



TWIN SHAFT
REGENERATIVE

LIME KILNS

CIMPROGETTI[®]
THE GREEN EDGE OF
LIME TECHNOLOGIES

LIME

STONE



To

Lime

Lime is one of the oldest chemicals known to man, it was used to plaster the pyramids of Egypt and, in the Roman times, the “Calcis Coctores” (Lime burners), had already studied the primordial lime kilns named “fornax calcaria”.

From that time, the chemistry & technology of lime have progressively evolved, although most of the progress has occurred since 1900, with the greatest step forward made since 1955.

Today, lime is still an irreplaceable and affordable chemical largely used in modern industry:

- from metallurgy, to the mining industry,
- in roads and the building industry,
- in agriculture,
- in the chemical industry,
- for the desulphurization of waste gases,
- water treatment and in many other sectors.

The calcination of limestone is a simple chemical process:



However experience and a well proven design are the secrets for a successful lime burning project as several factors influence the choice of lime kiln technology:

- the raw material quality,
- the fuel characteristics
- the specifications of the finished product.

The ideal calcination process features: progressive preheating, with a gradual increase in calcination temperature up to the point at which dissociation is complete, finally cooling down the burnt lime, avoiding as much as possible further retention time in order to prevent possible re-carbonation.

Cimprogetti Twin Shaft Regenerative kilns represent today the best proven technology for high and medium reactivity lime production in terms of:

- wider range of feeding limestone fraction,
- lower fuel consumption,
- lower maintenance costs,
- lower emission rates,
- higher quality lime.





Twin Shaft Regenerative process

The Cimprogetti TSR is a two-shaft vertical kiln which utilizes the regenerative process for lime calcination.

When one shaft operates in the burning mode, the other shaft operates in the regeneration (non-burning) mode. Each shaft operates for an equal amount of time in the burning and regeneration modes.

There are two distinguishing characteristics of the TSR kiln:

- the parallel flow of hot gases and stone in the burning zone, which allows a mild burning of the limestone without over-burning, and
- the regenerative preheating of all combustion air using the limestone contained in the preheating zone of the kiln (in the non-burning shaft) as a heat accumulator.

The two shafts are alternately loaded from the top, with pre-weighted limestone charges.

The fuel is introduced to only one of the two shafts at a time, at the upper side of the burning zone where the material is still un-calcined and can absorb most of the heat released by the combustion.

