Pyro processing

Lime hydration systems

metso
Expect results

Pyro processing

Lime hydrators

With over 100 years of experience in the minerals processing industries — the lime industry in particular — Metso has the resources and the expertise to design and supply a lime hydration system that best meets the specific requirements of each particular application.

Lime hydration process

The lime hydration process is one in which lime is combined with a proportional amount of water at a controlled rate. The chemical reaction that takes place between the lime and water (shown below in its simplest form) is an exothermic one, through which a significant amount of heat is generated — 497 Btu per pound of CaO.

$$CaO + H_2O \longrightarrow Ca(OH)_2 + Heat$$

The amount of water that is metered into this particular process is basically stoichiometric on a net basis; that is, only the amount required to combine with the amount of calcium oxide present, with the excess water supplied being flashed off as steam, as a result of the heat generated by the reaction. Because of this, the lime hydrate produced is a dry, powdery material with a moisture content that is typically less than 1%.

The typical Metso non-pressure or atmospheric hydration system consists of a weigh belt feeder, duplex mixer (or pre-mixer), seasoning chamber, transition duct, baghouse and vent fan, as well as the various field instruments required to control the process. (Please see Figure 1.)

The weigh belt feeder delivers lime — typically 3/8 in. x 0 or finer — to the duplex mixer at a controlled rate. Water is also metered into the mixer at an appropriately proportional rate. This addition of water is controlled so that the truly active part of the chemical reaction is not begun until the mixture of lime and water has entered the adjoining seasoning chamber. Minimal steam is developed in the duplex mixer, itself. "Hard-burned" limes — those with a low reactivity — require more time in the duplex mixer in order to begin reacting; therefore, the speed of the mixer must be relatively slow. On the other hand, "soft-burned" — more reactive limes — require less time for this initial step in the process and so, the mixer speed must be faster, in relative terms. The variable speed drive supplied with the duplex mixer serves to accommodate such potential variations in the lime feed to the hydration system.

1. **Duplex mixer** — This is the first chamber into which both lime and water are introduced. The unit is of carbon steel construction and is equipped with two paddle shafts for mixing. The unit includes a variable speed drive.

2. **Seasoning chamber** — This is the second system chamber in which the lime/water mixture is processed. The unit is of carbon steel construction and is equipped with a single paddle shaft for additional mixing. The unit is sized to provide a residence time sufficient for completing the hydration reaction.

3. **Baghouse collector** — A baghouse type collector is used to vent the super-heated steam from the process, while filtering out the very fine hydrate particles from the exhaust stream and keeping them in the process to ultimately discharge as product.

4. **System vent fan and exhaust stack** — A small capacity vent fan is provided to induce the super-heated water vapor (gas) released during the exothermic reaction in the seasoning chamber into the baghouse, and to then exhaust the filtered vaporous effluent to atmosphere through a small stack.

