

CEMENT GRINDING AIDS, PERFORMANCE ENHANCERS, AND SPECIALTY PRODUCTS

batimix[®]





Company overview

Holderchem Building Chemicals S.A.L. (hereinafter referred to as Holderchem) was founded in 1994 as a joint venture with Holcim, the world's leading Portland cement producer. It has since developed by virtue of technically innovative ideas, dedicated customer services, and highly skilled staff to become a main independent supplier to the cement and building industries in Lebanon as well as Middle East and Gulf countries.

Holderchem offers a wide range of products meeting the most challenging requirements of modern construction. Products include cement additives, concrete admixtures, ready-to-use masonry mortars, tile adhesives, curing and sealing compounds, epoxy adhesives, injection grouts, concrete repair and waterproofing products, protective coatings, pavement sealers, and miscellaneous other specialty building materials. The R & D work is being carried out by a qualified team of professionals in close coordination with clients to meet the various production requirements and site conditions. The aim is to constantly improve the performance of each supplied product by using high-quality raw materials together with the latest available production processes and technologies.

In the cement additives field, Holderchem has been a pioneer in spreading the use of grinding aids in Middle East countries, contributing to the development of a cost efficient grinding media. The combination of state-of-the art products with specialized sales force together with the assistance of Holcim Group Support Ltd, has provided customers with tremendous values. A dedicated skilled staff trained in cement technology and focused in offering its customers cost effective innovative value added solutions has, over a decade, optimized cement manufacturing process and enhanced the quality of the finished product.

Introduction

In a Portland cement factory, grinding mills are used to transform the clinker and pozzolan solid particles into fine and well-graded materials. During this process, only 10% of the total energy spent results into additional surface area while the remaining 90% is lost through heat and wear during the grinding. Among the main reasons of such low-efficiency are the agglomeration of fine particles together with a covering and steady built-up of particles around the ball grinding media.

Cement manufacturers recognize the need of applying sustainable production policies to optimize energy consumption and reduce CO₂ emissions while maintaining the quality and performance of the finished product. Energy may be optimized by enhancing mill performances and reducing particle tendency to agglomerate. The reduction of the clinker factor by substitution with fillers and pozzolans constitute a major alternative to lower CO₂ emissions. These objectives can be achieved by the use of cement additives with different types and chemical compositions.

Agglomeration vs. grinding aids

The mechanism of agglomeration results from the fragmentation and attrition during the grinding process of clinker. The resulting electrostatic surface charges in addition to the developed “Van der Waals” forces between neighboring particles lead to strong attractive forces along the newly fractured cement surfaces, causing agglomeration. The extent of this phenomenon depends on several parameters such as the degree of cement fineness, characteristics of clinker, grinding media, temperature, and humidity.

A grinding aid is essentially an organic compound active in the gaseous phase which adsorbs onto the cement particle surfaces during grinding. It generates around the polarized particles a very thin monomolecular film which helps neutralize and reduce electrostatic forces, thus significantly decreasing the process of cement agglomeration. The adsorption of the grinding aid molecules reduces the energy needed to break-up solid particles and weakens the surface charges that promote cohesion to other particles.

Products range

Holderchem Building Chemicals S.A.L. offers four groups of cement additives summarized in TABLE 1.

batimix. GA series are used to improve the grindability of clinker, calcium carbonate, slag, and pozzolans, thus minimizing energy consumption, pack set, and mechanical wear of the mill.

batimix. QS series are quality and strength enhancers for blended or composite cements with special characteristics such as reduced clinker factor, modified setting times, workability, and water repellency.

batimix. MC series are used for producing masonry and mortar cements with higher air entrainment and workability, controlled setting time, improved board life, and water retention.

batimix. specialty products are used to modify specific properties of the cement such as air entrainment, workability, set-acceleration or set-retardation, water repellency, and soluble chromium levels.