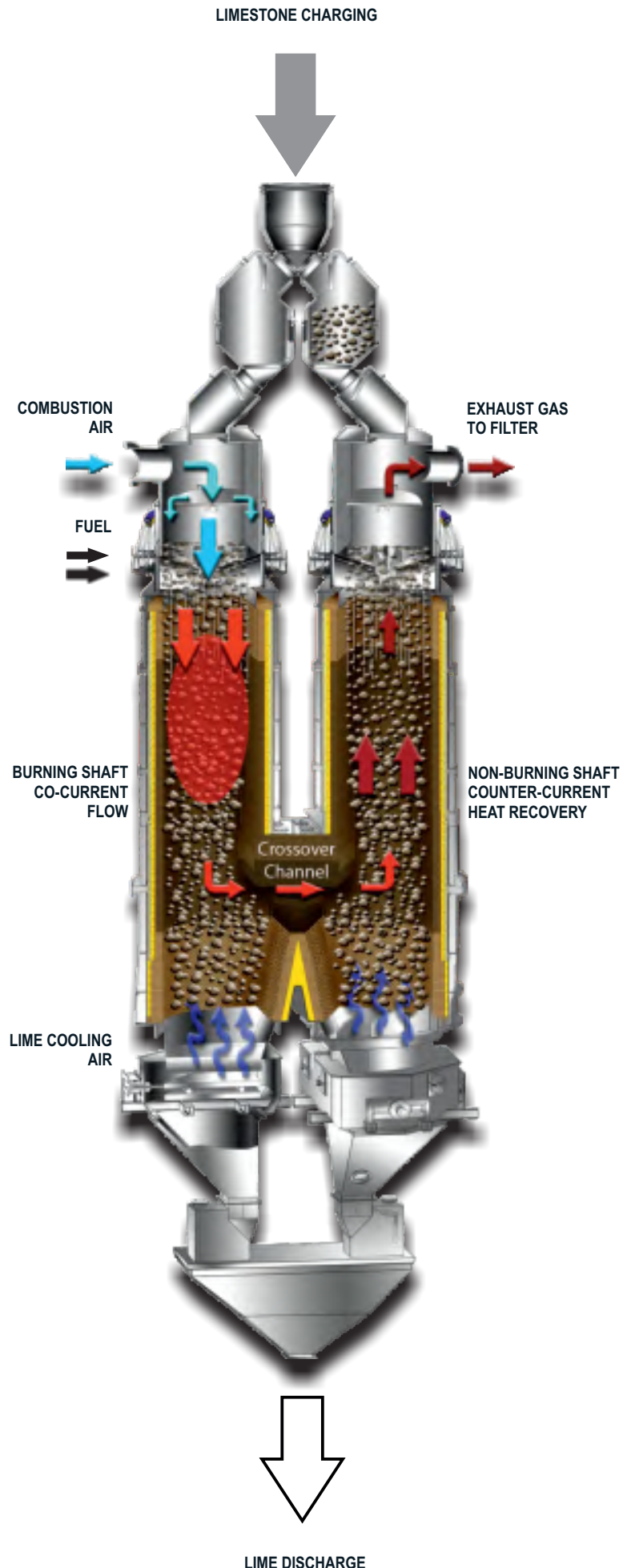
The combustion gases travel downwards, in parallel flow with the material and leave the burning shaft through the crossover channel, entering the non-burning shaft travelling upwards in counter flow with the stone.

The off-gases then cross the freshly loaded limestone in the pre-heating zone located in the upper part of the non-burning shaft, where they transfer most of their residual heat, before being vented off.

The heat transferred, as above said, is then recovered in the next cycle, from the combustion air entering from the top, when that given shaft will shift to burning mode.

The shifting between burning and non-burning modes is called "inversion" and it takes place at set intervals.

In the lower part of the TSR kiln, the hot lime lumps are progressively cooled down by cooling air introduced from the bottom of both shafts so as to be handled with standard conveying equipment.





● ● Kilns

range

Cimprogetti TSR kiln family consists of two main groups:

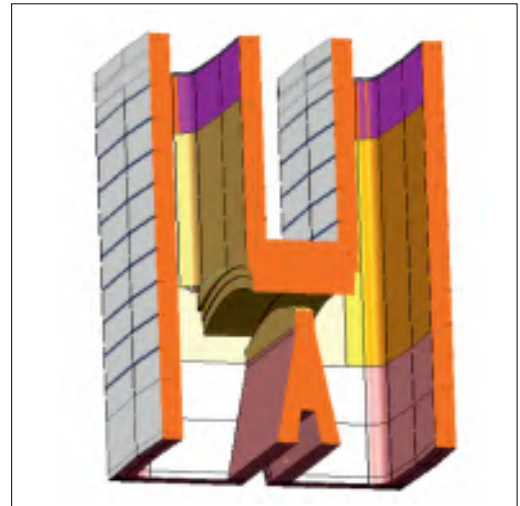
- «Direct Crossover» featuring a single channel placed between the shafts,
- «Radial Crossover» featuring circular channels around the shafts which are then connected in the central part.

The Cimprogetti direct crossover group includes:

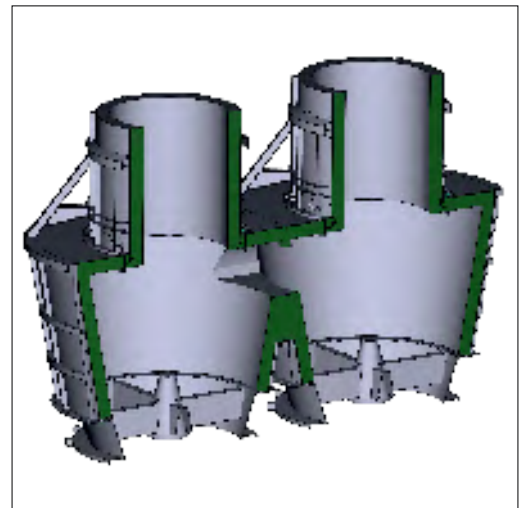
- the Flex Reversy® series, with polygonal cross section, derived from the former Twin-D® series, boast many outstanding design features, making it a top performer and a distinct model.

