



SICIT2000 S.p.A.

PlastRetard[®]L

Liquid Form

The Multifunctional Additive.



BEYOND RETARDING EFFECT

- Extension of the initial stiffening without slowing the setting speed.
- Cost effective price for a given effect.
- Easy to handle and to dose.
- Regular, reliable.
- No health hazard - Biodegradable product.
- Shelf Life: 3 years.
- Not affecting the strength of the final product.
- Compatible with other additives.
- Not nourishing moulds.

PlastRetard® L

The Multifunctional Additive



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SUMMARY - Why using PlastRetard L

FIELDS OF APPLICATION

1.1 Definitions

For the better understanding it is useful to give, first, some definitions of the terms used in the following:

Stucco:

generally a calcined Gypsum but usually designating Plaster of Paris. Mixed with water into a slurry it hardens to a solid body.

Plaster:

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

Water/Plaster ratio (W/P):

a measure for 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** = generally the point where a moulded body is hard enough to be handled or, in the case of a wall plaster, the finishing must end;
- **The speed of setting** = the maximum slope of the setting function.

Hydration:

the chemical process of recombination of crystalline water (generally called Combined Water, CW).

Retarder:

an additive postponing the initial setting or/and slowing the speed of setting.

Accelerator: BMA (Ball Milled Accelerator)

Finely grinded gypsum in a Ball Mill with the addition of sugar.

1.2 The use of PlastRetard L in Plasterboard production

There are two main applications of gypsum plasters: moulding of prefabricated products, like plasterboard or plaster blocks; and powder products for application on site like gypsum wall plaster. It is obvious that in powder products only dry additives can be used.

By contrast, in prefabrication, liquid products are advantageous. **PlastRetard L** is a powerful liquid retarding agent for gypsum plaster. It is therefore, in particular, suitable for applications in wallboard plants. The dry variety of PlastRetard, suitable for powdery admixtures, is **PlastRetard PE** (see other brochure).

This brochure deals solely with **PlastRetard L** because the conditions for manufacturing prefabricated products are completely different from those of powder products applied by people on site.

Since Plasterboard is by far the most important product, we will concentrate on the specifics of **plasterboard production**.

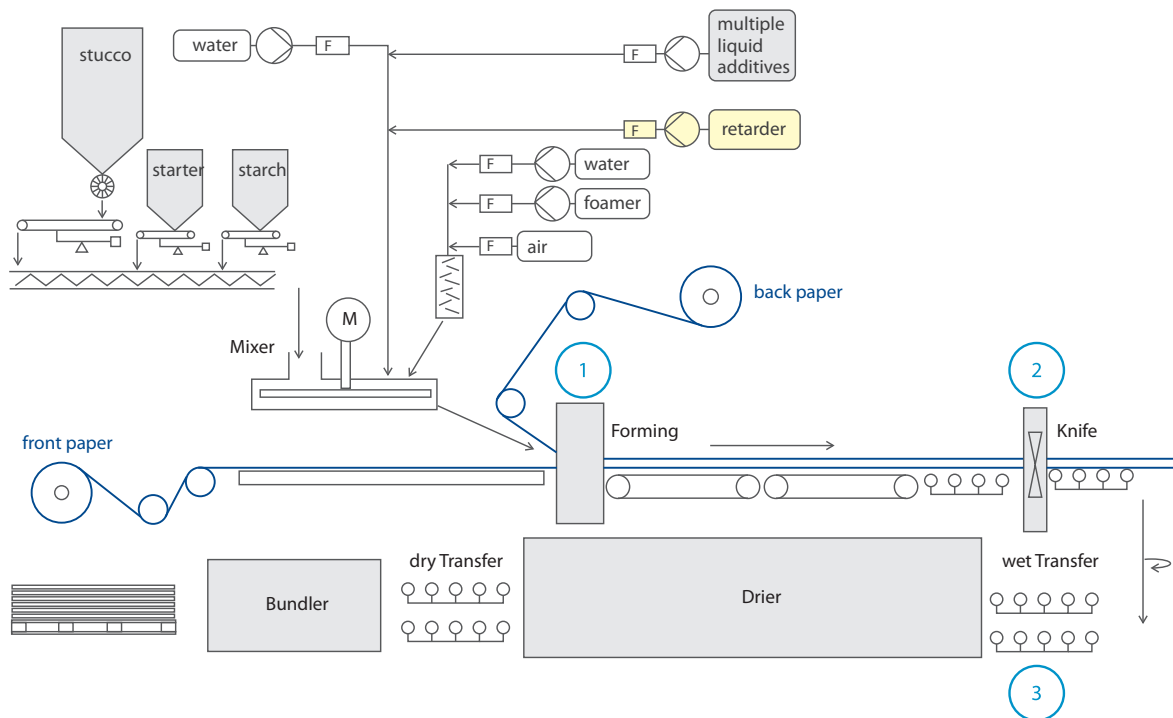
For better understanding, we show in figure (1) a sketch of a typical plasterboard line.