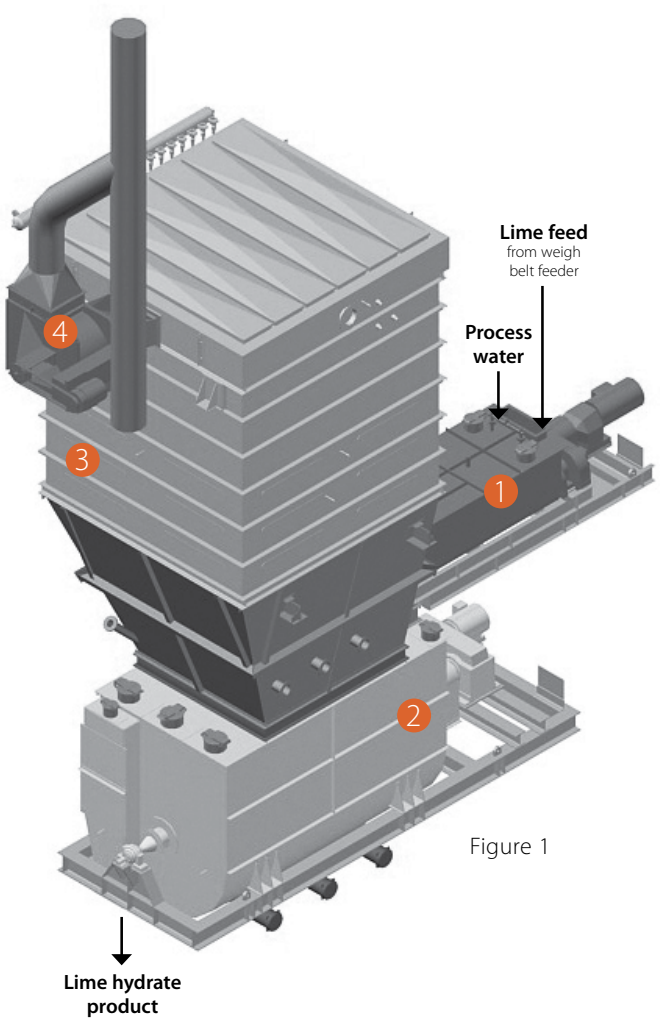


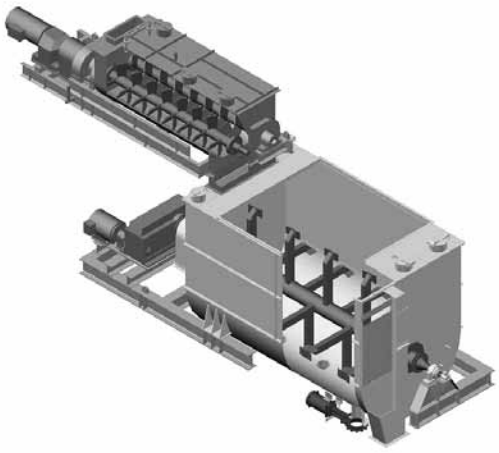
Figure 1

The paste or slurry of lime and water that forms in the mixer discharges into the seasoning chamber where it is retained for the proper length of time to complete the hydration reaction. The seasoning chamber is a horizontal, semi-cylindrical vessel in which a shaft fitted with arms and paddles slowly rotates to mix the mass of hydrating lime and slowly advance it to the product discharge. Retention time in the seasoning chamber can be adjusted, to some extent, by adding or removing plates that make up a variable height overflow weir at the discharge end of the seasoning chamber. The actual retention time required depends upon the type and quality of lime fed to the system.

Nearly all limes contain some hard-burned particles or impurities, which do not hydrate. These heavier particles, often referred to as grit, sink to the bottom of the agitated mass and do not overflow the discharge weir. Therefore, these particles must periodically be removed through openings provided in the bottom of the chamber. These openings are fitted with driven knife gates to facilitate removal of the grit during a shutdown.

The hydrated lime that overflows the weir at the seasoning chamber discharge is generally a finely divided powder. The normal temperature range for high calcium hydrate product is 194 to 212° F; this corresponds to approximately 0.5% free H_2O in the hydrate. It is advisable to operate with a small percentage of free water in the hydrate to assure complete hydration of the reactive oxides in the quicklime feed.

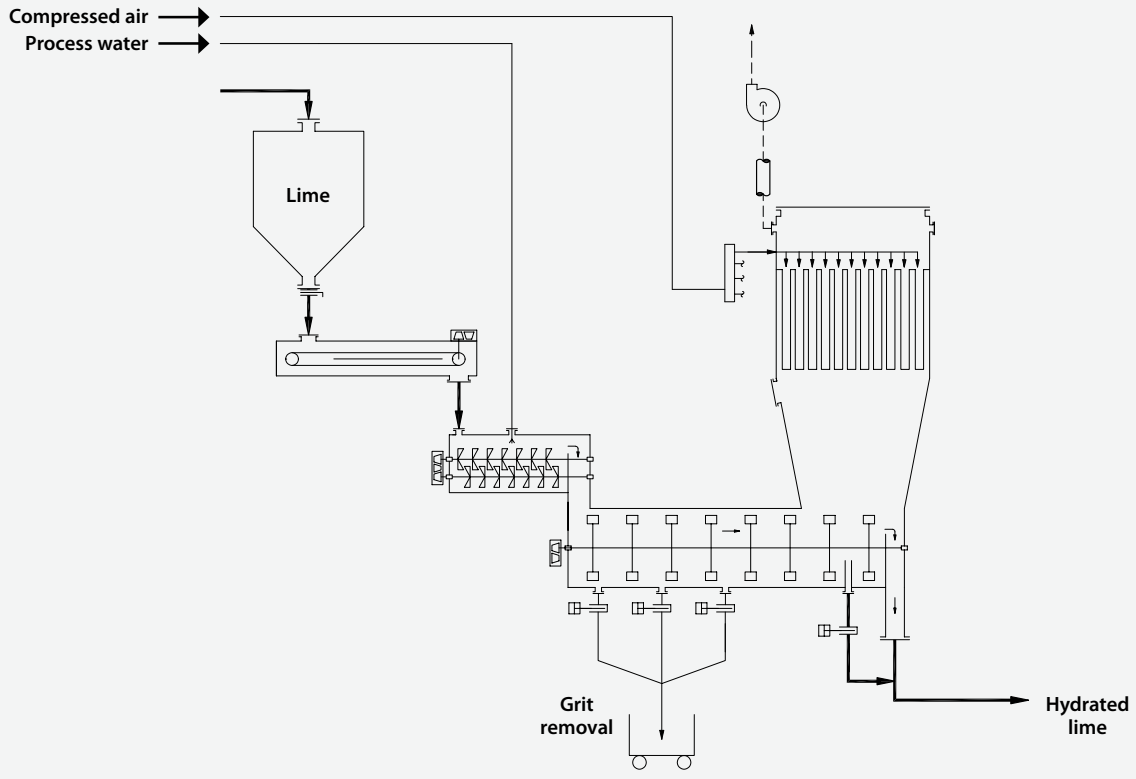
The steam generated in the seasoning chamber is vented through a baghouse type collector. The hydrate pulled into the baghouse with the steam generated by the hydration process collects on the outside of the filter bags. The bags are pulsed with compressed air from the inside, which loosens the hydrate from the outside of the bags, causing it to fall back into the seasoning chamber below, from where it eventually discharges as product.



