- Fercalx Vertical Lime Kiln
- Beckenbach Annular Shaft Kiln®
- Eco-LimeGasKiln
- Conversion of Existing Shaft Kilns
- Hydrated Lime Plant
- PCC Plant
- Auxiliary Plants

The Lime Technologies Company

ECO-LIMEGASKILN

TF LIME
WORKSHOP
2013 . JODHPUR
India

group

TERRUZZI FERCALX GROUP

www.terruzzifercalxgroup.com

OUR HISTORY

TERRUZZI FERCALX Group started its activity in the faraway 1897, when Daniele TERRUZZI started his enterprise that, through the sons and nephews has been carried out until today.

The field of application of the activity has always been the industry, with the design, engineering and realization of industrial plants.

TERRUZZI FERCALX GROUP has its own design & engineering centres as well as manufacturing plants in Italy and India, and exports worldwide.

Nowadays, the industrial activity of the Group is organized into several companies, established in Italy and India and operations also in Germany and China.

TERRUZZI FERCALX SPA is a world leading company for each of the fields of its activity:

Lime Kilns and **Lime Plants**, with the FERCALX and BECKENBACH technologies , mostly installed for steelmaking and chemical industry, building construction smelting and mining;

Autoclaves for aircraft, aerospace and glass industries, rubber and impregnation industries;

Freeze-driers and **Vacuum Driers** for pharmaceutical and food industries,

Gasification Plants for the production of Syngas from Biomass, RDF, sludge, coal, petcoke etc., under the trade-mark TERRUZZI FERCALX ENERGY – TFEnergy.

Reheat Furnaces and **Heat Treatment Furnaces** for the steel industry, with VULCAN ENGINEERS LIMITED - India.

ECO-LIMEGASKILN

The ECO-LIMEGASKILN is an Ecological Limestone Calcination Solution, incorporating TF Gasification Plant and the Fercalx Vertical Lime Kiln.
This system is designed to produce high temperature fuel gas, the **Syngas**, to calcine the limestone in a tailored Vertical lime Kiln from solid fuel such as coal, pet coke or other materials such as various bio-masses, municipal solid waste, industrial sludge , chicken litter, animal flour, etc.,
The result is to reduce or avoid the use of fossil fuels or other materials.
This Technical Solution incorporates the best technology available to produce top qulity of quicklime with a very efficient process solution, to minimize both the CAPEX and the OPEX.

TECHNICAL DATA

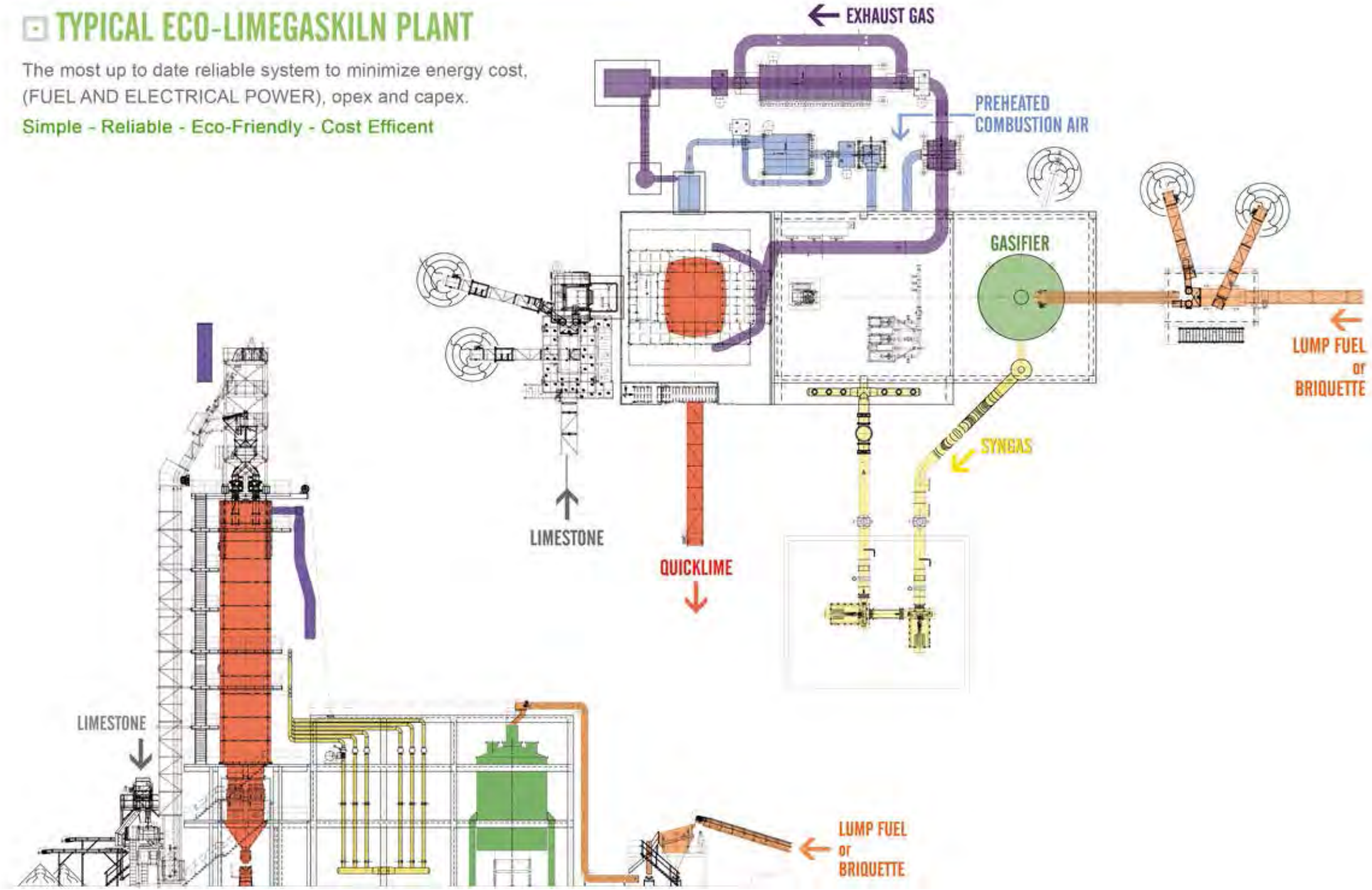
Fuel Consumption:	*≤ 865 kcal/kg of lime*
Electric power consumption:	*≤ 21 Kwh/Ton of lime*
Limestone size:	*from 15 mm to 250 mm*
Residual CO_2 in the Lime:	*≤ 1%*
Range from:	*Soft burnt lime (T60 ≤ 30 seconds)*
	o Hard burnt lime (T60 ≤ 20 minutes)
Calcitic Lime & Dolomitic lime	
Capacity from:	*30 TPD to 800 TPD*
Fuels:	*Lamp coal/petcoke, biomass, MSW, sludge, etc.*

