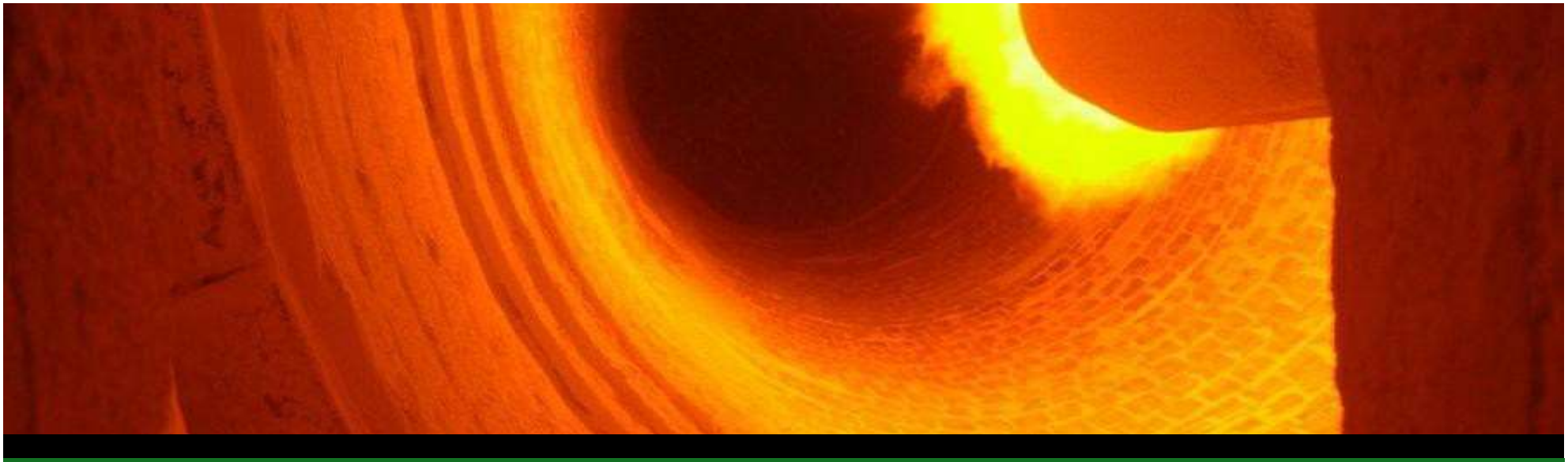
ROCKTEQ
Pyroprocessing



PYROPROCESS TECHNOLOGIES FOR HIGH QUALITY CLINKER PRODUCTION

THE BURNER CONCEPT:

ROCKTEQ Pyroprocessing

All of our ***ROCKTEQ*** kiln burners are founded upon the combustion research conducted by Prof. Clemente Greco (1937-2003), a distinguished lecturer at Brazil's Institute of Thermodynamics. Notably, he pioneered kiln burner designs tailored for challenging-to-combust fuels such as petcoke.

He innovated the kiln burner nozzles using a single air jet stream design, effectively imparting substantial burner momentum. This innovation facilitated a heightened influx of hot secondary air into the main flame, thus enhancing ignition reactions and fuel burn-out. His studies underscored the advantages of the axis-symmetric burner design.

Since 1998, ***ROCKTEQ*** has faithfully upheld and built upon this successful paradigm. Numerous installations of our main burners across the globe validate this concept, enabling exceptional clinker production performance even when dealing with hard to burn fuels.

Our Products:

ROCKTEQ Pyroprocessing

KILN BURNERS

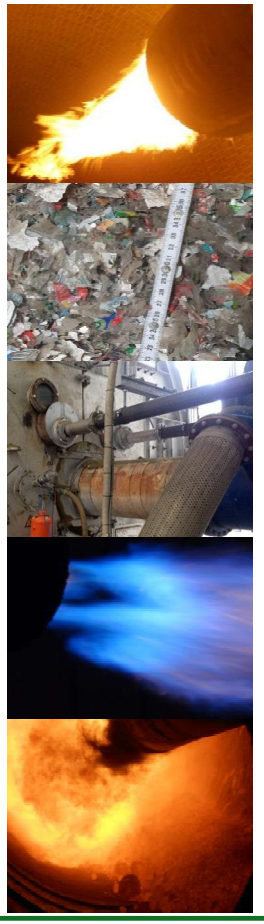
- **Burner Carriages**
- **Ignitors**
- **Oil Valve Skids & Gas Valve Skids**
- **Atomizer for Liquid Alternative Fuels**