The Cimprogetti radial crossover group includes:

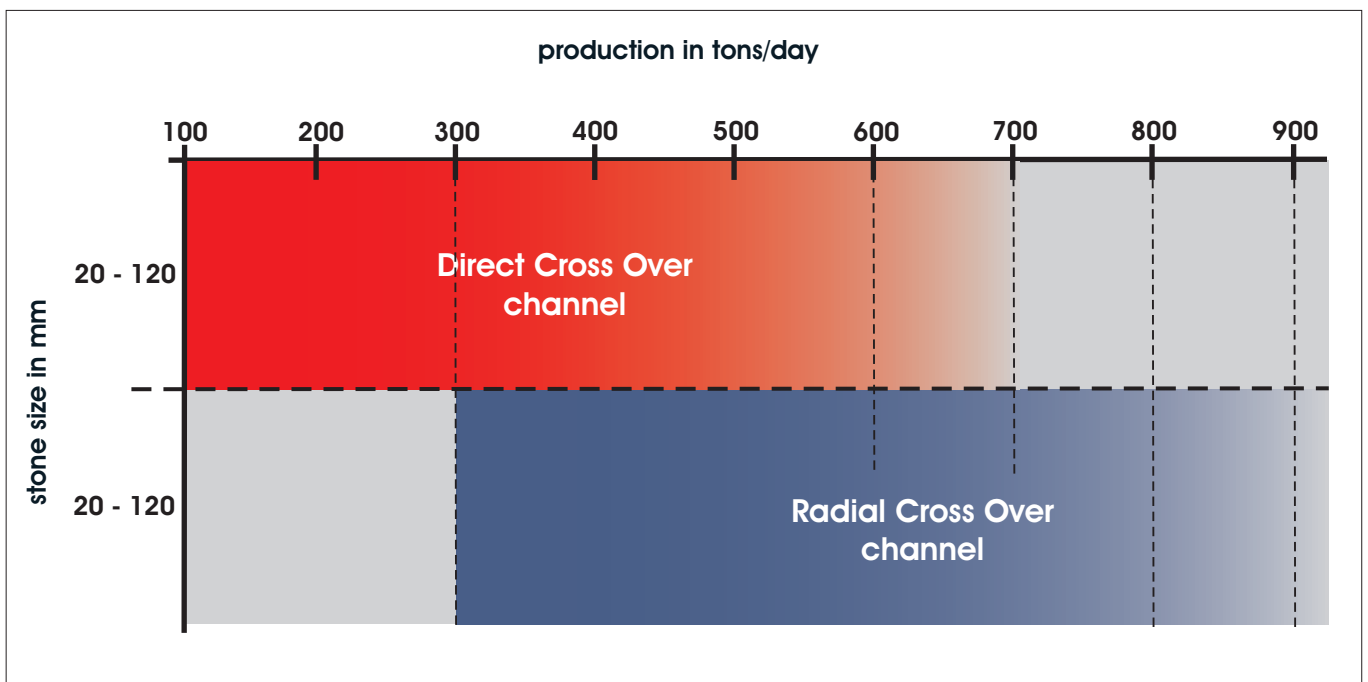
- the Vanguard® design with its circular cross section, which represents the state-of-the-art in its field and the top of the TSR kiln range.



Direct crossover channel



Radial crossover channel





Flex Reversy®

The Flex Reversy® kiln design represents the latest version of direct crossover channel kilns and the new generation of Twin Shaft Regenerative design.