Metso believes in the "keep it simple" design principle, as is evidenced by the equipment rendering shown above — not a lot of unnecessary "bells and whistles." It is the straightforward, user-friendly design of the Metso system that makes it an attractive lime hydrating solution.

There is a similar process in which an excess amount of water is used to hydrate the lime. This process is referred to as lime slaking and the product discharged from a lime slaker takes the form of a slurry. Information specific to Metso lime slakers is available separately.

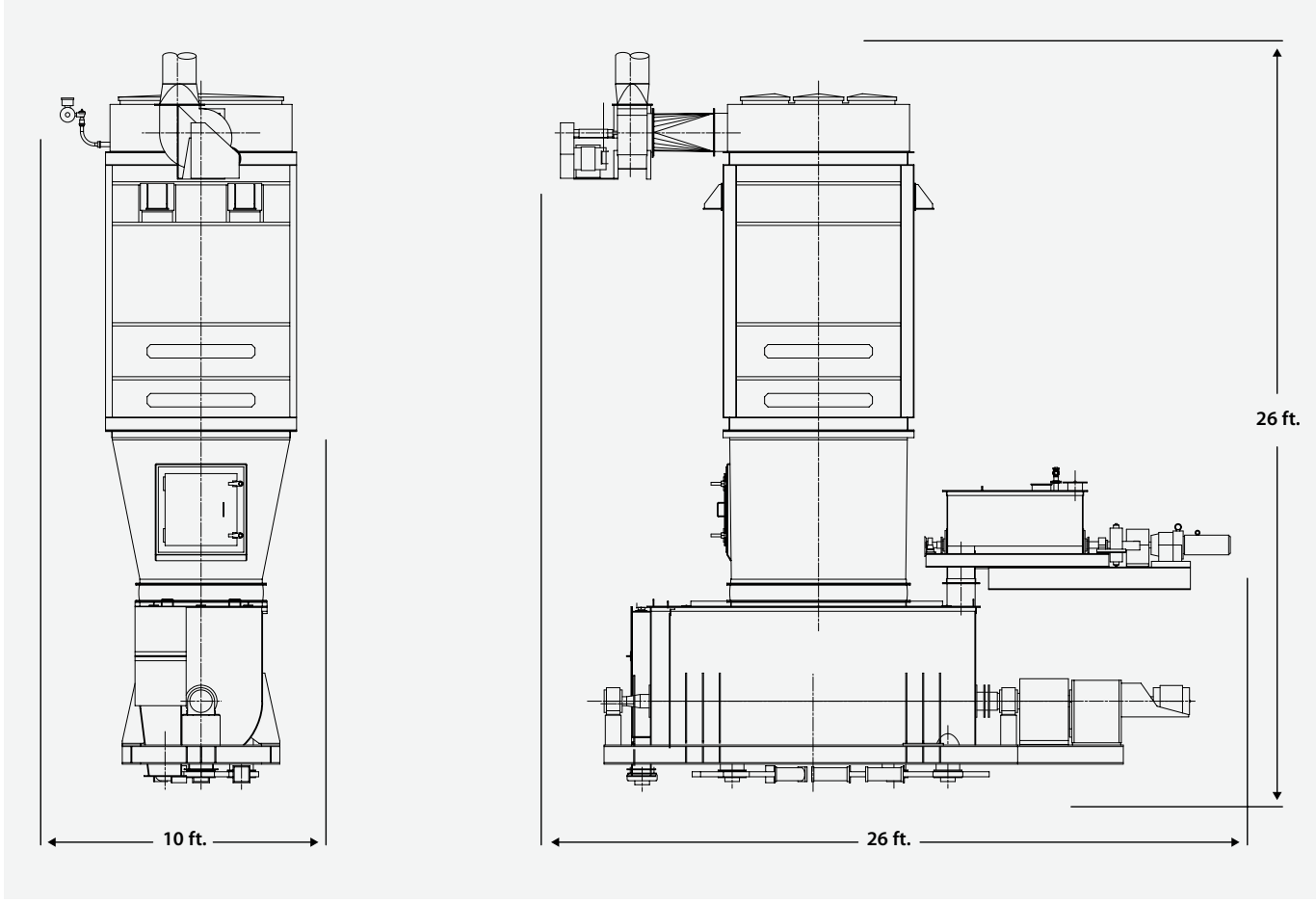
There is yet a third type of lime hydration process that involves lime containing a significant amount of magnesium, which is commonly referred to as dolomitic lime or simply dolime. This process also produces a dry, powdery hydrate, but because the magnesium oxide present in the dolime does not easily combine with water, the process requires pressure. Information specific to Metso pressure hydration systems is also available separately.

