



LIME
HYDRATION
PROCESS



QUICKLIME TO HYDRATED LIME



The term «hydrated lime» is used to describe a powdered calcium hydroxide product made by combining quicklime with sufficient water to satisfy the natural affinity for moisturing (generally 1%)



While the chemical reaction involved is quite simple, different variables can influence the hydration process, i.e.:

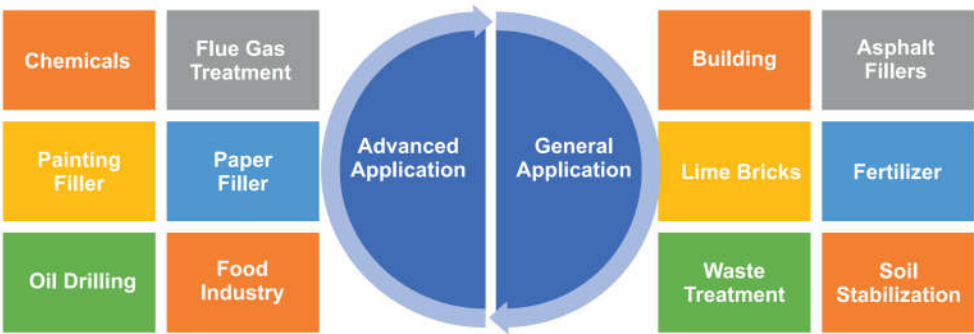
- limestone quality;
- calcium oxide properties in terms of size and reactivity;
- chemical properties and quantity of process water;
- retention time to evaluate kinetic reaction;
- mixing velocity;
- steam formation and contact with quicklime;
- final temperature.

The highly exothermic reaction between quicklime and water must be carefully controlled in order to achieve the desired product quality and fineness.

Properties	Low	Standard	«Intermediate» High	High
BET areas	<15 m²/g	15-20 m²/g	≤25 m²/g	>25 m²/g
Hydration Techniques	Standard Hydration	Standard Hydration and Double Hydration technique	Pre-Hydration	High moisture and Post Drying (*)
Industrial Applications	General Application	General Application	Advanced Applications	

(*) Chemicals to be defined during raw material evaluation

Cimprogetti has engaged an extensive scientific research and technological experimentation in specific and advanced uses of hydrated lime.



RESEARCH and DEVELOPMENT [LAB]

Cimprogetti has developed test protocols calibrated according to the characteristics of the raw material so as to identify the appropriate hydrator model.

To properly understand the physical chemistry and the reaction behaviour of raw material, preliminary modeling and specific laboratory tests must be carefully evaluated.

For instance, the specific BET surface area is a fundamental parameter necessary in estimating the capacity of calcium hydroxide Ca(OH)_2 to absorb / purify gases / fumes.

Oxide characterization in LAB	Hydration test in LAB or with the Pilot Plant	Hydrate characterization in LAB
Chemical analysis(XRF-WDS)	Moisture target	Chemical analysis(XRF-WDS)
Diffractometric analysis (XRD-QPA)	BET SSA target	Diffractometric analysis (XRD-QPA)
Available Lime Index (ALI)	Oxide / water ratio	Moistures
Reactivity Test (EN 459-2)	Water:hot/cold	Thermal analysis (LOI,TG-DTG)
Dry particle size distribution	Additives: yes/no	BET specific surface multipoint
	Oxide particle size distribution	Pore Volume / Pore size
	Double hydration	Particle size distribution dry method
	Pre-hydration	Grain particle size distribution
		Colour (spectrophotometer)
		Volume stability (expansion test)
		Plasticity test

LABORATORY PROTOCOL

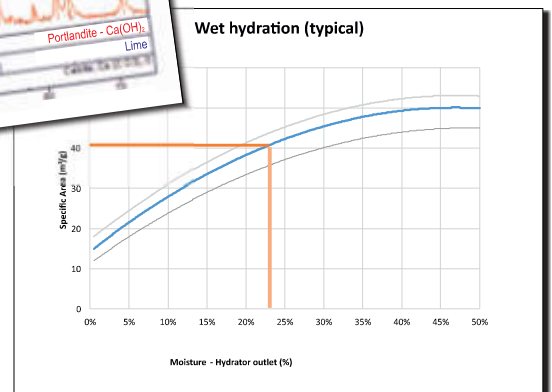
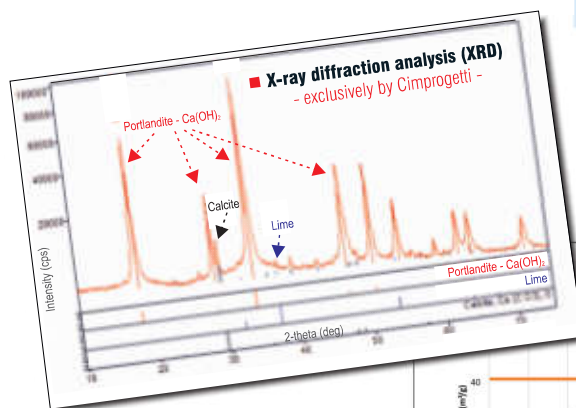
The BET specific surface area, pore-volume and pore-size distribution are determined by nitrogen gas absorption.

A thermo-balance is used to identify residual moisture.

Laser diffraction analysis coupled with X-ray sedimentation techniques measure particle-size-distribution.

The spectrophotometer evaluates brightness, important especially for applications in the construction sector.

Finally, XRD analysis allows constant quality control in terms of mineralogical / crystallographic features, including information related to the residual calcium-oxide content, the possible presence of calcite due to recarbonation, the formation of amorphous phase, the impurity content, as well as the crystallite-size, microstrain, and lattice parameter determinations.



