

Technical Circular T-5/95
March 10, 1995

TO: All Headquarters Directors, Prof. Services, Planning & Major Projects
All Regional Directors
All Regional Managers, Prof. Services, Planning & Operations
All District Highways Managers

SUBJECT:

CONCRETE ADDITIVES - SUMMARY OF TYPES AND USES

PURPOSE:

To inform Ministry staff as to the range of concrete admixtures currently used in British Columbia, and to provide general guidelines for appropriate use.

BACKGROUND:

The current edition of MOTH Standard Specifications for Highway Construction Section 211 "Portland Cement Concrete" was written in 1992 for the manufacture of plain concrete. Reference is made therein to Section 314 "Admixtures for Portland Cement Concrete". This latter section, written in 1985, discusses only Pozzolan admixtures, referring to CSA standards for details of air-entraining and chemical admixtures.

Many MOTH field staff do not have access to a set of current CSA standards. This Technical Circular is intended to summarize the range of admixtures now in common use in B.C. and will serve as an interim guide until Section 314 of the Standard Specifications is updated.

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E.A. Lund, P.Eng.
Chief Highway Engineer

Attachment

CONCRETE ADDITIVES - SUMMARY OF TYPES AND USES

1.0 ADMIXTURE TYPES

The main categories of admixture are described in the following section. The names of some commonly-used products are listed at the end. This list is for illustration only, and may not represent the complete range of products on the market.

1.1 Cement Types

Although not truly admixtures, the various types of portland cement, other than Type 10 (Normal) portland cement, are sometimes treated as if they belonged to such a category. Types 20 (Moderate), 30 (High Early Strength), 40 (Low Heat of Hydration), and 50 (Sulphate Resistant) portland cements are seldom encountered in Ministry use.

1.2 Cement Replacements

1.2.1 Pozzolans

Pozzolans, naturally-occurring volcanic ash, are used as an admixture to portland cement. The pozzolan combines with the water-soluble free lime (CaO) from the portland cement, providing additional strength while reducing expansion and permeability of the hardened concrete. Section 314 refers to Type N for natural ash, and Type F for flyash (see below). Sometimes, pozzolans are marketed with combinations of properties, to act as retarders, etc. Current Ministry policy does not permit the use of pozzolans in bridge decks.

1.2.2 Flyash

Flyash is a man-made pozzolan, recovered from coal-burning thermal generating plants. Type F flyash is produced when anthracite, bituminous or sub-bituminous coal is burned; it is generally low in lime, giving lower heat of curing and sulphide and sulphate resistance similar to Type 50 portland cement. Type C flyash comes from lignite or sub-bituminous coal; their higher lime content gives them self-hardening properties, making them more useful for high early strength concrete. In its dry form, flyash is more absorbent and flows more easily than portland cement. Trial mixes must be carried out on each type of flyash to determine the flyash:cement replacement ratio - usually greater than 1:1.

1.2.3 Silica Fume

Silica fume, also known as condensed silica fume, volatilized silica or microsilica, is a byproduct of electric arc furnaces. It behaves as a pozzolan due to its extreme fineness and high silica content.

CONCRETE ADDITIVES - SUMMARY OF TYPES AND USES

1.3 Accelerators and Antifreeze Admixtures

Because calcium chloride increases heat of hydration, thus increasing the concrete temperature, it was often used to permit placing in unheated forms during the winter. The Ministry does not allow use of chloride admixtures because of corrosion problems.

Recently, other chemical "antifreeze" admixtures have been tried out, including: chlorides, nitrates, sulphates, carbonates, urea and polyglycolester.

1.4 Retarders

Retarding admixtures are used to control setting times and to reduce heat of hydration. They are most often used in hot weather, or in large monolithic pours. They are less often used to permit longer time for finishing of large slabs.

1.5 Air-Entrainment

The entrainment of a small amount of air in concrete, typically 4 to 8%, realize benefits, including: better workability, reduced segregation, reduced permeability and increased freeze/thaw resistance. Improper use of admixtures can cause either excessive air or "entrapped" air (where the air bubbles interconnect), both of which are harmful to concrete.

1.6 Water Reducers

Water reducing admixtures permit reduction of water in concrete mix without loss of slump, or an increase in slump without loss of strength. Some of these admixtures retard setting time of concrete, while others have little or no effect.