The conditions for an economical operation are:

- A low water/plaster ratio is welcome. It saves drying energy and increases the drier capacity;
- The costs of the formula should be as low as possible;
- Off-spec production has to be avoided;
- Reduced maintenance requirements (Cleaner Mixer) have a major impact on costs.

Thus, it is standard practice to dress the setting characteristics by the combined use of BMA and retarder

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



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

- at point **1** an easy flowing slurry, setting starts behind forming station;
- at point **2** a board core, stiff enough to be safely cut;
- at point **3** a board core (ideally) completely re-hydrated.

Those requirements translate into setting characteristics:

- Extended time without stiffening;
- Rapid and complete hydration.

1.3 The benefits of PlastRetard L in Plasterboard production:

- PlastRetard L has proven to be the most efficient and reliable retarder for this purpose;
- PlastRetard L can be easily metered by conventional screw pumps;
- PlastRetard L, in many cases, if properly used, reduces the water demand;
- PlastRetard L poses no health hazard or other inconveniences;
- PlastRetard L is completely dissolvable in water;
- PlastRetard L retarding efficiency (measured by extension factor) is unaffected by the water/ gypsum ratio;
- PlastRetard L addition does not modify the bond of paper on the gypsum core;
- PlastRetard L is unaffected by pH values between 7 and 10;
- PlastRetard L is compatible with the additives used in Plasterboard production such as starch, plasticizers and surfactants which control properties as paper bond, fluidity and density.

DIGGING DEEPER

2.1 More about Retarders

2.1.1 Efficiency

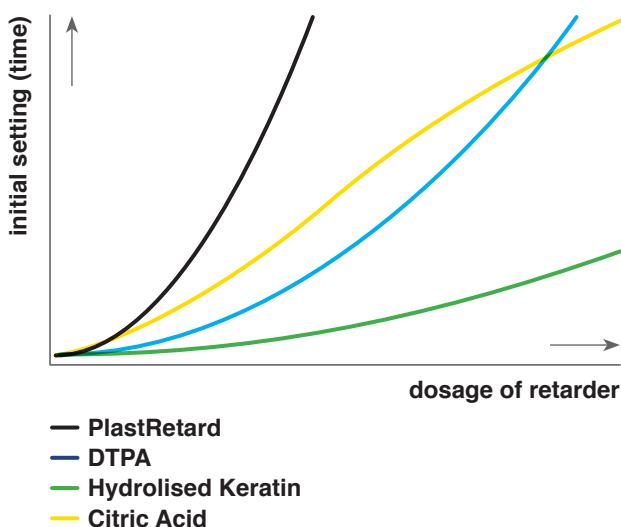
Different retarders act differently on plasters in terms of:

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

Independently of the type of retarder, a quick setting plaster needs more retarder for a given initial setting than a slow setting plaster.

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

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).

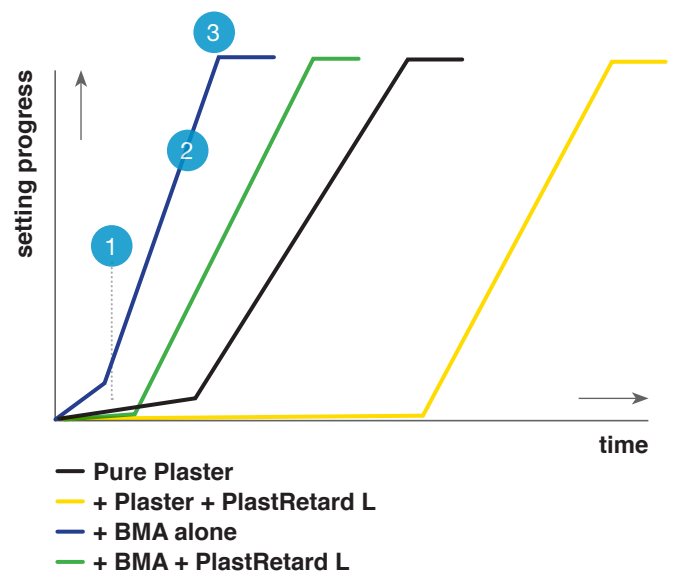


PlastRetard L is the most efficient product and has a slope suitable for setting control.