Analysis result example

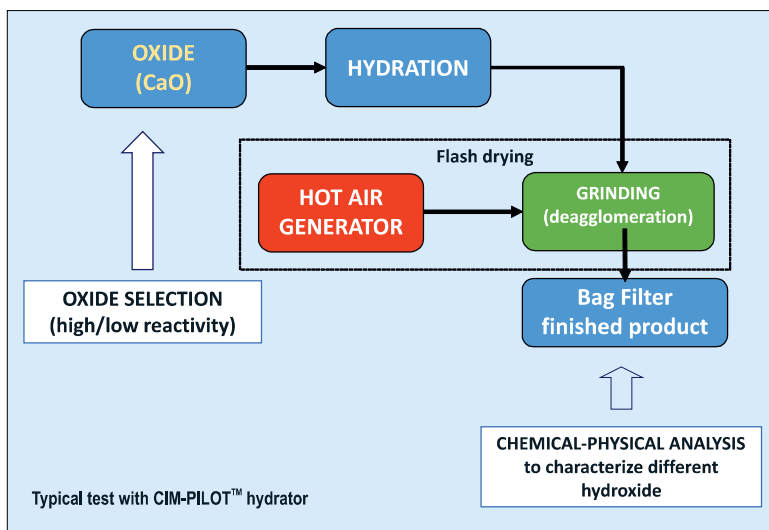
RESEARCH and **DEVELOPMENT** **[PILOT PLANT]**



After raw material characterization in the LAB, hydration tests are carried out with a pilot hydrator.

The **CIM-PILOT™** hydrator is a scaled down standard hydrating machine able to execute very effective testing campaigns at clients' plant sites. It has recently been revamped to close-track the processing conditions with enhanced automation and complementary modules able to boost the specific BET surface from standard values up to high BET grades $> 40 \text{ m}^2/\text{g}$, thanks to the patented process named **HYDRAX-BOOSTER BET®**.

The results of the test are then effectively applied to the design and supply of the industrial scale hydrator to best match client objectives.

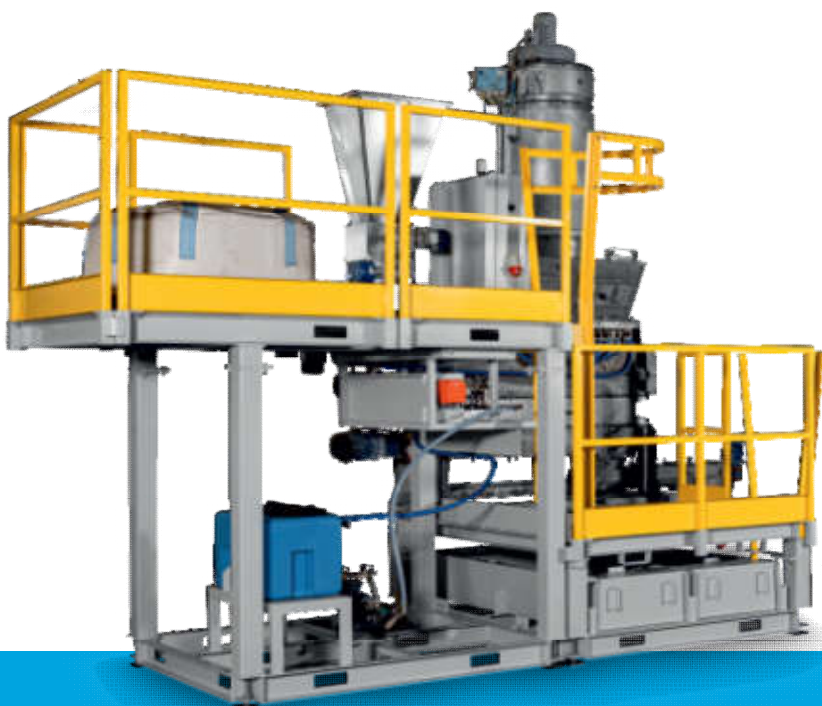


Technical data:

■ production:	50 kg/h at 25% moisture 120 kg/h at 1% moisture
■ dimensions:	50 sqm
■ installed power:	55 kW
■ total weight:	600 kg

The **CIM-PILOT™** hydrator also includes a drying module to produce a **HIGH BET WITHOUT CHEMICAL ADDITIVES**.

The **CIM-PILOT™** hydrator for High BET production is made available on a rental basis to be defined - Client to provide raw material and utilities.