1.7 Superplasticisers

Superplasticisers are organic chemical admixtures classified as Category A (melamine based) and Category B (naphthalene based). As with water reducing admixtures mentioned above, superplasticisers may be used either to increase slump without loss of strength, or to retain slump while increasing strength. Superplasticisers are most commonly used where concrete is to be pumped to the forms. A plain concrete mix with a 75 mm slump could have the slump increased to 200 mm or more after addition of superplasticiser. The effect is short-lived, so superplasticiser is usually added to the ready-mix truck at the site. They should be used only where necessary, and the Ministry does not permit their use for bridge decks.

CONCRETE ADDITIVES - SUMMARY OF TYPES AND USES

1.8 Water Repellents

Integral water repellent admixtures based on stearic acid are occasionally used on floor slabs, brick mortar and other areas in industrial buildings. They would not normally be encountered in Ministry work.

2.0 DISCUSSION

Admixtures other than pozzolans or air entraining agents are not usually required for the typical small MOTH project. On larger projects, however, superplasticisers are essential where concrete is pumped. Where required by the project conditions, admixtures recognized by CSA can, if used properly, greatly improve the quality of concrete.

3.0 RECOMMENDATIONS

In the early phases of project planning, MOTH staff must obtain complete mix data, including a description of all admixtures, their brand names, dosage, purposes and precautions. No mix should be accepted prior to receiving complete data, regardless of how reputable the testing agency or ready-mix supplier. Most Ministry contracts contain a price item for trial mix preparation. This should be used to verify mix proportions, admixtures and materials on all but the smallest jobs. Questions regarding specific admixtures or their recommended dosage should be referred to the Regional Geotechnical and Materials Engineer, or to the Central Materials Laboratory in Victoria.

LIST OF TYPICAL PRODUCT NAMES

The B.C. Ministry of Transportation and Highways does not have a list of recognized concrete admixtures. Attached, as an interim guide, is a copy of an 8-page list of admixtures accepted by the Ontario Ministry of Transportation. The list was issued in 1992, but is believed to be still current.

CONCRETE
ADMIXTURES, CHEMICAL

DSM # 9.25.10
DATE 92 06 09

SPECIFICATION(S): OPSS 1303, (OPSS 1350, OPSS 904) PAGE 1 OF 5
DRAWING(S): N/A
CUSTODIAL OFFICE: ENGINEERING MATERIALS BIDDERS TENDERING QUERIES
CONCRETE (416) 235-3705 CAIL (416) 235-3550

SOURCE	NAME	M:NOTE 1:	RIDE:ADMIXTURE	25 C	105 C
	: PRODUCT **: MIN	: MEETS	:	:	:
	: DOSE	: REQ'T FOR:	:	:REL-	:
	:F: PER	:REQUIRED	:	: ATIVE:	SOLID
	:O:100 KG:	TYPE:NON-	:AIR	:DENSITY:	CONT
	:R:CEMENT:***	:CHLO:ENTRAINING:	AT	: AT	
	:M:NOTE 1:	:RIDE:ADMIXTURE	:	25 C	:105 C
AXIM CONCRETE	:CATEXOL	:L: 260	: WR : X	:CATEXOL	: 1.202 : 40.0
TECHNOLOGIES	:900R	:	:	:A.E. 160	:
CANADA INC	:	:	:	:CATEXOL	:
141 SHEARSON CRES:	:	:	:	:A.E. 260	:
CAMBRIDGE, ONT	:	:	:	:CATEXOL	:
NIT 1J3	:	:	:	:V.R.	:
(519) 622-5940	:	:	:	:	:
FAX(519)622-5893	:CATEXOL	:L: 260	: WN : X	:CATEXOL	: 1.207 : 45.0
	:700N	:	:	:A.E. 160	:
	:	:	:	:CATEXOL	:
	:	:	:	:A.E. 260	:
	:	:	:	:CATEXOL	:
	:	:	:	:V.R.	:
	:CATEXOL	:L: 260	: SN : X	:CATEXOL	: 1.201 : 40.0
	:900N	:	:	:A.E. 160	:
	:	:	:	:CATEXOL	:
	:	:	:	:A.E. 260	:
	:	:	:	:CATEXOL	:
	:	:	:	:V.R.	:
CONCHEM	:CONCHEM	:L: 325	: WN : X	:CONCHEM	: 1.191 : 40.0
180 MARKET DR	: 25 XL	:	:	: AES	:
MILTON, ONT	:	:	:	:PROAIR OR	:
L9T 3H5	:	:	:	:EVERAIR	:
(416) 821-3761	:	:	:	: PLUS	:
1-800-263-4110	:	:	:	:	:
FAX(416)876-4960	:PROKRETE R:	L: 285	: SR : X	:CONCHEM	: 1.210 : 41.0
	:	:	:	: AES	:
	:	:	:	:PROAIR OR	:
	:	:	:	:EVERAIR	:
	:	:	:	: PLUS	:
	:PROKRETE N:	L: 225	: SN : X	:CONCHEM	: 1.208 : 45.0
	:	:	:	: AES	:
	:	:	:	:PROAIR OR	:
	:	:	:	:EVERAIR	:
	:	:	:	: PLUS	:

CONCRETE
ADMIXTURES, CHEMICAL

DSM # 9.25.10
DATE 92 06 09

SPECIFICATION(S): OPSS 1303, (OPSS 1350, OPSS 904) PAGE 2 OF 5
DRAWING(S): N/A
CUSTODIAL OFFICE: ENGINEERING MATERIALS BIDDERS TENDERING QUERIES
CONCRETE (416) 235-3705 CALL (416) 235-3550

SOURCE	NAME	M:NOTE 1:	RIDE:	ADMIXTURE	25 C	105 C
	PRODUCT **:	MIN	MFETS			
	DOSE	REQ'T FOR:		REL-		
	F: PER	REQUIRED		ATIVE:	SOLID	
	O:100 KG:	TYPE:NON-	AIR	DENSITY:	CONT	
	R:CEMENT:***	CHLO:	ENTRAINING:	AT	AT	
CONCHEM CONT'D	PROTARD	L: 185	R	X	CONCHEM	1.205 : 35.5
					AES	
					PROAIR OR	
					EVERAIR	
					PLUS	
	PROTARD	L: 315	RX	X	CONCHEM	1.205 : 35.5
					AES	
					PROAIR OR	
					EVERAIR	
					PLUS	
EUCLID ADMIXTURE	EUCO	L: 260	WR	X	AIREX D OR:	1.202 : 40.0
CANADA INC	RETARDER				AIREX L OR:	
2835 GRANDE-ALLEE:					AIREXTRA	
ST HUBERT, QUE					EUCO AIR	
J4T 2R4						
(514) 465-2233	EUCO WR	L: 260	WN	X	AIREX D OR:	1.207 : 45.0
*ONT SOURCE					AIREX L OR:	
EUCLID ADMIXTURE:					AIREXTRA	
CANADA INC					EUCO AIR	
175 REXDALE BLVD:						
ETOBICOKE, ONT	EUCO WR-75:	L: 260	SN	X	AIREX D OR:	1.201 : 40.0
M9W 1P8					AIREX I. OR:	
(416) 743-4831					AIREXTRA	
FAX(416)743-8231					EUCO AIR	
	TCDA 727	L: 185	R	X	AIREX D OR:	1.160 : 31.0
					AIREX L OR:	
					AIREXTRA	
					EUCO AIR	
	TCDA 727	L: 315	RX	X	AIREX D OR:	1.160 : 31.0
					AIREX L OR:	
					AIREXTRA	
					EUCO AIR	
	TCDA A	L: 465	WN	X	AIREX D OR:	1.160 : 34.0
					AIREX L OR:	
					AIREXTRA	
					EUCO AIR	

CONCRETE
ADMIXTURES, CHEMICAL

DSM # 9.25.10
DATE 92 06 09

SPECIFICATION(S): OPSS 1303, (OPSS 1350, OPSS 904) PAGE 3 OF 5
DRAWING(S): N/A
CUSTODIAL OFFICE: ENGINEERING MATERIALS RIDDERS TENDERING QUERIES
CONCRETE (416) 235-3705 CALL (416) 235-3550

