SICIT GROUP S.p.A.

PlastRetard®XCL

Product Brochure and Application Guide

The Multifunctional additive for a high performance wallboard line.

BEYOND RETARDING EFFECT

Extends initial stiffening without slowing the setting speed.
Cost effective price for a given effect.
Easy to handle and to dose.
Consistent quality, repeatable performance.
Non-hazardous and biodegradable product.
Shelf Life: 3 years in original packaging.
No adverse impact to strength.
Compatible with other additives.
Does not promote growth of moulds.

PlastRetard® XCL

The Multifunctional additive
for a high performance wallboard line.

Table of contents

SECTION 1

FIELDS OF APPLICATION

1.1 Definitions

For a better understanding it is useful to provide definitions of terms commonly used in the gypsum industry.

Stucco:
Calcined gypsum commonly referred to as Plaster of Paris. Mixed with water into a slurry, it hardens to a solid mass.

Plaster:
Calcined Gypsum of any type, generally formulated with functional additives and/or inert aggregates.

Water/Plaster ratio (W/P):
A measure of the amount of gauging water in a plaster slurry.

Setting:
The **mechanical** hardening process of a plaster slurry.
We distinguish:
- The initial setting = First stiffening of the slurry;
- The final setting = The point where a moulded body is hard enough to be handled/cut or, in the case of a wall plaster, the finishing must end;
- The speed of setting = The maximum slope of the setting function (rate at which the slurry hardens).

Hydration:
The chemical recombination of water with stucco to form gypsum crystals.

Retarder:
An additive that delays initial setting and/or slows the speed of setting.

Chemical Accelerator:
The opposite of a retarder; an additive that shortens the initial setting time and speeds up the setting reaction; potassium sulphate for example.

BMA (Ball Milled Accelerator):
Finely ground gypsum is used to initiate the setting reaction. The gypsum is often introduced to the ball mill in combination with grinding aids, preservatives and/or other additives (sugar or starch).

1.2 The use of PlastRetard XCL in Plasterboard production

There are two main applications for gypsum stucco:

1.
As a base material for the moulding of prefabricated products such as plasterboard or gypsum blocks.
2.
As a component of powdered products such as gypsum wall plaster.

PlastRetard is a powerful liquid retarding agent that is preferred for use in the manufacture of prefabricated products. It is particularly suitable for applications in wallboard plants. The dry variety of PlastRetard that is suitable for powdered admixtures is PlastRetard PE (see other brochure).

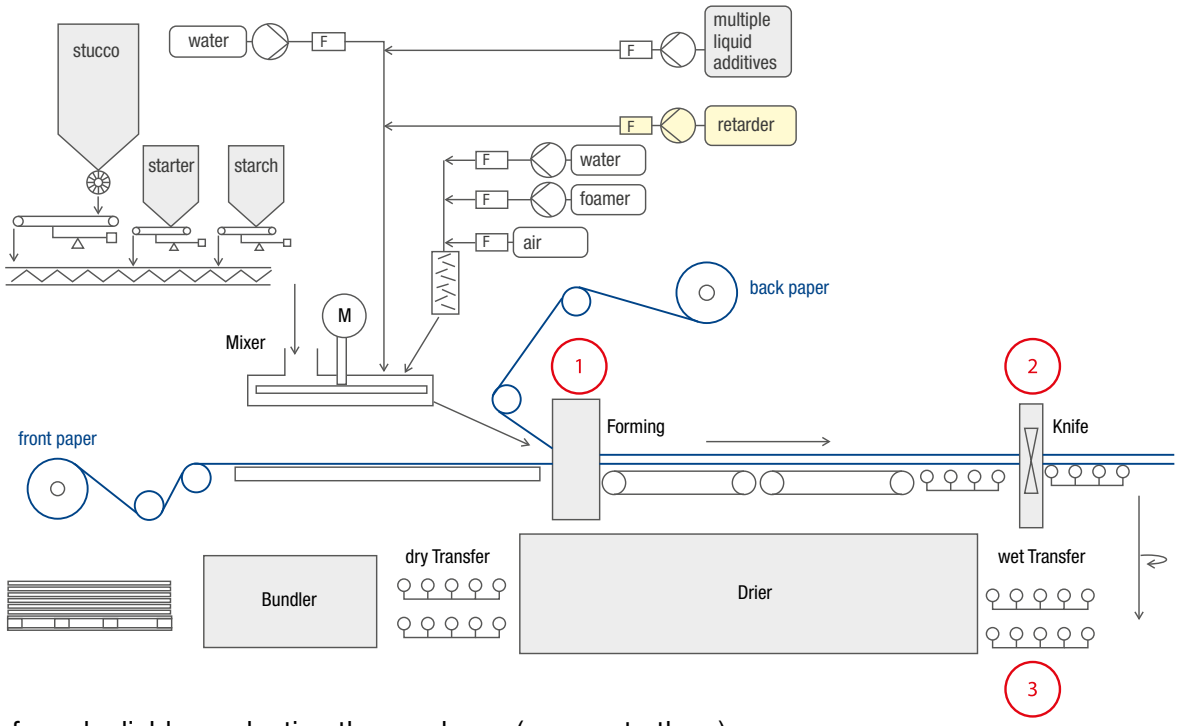
Since plasterboard is by far the most economically important product made from gypsum, we will concentrate on the specifics of retarder use in **plasterboard production**.