2.1.2 Adjustment of setting kinetics

The setting of calcined gypsum depends upon the raw gypsum source, the calcining equipment and storage conditions. Initial setting, for instance, can vary in extremis from a few seconds to 30 minutes. Plasters for wallboard production can have a span of initial setting from 3 to 15 minutes but are always kick-started with a starter. The combined use of PlastRetard L and accelerator, if needed, helps to optimise the setting kinetic as shown in figure 3:

Figure (3): Adjustment of setting kinetics.



The initial stiffening can be postponed, far enough behind the forming ①. The knife-point ② can be maintained and the final setting ③ can be achieved in time.

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 absorbed. A common indicator for fluidity is the slump. 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 L reduces the W/P needed for a given fluidity or, as shown in figure 4, increases the fluidity for a given W/P ratio. At a dosage of about 0.015% (active matter) of plaster the saturation is reached.

Figure (4): Slump and initial setting as a function of the addition PlastRetard L.

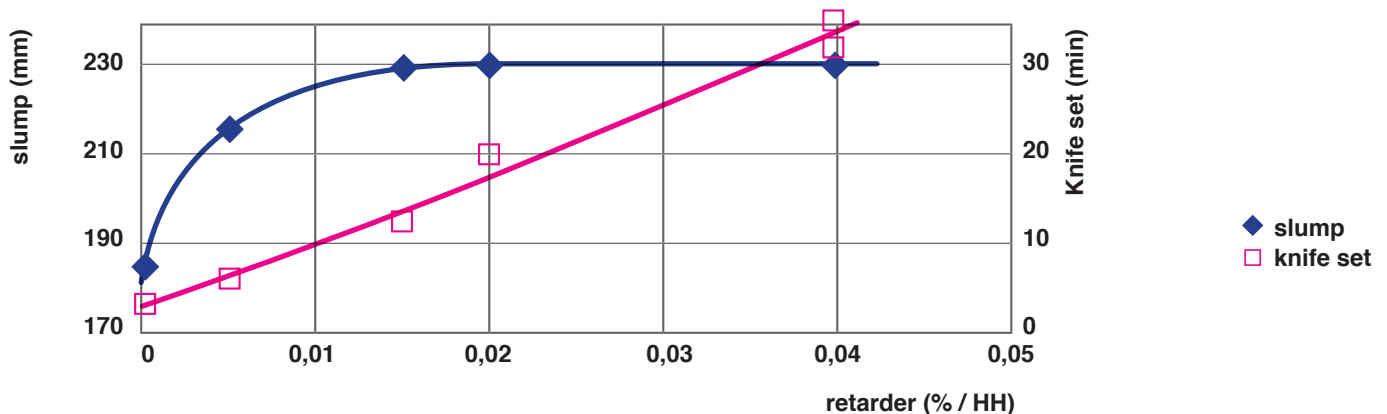
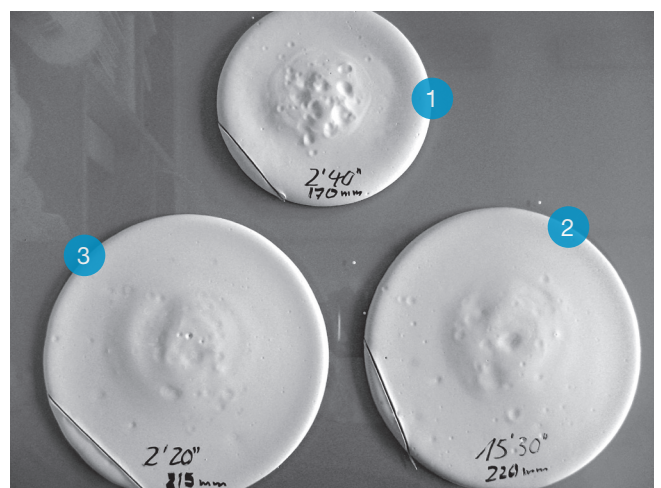


Figure (5): Slump (mm) and initial setting (min' sec'') as described above.

The increase of fluidity is not affected by the presence of BMA, as shown in fig. (5).

The base is a quick setting plaster with an initial setting of 3 min.

The slurry is vigorously mixed if as for Plasterboard production ①. The addition of 0.02% of PlastRetard L ② augments the slump and the initial setting. The addition of 0.1% BMA and of 0.02% PlastRetard L does not change the fluidity but regains the early set ③.