SOURCE	NAME	M:NOTE 1:	RIDE:	ADMIXTURE	25 C	105 C
	PRODUCT **:	MIN	MEETS			
		DOSE	REQ'T FOR:		REL-	
		F: PER	REQUIRED		ATIVE:	SOLID
		O:100 KG:	NON-AIR		DENSITY:	CONT
		R:CEMENT:***	CHLO:ENTRAINING:		AT	AT
EUCLID ADMIXTURE CONT'D	TCDA XA	L: 250	WN	X	AIREX D OR:	1.210 : 43.0
					AIREX L OR:	
					AIREXTRA	
					EUCO AIR	
	TCDA D	L: 565	WR	X	AIREX D OR:	1.210 : 40.0
					AIREX L OR:	
					AIREXTRA	
					EUCO AIR	
W.R. GRACE & CO OF CANADA LTD 294 CLEMENTS RD W AJAX, ONT L1S 3C6 (416) 683-8561 FAX(416)683-5947	DARATARD	L: 190	R	X	DAREX AEA/:	1.1725: 31.0
	HC				DARAVAIR	
					DARAVAIR R:	
	DARATARD	L: 330	RX	X	DAREX AEA/:	1.1725: 31.0
	HC				DARAVAIR	
					DARAVAIR R:	
	DARATARD	L: 190	R	X	DAREX AEA/:	1.2450: 47.3
	:17				DARAVAIR	
					DARAVAIR R:	
	DARATARD	L: 250	RX	X	DAREX AEA/:	1.2450: 47.3
	:17				DARAVAIR	
					DARAVAIR R:	
	WRDA	L: 440	WN	X	DAREX AEA/:	1.157 : 34.5
					DARAVAIR	
					DARAVAIR R:	
	WRDA 20	L: 220	WN	X	DAREX AEA/:	1.208 : 49.5
					DARAVAIR	
					DARAVAIR R:	
	WRDA 20	L: 220	SN	X	DAREX AEA/:	1.208 : 49.5
					DARAVAIR	
					DARAVAIR R:	
	WRDA 82	L: 190	WN	X	DAREX AEA/:	1.216 : 45.2
					DARAVAIR	
					DARAVAIR R:	

CONCRETE
ADMIXTURES, CHEMICAL

DSN # 9.25.10
DATE 92 06 09

SPECIFICATION(S): OPSS 1303, (OPSS 1350, OPSS 904) PAGE 5 OF 5
DRAWING(S): N/A
CUSTODIAL OFFICE: ENGINEERING MATERIALS BIDDERS TENDERING QUERIES
CONCRETE (416) 235-3705 CALL (416) 235-3550

SOURCE : PRODUCT **: MIN : MEETS : : :
: DOSE : REQ'T FOR: : REL- :
: F: PER : REQUIRED : ATIVE: SOLID
: O: 100 KG: TYPE: NON-: AIR : DENSITY: CONT
: R: CEMENT: *** : CHLO: ENTRAINING: AT : AT
: NAME : M: NOTE 1: : RIDE: ADMIXTURE : 25 C : 105 C

SIKA CANADA INC : PLASTIMENT: L: 215 : R : X : SIKA AER : 1.180 : 33.5
601 DELMAR AVE : : : : : : : :
POINT CLAIRE, QUE: : : : : : : :
H9R 4A9 : PLASTIMENT: L: 330 : RX : X : SIKA AER : 1.180 : 33.5
(514) 697-2610 : : : : : : : :
*ONT SOURCE: : : : : : : : :
SIKA CANADA INC : : : : : : : :
2395 DREW RD : : : : : : : :
UNIT 6, : : : : : : : :
MISSISSAUGA ONT : : : : : : : :
L5S 1A1 : : : : : : : :
(416) 678-2843 : : : : : : : :
FAX(416)678-6818: : : : : : : :

NOTES:

** P - POWDER, L - LIQUID.

*** WN - WATER REDUCING, NORMAL SETTING ADMIXTURE
WR - WATER REDUCING, SET-RETARDING ADMIXTURE
R - SET RETARDING ADMIXTURE
RX - SET-RETARDING ADMIXTURE (EXTENDED RETARDATION)
AC - ACCELERATING ADMIXTURE
SN - STRENGTH INCREASING, NORMAL SETTING ADMIXTURE
SR - STRENGTH INCREASING, SET-RETARDING ADMIXTURE

(1) DOSAGE DESIGNATED IS MINIMUM AND IN ML, OR GRAMS (G) SHOWN.