TABLE 1

Summary of batmix. cement additive range of products, applications, and main uses

		Applications and effects on specific properties											Main uses					
		Increase production rate	Reduce power consumption	Reduce pack set	Optimize particle size distribution	Increase cement strength	Air entrainment	Improve workability and reduce water demand	Accelerate setting times	Retard setting times	Impart water repellency	Improve board life and water retention	Reduce soluble chromium	Portland / Blended cement	Masonry / Mortar cement	White cement	Limestone blends	Mineral blends
<p>X Refers to main influence</p> <p>(X) Refers to secondary influence</p> <p>Note: Alternative products with combined desired properties can be made available, upon request.</p>																		
Grinding Aids	GA	X	X	X	X									X	X	X		
	GA-H	X	X	X	X									X	X	X		
	GA-HP	X	X	X	X									X	X	X		
	GA-RM	X	X	X	X												X	
	GA-M	X	X	X	X													X
Quality & Strength Enhancers	QS	X	X	(X)	(X)	X								X		X		
	QS-HP	X	X	X	X	X								X		X		
	QS-WR	X	X	(X)	(X)	(X)		X						X		X		
	QS-AC	X	X	(X)	(X)	(X)			X					X		X		
	QS-RE	X	X	(X)	(X)	(X)				X				X		X		
	QS-WPR	X	X	(X)	(X)	(X)					X			X		X		
Masonry & Mortar Cement Additives	MC	X	X	(X)	(X)	(X)	X					(X)			X			
	MC-HP	X	X	X	X	X	X					X			X			
	MC-WR	(X)	(X)	(X)	(X)		X	X				X			X			
	MC-RE	(X)	(X)	(X)	(X)		X		X			X			X			
	MC-WPR	(X)	(X)	(X)	(X)		X				X	X			X			
Specialty Products	Air	(X)	(X)				X							X	X	X		
	WR	(X)	(X)					X						X	X	X		
	AC	(X)	(X)						X					X	X	X		
	RE	(X)	(X)							X				X	X	X		
	WPR	(X)	(X)								X			X	X	X		
	CR												X	X	X	X		

batimix® grinding aid products

TABLE 2 below summarizes the properties of five different grinding aid products offered by Holderchem. Each of these products can be customized to specifically suit grinding conditions such as the characteristics of clinker and raw meal, operating parameters of the mill, grinding media, and targeted material fineness.

TABLE 2 General description and specific properties of batimix® GA series

	Description	Main chemical composition	Avg. specific gravity	Avg. pH @ 25 °C	Avg. viscosity @ 25 °C	Dosage rates, % of c. w.
GA	Grinding aid and pack set inhibitor	Amines blend mixture	1.03 to 1.10	9 to 11	15 to 30 cP	0.02 to 0.12
GA-H	Enhanced grinding aid and pack set inhibitor	Amines and glycols blend mixture	1.05 to 1.12	9 to 11	20 to 45 cP	0.02 to 0.1
GA-HP	High performance grinding aid and pack set inhibitor	Mixture of amines, glycols, and acids	1.05 to 1.13	7 to 10	30 to 60 cP	0.01 to 0.08
GA-RM	Grinding aid for cement raw materials	Glycols and/or amines blend mixture	1.05 to 1.12	8 to 10	25 to 80 cP	0.01 to 0.1
GA-M	Mineral grinding aid	Amines, glycols, and acids blend mixture	1.04 to 1.14	7 to 10	10 to 40 cP	0.01 to 0.08

Cement additives are normally introduced in the grinding mill as received. In some cases, they can be diluted with 10% to 50% water to facilitate greater proportioning accuracy and better additive distribution.

All products can be supplied in drums, containers, or bulk with a minimum shelf life of 12 months if kept unopened and stored at temperatures ranging from -10 to +50 °C. They may be irritant to skin and eyes, users should refer to the product's MSDS.

Features and benefits

- **Gain in cement productivity:** increased mill output at same cement fineness and energy consumption ensures savings through lower grinding costs and shorter times needed for grinding.

- **Reduced pack set:** the dry disperse action of the organic compounds results in increased cement flowability, reduced loading and unloading times of bulk tankers, and increased capacities of silos.

- **Reduced agglomeration:** the partial neutralization of surface charges developed during milling as well as elimination of “coating” effect on the grinding media enhances the overall separators efficiency.

- **Optimized grain size distribution:** improved particle distribution increases bulk density and compressive strength of cement.

Technical information

It is always recommended to run industrial tests to evaluate the suitability of using grinding aids and optimize dosage rates. The performances achieved depend on the characteristics of materials to be ground and operating conditions.