DIGGING DEEPER

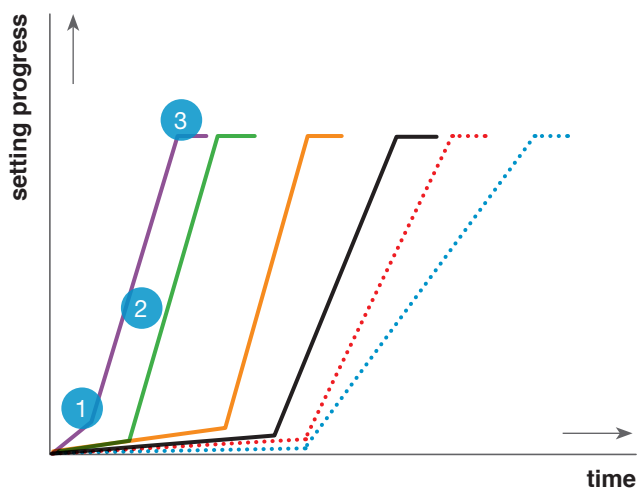
2.2 More about setting control in Plasterboard production

2.2.1 The role of retarders

Setting and W/P ratio can be controlled, to a certain degree, by additives. It is state of the art to combine BMA with PlastRetard L.

Every retarder acts a bit differently in regard to the setting kinetics as shown in figure 6. These differences are crucial in plasterboard production as will be shown below.

Figure (6): schematic representation of the characteristic setting kinetics induced by different retarders and different combinations of retarders and BMA, as used in plasterboard production.



Remark: PlastRetard L and Citric Acid in a dosage which results in the same initial setting.

- Pure Plaster
- Citric Acid
- PlastRetard L
- BMA Alone
- Citric Acid + BMA
- PlastRetard L + BMA

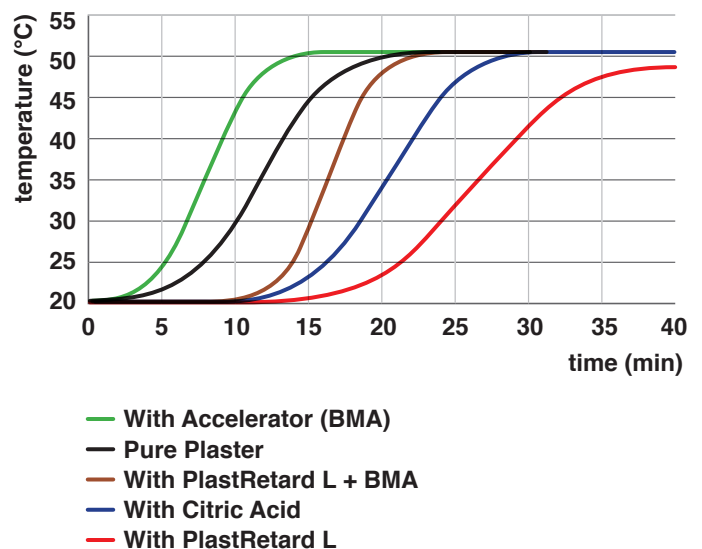
The first section represents the increase of the yield stress, equivalent to a decrease of fluidity of the slurry before the initial setting. The sharp bend is equivalent to the initial setting. The more or less steep slope indicates the speed of the setting and the second sharp bend indicates the end of hydration.

In Plasterboard production BMA is always used in order to get an early complete set. But BMA causes an almost immediate initialisation of the setting which is not beneficial for fluidity, water demand and other properties of the slurry (violet curve in figure (6)).

The use of a retarder will eliminate all these problems (green curve in figure (6)).

As can be seen, the usage of a retarder postponed the initial setting, far enough behind the forming ①. If the final setting ③ should be achieved earlier, an accelerator (BMA) must be used. With PlastRetard L even the knife-point ② can be maintained.

Figure (7): Further graphs.



2.2.2 The role of BMA

Accelerator (BMA = Ball Milled Accelerator) is an inevitable part of the plasterboard formula and it is a kind of antagonist of retarder.

Therefore, the system works only as well as both elements work appropriately.

BMA is a finely ground gypsum (Dihydrate) which acts as a source of crystallisation germs. Traces of Dihydrate are often present in plaster in variable amounts.

They are the main reason for the variability of the setting times of a given plaster product. Thus, BMA has the double role of obliteration, by overdose, the natural variability of traces of germs and to reduce the time needed for the completion of the hydration.

SECTION 3

SPECIFIC PRODUCT INFORMATION

3.1 Typical composition and properties

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:	21 cPoise
Shelf life:	3 years (if kept sealed, in its original packaging)

PlastRetard L is carefully produced and controlled in our laboratories at every step of production in order to assure a standardized product.