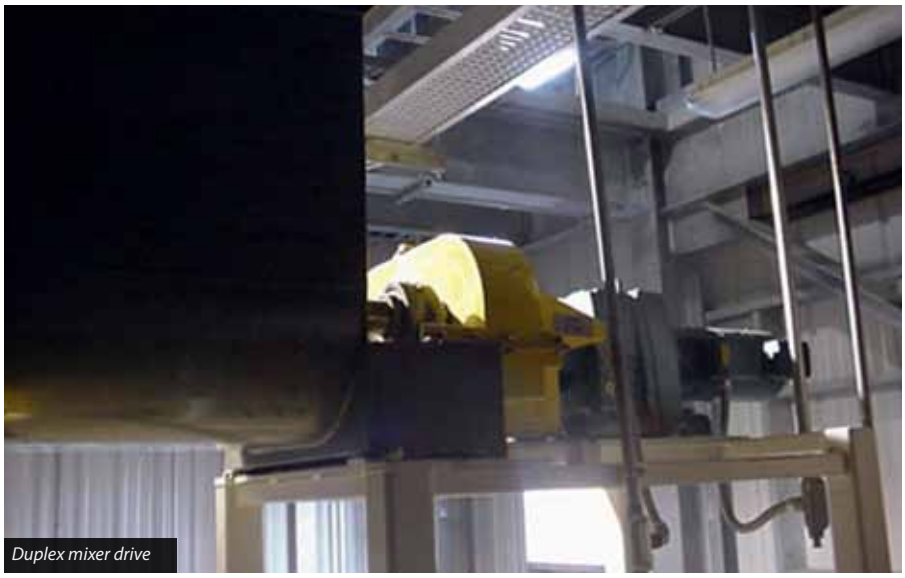


Lime feed bin and enclosed weigh feeder

Duplex mixer and seasoning chamber

The figure below shows a typical stack-up of a standard Metso hydration system with a nominal hydrate production capacity of 8.5 STPH.





Duplex mixer drive

Properties of commercial high calcium lime products

Properties	Pebble Lime	Lime Hydrate
Chemical Name	Calcium Oxide	Calcium Hydroxide
Chemical Formula	CaO	Ca(OH)2
Specific Gravity	3.2 – 3.4	2.3 – 2.4
Molecular Weight	56.08	74.09
Bulk Density lb./cu ft.	55 – 60	25 – 35
Specific Heat @ 100° F, Btu/lb.	0.19	0.29
Angle Of Repose	55°	70°

Metso hydrators — standard sizes

Production Capacity (STPH)	Lime Feed (STPH)	Process Water Required (GPM)	Duplex Mixer Size (INCHES)	Seasoning Chamber Size (FEET)
8.5	6.60	16	33 x 60	4.5 x 12
15	11.30	28	33 x 60	6 x 12
25	18.90	47	51 x 122	8 x 14
40	30.25	75	51 x 122	9 x 14

Expect results

It is our promise
to our customers and
the essence of our strategy.

It is the attitude
we share globally;
our business is to deliver
results to our customers,
to help them reach
their goals.

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