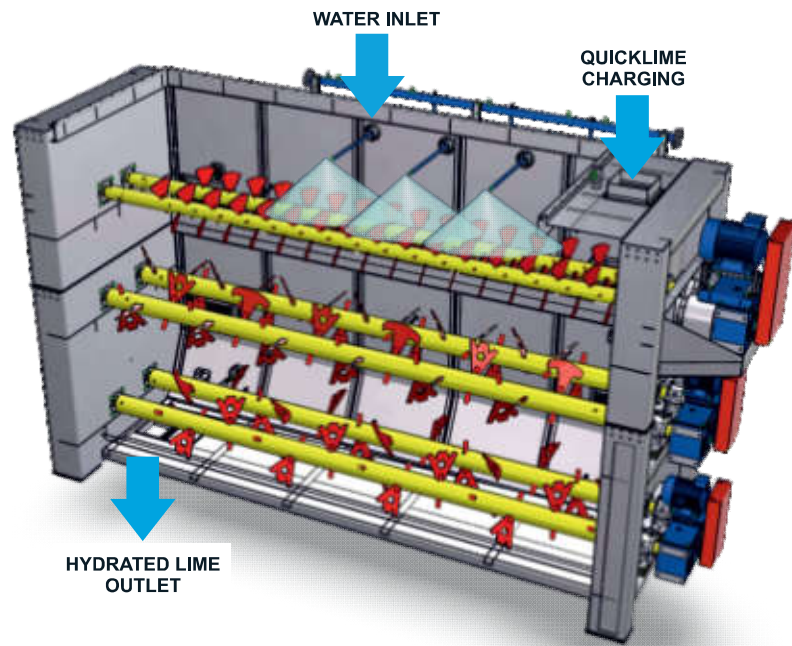


THE HYDRATORS MODELS

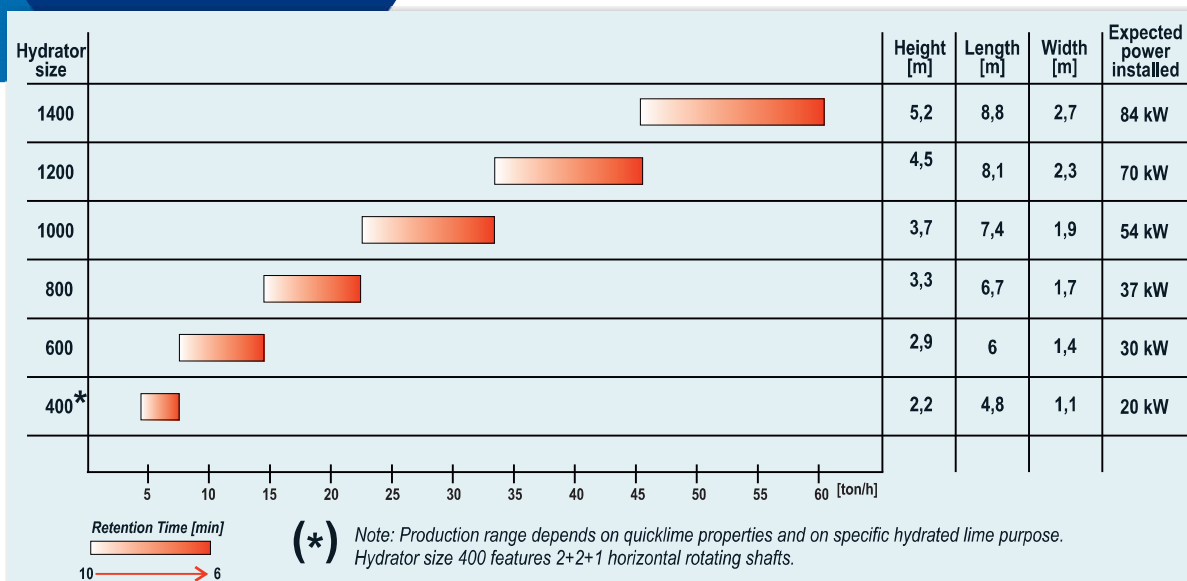
New uses of hydrated lime led to the search for new technological processes and equipment. Cimprogetti has a wide range of equipment and plant to meet every application in lime hydration.

Cimprogetti has developed the multi-stage **CIM-HYDRAX™** series, a consolidated technology in the lime hydration sector.

Each stage contains horizontal rotating shafts with specially designed hi-efficiency paddles to mix continuously the reacting lime and water. Paddle design differs in the various hydrator stages to ensure optimal performance in each specific operational phase.



**Cimprogetti's hydrators
produce a finished product
free of reactive
components, with an
average residual moisture
around 1%**



THE HYDRATORS

MODELS

[4G-series]



The **CIM-HYDRAX-4G™** hydrator is a three-stage machine.

The **CIM-HYDRAX-4G™** series features a first stage with two high-speed shafts, equipped with an advanced multi-point water injection system for highly accurate control during the initial phase of the slaking process.

The second stage mixes the material strenuously, enabling reaction to be completed in this large second chamber which is approximately double the size of the first one.

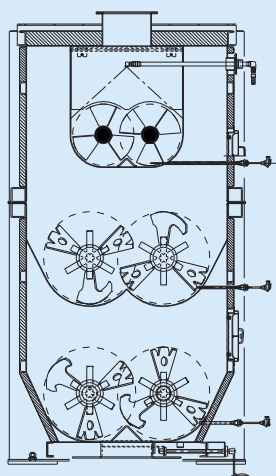
The third stage vigorously ventilates the hydrated lime in order to minimize any possible light agglomeration so that the hydrate coming out of the hydrator is of enhanced fineness.

The **CIM-HYDRAX-4G™ MAX** version has been developed to allow its use for a wide variety of calcium oxide in specific plant configuration. The first stage is independent from the hydrator body and operates as a pre mixer with double-shaft paddles.

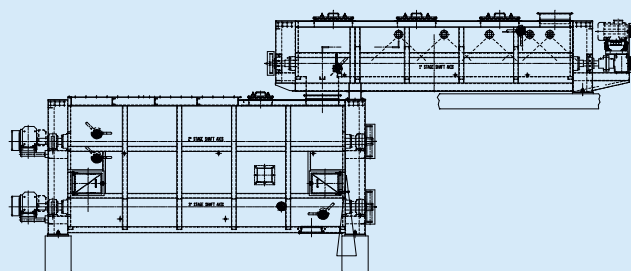
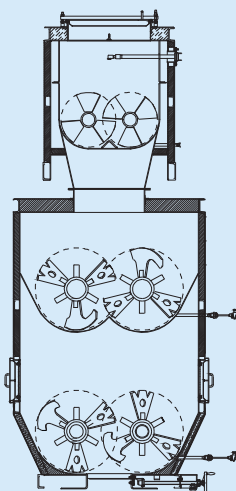
Design characteristics:

- a compact machine capable of converting a given raw material into high quality finished products with continuous operation;
- sturdy construction, easy to operate with minimum maintenance required;
- tank system able to avoid contact between steam and oxide;
- high flexibility in terms of turn-down ratio;
- wide range of acceptable raw material qualities;
- wide range of feasible finished products;
- possibility of automated, unmanned control;
- reliable operational safety throughout the process.

The **CIM-HYDRAX-4G™** series works in campaign producing either standard BET hydrated lime for general use or intermediate/high BET hydrated lime for FGT processes.



