

Type S HYDRATED LIME

MASONRY MORTAR, EXTERIOR PLASTER and STUCCO

DESCRIPTION

Formulated for use in masonry mortar, exterior plaster, and stucco, CHEMSTAR Type S hydrated lime is produced through calcination and subsequent pressure hydration of high purity dolomitic limestone. The resulting product is a white powder with excellent plasticizing and cementitious properties that make it as easy to use as regular portland cement.

Bond Strength

The most rigorous mortar requirements are adequate, uniform bond strength and prevention of water leakage. CHEMSTAR Type S has a direct, positive impact on these requirements.

Bond strength is the ability of masonry to resist lateral movement both parallel and perpendicular to the bedding. Although it is often considered less important than mortar compressive strength, the reverse is actually true. Mortar compressive strength contributes relatively little to overall load-bearing, while bond strength plays a major role in preventing cracks and water leakage.

BENEFITS

CHEMSTAR Type S improves the characteristics of mortar, exterior plaster, and stucco both during use and in the hardened state by creating extremely small crystallites that are water-retentive and surface-active. The particle size reduction achievable with good process control is illustrated, in photo, at right.

Workability

Smooth-spreading mortar is essential for good workmanship and productivity. Many factors combine to impart these attributes; the most important are water retention and the ability of particles to "slide" under low shear.

CHEMSTAR Type S far exceeds minimum requirements for water retention. Yet the mortar easily supports masonry units after they are bedded because it attaches water molecules in a stable orientation rather than simply in a random fluid state. As a result, mortars spread easily under the trowel, but show a surprising ability to maintain joint thickness after bedding.

In masonry, CHEMSTAR Type S eliminates the bleeding and retempering that typically indicate poor workability.

In stucco, CHEMSTAR Type S provides a buttering effect by reducing frictional forces like a natural lubricant to eliminate feathering, which is caused by particles that roll instead of slide during finishing.



Highlighted areas show individual lime particles so thin they are nearly transparent. Their particle diameters are about 1/800th of a micron.

Compressive Strength

A distinction should be made between Type S lime and Type S mortar. As the chart at right shows, Type S mortar denotes a compressive strength class (1800 psi minimum). Any mortar meeting this compressive strength is considered a Type S mortar, whether or not it contains Type S lime as an ingredient. Because Type S lime contributes greatly to bond strength, special care should be taken to specify the use of *Type S lime* in mortar as well as the strength class. (See, "The Role of Bond Strength," in box on the next page.)

Water Resistance

The problem most often cited in masonry is water penetration and leakage, which occurs normally at the contact point between mortar and masonry unit. CHEMSTAR Type S has consistently been shown to reduce leakage – in part because of its high bond to units, and in part because it has the ability to repair hairline cracks through crystal growth known as "autogenous healing."

An example of Type S's remarkable ability to resist water intrusion is demonstrated in the two photos at bottom left showing the effects of a simulated driving rainstorm on a single wythe brick wall. During the 72-hour test, the wall was subjected to rain driven

ASTM C270 SPECIFICATIONS

PROPERTY SPECIFICATION				MORTAR FOR UNIT MASONRY		
				PROPORTION BY VOLUME		
Mortar Type	Average Compressive Strength @ 28 Days Min. psi	Water Retention Min. %	Air Content Min. %	Portland Cement	Hydrated Lime	Sand
M	2500	75	12	1	1/4	2.8 - 3-3/4
S	1800	75	12	1	1/4 to 1/2	2.8 - 4-1/2
N	750	75	12	1	1/2 to 1-1/4	3.4 - 6-3/4
O	350	75	12	1	1-1/4 to 2-1/2	5.1 - 10-1/2

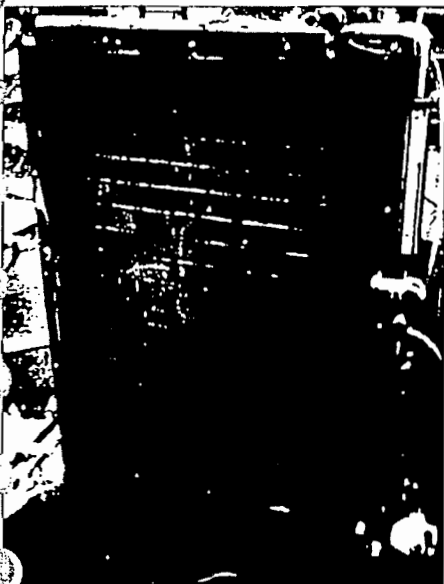
AVERAGE TEST RESULTS

PERFORMANCE PROPERTIES				PROPORTIONS TESTED		
Mortar Type	Average Compressive Strength @ 28 Days Min. psi	Water Retention Min. %	Air Content Min. %	Portland Cement	CHEMSTAR Type S Hydrated Lime	Sand
M	2885	86	3.0	1	1/4	3-3/4
S	2190	89	3.2	1	1/2	4-1/2
N	1595	86	3.4	1	1	6
O	625	90	4.4	1	1-1/2	7-1/2

by a 62.5 mph wind, with a rainfall rate of 5" per hour (ASTM E514).

