

# **XYPEX AUSTRALIA**

## **PLASTIC AND HARDENED STATE PROPERTIES OF XYPEX ADMIX C-1000NF MODIFIED COMMERCIAL CONCRETES**

*AUSINDUSTRY START RESEARCH PROJECT*

**By Gary Kao  
B.Mat.E, MSc, UNSW  
Research Engineer**

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## 1. INTRODUCTION

A substantial research program was undertaken at the The Australian Centre for Construction Innovation of the University of New South Wales with financial support from AUSINDUSTRY under a START Graduate Research Grant. The primary aim of this research was to determine the benefits resulting from the use of Xypex Admix C-1000NF as an integral component of concrete required to demonstrate superior durability in aggressive environments.

This program used commercial concretes which contained conventional water reducing admixture, different types of supplementary cementitious materials and Xypex Admix C-1000NF at various dose rates,

This brief abstract only outlines the plastic and hardened state properties of commercial concretes modified with Xypex Admix C-1000NF at various dose rates. These properties included **slump**, **setting time**, **compressive strength**, and **drying shrinkage**. The test results showed minor to moderate set extension and similar plastic state concrete properties. Xypex Admix modified concretes showed higher compressive strengths and similar to, or lower drying shrinkage.

## 2. MATERIALS

To minimise the difference in performance between “lab concrete” and “site concrete”, and to ensure relevance for construction applications, commercial concrete batches were used in this research. One of three types of cement was used in each of the concrete mixes, i.e. AS3972 Type-GP (SL) Portland cement only, or AS3972 Type-GB fly ash blend with 20% fine fly ash (Type F) or AS3972 Type-GB slag blend with approximately 38% slag.

All concrete batches were supplied by a ready-mix plant based on 32 MPa grade commercial concrete mixes. AS1478.1 Type-WR (neutral set) admixture was added as required to achieve a target slump of 80mm. Xypex Admix C-1000NF was dosed at 0.8% or 1.2% in accordance with manufacturer’s directions.

### 3. TEST RESULTS AND DISCUSSIONS

Test results are summarised and shown in Table 3-A.

**Table 3-A Summary of Test Results**

Mix Code	W/C Ratio	Cement Type and Content (kg)	Xypex Admix C-1000NF (% of Cement Content)	Setting Time	Compressive Strength		Drying Shrinkage
					3 days	28 days	
GPC	0.55	GP (330)	Nil	Control	24.1	43.8	648
GPX1	0.55	GP (330)	0.8%	+0.5~1 hr	26.1	46.0	643
GPX2	0.55	GP (330)	1.2%	+1.5~2 hrs	27.2	46.8	649
FAC	0.50	20% Fly Ash (360)	Nil	Control	25.4	42.0	568
FAX1	0.50	20% Fly Ash (360)	0.8%	+2~2.5 hrs	25.4	44.6	486
FAX2	0.50	20% Fly Ash (360)	1.2%	+3.5~4 hrs	26.1	44.9	500
SC	0.55	38% Slag (330)	Nil	Control	17.4	40.2	597
SX1	0.55	38% Slag (330)	0.8%	+2~2.5 hrs	17.8	42.7	595

#### **3.1 Slump (AS1012.3):**

Xypex Admix C-1000NF was found to have no adverse effects on concrete slump and workability. The actual slump of concrete batches tested at the ACCI laboratory was in the range of 70mm to 95 mm on delivery from the concrete plant.

#### **3.2 Setting Time (AS1012.18):**

Xypex Admix modified concrete mixes had minor to moderate extensions in setting times compared to the control mixes. Actual concrete setting time in construction will be influenced by conditions such as: humidity, ambient temperature, wind speed and physical properties of aggregates, etc.

#### **3.3 Compressive Strength (AS1012.9):**

**Xypex Admix modified Type-GP (SL) concrete:**

- A) At age 3 days, compressive strengths were higher than the control by 8 to 13%;

B) At age of 28 days, mixes recorded up to 7% higher strengths than the control.

**Xypex Admix modified Type-GB 20% fly ash (Type F) concrete:**

- A) At age of 3 days, compressive strengths were higher than the control by up to 3%;
- B) At 28 days, compressive strengths showed an increase of 7% over the control.

**Xypex Admix modified Type-GB 38 % slag concrete:**

- A) At age of 3 days, compressive strengths were higher than the control by up to 2%;
- B) At age of 28 days, compressive strengths were higher than the control by up to 6%.

Overall, Xypex Admix modified concrete mixes have shown higher compressive strength at all ages compared with the control mix. Two factors could be taken into consideration for strength increases on Xypex Admix modified concrete:

- (1) Xypex Admix modifies the microstructure of concrete through crystallisation in pore and capillary systems, effectively reducing the total volume of permeable voids.
- (2) Set extension on Xypex Admix modified concretes.

**3.4 Drying Shrinkage (AS1012.13):**

Xypex Admix modified Type-GP (SL) or Type-GB (38% slag) concretes had equal to or slightly improved performance on drying shrinkage compared with the control. Xypex Admix modified Type-GB 20% fly ash, (Type F) had significant lower drying shrinkage (by up to 14%) in comparison with the control mix.

**4. CONCLUSION:**

This brief report outlines the plastic and hardened state properties of Xypex Admix C-1000NF modified concretes. Two dosage rates (0.8% and 1.2%) were used with three types of cement in commercial concretes with nominal strength of 32MPa. The test results and conclusions are summarised with respect to cement type as follows, except for minor to moderate set extension plastic state concrete properties were equal to or slightly improved with Xypex Admix C-1000NF.

1. For **Type-GP (SL) cement concretes**, mixes modified with Xypex Admix C-1000NF have shown from modest to significant improvements in hardened state properties:
  - i.* No adverse effects on concrete slump and workability;
  - ii.* Minor set extension;
  - iii.* Early age strength gains by up to 13% compared with control;
  - iv.* High dose rate (at 1.2%) of Xypex Admix C-1000NF has resulted in further increases in compressive strength compared with concrete modified with Xypex Admix C-1000NF at the dosage rate of 0.8%;
  - v.* Drying shrinkage was similar to the control concrete
  
2. For **Type-GB cement concretes (using 20% fly ash, Type F)**, concretes modified with Xypex Admix C-1000NF have shown modest to significant improvements in hardened state properties.
  - i.* No adverse effects on concrete slump and workability;
  - ii.* Moderate set extension;
  - iii.* Early age strength gains by up to 3% compared with control;
  - iv.* Later age strength (at 365 days) had increased significantly, especially at the higher dose rate (1.2%), by up to 19% compared with control;
  - v.* Drying shrinkage was reduced significantly by up to 14% compared with control.
  
3. For **Type-GB cement concrete (using 38% slag)**, concretes modified with Xypex Admix C-1000NF have shown modest to significant improvements in hardened state properties:
  - i.* No adverse effects on concrete slump and workability;
  - ii.* Minor to moderate set extension;
  - iii.* Strengths at all ages showed improvements over the control;
  - iv.* Drying shrinkage showed a slight improvement over the control concrete.

Test results confirm that Xypex Admix C-1000NF was compatible with both Portland and blended cement concretes which also contained a typical neutral set water reducing admixture. Overall, Xypex Admix C-1000NF has demonstrated no adverse effects on general properties of concrete in both its plastic and hardened state.