Hydrator
CIM-HYDRAX-4G™



Hydrator
CIM-HYDRAX-4G™ MAX



THE HYDRATORS **MODELS** **[FGD-series]**

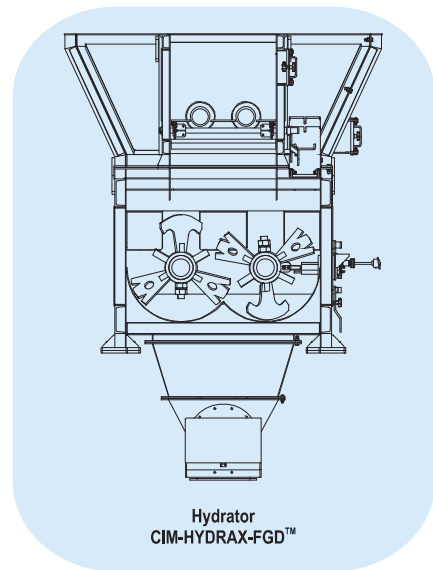
All methods applied in gas neutralization and purification systems involve the addition of an absorbent. The most important chemisorbant for its high removal efficiency is calcium hydroxide, able to capture either sulfur and acid pollutant.

The single-stage **CIM-HYDRAX-FGD™** is Cimprogetti's dedicated hydrator for Waste-to-Energy (WtE) technologies.

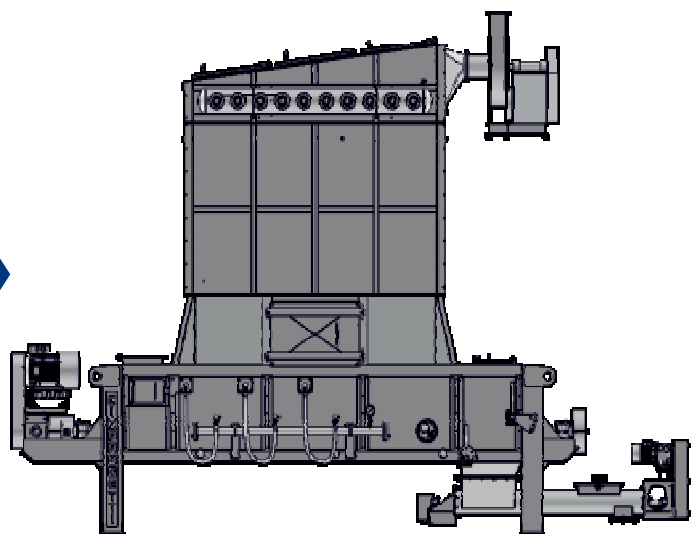
This new compact hydrator design is pre-assembled, pre-tested and easy to install.

Design characteristics:

- suitable for production up to 5 tph;
- ready for automatic «in-line» operation with the FGD scrubbing system;
- flexible sorbent quality production;
- reduced overall dimensions;
- integrated pre-mixer possible;
- easy maintenance;
- plug&play unit.



**PLUG & PLAY
CONCEPT**



THE HYDRATORS MODELS [COMPACT-series]



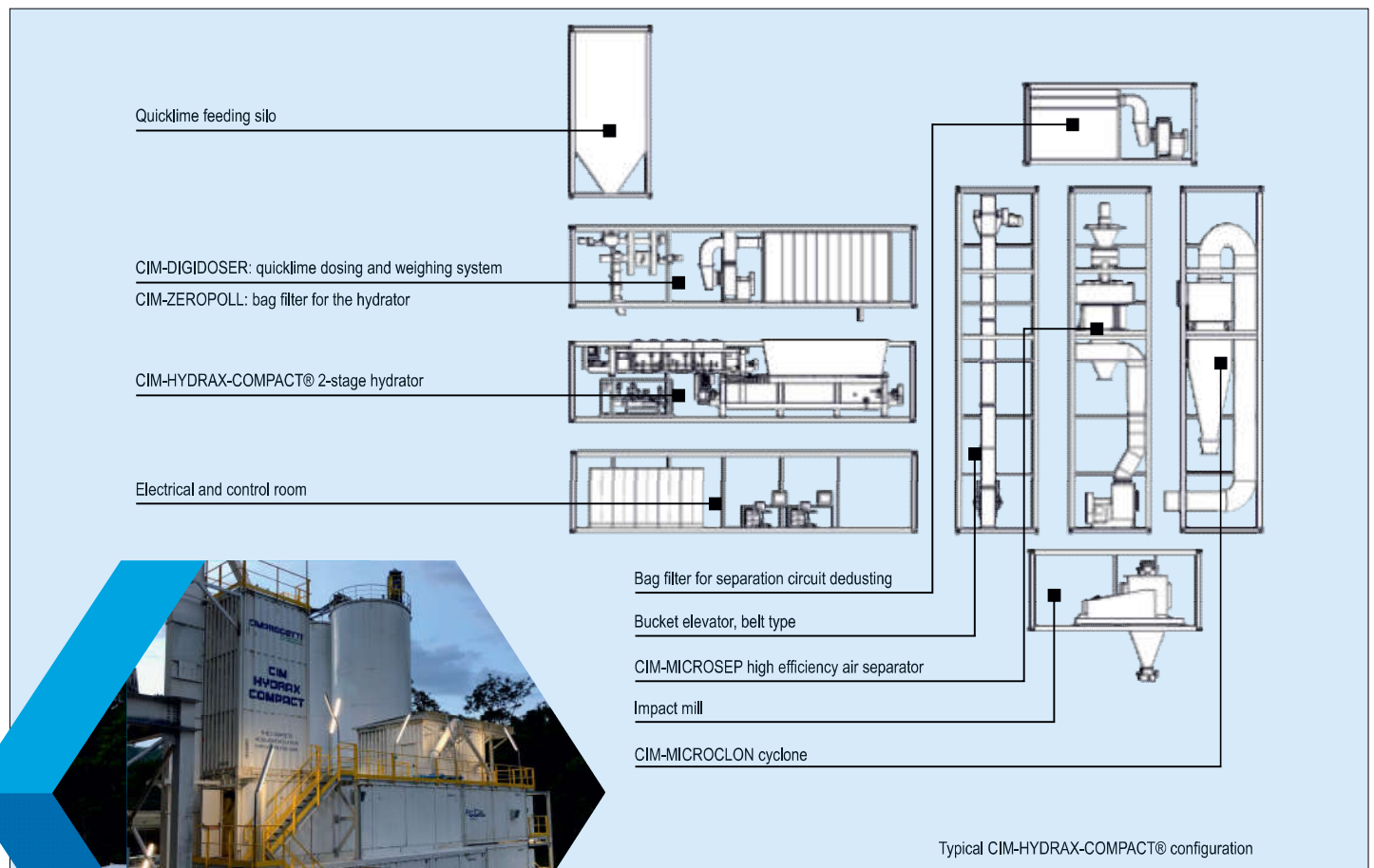
The **CIM-HYDRAX-COMPACT®** is a complete and autonomous hydration plant, suitable for production up to 30 tph, based on the modular conventional process: CaO hydration, separation, grinding. The **CIM-HYDRAX-COMPACT®** is made up of transportable modules certified as containers.