The conditions for an economical plasterboard operation are:

- A low water/plaster ratio to minimize drying costs and maximize output
- Low weight and minimized formulation costs.
- High quality final products with minimal generation of production waste.
- Maximized operating time with minimal production stops.

For better understanding please refer to figure (1).

Figure (1): Schematic presentation of a common plasterboard production line



For a safe and reliable production the needs are (amongst others):

at point (1) spreadable slurry with initial setting delayed until after forming

at point (2) a board core, stiff enough to be safely cut without damage

at point (3) complete rehydration of the gypsum core

Those requirements translate into the following setting characteristics:

- Delayed stiffening;
- Rapid setting speed;
- Complete hydration.

1.3 The benefits of PlastRetard XCL in Plasterboard production:

- PlastRetard XCL is the most efficient and reliable retarder for plasterboard production.
- PlastRetard XCL can be easily dosed using conventional volumetric metering pumps.
- PlastRetard XCL can reduce the water requirement of the slurry.
- PlastRetard XCL pose no health or environmental hazards.
- PlastRetard XCL is completely soluble in water for maximum efficiency.
- PlastRetard XCL performances is unaffected by the water/gypsum ratio.
- PlastRetard XCL addition can enhance the bond of paper to the gypsum core.
- PlastRetard XCL is unaffected by pH values between 7 and 10.
- PlastRetard XCL is compatible with the common additives used in plasterboard production such as starches, plasticizers and foaming agents.

SECTION 2

DIGGING DEEPER

2.1 More about Retarders

2.1.1 Efficiency

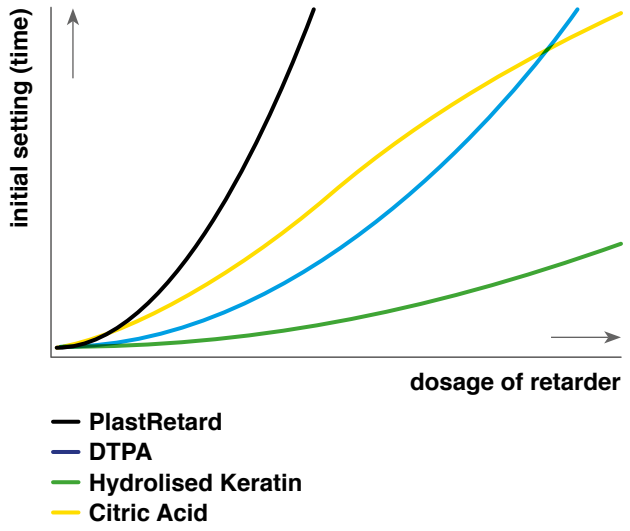
Different retarders act differently on plasters in terms of:

- Effectiveness;
- Slope of the setting curve;
- Completion of hydration.

Independent of the type of retarder, quick setting stucco (for example, flash calcined) needs more retarder for a given initial setting time than a slow setting stucco (for example, kettle stucco).

In figure 2 we show the typical efficiency curves of different retarders. They show that setting time is generally a non-linear function of dosage. For practical purposes, if a fixed setting time is targeted, only small adjustments need to be made and we can assume a linear function over the applicable dosage range.

Figure (2): Delay of initial setting as a function of dosage for different retarders.
Schematic presentation of the characteristic behaviours (at pH close to 7).