Its shape has been finalized taking into account the proven features of the Cim-Reversy and Twin-D® kilns installed worldwide.

The Flex Reversy® series is the logical evolution that matches higher performance and lower investment cost.

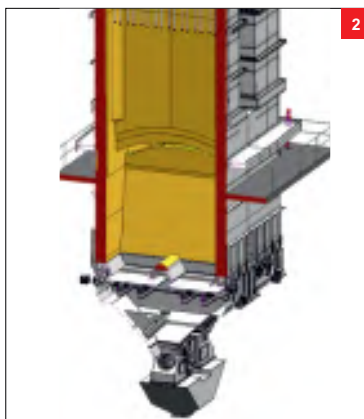
The Flex Reversy® kiln is especially suitable for obtaining quicklime with consistent quality along with the use of smaller limestone fractions to the benefit of a better quarry mass balance.

The key technological features of the process are:

- the efficiency of the regenerative calcination technology, proven by innumerable installations around the world;
- the simple shell section which results cheaper to build than similar kilns having the same cross section;
- the technological innovations developed for the Twin-D® and Vanguard® kiln families, namely for the charging and discharging systems are gathered together.

■ Fig.1 - Discharging drawers assembly

■ Fig.2 - Vertical kiln section





Vanguard®

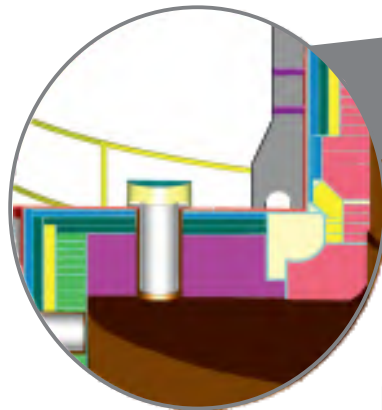
To respond to the lime market trend moving towards larger kiln capacities, Cimprogetti has developed the Vanguard® kiln design, featuring a circular cross section.

The Vanguard® kiln represents the new cope in its field while it retains the well proven design features of the other Cimprogetti TSR kilns, for most of the process sub-systems (combustion and cooling air units, hydraulic power-pack, automation and control system logic, etc).

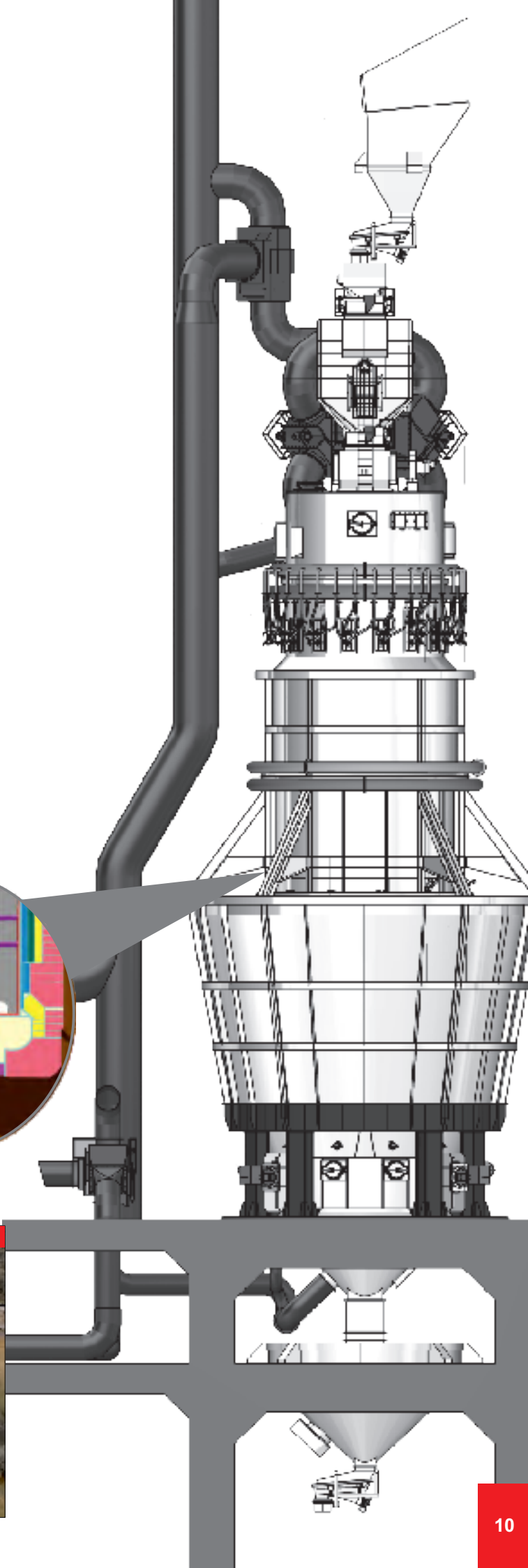
The kiln is made of two cylindrical parts , the upper cylinder, of smaller diameter, where limestone charging and burning take place, and the larger diameter lower cylinder where lime cooling and the lime discharge are effected.