Fully Automatic Operation

TYPICAL ECO-LIMEGASKILN PLANT

The most up to date reliable system to minimize energy cost, (FUEL AND ELECTRICAL POWER), opex and capex.

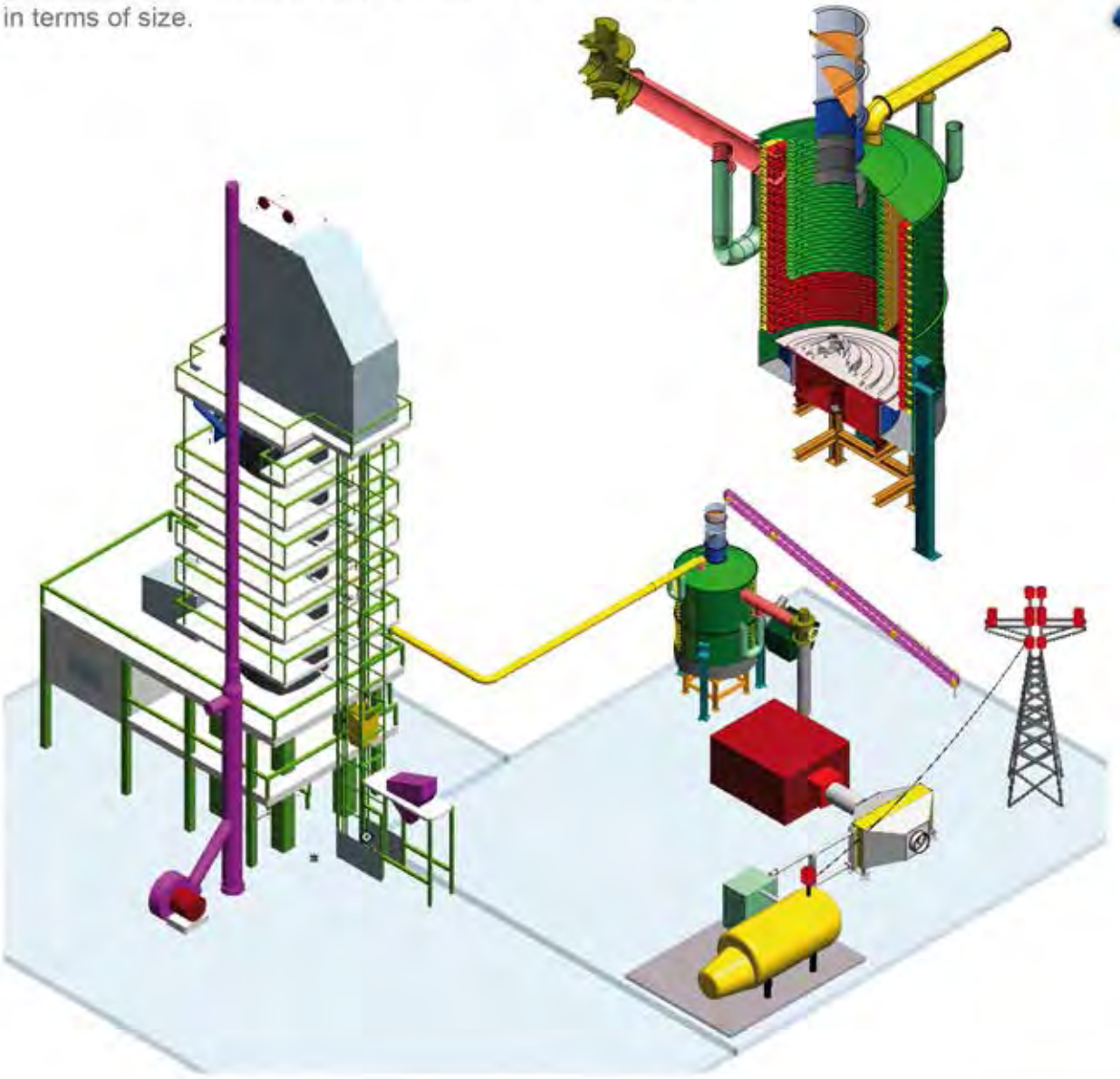
Simple - Reliable - Eco-Friendly - Cost Efficent



The ECO-LIMEGASKILN into details: FERCALX VERTICAL LIME KILN & TF GASIFICATION PLANT

The limestone charging system is designed for preventing air leakage out the kiln as well as allowing a uniform charging of the limestone inside the kiln in terms of size.