Comparative values of cement and mortars with or without **batimix**. GA products are presented in TABLE 3.

At a given energy consumption of 40 kWh/t, the use of cement additive is shown to considerably improve cement fineness which increases the Blaine values and reduces residues on 40- μ m sieve. However, water demand for normal consistency, setting time, and mortar properties are not much affected.

A significant improvement in limestone fineness is noticed when using the GA-RM 1400 product at a dosage of 0.06%.

TABLE 3

Typical properties of batimix GA products

Mixture composition						
• Clinker, %	90	90	90	90	0	0
• Gypsum, %	5	5	5	5	0	0
• Limestone, %	5	5	5	5	100	100
Cement additive						
• Type	–	GA 1102	GA-H 1200	GA-HP 1301	–	GA-RM 1400
• Dosage, % of c.w.	–	0.05	0.05	0.05	–	0.06
Energy consumption, kWh/t	40	40	40	40	70	70
Cement properties						
• Blaine, cm ² /gram	3350	3535	3580	3645	5210	6120
• Residue on 40- μ m, %	24.8	22.3	20.1	18.2	6.3	4.1
• Water demand, % of c.w.	27	27.3	27.4	27.6	N/A	N/A
• Avg. setting time, min	180	175	175	170	N/A	N/A
Mortar properties						
• Water absorption, gram	26	24.5	24	23.7	N/A	N/A
• Compressive strength at 1 day, MPa	7.5	7.5	7.7	8.2	N/A	N/A
• Compressive strength at 28 days, MPa	28	28.8	29	30.6		

Values are given for indications purposes only as they may be affected by the characteristics of raw materials and operation conditions.

batimix[®] quality and strength enhancers

The description and specific properties of the quality and strength enhancing cement additives are summarized in **TABLE 4**.

In addition to increased grindability, these products are used to modify the physico-chemical characteristics of the cement

such as water demand, rate of hydration, early and final strength gains, and water repellency.

TABLE 4 General description and specific properties of batimix QS series

	Description	Main chemical composition	Avg. specific gravity	Avg. pH @ 25 °C	Avg. viscosity @ 25 °C	Dosage rates, % of c. w.
QS	Grinding aid and strength enhancer	Amines, glycols, and acids blend mixture	1.03 to 1.05	6 to 9	15 to 40 cP	0.02 to 0.1
QS-HP	High performance grinding aid and strength enhancer	Amines, glycols, and acids blend mixture	1.04 to 1.06	6 to 9	20 to 50 cP	0.01 to 0.08
QS-WR	Grinding aid, strength enhancer, and water reducer	Amines, glycols, and acrylic co-polymers	1.06 to 1.14	6 to 9	30 to 90 cP	0.05 to 0.6
QS-AC	Grinding aid, strength enhancer, and set-accelerator	Amines, glycols, and specialty chemicals	1.18 to 1.24	6 to 9	50 to 150 cP	0.05 to 0.4
QS-RE	Grinding aid, strength enhancer, and set-retarder	Amines, glycols, and specialty chemicals	1.11 to 1.17	6 to 9	50 to 150 cP	0.05 to 0.4
QS-WPR	Grinding aid, strength enhancer, and water repellent	Amines, glycols, acids, and stearate polymers	1.02 to 1.08	7 to 10	25 to 60 cP	0.05 to 0.4

Cement additives are normally introduced in the grinding mill as received. In some cases, they can be diluted with 10% to 50% water to facilitate greater proportioning accuracy and better additive distribution.

All products can be supplied in drums, containers, or bulk with a minimum shelf life of 12 months if kept unopened and stored at temperatures ranging from -10 to +50 °C. They may be irritant to skin and eyes, users should refer to the product's MSDS.

Features and benefits

• **batimix. QS and QS-HP products**, are used as grinding aids and strength enhancers to maximize cement quality and optimize cement design by reducing the clinker factor while utilizing existing raw materials.

• **batimix. QS-WR products**, are strength enhancers blended with acrylic co-polymers which can enhance cement particles dispersion upon mixing with water, reducing water demand and/or improving workability.

• **batimix. QS-AC and QS-RE products**, contain set-modifying chemicals which can prolong or reduce the dormant period of the main cement compounds. Noticeable increases in strength are measured.