It features a “free flow” radial channel of adequate cross section, all around the shafts, for an unobstructed hot gas flow from one shaft to the other.

The Vanguard® kiln is also available for smaller limestone fractions.



■ Fig.1 - Kiln ring assembly
■ Fig.2 - Corner ring assembly





The **Main**
Features

The Loading system

The SRT+ULD charging systems have introduced a number of innovations to the TSR kiln charging operation, in order to enhance flexibility, control segregation of materials and properly distribute the charges to facilitate uniform calcination.

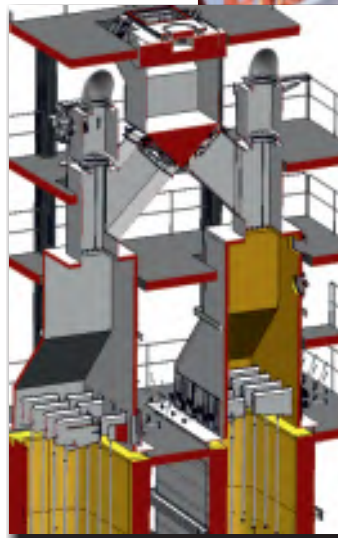
The **SRT charging device** allows the charging of fresh limestone during the burning cycle (and not during reversal) as normally made in this type of kilns.

Furthermore, charging is effected in two or more steps to better control the waste gas temperature (which determines the practical limit to the cycle length) and therefore to extend the burning time by reducing the reversal (idle) time.

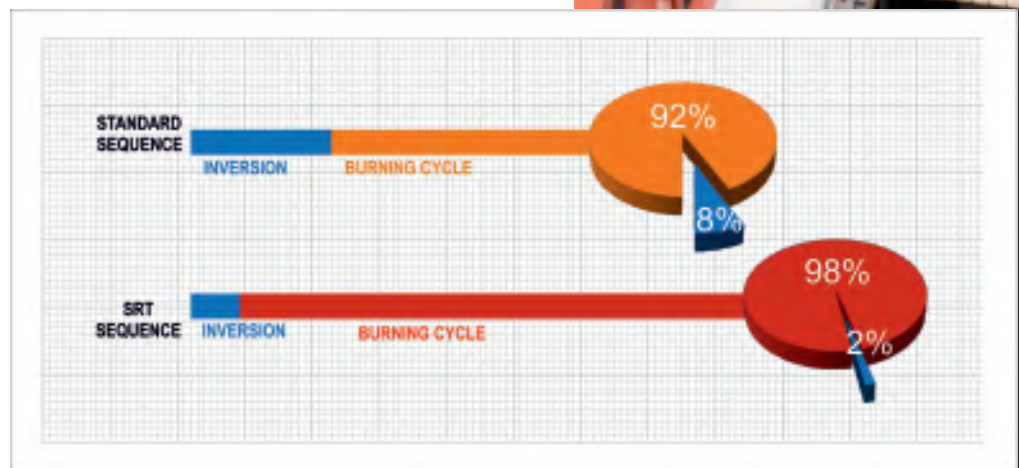
The split charge may allow, in some cases, operation of the kiln with a much wider stone gradation (up to 1:4).