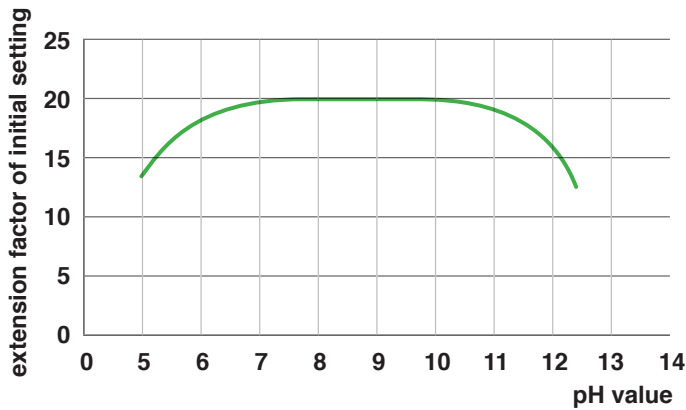
3.2 Usage levels

PlastRetard L can be used in any type of natural or by-product gypsum (e.g. from flue gas desulfurization, phosphoric acid, citric acid, titanium dioxide), both low and high quality and at any water/gypsum ratio.

PlastRetard L is effective at a pH range comprises from 5 to 12 and its maximum efficiency is between 7 and 10 (Figure 8).

The pH where plasterboard and other pre-fabricated products are manufactured lies in the centre of effectiveness.

Figure 8: Efficiency of different PlastRetard L as a function of the pH



3.3 Compatibility

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

SECTION 4

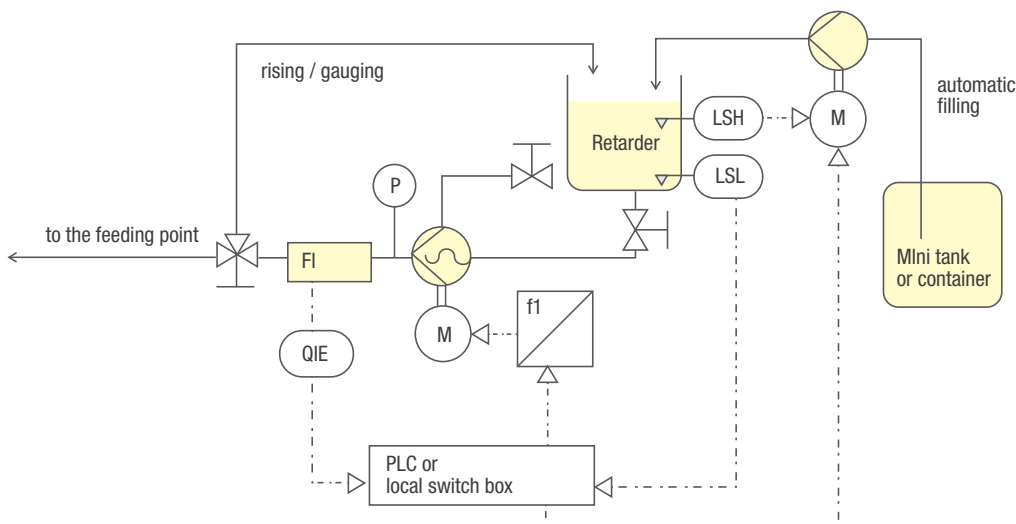
HANDLING, STORAGE AND METERING

PlastRetard L does not contain preservatives and it is stable when stored in its original packaging at temperatures that range from 4°C to 30 °C.

If diluted with water and stored over days, PlastRetard L might turn a bit gelatinous, thus it is advised against the dilution of the product.

Metering is best done in undiluted form into the main water feed using a one-way valve in order to resist to the back pressure. The most appropriate pump to be used is a Mohn-pump (screw pump). Figure 9.

Figure 9: a scheme for a metering device 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 L 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 the transportation of PlastRetard L.

SECTION 6

SUMMARY - Why using PlastRetard L

- 1) To have maximum effect with minimum dosage;
- 2) To define a precise and predictable hydration point. This results in a higher control on the exact position of the knife point.
- 3) Since PlastRetard L provides a certain fluidizer effect, you will get a reduction (about 5%) in the quantity of water needed in the pin mixer and then:
 - a) The saving in water directly translates to a proportional saving in the drying cost;
 - b) Reducing water increases the plant capacity.
- 4) PlastRetard L is a reliable cleaner inside the pin mixer. This will result in a reduction in little lumps formation and imperfections of Gypsum coming from the pin mixer. This enables longer running time of your line because there is a longer period between the cleaning of the pin mixer.
- 5) To increase the homogeneity of the board.
- 6) To obtain better edge profiles of the board showing then a more stable shape.
- 7) Unlike other retarders present in the market, PlastRetard L does not contain any hazardous substances.



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