• **batimix. QS-WPR products**, are quality and strength enhancers blended with stearate polymers which react with the cement hydrating compounds to form a hydrophobic “water-repellent” coatings in the cement paste pores and voids.

Technical information

Typical effects of **batimix. QS** products on the cement and mortar properties are presented in **TABLE 5**.

For a given energy consumption of 40 kWh/t, the use of QS 2100 and QS-HP 2203 is shown to improve cement fineness and compressive strength at all ages despite reduced clinker factor. No negative influence on water demand or setting time is noticed.

A mix made with QS-WR 2301 required around 10% less water to achieve normal consistency. This has led to increased mortar compressive strength as well as reduced water absorption.

The QS-AC 2400 and QS-RE 2502 additives are shown to exhibit changes in the rates of setting, whereas the QS-WPR 2601 has mainly decreased water absorption of the mortar.

TABLE 5

Typical properties of **batimix. QS** products

Mixture composition							
• Clinker, %	90	85	80	85	85	85	85
• Gypsum, %	5	5	5	5	5	5	5
• Limestone, %	5	5	5	5	5	5	5
• Pozzolan, %	0	5	10	5	5	5	5
Cement additive							
• Type	--	QS 2100	QS-HP 2203	QS-WR 2301	QS-AC 2400	QS-RE 2502	QS-WPR 2601
• Dosage, % of c.w.	--	0.05	0.05	0.2	0.2	0.2	0.2
Energy consumption, kWh/t	40	40	40	40	40	40	40
Cement properties							
• Blaine, cm ² /gram	3350	3540	3705	3670	3610	3640	3590
• Residue on 40-µm, %	24.8	20.5	18.1	17.7	19.5	18.8	21.1
• Water demand, % of c.w.	27	27.2	27.5	24.5	27.3	27.3	27.5
• Avg. setting time, min	180	180	170	170	150	200	175
Mortar properties							
• Water absorption, gram	26	24.8	24.1	19.7	24.7	24.5	16.6
• Compressive strength at 1 day, MPa	7.5	7.1	7.9	8.4	8.1	7.5	7.3
• Compressive strength at 28 days, MPa	28	28.3	30.1	33	30	30.2	29

Values are given for indications purposes only as they may be affected by the characteristics of raw materials and operation conditions.


batimix[®]

masonry and mortar cement additives

Five products are offered by Holderchem for use when producing masonry and mortar cements according to the requirements of ASTM C 91 and/or EN 413. These

are introduced during the grinding of clinker and raw meal to enhance one or more desirable properties such as air entrainment, workability, setting time, early

and final strength, and water repellency. Product description and specific properties are summarized in [TABLE 6](#).

TABLE 6**General description and specific properties of batimix MC series**

	Description	Main chemical composition	Avg. specific gravity	Avg. pH @ 25 °C	Avg. viscosity @ 25 °C	Dosage rates, % of c. w.
MC	Grinding aid	Amines and glycols blend mixture	1.02 to 1.08	6 to 9	15 to 35 cP	0.02 to 0.1
MC-HP	Grinding aid and strength enhancer	Amines, glycols, and acids blend mixture	1.02 to 1.08	6 to 9	20 to 50 cP	0.02 to 0.08
MC-WR	Grinding aid and water reducer	Amines, glycols, acids, and acrylics	1.05 to 1.1	7 to 10	25 to 70 cP	0.05 to 0.4
MC-RE	Grinding aid and set-retarder	Amines, glycols, and specialty chemicals	1.1 to 1.15	7 to 10	25 to 80 cP	0.05 to 0.3
MC-WPR	Grinding aid and water repellent	Amines, glycols, acids, and stearate polymers	1.02 to 1.08	7 to 10	15 to 40 cP	0.05 to 0.4

Cement additives are normally introduced in the grinding mill as received. In some cases, they can be diluted with 10% to 50% water to facilitate greater proportioning accuracy and better additive distribution.

All products can be supplied in drums, containers, or bulk with a minimum shelf life of 12 months if kept unopened and stored at temperatures ranging from -10 to +50 °C. They may be irritant to skin and eyes, users should refer to the product's MSDS.