The **ULD hydraulic distribution device** allows directing the fresh limestone charges as necessary to improve distribution and avoid segregation.

The smaller the particle size of limestone, the higher the importance of accurate stone spectrum distribution during charging.

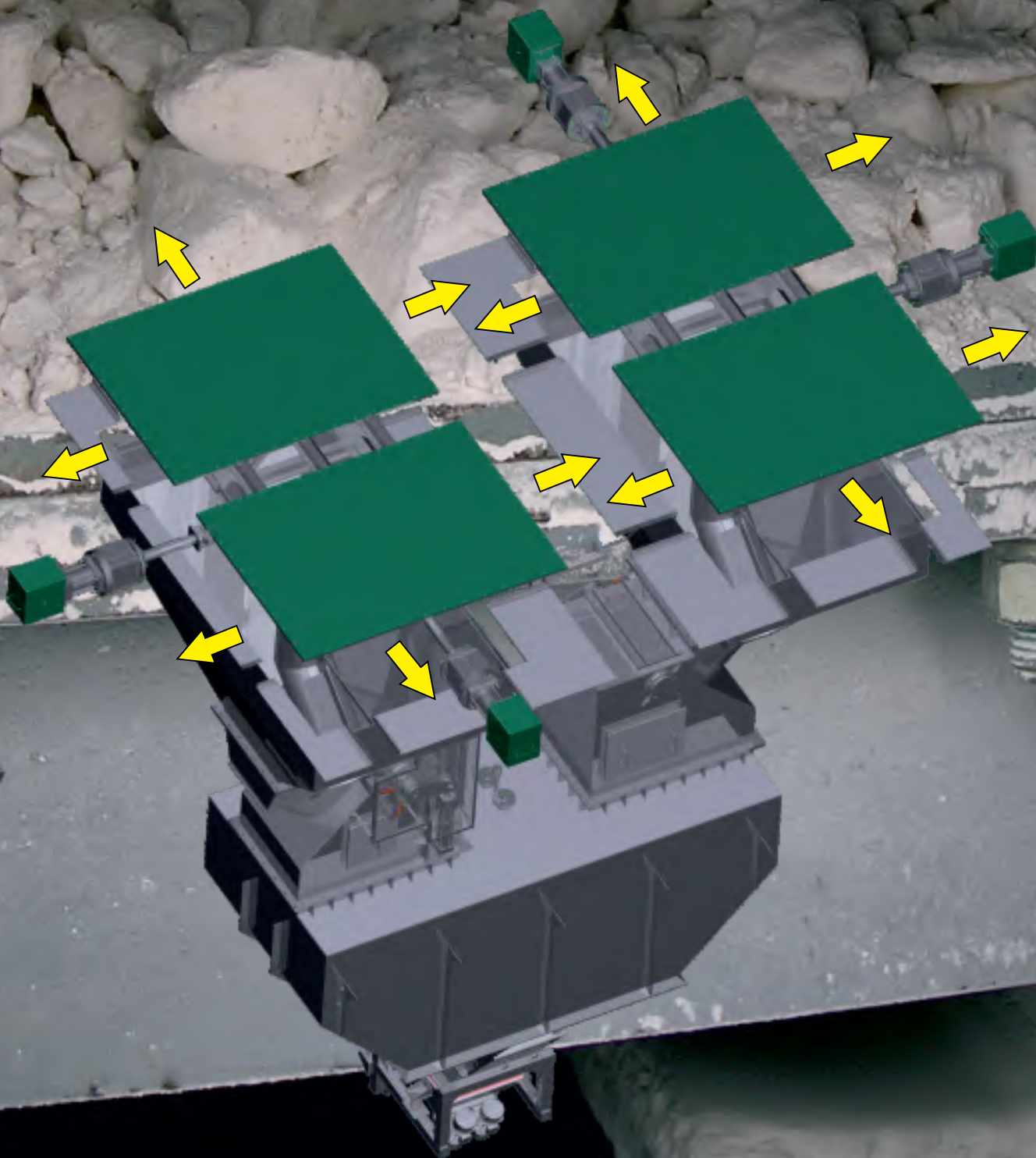


The table shows the comparison between the duration of typical standard cycles and the extended cycles resulting from SRT technology.