As a result of its modular design, the compact configuration allows the installation of the hydration plant directly in the production facility occupying a minimal footprint, and it represents a truly cost effective/short lead-time solution.

Bespoke design for industrial hydration plant aimed:

- at reducing the overall dimensions,
- being as compact as possible by eliminating unnecessary auxiliary machines and spaces,
- reducing the CAPEX,
- total mechanical and electrical shop pre-assembly,
- preserving contractual hydrator performance.

With its flexible layout and simple plant arrangement, the **CIM-HYDRAX-COMPACT®** can be easily adapted and modified to meet changing operational needs.



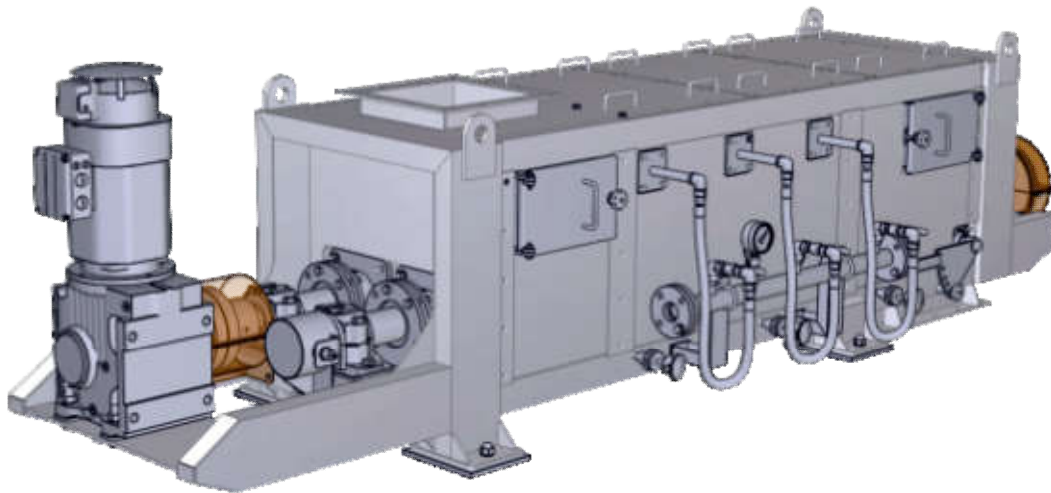


ANCILLARY EQUIPMENT

CIM-Premix™ – the optimized stage model specially designed to boost the conversion rate from CaO to Ca(OH)_2 .

Our technical department start with an indepth study and detailed analysis of the characteristics of the raw material to be processed and precisely evaluate process efficiency.

The **CIM-Premix™** can easily integrate an existing hydration plant supplied by third parties or complete the FGD-series hydrator in case of specific raw material.



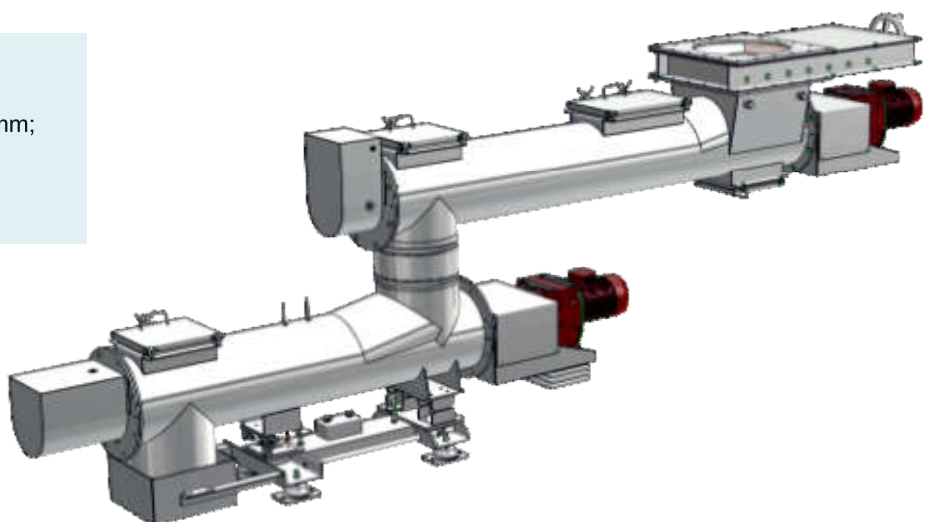
DIGIDOSER-SYSTEM™ (integrated feeder control) is provided to enhance product quality uniformity, and represents an improvement to the traditional volumetric units.

An automatic speed adjustment allows a constant feed rate in tons per hour of quicklime through the screw conveyor.

Pre-setting of feeding or change values is effected both locally and/or from a remote control room.

Design characteristics:

- quicklime inlet size range from 0 up to 10 mm;
- suitable for production from 3 up to 50 tph;
- calculated @ 0.8 t/m³ density;
- Accuracy $\pm 1\%$.



