**MAHAFFEY ASSOCIATES PTY LTD**
Unit 9/108-110 Percival Rd (PO Box 2162) Smithfield NSW 2164
Ph: (02) 9756 4003 Email: admin@mahaffey.com.au
ABN: 90 001 629 036

NATA
WORLD RECOGNISED ACCREDITATION

***Client:*** Hy Tec
***Job Number:*** 20401
***Details:*** 68923
N502B80C-S50 MPa Control

***Test Method:*** Determination of chloride and sulfate in hardened concrete and aggregates Nitric acid extraction method AS 1012.20.1

***Cast Date:*** 1/07/2024
***Received Date:*** 2/07/2024
***Test Date:*** 24/07/2024

## ***Chloride Test Report***

| ***Specimen*** | ***Depth (mm)*** | | ***$Cl^-$ (% w/w Specimen)*** |
|---|---|---|---|
| | ***From*** | ***To*** | |
| 68923 | - | - | <0.001 |

Notes: Specimens prepared in this laboratory using AS1012 Method 20.1 – 2016 Section 6
Work covered by Clause 7 of the standard by NATA accredited facility no. 1884

Signed: _____

David Wilmshurst
Approved Signatory
Date of Issue: 24/07/2024

**Accredited for compliance with ISO/IEC 17025 - Testing**

**MAHAFFEY ASSOCIATES PTY LTD**
Unit 9/108-110 Percival Rd (PO Box 2162) Smithfield NSW 2164
Ph: (02) 9756 4003 Email: admin@mahaffey.com.au
ABN: 90 001 629 036

NATA
WORLD RECOGNISED ACCREDITATION

***Client:*** Hy Tec
***Job Number:*** 20401
***Details:*** 68924
N502B80C-S50 MPa Waterproofing

***Test Method:*** Determination of chloride and sulfate in hardened concrete and aggregates Nitric acid extraction method AS 1012.20.1

***Cast Date:*** 1/07/2024
***Received Date:*** 2/07/2024
***Test Date:*** 24/07/2024

## ***Chloride Test Report***

| ***Specimen*** | ***Depth (mm)*** | | ***$Cl^-$ (% w/w Specimen)*** |
|---|---|---|---|
| | ***From*** | ***To*** | |
| 68924 | - | - | <0.001 |

Notes: Specimens prepared in this laboratory using AS1012 Method 20.1 – 2016 Section 6
Work covered by Clause 7 of the standard by NATA accredited facility no. 1884

Signed: _____

David Wilmshurst
Approved Signatory
Date of Issue: 24/07/2024

**Accredited for compliance with ISO/IEC 17025 - Testing**

## CONCLUSIONS

**In conclusion, independent testing results show that ChemConcrete Hybrid Admixture provides permanently waterproof concrete with significantly improved fresh, strength, and durability properties compared to untreated concrete and concrete treated with other commercial waterproofing admixtures. Depending on the dosage of the admixture used, concrete treated with ChemConcrete Admixture provides significantly higher compressive strength, lower water absorption rate and permeability, and doubled to tripled service life compared to untreated concrete or concrete treated with some other similar admixtures. Contact CHEM CONCRETE's team for detailed "Life-Cycle Cost", "Environmental Impact Analysis", and more testing reports.**

## Contact Info


**Headquarter office: 16 Caird Place, Seven Hills, NSW, 2147, Australia.**

**Distribution warehouse: 27, 45 Powers Road, Seven Hills, NSW, 2147.**

**www.chemconcrete.com.au**

**sales@chemconcrete.com.au**

**+61-4-2-388-1091**

**+61-4-8-169-1552**

**+61-4-0-133-5611**


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