In the discharging system of the Flex Reversy® kiln, the lime discharge is effected from the whole perimeter of the discharge tables to the benefit of a more uniform and undisturbed downwards flow of the material.

This is an unique feature which sets the Flex Reversy® apart from competitors «direct crossover» kiln design where lime discharge is only possible through limited areas of the perimeter.



The Discharging system

The lime discharged from the drawers, is collected in the bottom of the kiln itself.

In standard regenerative kilns, the lime is then discharged into collecting hoppers placed underneath and fed to the product conveyor by means of vibrating feeders.

As regenerative kilns work in positive pressure, the final lime discharge is a batch process which is effected during the cycles reversal.

In the discharging system for the Vanguard® kiln, the lime discharge is effected from the whole perimeter and it is also possible from the center (optional).

- Four independent discharging drawers for each shaft are foreseen, to allow the maximum control over the whole discharge section.
- The cooling air distribution is also optimized and split both through the drawers circumference as well as through the centre cone and the cross divider in order to achieve the best efficiency with the minimum cooling air demand.
- Differently from other designs, the four hydraulic drawers can be operated independently one by one, two by two, or all together.

The additional flexibility given by the combination of all three methods is purposely intended to optimize lime discharge even in the most demanding conditions.

Zero-Inversion system®

For kilns fired with gaseous fuel, a second sealed valve is introduced to lengthen the cycle time and reduce the inversion time until the virtual time "zero".



2nd sealed valve at each shaft





The single arch connecting the two shafts is a well proven solution by dozens of similar units operating worldwide.

The Refractory lining

The heart of a lime kiln is definitely its refractory lining, which should ideally be simple and robust, so as to be easily built everywhere in the world.

As shown in the side page, the Flex Reversy® kiln is characterized by a rounded corner refractory design.

The Flex Reversy® kiln has been designed in order to further improve the flow of material and hot gas, the corners are rounded with the use of 100% standard bricks.

The refractory lining is substantially made of commercial shapes available from suppliers worldwide.

The **«Pillarless» design** of the Vanguard® kiln design adopts an innovative connection between upper and lower cylinders.

This solution (Patent Pending) has been developed as a result of years of studies and mathematical simulations.

There are no pillars (hence the name “pillarless”) or hanging walls, featuring a “free flow” radial channel all around the shafts.

Furthermore the junction between the upper and lower sections of the kiln is made of bricks, with the evident advantage of having full control of the refractory material quality, thus increasing the lining lifetime and simplifying its maintenance.



The Firing system

Nowadays, great importance is given to the ability to use different fuels.

The primary driving force for fuel selection is the cost, as it represents about 40-50% of the total production cost of the quicklime.

Environmental regulations are the second major driving force.

The third is product quality requirements.

Cimprogetti has also focused on the development of burner lances to give the best flame quality and safe working conditions.

TSR kilns can be fired with:

► Natural gas

Gaseous



Lean Gas such as:

- COG
- BF
- Corex gas
- Mixed gas
- Syngas
- ...

Liquid



Liquid fuels:

- LDO
- MDO
- HFO
- Waste oils
- ...

Solid



Solid fuels:

- Petcoke
- Anthracite
- Lignite
- Coal
- Saw dust
- ...

Cimprogetti dual-fuels combustion system is able to operate alternately using 100% of either fuel or a combination of both fuels in pre fixed ratios, allowing maximum operational flexibility and reduced operating costs.

The **TurNOx**[®] device

TurNOx[®] (patent WO 2018220520 A1) is a unique integrated solution for NOx reduction, specially developed by Cimprogetti, for lime kilns based on regenerative process (TSR).