The first photo, on left, shows the test side of the wall. Water contacting this side must pass through the wall to be measured. The second photo shows the back side, which has been whitewashed to show leaks more readily. Under the severe conditions of the test, little water has passed through the wall, a result that is typical of mortar containing CHEMSTAR Type S. ASTM E514's rating system would classify this wall's ability to resist leakage as excellent.

The photo on the far right shows a wall in which a mortar



"Test" side of wall exposed to simulated wind and rain.



Backside showing little leakage through the wall.



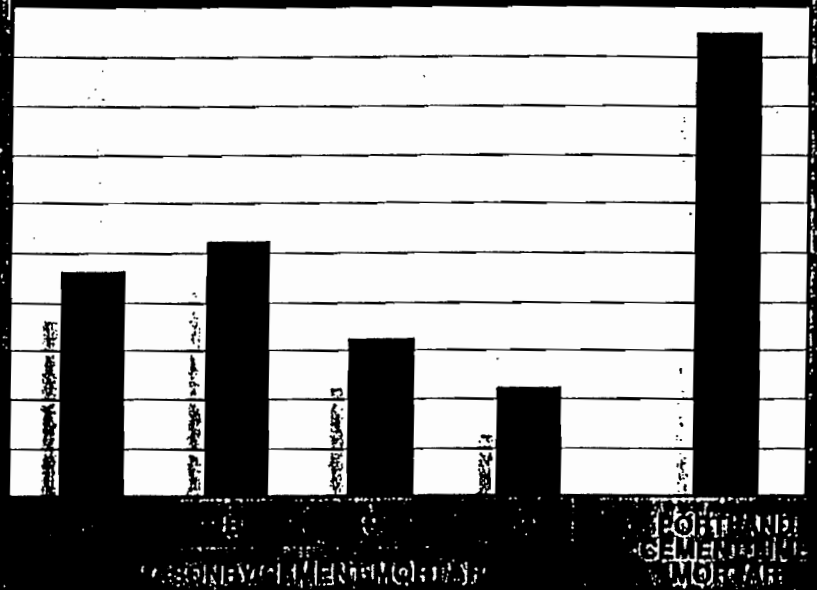
Mortars containing interground limestone leak as much as 40 times more.

THE ROLE OF BOND STRENGTH

It has long been known that good bond between mortar and unit is essential in resisting the flexing forces of wind and ground movement. In the last decade, evaluation techniques have been refined to provide a basis on which the role of bond in preventing wall cracking and water leakage is well defined. The most reliable measure of bond is ASTM D72 Measurement of Masonry Flexural Bond Strength. More commonly referred to as bond strength test, this method may provide the direct link between extent of bond to mortar unit combinations and prevention of cracking and leakage in walls.

As the benchmark of quality for masonry mortar, ASTM D72 provides a basis for CHEMSTAR Type S lime mortar. Low bond strength values which are typical of a portland cement mortar, and the high bond strength of portland cement lime mortar indicate that the walls constructed with CHEMSTAR Type S lime mortar are resistant to cracking and leakage.

FLEXURAL BOND STRENGTH



of masonry cement containing interground limestone has been used. The leakage rate was so high that virtually all of the whitewash was carried away. While masonry cements containing interground limestone instead of Type S lime have become popular in some regions, they are not suitable for areas of moderate to heavy rainfall.

Cost

Adding CHEMSTAR Type S to mortar is no more costly than using commercial masonry cements. Type S hydrated lime is cementitious and can be substituted one-for-one with portland cement within the limits set forth in ASTM C270, Mortar for Unit Masonry. A portland cement-lime mortar carries at least as much sand as masonry cement mortar, and in most cases, more.

B. ASTM C150 - Portland Cement

C. ASTM C144 - Aggregate for Masonry Mortar

D. ASTM C780 - Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry

E. International Masonry All-Weather Council (IMAC) - Recommended Practice and Guide Specifications for Cold Weather Masonry Construction, Section 04200, Article 3.