PlastRetard XCL is the most efficient retarder and has a slope suitable for setting control.

PlastRetard XCL

PlastRetard XCL an even more powerful set retarder than PlastRetard L; the original formulation.
It has been developed to reduce water gauge by targeting improvements to slurry fluidity and delay of stiffening time while maintaining a predictable and rapid rate of hardening.
When compared to PlastRetard L, XCL provides about 3 times greater impact to fluidity and delay of initial stiffening but only twice the impact to final setting (see figures 3.0 a to 3.0 c). This allows maximum delay of initial setting and fluidization to promote water removal and full hydration of the slurry by the time the green boards enter the dryer. Typical usage rates are one half to one third that of PlastRetard L. All physical, environmental, storage, handling and dosing properties are similar to those of PlastRetard L.

Figure 3.0 a:

Fluidity Response of Retarders
Flash Calcined Synthetic Gypsum/Recycle

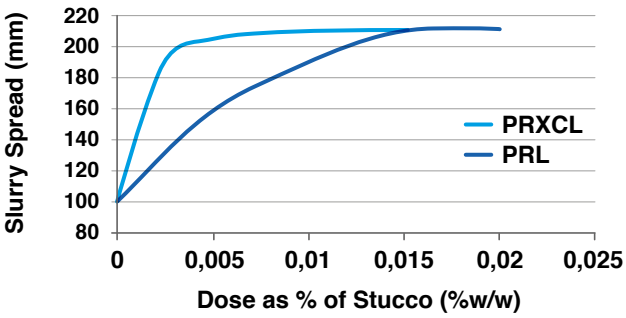


Figure 3.0 b

Stiffening Time of Retarders
Flash Calcined Synthetic Gypsum/Recycle

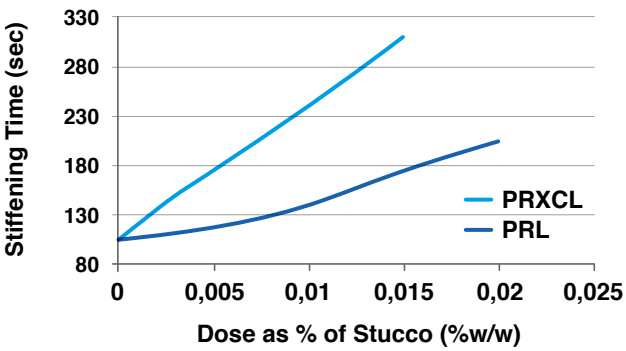
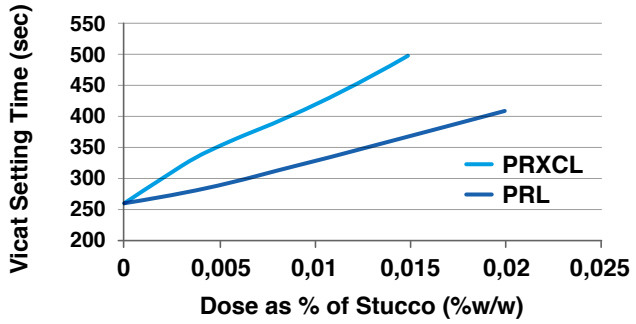


Figure 3.0 c:

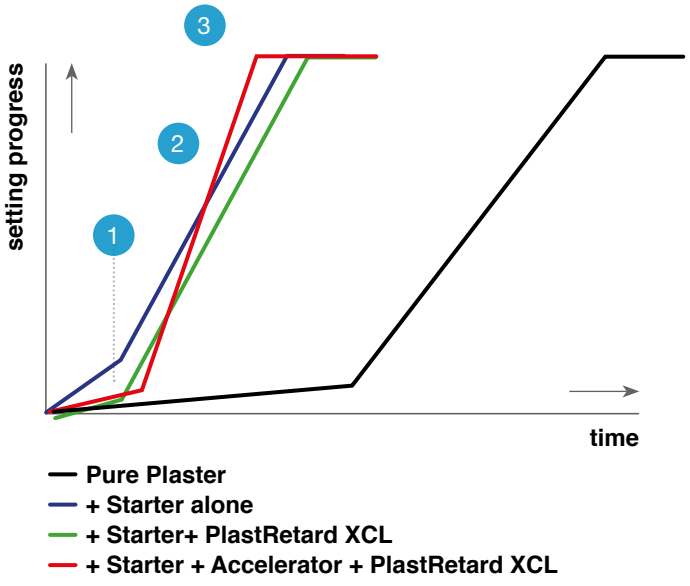
Vicat Setting Time of Retarders
Flash Calcined Synthetic Gypsum/Recycle