Features and benefits

• **batimix**. MC and MC-HP products, are used as grinding aids and strength enhancers during the production of masonry and mortar cements. They impart increased air entrainment together with improved board life and water retention.

• **batimix**. MC-WR products, are carefully blended with acrylic co-polymers to reduce water demand and/or improve workability without detrimentally affecting adhesion and strength.

• **batimix**. MC-RE products, are characterized by their ability to prolong cement setting times and board lives, making them primarily suitable for use in hot weather climate regions.

• **batimix**. MC-WPR products, are special grinding aids blended with hydrophobic stearate polymers which reduce the rate of water absorption in masonry and cement mortars.

Technical information

Typical effects of **batimix**. MC products on the cement and mortar properties are given in TABLE 7.

Cement properties: For a given energy consumption of 40 kWh/t, the use of MC products is shown to improve the Blaine values and reduce the residues on 40- μ m sieve. Water demand and setting time values remained close to those of the reference mix, except for the MC-WR 3302 and MC-RE 3400 especially formulated to modify such properties.

Mortar properties: Unlike the reference mix made without any additive, mixtures made with the MC products are shown to fulfill the ASTM C 91 or EN 413 requirements pertaining to air content and water retention. Water absorption has dramatically decreased when using MC-WPR 3501, whereas the compressive strength has significantly increased when using MC-HP 3200 and MC-WR 3302.

TABLE 7

Typical properties of batimix. MC products

	MC 3101	MC-HP 3200	MC-WR 3302	MC-RE 3400	MC-WPR 3501	
Mixture composition						
• Clinker, %	60	60	60	60	60	
• Gypsum, %	5	5	5	5	5	
• Limestone, %	35	35	35	35	35	
Cement additive						
• Type	–	MC 3101	MC-HP 3200	MC-WR 3302	MC-RE 3400	MC-WPR 3501
• Dosage, % of c.w.	–	0.05	0.05	0.2	0.2	0.2
Energy consumption, kWh/t						
	40	40	40	40	40	
Cement properties						
• Blaine, cm ² /gram	3510	3660	3785	3650	3660	3670
• Residue on 40- μ m, %	20.5	17.9	15	18	17.5	17.3
• Water demand, % of c.w.	29.5	29.7	29.9	27.5	30	30
• Avg. setting time, min	190	190	180	185	210	190
Mortar properties						
• Air content, %	6	14	13	12	13	13
• Water retention, %	65	80	82	85	84	85
• Water absorption, gram	28.5	25.7	25.2	22.4	25.9	19.6
• Compressive strength at 1 day, MPa	5.5	5.8	6.1	6.2	5.3	5.1
• Compressive strength at 28 days, MPa	22	23.3	25	26.1	24	23.2

Values are given for indications purposes only as they may be affected by the characteristics of raw materials and operation conditions.



specialty products

Holderchem offers six specialty cement additives that are used to enhance a specific desirable property such as air en-

trainment, water reduction, set-acceleration, set-retardation, water repellency, and reduction of soluble chromium VI. Product

description, specific properties, and dosage rates are summarized in [TABLE 8](#).

TABLE 8

General description and specific properties of batimix specialty products

	Description	Main chemical composition	Avg. specific gravity	Avg. pH @ 25 °C	Avg. viscosity @ 25 °C	Dosage rates, % of c. w.
Air	Air entrainer	Proprietary blended mixture	1.01 to 1.05	7 to 10	15 to 30 cP	0.05 to 0.4
WR	Water reducer	Acrylic and methacrylic acid co-polymers	1.05 to 1.1	7 to 10	40 to 100 cP	0.05 to 0.5
AC	Set-accelerator	Chloride-free set-accelerating chemicals	1.17 to 1.23	7 to 10	50 to 180 cP	0.05 to 0.4
RE	Set-retarder	Specialty set-retarding chemicals	1.12 to 1.16	7 to 10	50 to 150 cP	0.05 to 0.4
WPR	Water permeability reducer	Stearate blend mixture	1.02 to 1.08	7 to 10	15 to 40 cP	0.05 to 0.4
CR	Reducer of soluble chromium VI	Ferrous or stannous sulphate mixture	1.35 to 1.5	4 to 8	120 to 180 cP	0.01 to 0.1

Cement additives are normally introduced in the grinding mill as received. In some cases, they can be diluted with 10% to 50% water to facilitate greater proportioning accuracy and better additive distribution.