F. ASTM C270 - Mortar for Unit Masonry

1.03 DELIVERY AND STORAGE OF MATERIALS

All materials shall be delivered in their original packages or containers and stored in a manner to prevent deterioration or contamination. Broken packages or materials shall be discarded.

Delivery of materials shall be verified by signed tickets. When mortars are delivered in dry preblended form in silos, the delivery ticket shall indicate the quantity, mortar type and date of manufacture.

1.04 ENVIRONMENTAL REQUIREMENTS

Masonry construction shall conform to the requirements of IMAC.

PART 2: MATERIALS AND MORTAR PREPARATION

2.01 MATERIALS

- A. Hydrated lime - CHEMSTAR Type S conforming to ASTM C-207
- B. Portland Cement - Conforming to ASTM C-150
- C. Aggregate - Conforming to ASTM C-144
- D. Water - Clean and free of oils, acids, alkalis, organic materials and other substances in amounts deleterious to mortar or metal in masonry.
- E. Colorants - Mineral oxides known to have no effect on mortar durability.

ARCHITECTURAL SPECIFICATIONS

PART 1: GENERAL

1.01 WORK INCLUDED

This specification pertains to mortar for unit masonry. It does not include mortar for luck pointing, chemically resistant mortar or grout for masonry.

1.02 REFERENCES

- A. ASTM C207 - Hydrated Lime for Masonry Purposes

- F. Admixtures - Admixtures such as accelerators, retarders, water-repellent agents and antifreeze compounds shall not be added to mortar unless approved in advance of use. Air entraining agents shall not be added under any circumstances.
- G. Masonry Cement - Masonry cement shall not be used in seismic zones 2, 3 and 4. Addition of masonry cement to mortar for use in zones 0 and 1 must be approved in advance of use.

2.02 PROPORTIONING

- A. Mortar compressive strength shall be approximately equal to the strength of the masonry units to be used.
- B. Mortars shall be proportioned by volume as follows for the indicated mortar types:
 1. Type O - 1 bag of portland cement and 1.25 - 2 bags of lime.
 2. Type N - 1 bag of portland cement and 1 bag of lime.
 3. Type S - 1 bag of portland cement and 1/2 bag of lime
 4. Type M - 1 bag of portland cement and 1/4 bag of lime.
- C. The volumetric ratio of damp, loose aggregate shall be not less than 2-1/4 nor more than 3-1/2 times the sum of the portland cement and lime. Refer to ASTM C-270, section 6 for weights per cubic foot of mortar materials.
- D. Colorant shall not exceed 9 lbs. per bag of portland cement except that carbon black shall not exceed 1.7 lbs. per bag.

- E. Water shall be adjusted to provide optimum workability.
- F. Dry preblended mortars delivered in silos shall be proportioned in the batching plant in accordance with sections B-D.

2.03 PREPARATION

- A. Masonry Unit Preparation - Highly absorbent units shall be wetted before laying. Do not soak units.
- B. Mortar
 1. JOBSITE PROPORTIONING - Mix three quarters of the required water, all cement and lime, and half of the aggregate for two minutes. Add the remainder of sand and water, mixing for an additional three minutes. Use a mechanical batch mixer. Hand mixing is not permitted.
 2. DRY PREBLENDED IN SILOS - Mixing shall be done using a continuous, self-cleaning mixer mounted at the apex of the silo cone. The water flow valve shall be set to provide desired workability.

PART 3. EXECUTION

- 3.01 Lay mortar in a uniform bed. Completely fill all joints. Special care shall be exercised to promote mortar-unit bonding by avoiding realignment of units already in contact with mortar.
- 3.02 Mortar may be retempered by adding water. Mortar shall be used within 2-1/2 hours of mixing.

EXTERIOR PLASTER¹

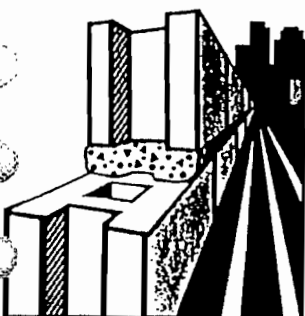
COAT	CEMENT	CHEMSTAR Type S	SAND
Scratch	1	1	8
Brown ²	1	1	9
Finish	1	1	6

Proportions are by volume.

¹Three coat work applied over metal or wire lath.

²For two coat work on masonry or concrete use as the basecoat.

Specification Bulletin C-90 provides technical data for hydrated lime in interior plaster.



CHEMSTAR LIME

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