Once inside the kiln, the limestone slowly works its way through different zones of the shaft as it is calcined into lime, as follows:



1 - Plenum

2 - Storage & Preheating

3 - Calcination

4 - Post calcination

5 - Cooling & Discharge

6 - Gasification system

1 - PLENUM ZONE

The off-take pipes, through which the exhaust gases are removed from the kiln, are placed at the top of the plenum zone.

2 - STORAGE and PREHEATING ZONE

The limestone is fed in the storage zone of the kiln, whose height is constantly controlled by the level indicator. The height of the storage zone can be adjusted in order to have the best operating conditions according to the limestone quality and size distribution.

Below the storage zone, the limestone enters the preheating zone. Here, the limestone picks up heat from the hot rising gases. This efficient heat exchange brings the stone preheated to the calcining zone.

3 - CALCINATION ZONE

After the Storage and Preheating, the limestone slowly works its way through the calcining zone, as it is calcined into lime.

Fuel and Primary/Secondary Air flow rate and temperature control and the TT BURNER BEAMS are the "Invention" that make the ECO-LIMEGAS-KILN* the most competitive shaft kiln available in the market.

The Fuel is injected uniformly into the bed of the kiln through the TT BURNER BEAMS (PATENT PENDING) extending across the kiln section and positioned on two tiers.

Each TT BURNER BEAM is essentially an elongated diathermic oil cooled steel box.

The Hot Fuel is produced with the TF Gasification Plant using lump fuel. The features of the Gasification Plant are described in a separate section of this document.

Independent lances housed in the TT BURNER BEAMS carry the hot fuel to a series of evenly spaced ports on the TT BURNER BEAMS. The gaseous fuel is injected into the limestone bed at high temperature and mixed with Hot Primary Combustion Air - preheated with the heat available from the lime cooling - right after entering the limestone bed.

The Hot Secondary Combustion Air - preheated with the heat available from the exhaust gases - is fed into the limestone bed to complete the combustion of the fuel.

The resulting closely controlled fuel-air mixture ignites, providing the heat for efficient and uniform calcination.

Temperature, Flowrate and Distribution of Hot Fuel, Primary and Secondary Combustion Air are independently controlled for each burner lance and/or set of burner lances.

4 - POST-CALCINATION ZONE

The POST CALCINATION ZONE is created between the lower BURNER BEAMS and the AIR BEAMS reproducing similar conditions of the laboratory muffle, where the operating condition of high temperature without pressure interference; with these conditions the lime reactivity is optimised.

The hot air extracted by the AIR BEAMS, is fed to an hot air / fresh clean air heat exchanger; the fresh hot air is heated up to be used as Hot Primary Combustion Air to be fed separately from the Hot Secondary Combustion Air coming from the Exhaust Gas / air heat exchanger.
The Hot Primary Combustion Air is fed to the BURNER BEAMS, while the air extracted from the air beams is de-dusted in a Bag Filter before being discharged into atmosphere.

5 - COOLING and DISCHARGING ZONE

After the lime passes the post calcination zone enters the next zone where it is cooled from the air entering from the kiln discharge.
Conversely, this cooling air is preheated and then extracted from the kiln through the air bems.
The lime is discharged automatically with volumetric tables equipped with weigh scales.

6 - TF GASIFICATION PLANT

The technology of lump gasification to produce Syngas is quite old and was prevalent in Europe and America for over 60 years before the discovery of cheap fossil fuels like natural gas and oil. This technology is now revived in view of depleting oil and natural gas resources, and significant innovative solutions have been implemented in both.
The heat recovered in hot raw gases exceeds 90% of the heat available in coal, coke or any other fuel.
This Syngas is piped in the Lime Kiln.

GASIFICATION SYSTEM

The lump fuel is screened and then fed to the hopper of the gasifier charging system by means of a steep angle conveyor.

The charging system is equipped with two sealing valves in order to prevent the fresh air entering the system during the charging cycles.

The TF Gas Generator is basically a fixed bed type furnace to produce lean gas, where the lumped fuel is fed at the top of the shaft and the ashes are removed through the rotating grates at the bottom.

The air-steam blast is introduced from the bottom and it flows upwards, counter-current to the descending lumped fuel. The chemical process, that takes place produces the gas (Syngas), highly concentrated in carbon monoxide, hydrogen, nitrogen, with small amounts of carbon dioxide, some products of destructive distillation of lump fuel, such as methane and oils, and moisture.
The Syngas is then extracted from the top of the shaft.

The process is characterized by four distinct stages:

1 - Drying

lump fuel heats up and loses its water content, which turns into steam.

2 - Pyrolisis

It is a lump fuel decomposition process in absence of oxygen, which is triggered at temperatures between 150 and 800 ° C.
The Pyrolysis breaks down and extracts hydrocarbons.

3 - Reduction

Derivatives of the Pyrolysis heat up further and carbonize. The lump fuel bed reacts with the high-temperature increasing the calorific value of the Syngas.