ANCILLARY EQUIPMENT



The **Loss-In-Weight feeder** is a gravimetric metering device that receives material from upstream equipment and accurately doses material into the process at a predetermined feedrate.

The feeder's operation is regulated by the amount of live load that is lost as product is discharged. In order to do this effectively, the Loss-In-Weight feeder receives constant feedback from a sensitive weighing device, which ensures that the precise amount of material is delivered either continuously or in each batch.

Design characteristics:

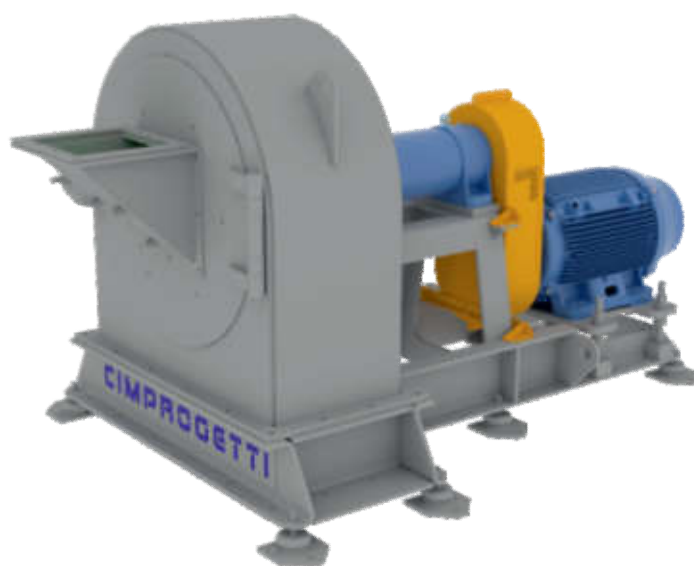
- suitable for production from 3 up to 50 tph;
- calculated @ 0.8 t/m³ density;
- Accuracy $\pm 0,5\%$.

CIM-CAGE™ is a compact and highly efficient machine which reliably removes agglomerates and clumps from Ca(OH)_2 and enhances product uniformity at the hydrator outlet.

CIM-CAGE™ can easily integrate existing facilities. The robust design contributes to an extended service life.

Design characteristics:

- suitable for production from 3 up to 30 tph.





ANCILLARY EQUIPMENT

The **CIM-ZEROPOLL™** is the dedicated bag filter for hydrator dedusting. It is based on the well proven pulse-jet cleaning effect. This device represents the most modern pollution control system and dust emission content in the stack complies with the lowest thresholds specified in the most stringent air quality standards.

The bag filter is located at the top of the hydrator as a result of extensive studies and industrial experiences. Selection of the filtering area and operation parameters is also the result of several years of testing to determine the right air to cloth ratio and the most suitable fabric for the bags, featuring good value for money and extended operational life.

The ID fan is controlled by a frequency converter, to adapt the filter operation to the variable flow of steam that the hydrator may generate in different operating conditions.

The **CIM-ZEROPOLL™** can also be installed on any hydrator supplied by third parties.

Design characteristics:

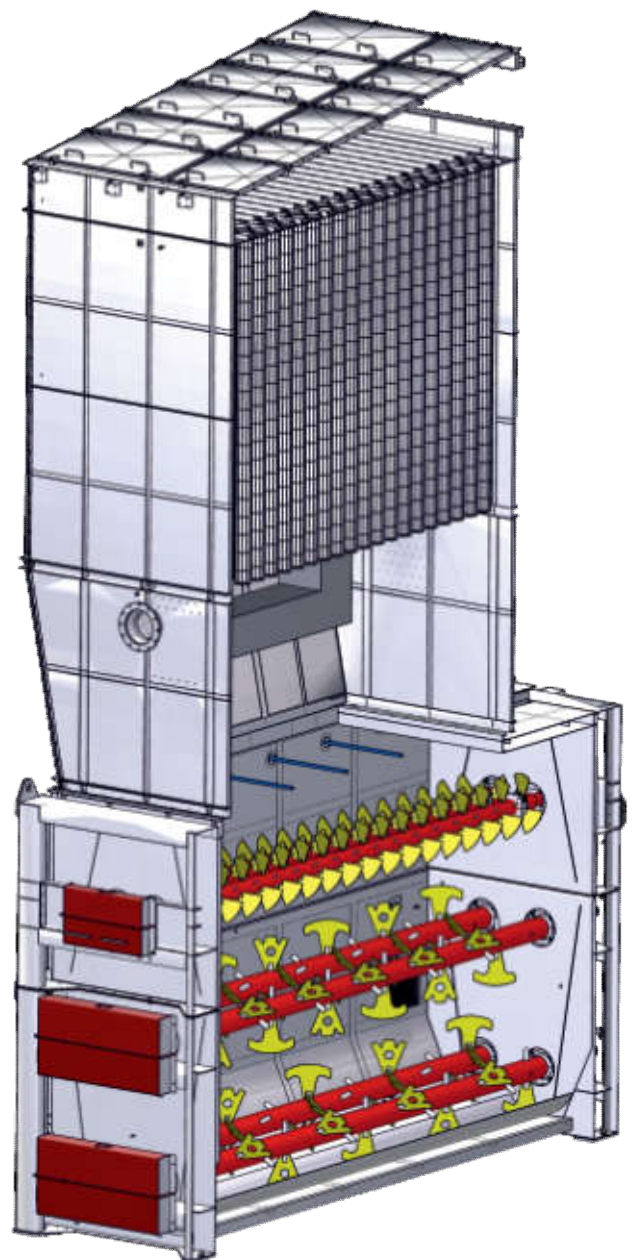
Dust content at the chimney outlet : $<10 \text{ mg/Nm}^3$

Main features:

- filtering chamber in structural steel sheets in which the filtering bags, supported by cages, are placed;
- self-supporting structure with connection chute to the hydrator;
- air-tight inspection doors;
- pulse-jet bag cleaning devices with automatic cleaning cycle;
- thermal insulation of the lateral walls and of the top to reduce material incrustation;
- ID centrifugal fan, motor driven by VSD.