All products can be supplied in drums, containers, or bulk with a minimum shelf life of 12 months if kept unopened and stored at temperatures ranging from -10 to +50 °C. They may be irritant to skin and eyes, users should refer to the product's MSDS.

Features and benefits

- **batimix**. Air products, are highly efficient aqueous solutions that are used as air entrainers during the cement production process.

- **batimix**. WR products, adhere to the cement particles during grinding and become active upon contact with water to disperse fine particles.

- **batimix**. AC and RE products, are used to accelerate/retard setting times of cement pastes, respectively.

- **batimix**. WPR products, are water permeability reducers for hydraulic, composite, and blended cements.

- **batimix**. CR products, are used to control the level of soluble chromium VI to below 2 ppm by dry weight of cement when mixed with water. They can be supplied either in powder form (ferrous sulphate) or in liquid form (stannous sulphate).

Technical information

Typical effects of **batimix**.specialty products are given in TABLE 9.

Cement properties: Compared to a reference mix, water demand is shown to decrease by around 25% for the mixture made with WR 4203. This leads to improved mortar skeleton with decreased water absorption and increased compressive strength at all ages. On the other hand, setting times are altered with the use of AC 4301 and RE 4401 because of the set-modifying chemicals.

Mortar properties: Air content in fresh mortars is shown to increase by two-folds with the use of Air 4102 compared to the reference mix. However, no effects on water demand or setting times are noticed. Water absorption and soluble chromium VI decreased significantly when using the WPR 4500 and CR 4600.

TABLE 9

Typical properties of **batimix**. specialty products

Mixture composition							
• Clinker, %	90	90	90	90	90	90	90
• Gypsum, %	5	5	5	5	5	5	5
• Limestone, %	5	5	5	5	5	5	5
Cement additive							
• Type	–	Air 4102	WR 4203	AC 4301	RE 4401	WPR 4500	CR 4600
• Dosage, % of c.w.	–	0.2	0.2	0.2	0.2	0.2	0.04
Energy consumption, kWh/t							
	40	40	40	40	40	40	40
Cement properties							
• Blaine, cm ² /gram	3350	3390	3450	3370	3350	3400	3345
• Residue on 40-µm, %	24.8	23.1	22.4	24.3	24.8	24.5	24.9
• Water demand, % of c.w.	27	27	25.3	27.3	27.2	27.4	27
• Avg. setting time, min	180	180	165	160	210	180	180
Mortar properties							
• Air content, %	6	14	7	6	6	7	6
• Chromium VI, ppm	8.5	8.5	8.5	8.5	8.5	8.5	1.5
• Water absorption, gram	26	26.3	21.5	26	25.7	19.4	25.7
• Compressive strength at 1 day, MPa	7.5	7.1	8.5	7.9	7.2	7.5	7.4
• Compressive strength at 28 days, MPa	28	26	32	28.3	28	28.6	28

Values are given for indications purposes only as they may be affected by the characteristics of raw materials and operation conditions.

Important notes

Referenced EN & ASTM standards

EN 197 Common cements - Composition, specifications and conformity criteria
EN 413 Masonry cement - Composition, specifications and conformity criteria
ASTM C 91 Standard specification for masonry cement
ASTM C 150 Standard specification for Portland cement
ASTM C 226 Standard specification for air-entraining additions for use in the manufacture of air-entraining Portland cement
ASTM C 465 Standard specification for processing additions for use in the manufacture of hydraulic cements
ASTM C 595 Standard specification for blended hydraulic cements
ASTM C 688 Standard specification for functional additions for use in hydraulic cements
ASTM C 1157 Standard performance specification for hydraulic cement
ASTM C 1329 Standard specification for mortar cement

Important notes

- For proper use of any specific product, you may consult the corresponding “Technical Data Sheet” by visiting our web-site at www.holderchem.net.
- All of the reported values in this brochure are given for indication purposes only. They are averages of several tests under laboratory conditions. In practice, these values may be significantly affected by the characteristics of raw materials and operating conditions.

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