4 - Oxidation

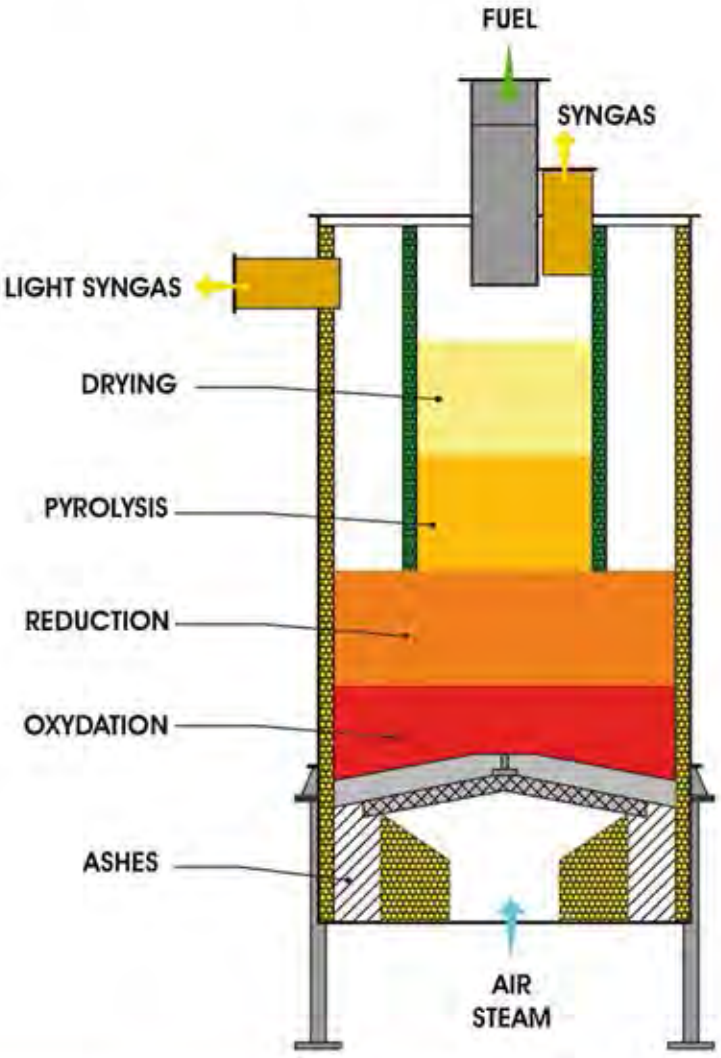
It is the high temperature (1000-1100 °C) oxidation of the carbonized Pyrolysis derivatives.

The lump fuel which is finally converted into ashes are discharged from the bottom of the gasifier and are removed together with the water of the sealing system, and extracted with a screw classifier and then fed to a stock pile.

Water is recycled to the water seal by means of two small pumps working alternatively.

The gas produced - Syngas – which is sucted from the top of the gasifier, is fed to a Booster station to increase and stabilize the pressure of the gas that is fed to the lime kiln.
A LHV analyser is installed to monitor on line the gas calorific power.

The Gas Generator is used to provide Syngas to fuel the FERCALX VERTICAL LIME KILN.



PROCESS CONTROL

The ECO-LIMEGASKILN is equipped with a process panel suitable to control and regulate the kiln operation. A PLC (Programmable Logic Controller) is installed as standard system in order to control all the plant operation.
The control system is complete of:

- PC for the control of the main process data of the kiln plant operation.
- TF industrial graphic supervision software.
- Colour printer

Through the TF Supervision Graphic Software the visualisation of the following functions:
- graphic pages with start-stop lighted signals of electric motors, alarms and main analogical values in real time.
- Historical trend in real time of the main variables of the plant.
- Alarms list.

The control of the plant is performed from the pc and all the set-points are inserted through the TF Supervision Software, using the keyboard of the pc.

ADVANTAGES

Advantages of the Lump fuel Gasification Plant for lime production vs direct heating with pulverized lump pet coke/coal.

1. The Syngas is fed to the Lime Kiln at a temperature of about 500°C as Hot Fuel and the fuel efficiency of the lime kiln is consequently improved with substantial reduction of the specific heat consumption.

2. No need to install expensive devices and mechanical equipment (silos, dosing system, weighing system, ejectors, splitters, instrumentation, etc) to control the flow of the pulverized solid fuel, but only regulating valves for the Syngas.

3. No requirement of ATEX classification for the lime kiln.

4. The ECO-LIMEGASKILN is a fully Syngas heated lime kiln.

5. Save of fuel cost due to the cost of Lump Pet Coke / Coal compared to Pulverized Pet Coke / Coal cost or RDF to natural gas and the different fuel consumption.

6. Save of electrical power cost due to the reduced electrical power consumption of the ECO-LIMEGASKILN compared to electrical power consumption of the Double Shaft Kiln.

7. Use of any kind of fuel without any particular requirement, except LHV and granulometric scale.

8. It is not necessary to pulverize the lump pet coke / coal , saving consequently capital, operating and maintenance.

9. It is possible to use alternatively different types of lump pet coke / coal with different LHV, according to the market availability and cost.

10. The sulphur content eventually present in the lump coal will remain in the ashes and evacuated with the ashes of Gasifier. Therefore the lime will be sulphur free, which is an utmost advantage for steel application. In case of lime kiln directly heated with pulverized coal the coal sulphur is collected together with the lime discharged with the lime kiln.

FERCALX VERTICAL LIME KILN

The FERCALX VERTICAL LIME KILN *Three Way Pressure System* is today – economically and technically wise - the most updated solution available in the market.