The advantages of **CIM-ZEROPOLL™** filter, compared to traditional wet scrubbers, are mainly:

- low dust content at the chimney outlet;
- reduced maintenance;
- full automation possible;
- more control of the heat released by the reaction.



CLASSIFICATION SYSTEMS



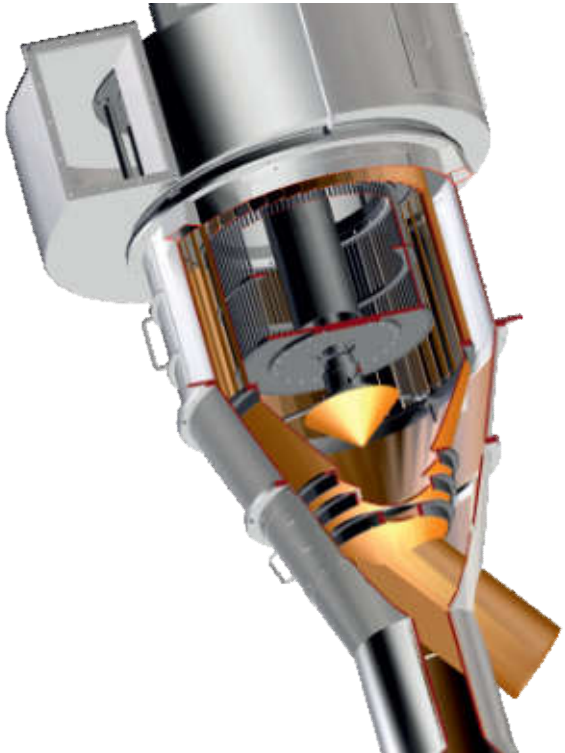
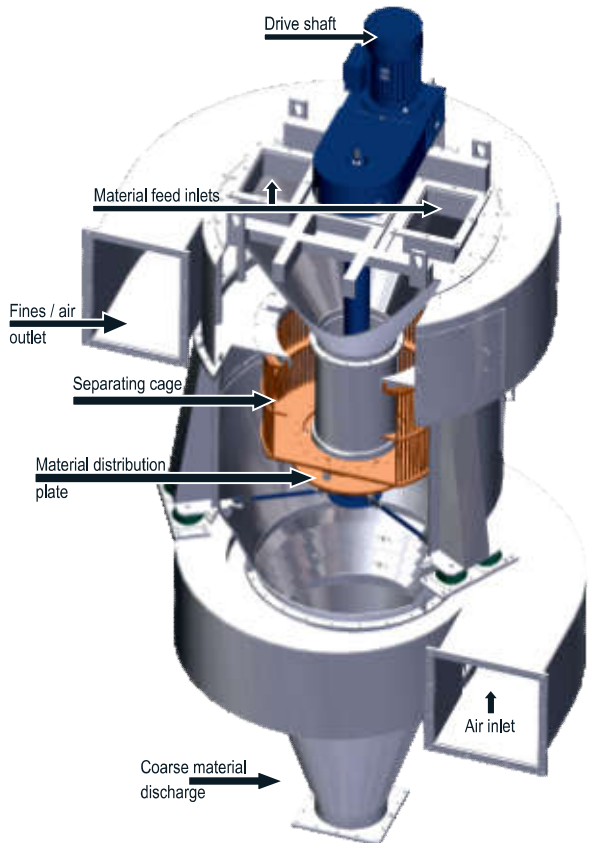
Reaching 95% hydrated lime lower than 45 μm , the **CIM-MICROSEP™** separator is designed to ensure maximum efficiency & quality control of the end-product.

The separator is highly adaptable to different product fineness requirements, thanks to the wide range and combination of settings applicable to the rotation speed of the selection cage and to the air flow.

Pressure sensors in the circuit and selection cage speed control assure a smooth and stable running of the separator.

The **CIM-MICROSEP's** latest generation combines consistent flow distribution into the entire cage with a reduced pressure loss and energy consumption. The performances of the separator are extremely high in terms of fine material yielding (more separating cuts) and in terms of separation «cleanliness».

The raw material entering through the feed inlets is subject to centrifugal force, which uniformly distributes the material within the air stream. The ascending air flow pushes the material towards the multi-blade selecting cage. The fines are then exhausted into the system collector, while the coarse material is discharged by gravitational force through a cone for further processing.



For special configurations with reduced footprint and less mechanical conveying capacity, Cimprogetti has specially designed the lower end feeding High Efficiency separator **MICRO-JETSEP®**.

The **MICRO-JETSEP®** separator has been optimized in terms of fluidodynamic yielding by way of computerized analysis of the internal flows, offering significant advantages in terms of capacity, adaptability and efficiency.

CLASSIFIER TYPE	FEED t/h	CAGE POWER kW	FAN POWER kW	AIR FLOW m³/h
100	6-15	7,5	22	12500
200	15-25	11	37	25000
300	25-40	22	55	37500
400	40-50	37	90	50000
500	50-75	55	132	70000
600	75-85	75	160	90000