2.1.2 Adjustment of setting kinetics

The setting of calcined gypsum depends upon a number of factors including the raw gypsum source, the calcining equipment used and the calcining and storage conditions. Initial setting, for instance, can vary from a few seconds to 30 minutes. Typical stuccoes used for wallboard production have initial setting times that range from about 3 to 15 minutes. The setting reaction is always kick-started with a starter (BMA). The combined use of PlastRetard XCL, starter and accelerator (if needed) helps to optimise setting kinetics as shown by the curves in figure 4:

Figure (4): Adjustment of setting kinetics.



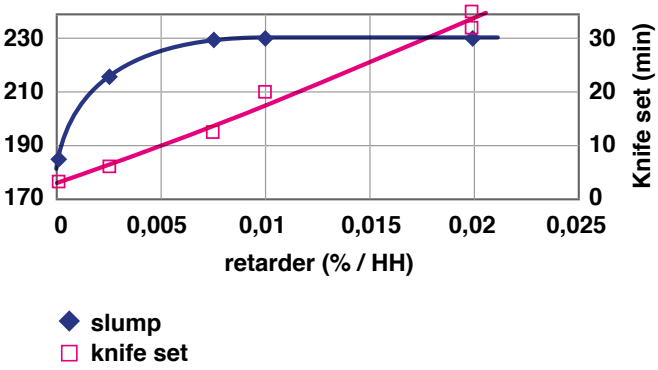
The initial stiffening can be delayed until after forming, ❶ the wet board can be set enough to cut at the knife ❷ and full hydration can be achieved by the time the board enters the dryer ❸.

2.1.3 Improvement of fluidity

The water/plaster ratio depends on the same parameters as the setting but also on the kind of mixing equipment and mixing energy applied. A common indicator for fluidity is the slump test. It is the spread (measured in mm) of a slurry, filled in a bottomless cylinder (60 mm diameter and 50 mm height) and lifted quickly.

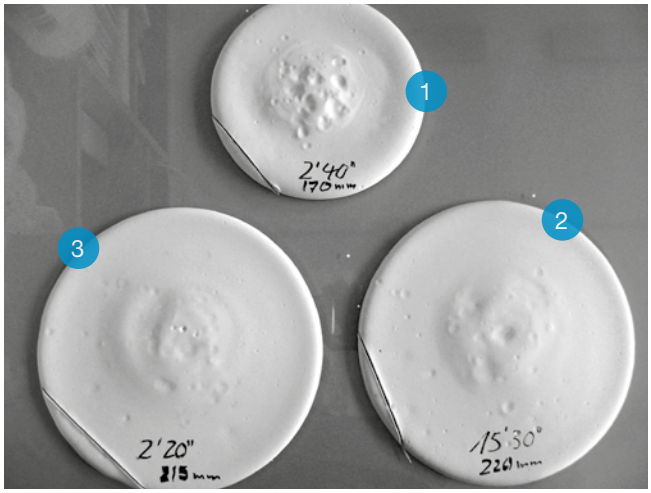
PlastRetard XCL can reduce the amount of water needed for a given fluidity or, as shown in figure 5, increases the fluidity for a given W/P ratio. At a dosage of about 0.015% (active matter) of stucco a maximum in fluidity is reached. Different stuccos will yield different results.

Figure (5): Slump and initial setting as a function of the addition PlastRetard XCL.



The increased fluidity is not affected by the presence of a starter, as shown in fig. 6. In the example below, the base is a quick setting plaster with stiffening time of 3 min. The slurry was vigorously mixed as if for plasterboard production. ❶ The addition of 0.02% of PlastRetard XCL ❷ augments the slump and delays the initial setting time. The addition of 0.1% starter and of 0.02% PlastRetard XCL does not change the fluidity but regains the early set ❸.