Single Shaft Kiln that combines the simplicity of its concept with advanced technology to reach top performances, producing quicklime and dolomitic lime for all industrial needs.

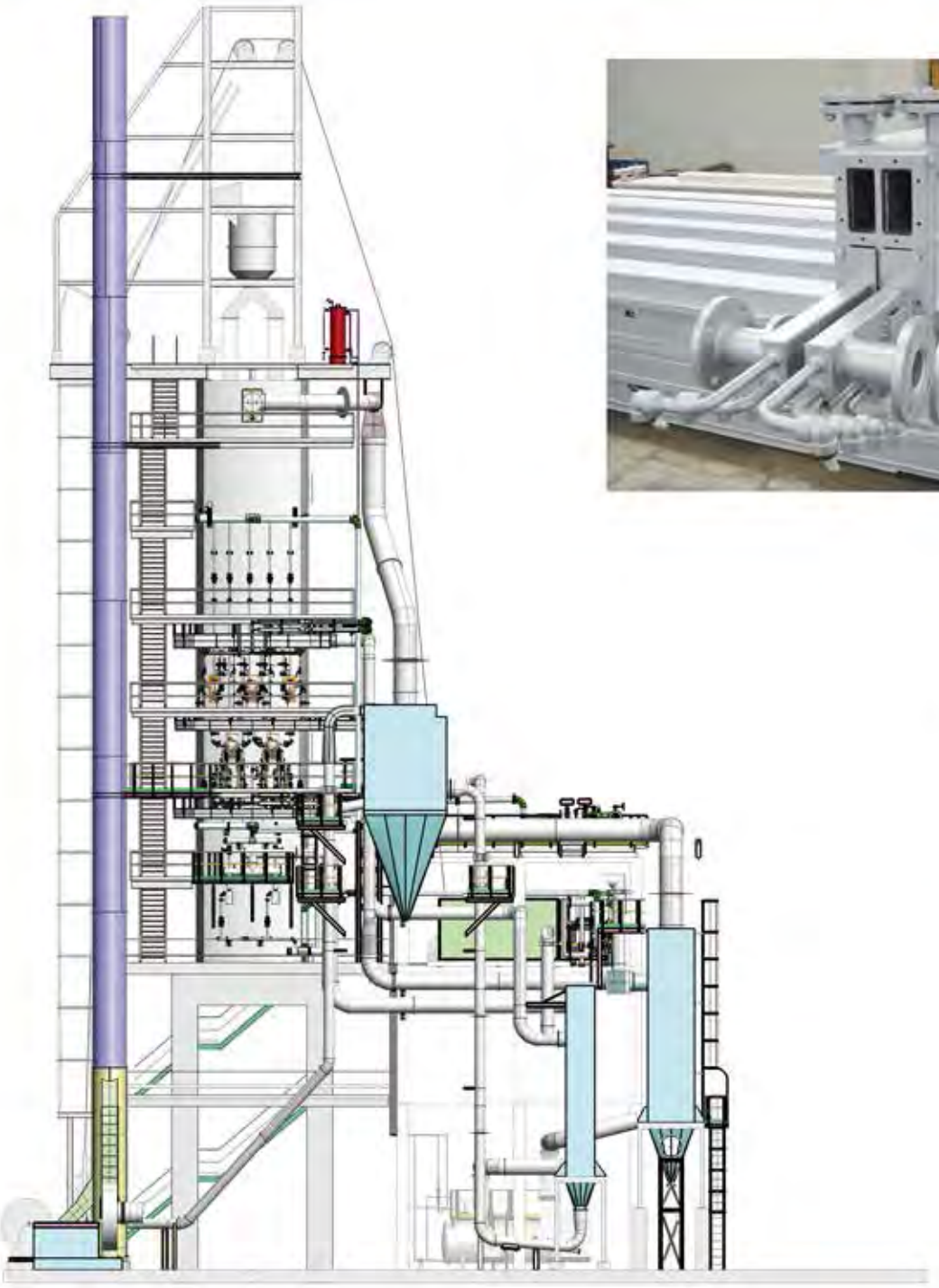
Innovative solutions with several Patents and Pending Patents applied to the kiln system allow to obtain very high flexibility in terms of lime quality for both residual CO2 content (even < 1%) and T60 (from 30 seconds to 20 minutes) and fuel consumption (< 870/930 Kcal/Kg of lime).

Reliability and consistency in the operation and performances are distinctive features.

The Post-calcination Zone and the TT Burner Beams are the Inventions of this New Century.

TECHNICAL DATA

Fuel Consumption:	*≤ 880 kcal/kg of lime*
Electric power consumption:	*≤ 20 Kwh/Ton of lime*
Limestone size:	*from 15 mm to 250 mm*
Residual CO2 in the Lime:	*< 1 %*
Range from:	*Soft burnt lime (T60 ≤ 30 seconds)*
	o Hard burnt lime (T60 ≤ 20 minutes)
Calcitic Lime & Dolomitic lime	
Capacity from:	*30 TPD to 800 TPD*
Fuels:	*natural gas , lean gas (min. 700 kcal/Nm3)*
	liquid/oil pulverized solid (i.e. lignite, coal, coke)
Fully Automatic Operation	