CIM-MICROSEP™ and MICRO-JETSEP® - typical data

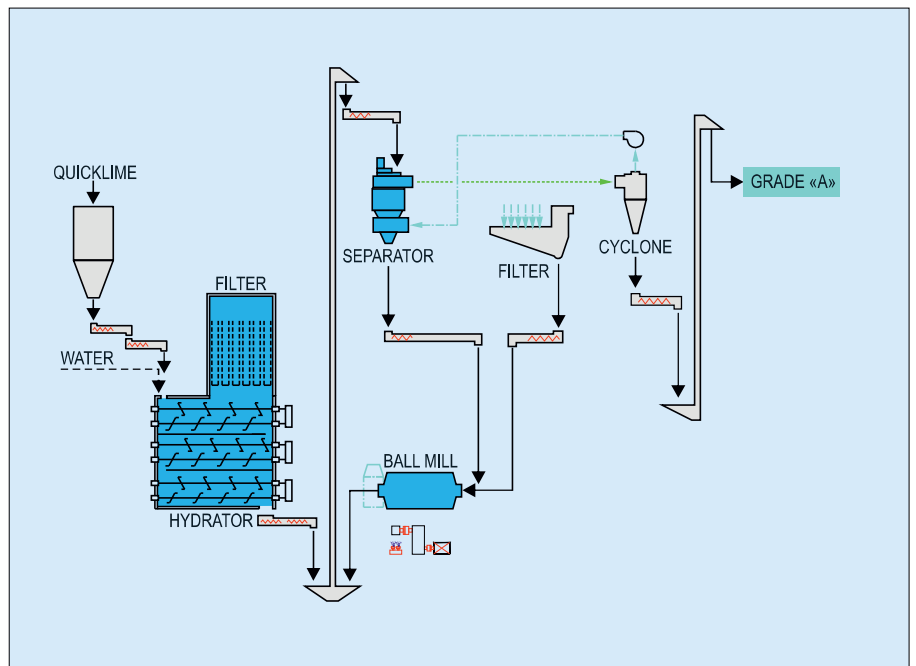
CLASSIFICATION SYSTEMS

Downstream from the hydrator, calcium hydroxide is separated from the grits. The grits are ground to meet fineness specifications. With numerous material feeding possibilities Cimprogetti's classifying systems offers a large range of configurations.

A distinctive feature of Cimprogetti's classifying circuits is the presence of the Third Generation **CIM-MICROSEP™** separator, together with a cyclone and a high efficiency tail fan.

ONE-PRODUCT GRADE

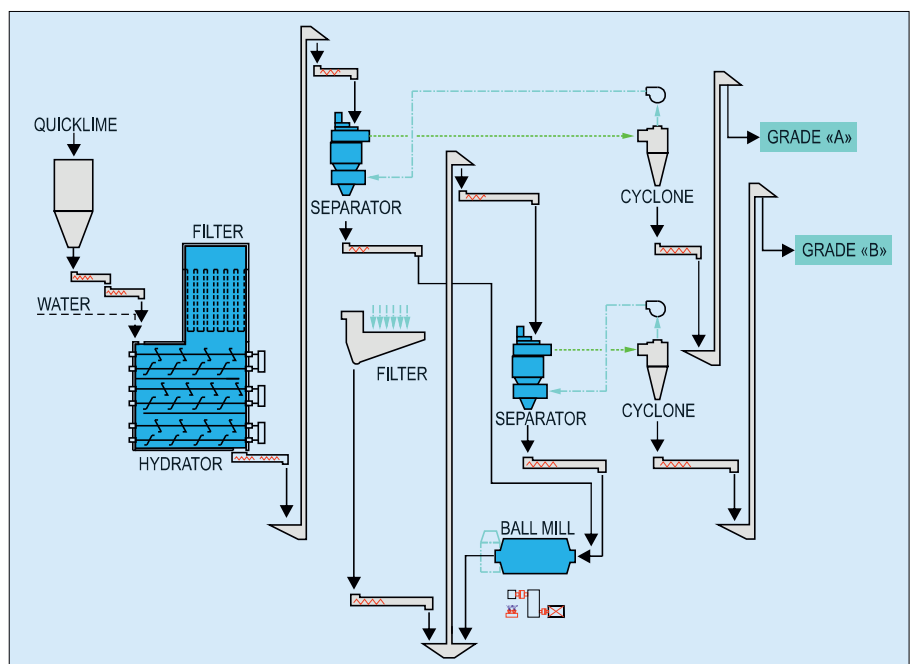
In order to achieve best performance, the separation circuit is enhanced by a grinding mill for improved product quality.



TWO-PRODUCT GRADE

The two sequential separation circuits enable the simultaneous production of a 1st grade with higher Ca(OH)_2 content (called "chemical grade") and of a 2nd grade (called "building grade").

Remarkable production flexibility in adjusting the production ratio of 1st grade vs. 2nd grade allows market demand to be met.



OUR SERVICES



One of the main needs for an industrial production company is guaranteed continuous and remote technical support directly from the supplier, after plant start-up.

To achieve excellence in its equipment and plant operation, Cimprogetti has developed a superb worldwide service and support system for its state-of-the-art facilities.

INTERNATIONAL NETWORK

No matter where you are located on the globe, we can rapidly supply highly skilled and reliable technical supervision on site, for installation, commissioning, maintenance, retrofitting and revamping.

SPARE PARTS

Cimprogetti promptly allocates spare parts all over the world from renowned and audited sub-suppliers.

REMOTE ASSISTANCE

Today, remote assistance has become one of the standards available as a solution to support our clients worldwide, from South America to the Far East and Middle East.

CIM-REMOTE ASSISTANCE™ is a 24/7 service delivered remotely by a dedicated team.

EDUCATION & TRAINING

Process operator training is essential for the safe operation of plant facilities.

In our headquarters, skilled instructors deliver training courses and seminars for operators and production supervisors.

More than fifty years of experience and knowledge is at our Customers' disposal, providing a certified process operators training program.



ON SITE



FROM HQ





DALMINE (ITALY) | NEW DELHI (INDIA)

CIMPROGETTI GROUP

THE GREEN EDGE OF
LIME TECHNOLOGIES

Cimprogetti of India Pvt. Ltd.

#407, IVth Floor | NDM-2, Netaji Subhash Place
C-Block | Pitampura | New Delhi 110034 | India
T / F: +91 11 4706037

E: inform@cimprogetti.co.in | www.cimprogetti.co.in

Cimprogetti Srl

Via Pasubio 5 (ang. Via Einstein)
24044 Dalmine (Italy)

T: +39 0354550 111 | F: +39 0354550 335
E: inform@cimprogetti.com | www.cimprogetti.com