Figure (6): Slump (mm) and initial setting (min' sec") as described above



SECTION 2

DIGGING DEEPER

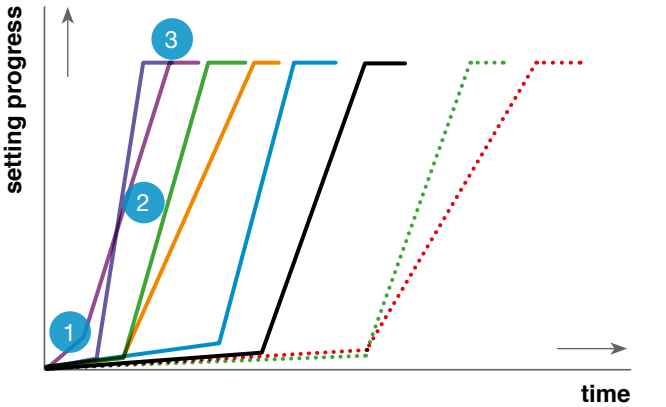
2.2 More about setting control in Plasterboard production

2.2.1 The role of retarders

Setting time and W/P ratio can be controlled by the use of additives. It is state of the art to combine a starter (BMA) with a retarder (PlastRetard XCL) and an accelerator (potassium sulphate) to delay the initial setting time while still achieving full rehydration prior to dryer entry.

Every retarder acts differently with regard to the setting kinetics as shown in figure 7. These differences are crucial in plasterboard production as will be shown below.

Figure 7: schematic representation of the characteristic setting kinetics induced by different retarders and different combinations of retarders, starter and accelerator, as used in plasterboard production.



Remark: PlastRetard XCL and Citric Acid are added at a dosage that results in the same initial setting time.

The first section of each curve represents the decrease of fluidity of the slurry that occurs prior to initial setting. The first bend is equivalent to the initial setting time. The slope of the second section indicates the speed of the setting reaction and the second bend indicates the end of hydration.

In plasterboard production, a starter (BMA) is nearly always used to ensure an early and complete hydration. Addition of starter alone (violet curve in figure 7) causes an almost immediate initialisation of the setting reaction that is not beneficial for fluidity, water requirements or maintaining a clean mixer.

The use of a retarder can eliminate these problems (blue and green curve in figure 7).
As can be seen, the usage of a retarder delays the initial setting time until after forming. ❶ If full hydration is not reached before the boards enter the dryer ❸ then an accelerator must be used. With PlastRetard XCL, even the knife-point ❷ can be maintained.

2.2.2 The role of Starter (BMA)

Starter (BMA = Ball Milled Accelerator) is a finely ground gypsum (dihydrate) which acts as a substrate for precipitating gypsum crystals to grow on. Trace amounts of dihydrate are often present in stucco and are the main reason for variations in setting times. BMA has the dual role of masking this variability and reducing the time needed for completion of the hydration reaction.

BMA is a necessary part of the plasterboard formula and works somewhat in opposition to retarder. Care must be taken to ensure that both the starter and retarder are used properly to give maximum effect.

SECTION 3

SPECIFIC PRODUCT INFORMATION

3.1 Typical composition and properties

	PlastRetard XCL
Physical form:	Brown coloured liquid
Active substance:	43 - 45 % w/w
Water content:	55 - 57 % w/w
Solubility in water:	total
pH relative to 10% w/w solutions:	7 - 8,5
Density:	1,22 - 1,25 g/ml
Viscosity:	30 cPoise
Shelf life:	3 years (if kept sealed, in its original packaging)

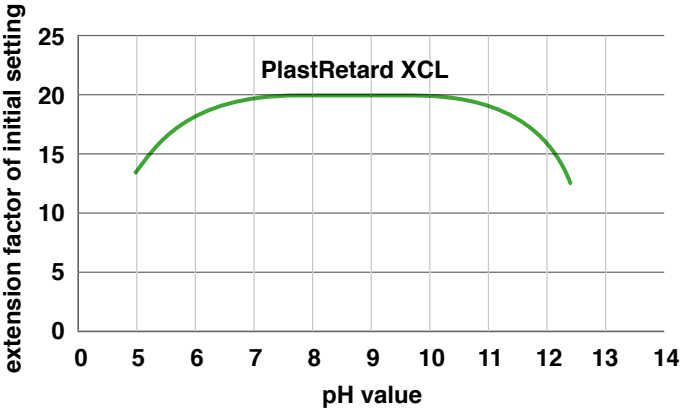
PlastRetard XCL is carefully produced and controlled.
Every step in the production process is monitored and evaluated by our laboratories to assure high quality standardized product.