NOx abatement and emission control in flue gases are chemically provided (i.e. reversal of oxidation) with an «add-on» technology (SCR technique). A Catalyst located in the air flow promotes the reaction between ammonia and NOx. This technique is the most effective for NOx removal.

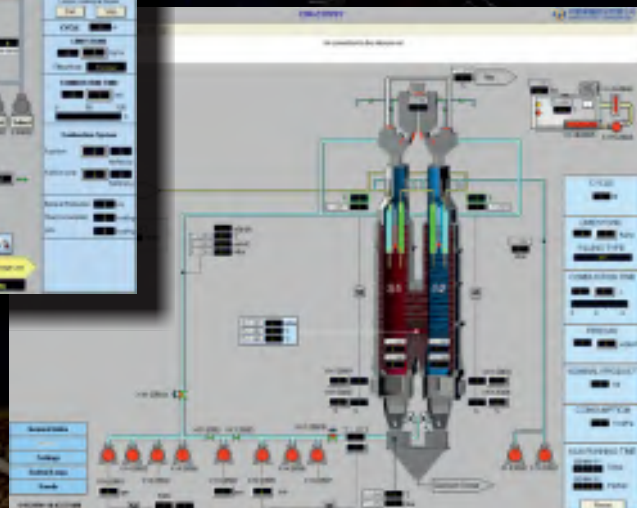
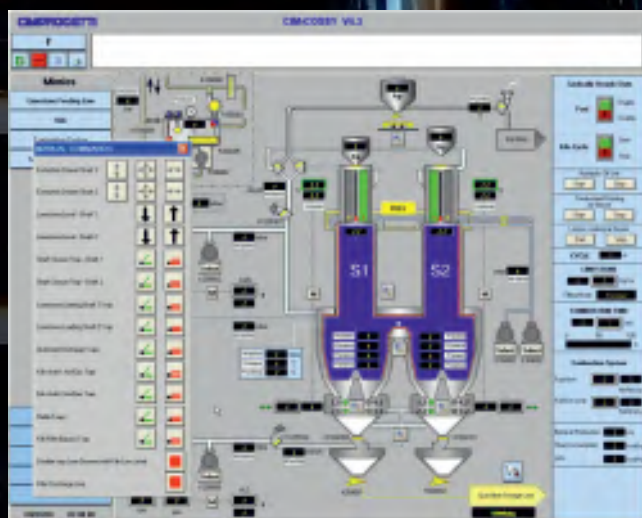
Other benefits of the TurNOx[®] device include its minimal space requirements, lower operating costs and energy consumption through the use of waste heat together with minimal maintenance requirements.

The TurNOx[®] device modulates the parameters without affecting the calcination process in the kiln.

With the TurNOx[®] device, existing plants can easily be upgraded to ensure compliance with the most severe environmental regulations.

THE GREEN EDGE OF LIME TECHNOLOGIES





Automation & Control

system

Having always been sensitive to technical innovation and striving to add value to its plants, Cimprogetti studied, designed and realized its own control system since the second half of the 80s.

With more than 400 plants installed worldwide, Cimprogetti has a sound background of plant automation, which is continuously updated on the basis of the experience gained in the design and commissioning kilns worldwide.

Designed for industrial environments, where the security of data and personnel is a primary issue, **BOT Platform™** manages all the problems relevant to the regulation, control and tracking of data and functions of plant operation while keeping its user friendly characteristics. Last but not least, remote data transfer and analysis of the kiln operation, alarm management as well as on line scheduled maintenance support, are only but a few of the standard features of the Cimprogetti control package.

BOT Platform™ is also able to transform raw data into analytics assets, statistical reports, and a dashboard, in order to understand the process, evaluate performances, compare situations, research results and settings into the historical data, and help with making the best decisions.

BOT Platform™ is the extended management software for the lime industry.



**SURPLUS
VALUE
TO YOUR
ACQUISITION**

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.



建设优质工程

展示工程质量

Lime Technologies
from A to Z
since 1967

Cimprogetti Srl - M.A. Grellier - 10/2023

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