WORLD WIDE INSTALLATIONS

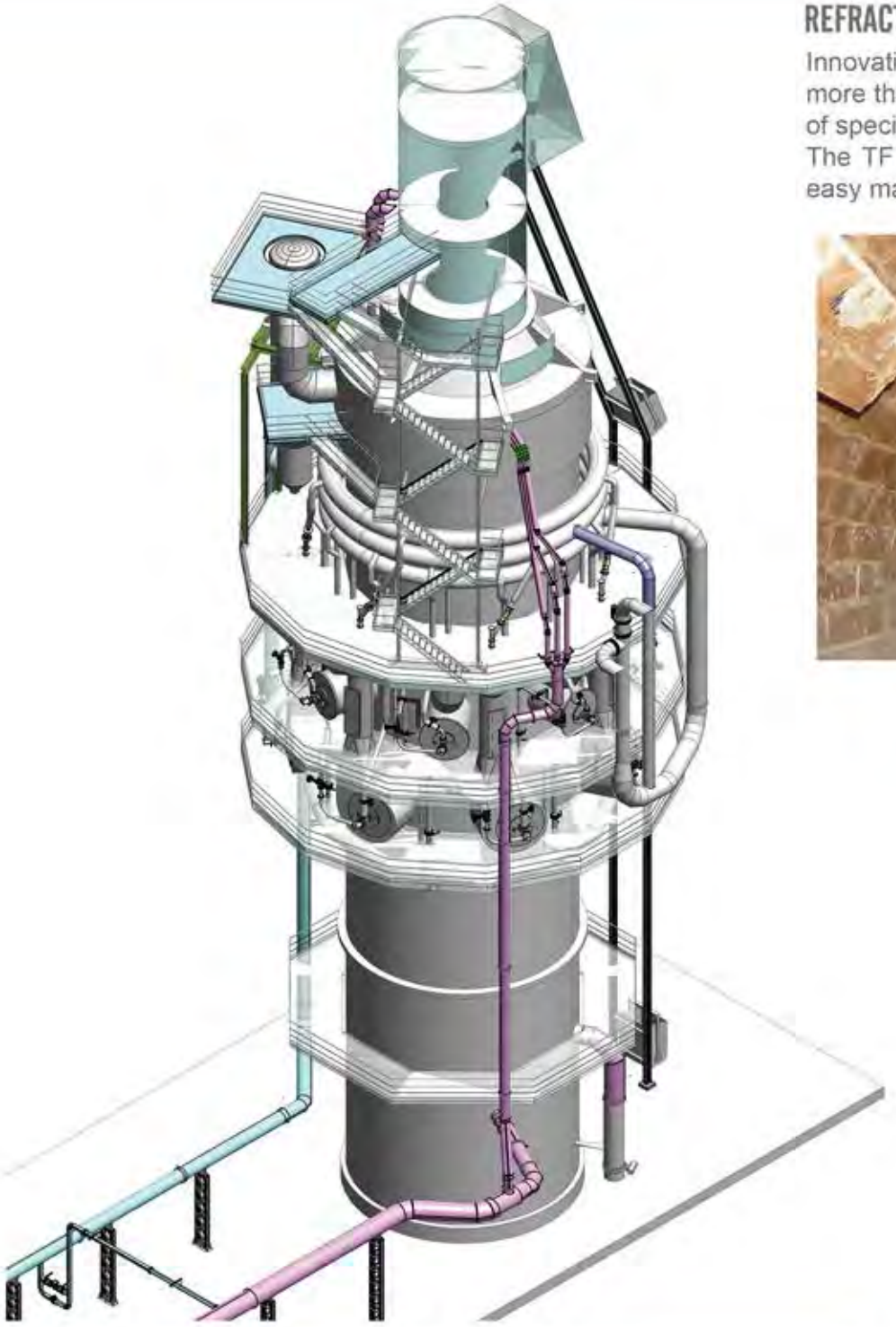
- *Areas where Fercalx Lime Kilns are installed .*
  More than 140 Kilns/Plants are installed worldwide.

BECKENBACH ANNULAR SHAFT KILN®

After the acquisition of the Technology and Patents of Beckenbach Waermestelle GmbH – Germany, that took place in the year 2001, tradition has been continued by Terruzzi Fercalx with the Beckenbach Annular Shaft Kiln®.
Furthermore, automatic operations, refined controlling of combustion system, implemented refractory design and updated engineering applied by Terruzzi Fercalx have furthermore improved the quality of the performances of the Beckenbach Annular Shaft Kiln®, a lime kiln system already well known in the market.
Innovative solutions certificated by several Patents and Pending Patents applied to the kiln system by Beckenbach Waermestelle GmbH and Terruzzi Fercalx Group, allow to obtain very high flexibility in terms of lime quality for both CO2 residual content (< 1 %) and lime reactivity (SOFT BURNT T60 from less than 30 seconds up to 3 minutes) and fuel consumption (< 900 Kcal/Kg of lime).
Any type of fuel can be used: gas, liquid or solid. Extensive expertise has been acquired by Terruzzi Fercalx Group in the design, realization and operation of the Beckenbach Annular Shaft Kiln®, thanks to the more than 60 installations realized since 2001.