3.2 Usage levels

PlastRetard XCL can be used with any type of natural or by-product gypsum (e.g. from flue gas desulfurization, phosphoric acid, citric acid, titanium dioxide).

PlastRetard XCL is effective over a pH range of 5 to 12. Maximum efficiency is realized between pH 7 and 10 (Figure 8). The pH where plasterboard and other pre-fabricated products are prepared typically lies within this range.

Figure 8: Efficiency of PlastRetard XCL as a function of the pH value



3.3 Compatibility

Generally, PlastRetard XCL is used alone in gypsum formulations, but it is totally compatible with other retarders. It is also compatible with most other additives commonly used in plasterboard formulations. The only known incompatibility is with soluble Aluminium salts, which are not common in plasterboard production.

SECTION 4

HANDLING, STORAGE AND METERING

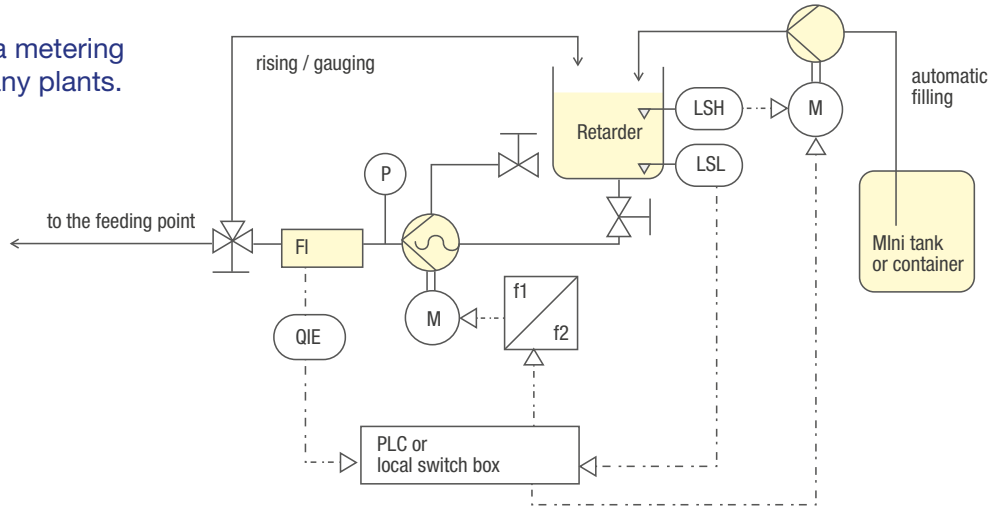
PlastRetard XCL does not contain preservatives and it is stable when stored in its original packaging at temperatures that range from -10°C to 50°C.

If diluted with water and stored over days, PlastRetard XCL may turn a bit gelatinous. If dilution is required for accurate metering, it is recommended that during extended production stops any unused material be disposed and replaced with a fresh batch prior restarting production.

Alternatively, it is possible to add a preservative as Benzoic Acid in the retarder solution.

Metering is best done in undiluted form into the main process water feed using a one-way valve to prevent backflow of water. The most appropriate pump to be used is a positive displacement screw pump (eg. Netzsch, Seepex or similar).

Figure 9: a scheme for a metering system as proven in many plants.



SECTION 5

TOXICOLOGY/ REGULATORY/ HEALTH, SAFETY AND ENVIRONMENT

Toxicology: On the basis of the results, obtained according to OECD n° 420 dated 17th December 2001, PlastRetard L is included in the category 5 of the GHS classification and consequently is NON TOXIC. On the basis of the results and according to Italian Ministerial Decree dated 28th of April, 1997, PlastRetard L is classified NOT IRRITANT FOR EYES AND SKIN. PlastRetard XCL can therefore be handled following reasonable safety precautions and good manufacturing practices.

Ecology:
On the basis of the obtained results, according to the screening method and guidelines reported in OECD n° 301/1992 and ISO 14593/1999 to which CE 648/2004 concerns, PlastRetard L is biodegradable under aerobic conditions.

No special regulations apply to transportation of PlastRetard L and of PlastRetard XCL.

SECTION 6

SUMMARY - WHY USE PLASTRETARD XCL

1.
PlastRetard is the most efficient and cost effective set retarder available to plasterboard manufacturers today.

2.
PlastRetard provides precise control of the setting reaction and helps operators to manage the production process in a better way.