CONCRETE
ADMIXTURES, AIR ENTRAINING

DSM # 9.25.05
DATE 92 06 09

SPECIFICATION(S): OPSS 1303, (OPSS 904, OPSS 1350) PAGE 1 OF 2
DRAWING(S): N/A
CUSTODIAL OFFICE: ENGINEERING MATERIALS BIDDERS TENDERING QUERIES
CONCRETE (416) 235-3705 CALL (416) 235-3550

SOURCE	PRODUCT	RELATIVE DENSITY	PH
AXIM CONCRETE TECHNOLOGIES CANADA INC 141 SHEARSON CR CAMBRIDGE, ONT N1T 1J3 (519) 622-5940 FAX (519) 622-5893	CATEXOL AE160 CATEXOL A.E.260 CATEXOL V.R.	1.009 : 1.008 : 1.036	8.0 : 12.3 : 12.4
CONCHEM 180 MARKET DR MILTON, ONT L9T 3H5 (416) 821-3761 1-800-263-4110 FAX (416) 876-4960	PRO-AIR CONCHEM AES EVERAIR PLUS	1.019 1.041 1.010	12.3 12.5 10.0
EUCLID ADMIXTURE CANADA INC 2835 GRANDE-ALLEE ST HUBERT, QUEBEC J4T 2R4 (514) 465-2233 *ONT SOURCE: EUCLID ADMIXTURE CANADA INC 175 REXDALE BLVD ETOBICOKE, ONT M9W 1P8 (416) 743-4831 FAX (416) 743-8231	AIREX D AIREX L AIREXTRA EUACO AIR	1.016 1.007 1.007 1.009	8.9 7.0 9.5 8.0
W.R. GRACE AND COMPANY OF CANADA LTD 294 CLEMENTS RD W AJAX, ONT L1S 3C6 (416) 683-8561 FAX (416) 683-5947	DAREX AEA DARAVAIR R DARAVAIR	1.014 1.065 1.038	8.0 12.5 12.0
MASTER BUILDERS TECHNOLOGIES LTD 3637 WESTON RD TORONTO, ONT M9L 1W1 (416) 741-3830 1-800-387-5862 FAX (416) 741-7925	MBVR MICRO-AIR I	1.037 1.020	12.7 11.25
W.R. MEADOWS OF CANADA LTD 70 HANNANT CRT MILTON, ONT L9T 5C1 (416) 542-7220 (416) 878-4122 FAX (416) 878-4125	SEALTIGHT AEA	1.050	13.7

CONCRETE
ADMIXTURES, AIR ENTRAINING

DSM # 9.25.05
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SPECIFICATION(S): OPSS 1303, (OPSS 904, OPSS 1350) PAGE 2 OF 2
DRAWING(S): N/A
CUSTODIAL OFFICE: ENGINEERING MATERIALS BIDDERS TENDERING QUERIES
CONCRETE (416) 235-3705 CALI. (416) 235-3550

SOURCE	PRODUCT	RELATIVE DENSITY	PH
SIKA CANADA INC 601 DELMAR AVE POINTE CLAIRE, QUEBEC H9R 4A9 (514) 697-2610 *ONT SOURCE: SIKA CANADA INC 2395 DREW RD, UNIT 6 MISSISSAUGA, ONT L5S 1A1 (416) 678-2843 FAX (416) 678-6818	SIKA AER	1.050	12.0
STERNSON LTD PO BOX 130 BRANTFORD, ONT N3T 5N1 (519) 759-6600 FAX (519) 753-6592	STERNSON NVR	1.045	12.9
WITCO CHEMICAL CORP 520 MADISON AVE NEW YORK, NEW YORK, USA 10022 (212) 605-3800 *CDN SOURCE: WITCO CANADA INC 2 LANSING SQ, SUITE 1200 WILLOWDALE, ONT M2J 4Z4 (416) 497-9991 FAX (416) 497-7110	WITCAMIDE** 5140	1.030	9.0

** MATERIAL TO BE DILUTED PRIOR TO ADDING TO CONCRETE.

ALL OF THE LISTED PRODUCTS ARE IN THE FORM OF A LIQUID. THE AIR EN-
TRAINING ADMIXTURES LISTED MUST NOT BE PREMIXED WITH A CHEMICAL
ADMIXTURE SOLUTION. WHERE BOTH A CHEMICAL ADMIXTURE AND AN AIR
ENTRAINING ADMIXTURE ARE USED IN CONCRETE, THE TWO MATERIALS MUST BE
DISPENSED SEPARATELY.