TECHNICAL DATA

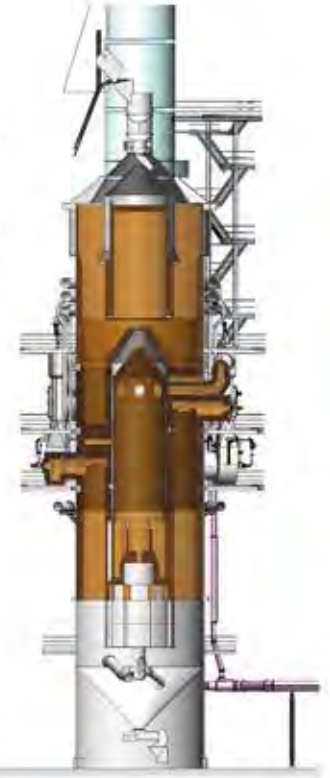
Fuel Consumption:	*≤ 900 Kcal/kg of lime*
Electric power consumption:	*≤ 25 Kwh/Ton of lime*
Limestone size:	*from 15 mm to 150 mm*
Residual CO2 in the Lime:	*< 1 %*
Range from:	*Soft burnt lime (T60 ≤ 30 seconds)*
	to Hard burnt lime (T60 ≤ 6 minutes)
Lime & Dolomitic lime	
Capacity from:	*100 TPD to 800 TPD*
Fuels:	*natural gas, lean gas (min. 1400 Kcal/Nm3), liquid/oil, pulverized solid (i.e. lignite, coal, coke etc,)*
Fully Automatic Operation	



REFRACTORY

Innovative design has been applied in order to prolungate furthermore the service life of the refractory and to elimate the requirement of special bricks.

The TF consol technology has been applied, in order to allow the easy maintenance of the refractory walls by section, upon necessity.



WORLD WIDE PRESENCE

- *Areas where Beckenbach Annular Shaft Kilns are installed. More than 192 Kilns/Plants are installed worldwide.*

CONVERSION OF EXISTING KILNS TO THE FERCALX SYSTEM

All the features of the FERCALX VERTICAL LIME KILN are applied to the existing shaft kilns that are converted to the Fercalx System.
In addition to these features, the typical capacity increase after conversion is not lower than 50%.

The Burner Beam Technology remains the key factor of the success experienced with the conversion that has been realized in very many existing shaft kilns worldwide, for application in steel, soda ash, sugar, bauxite, carbonite, environmental and building industries.

FERCALX HYDRATED LIME PLANT

Hydrated lime fineness, purity and moisture residual content are the key ingredients of our hydration plant, which is suitable for chemical, steel, environmental and building applications.

The key equipment of the plant are of FERCALX own design and fabrication, such as:

. Three Stages Hydrator *WIT SYSTEM*
. Classification system with last generation Air Separators
. Grinding and micronisation mills (hammer mill, ball mill etc.)
. Transport equipment (belt conveyors, screw conveyors, bucket elevators)
. Packing equipment

The design of FERCALX THREE STAGES HYDRATOR allows a flexibility and a reliability that make possible the adjustment of its operating parameters to any necessity, according to the raw material fed to the plant and the requirement of final product.

TECHNICAL DATA

Capacity:	*from 3 to 30 tph*
Residual moisture :	*< 1%*
Fineness suitable for chemical and building applications:	*According to the requirement.* *Up to 95% ≤ 90micron*
High BET:	≥ 40m²/gr.

PRECIPITATED CALCIUM CARBONATE PLANT(PCC)

PCC is utilised in several industrial processes, as:

. Cosmetics and tooth paste
. Paper and painting industries
. Antiacid in medicine and veterinary
. Basis of polish pastes
. Neautralizing the wine acidity
. In medicine (as absorber, antirachitic, etc.)
. Additive for rubber, plastic, linoleum, paper and insulating materials

Terruzzi Fercalx has its own proprietary design for the key parts of the PCC Plant, and among these the Dryer and the Reactors are protected by Patents. These Technologies have been developed by the R & D Department of TERRUZZI
FERCALX and represent the result of the extensive experience achieved in this specific field.
The PCC Plant is suitable to produce different fineness that, according to the standards identified for PCC, are the following:

. EEL - Extralight
. EL - Light

FERCALX AUXILIARY PLANTS

Tailored solutions developed by Terruzzi Fercalx to meet customers 'requirements concerning the full output cycle before and after calcination. Milk of lime, Ready-mix, Putty lime, Limestone preparation, Packing and palletizing plants.

READY MIX PLANT

. Dry and Wet systems.
. Preparation dosing and mixing of different mineral products: limestone, lime, magnesite and products having similar characteristics and granulometry.
. Preparation of each necessary process to create the product (grinding, screening, weighting).
. Fully automated.

QUICK LIME GRINDING PLANT

. Complete plants to produce ground and pulverized quicklime at different sizes and fineness.

MILK OF LIME PLANT

. Rotary slaker with cleaning system
. Two stages classification system: intermediate and final filtering
. Continuous density control of the final product
. Suitable for cold, hot and sweet water

PUTTY LIME PLANT

. High quality putty lime for any building application.
. Simple to operate and maintain.
. Packing unit.