3.
PlastRetard provides a certain amount of slurry fluidization and allows for water reduction of about 5% that translates into equivalent savings in drying costs and increases plant capacity.

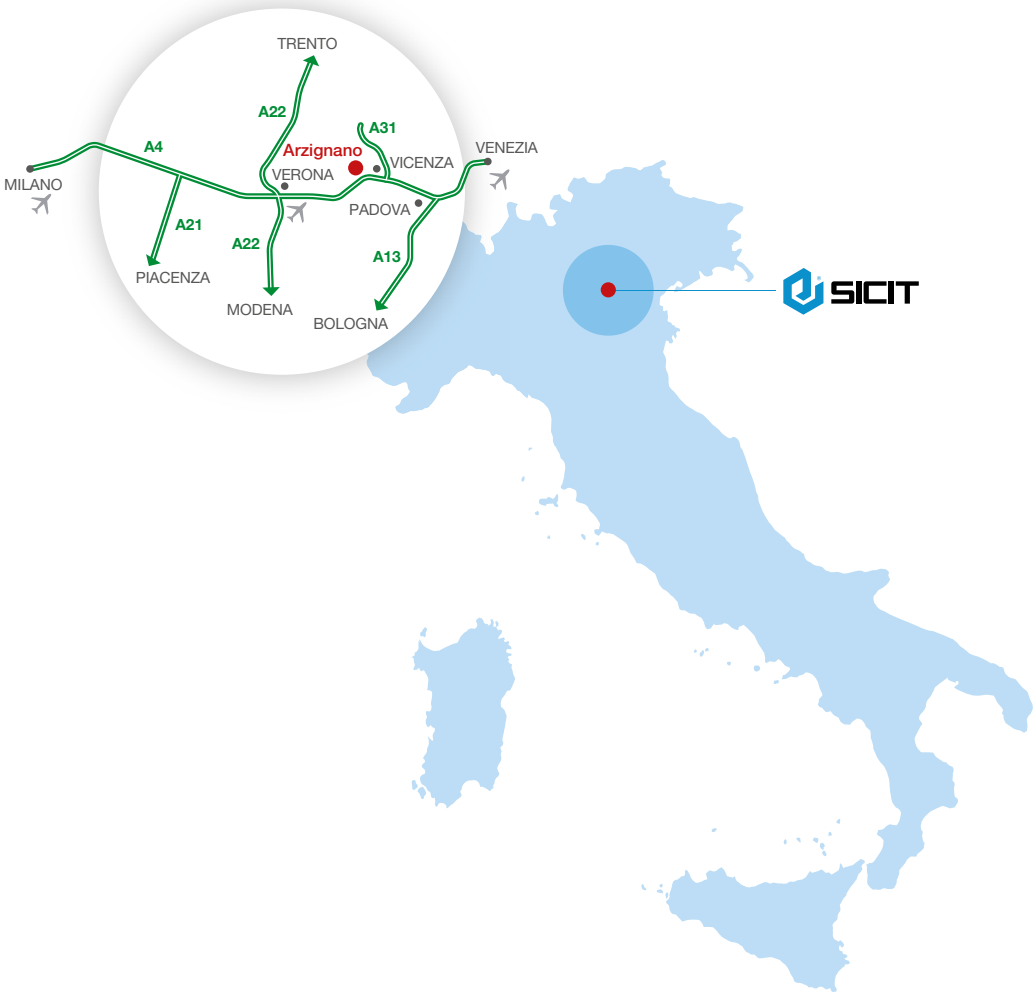
4.
PlastRetard delays the initial setting time which helps to prevent the formation of set gypsum inside the mixer and keeps it clean. This results in a reduction of paper breaks and line stoppages and extends the net operating time of the production line.

5.
PlastRetard is supplied in liquid form that makes it easy to use and dose.

6.
PlastRetard does not contain any hazardous substances such as Nitrilotriacetic acid or Formaldehyde and is completely soluble and biodegradable.

SICIT GROUP S.p.A.

Via Arzignano, 80
36072 Chiampo (VI) Italy
Tel. +39 0444 450 946
Fax +39 0444 677 180
Mobile +39 345 720 35 81
sales@sicitgroup.com
www.sicitgroup.com



PlastRetard® XCL

The Multifunctional additive for a high performance wallboard line.