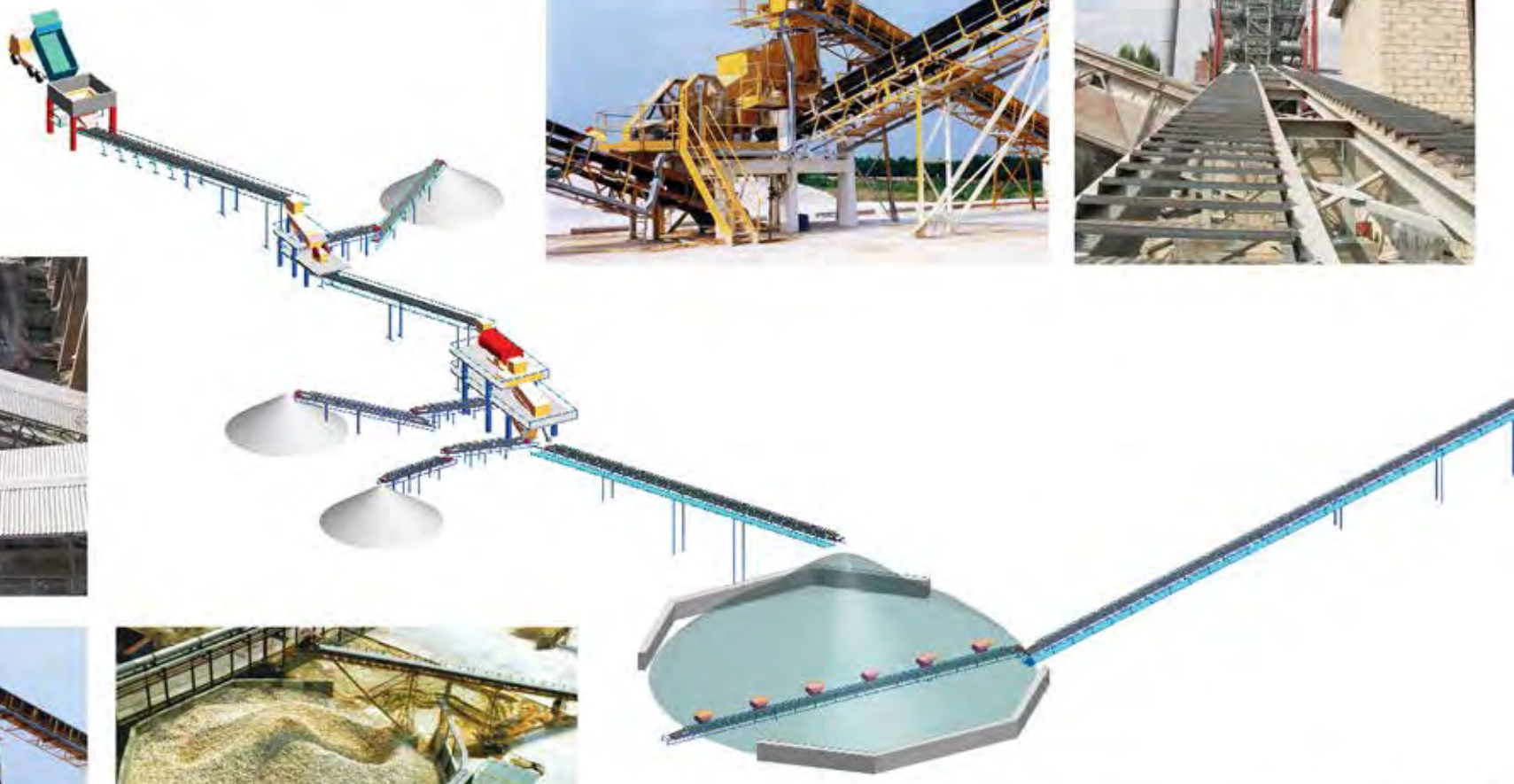
LIMESTONE PREPARATION PLANT

Complete plants to prepare the limestone in different sizes for the lime kilns composed of primary and secondary crushing, wet washing or dry cleaning, storage in open or covered stockpiles and / or in silos and final screening before the feeding to the lime kiln.

PACKING AND PALLETIZING PLANT

. Automatic Bag Filling machine and
. Palletizer

TYPICAL FERCALX LIME PLANT



OUR IN HOUSE ACTIVITY

DESIGN

MANUFACTURING

TEST LABORATORY

ERECTION

COMMISSIONING

AFTER SALES & SPARE PARTS

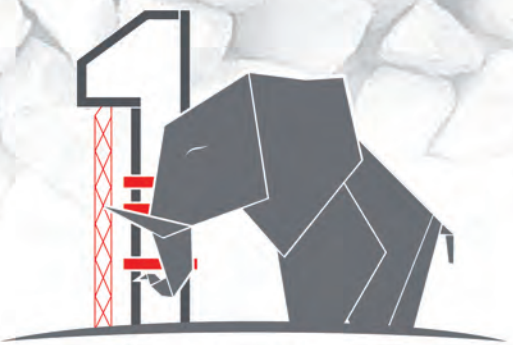
TERRUZZI FERCALX GROUP

www.terruzzifercalxgroup.com

TERRUZZI FERCALX SPA
HEADQUARTERS
Viale Lombardia, 7 – Zona Industriale 2,
24050 Spirano - Italy
Tel. +39 03 54 87 98 11
Fax +39 03 54 87 98 00
E-mail: info@terruzzifercalxgroup.com

VULCAN ENGINEERS LTD.
HEADQUARTERS
Trade Centre Office No 104, 105 & 106, Wing C, First Floor,
North Main Road, Koregaon Park
Pune 411001 Maharashtra – India.
Tel. +91 20 66 45 08 00
Fax +91 20 66 45 08 01
E-mail: info.vel@vulcanengineers.com
Website: www.vulcanengineers.com

TERRUZZI FERCALX ENGINEERING PVT LTD
HEADQUARTERS
953/A, 2nd Floor, 2nd Main Road, 4th Block, Rajajinagar,
560010 Bangalore - India.
Tel. +91 80 23 40 33 20
Fax +91 80 23 40 33 19
E-mail: info.tfe@terruzzifercalxgroup.com



TF LIME WORKSHOP

2013. JODHPUR *India*