SATELLITE BURNERS FOR SOLID ALTERNATIVE FUELS

CALCINER BURNERS

AF - BOOSTER® FOR SOLID ALTERNATIVE FUELS

ANALYSIS OF CLINKER PRODUCTION – INCREASE OF ALTERNATIVE FUELS



Our design:

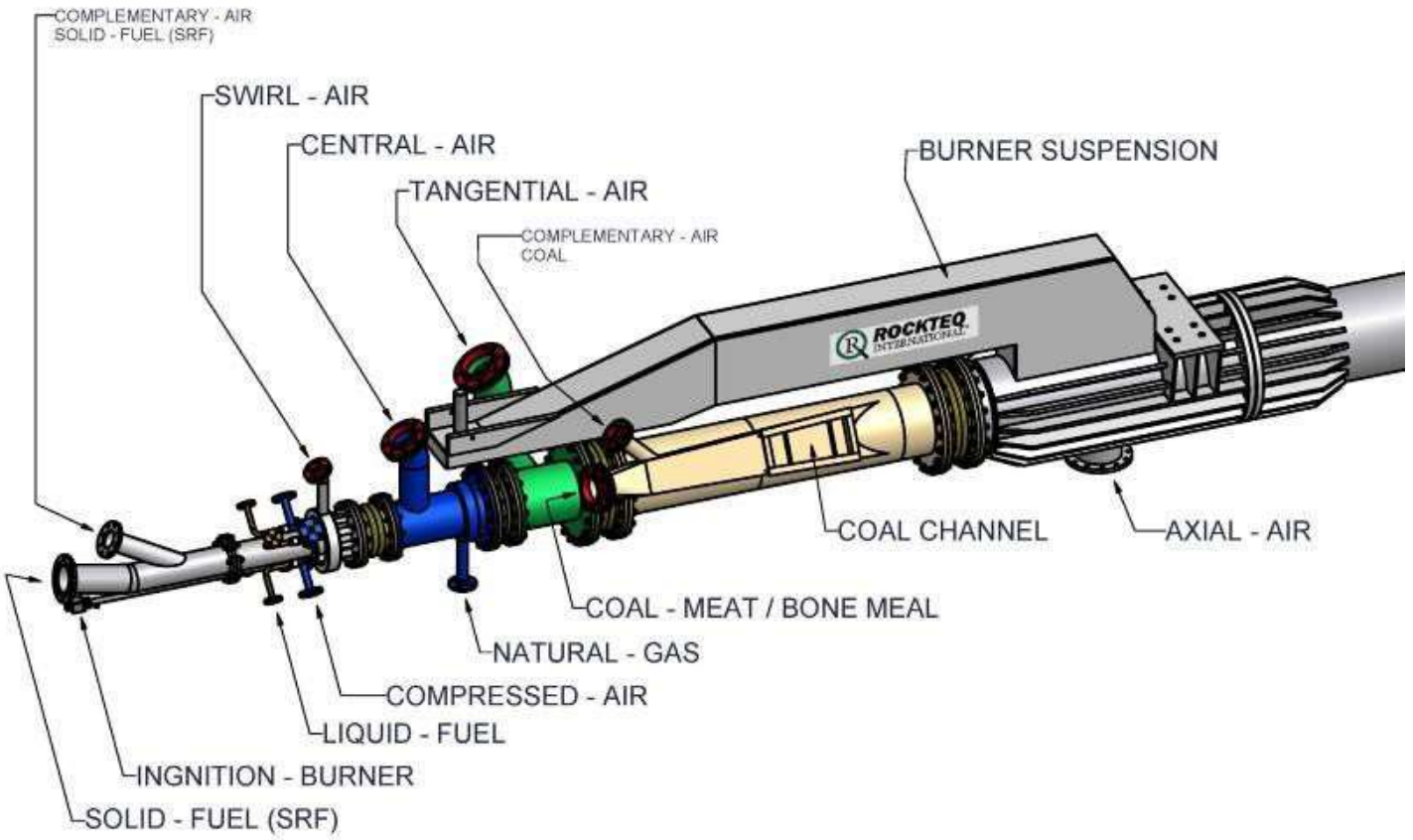
ROCKTEQ Pyroprocessing

Important aspects for a modern burner system

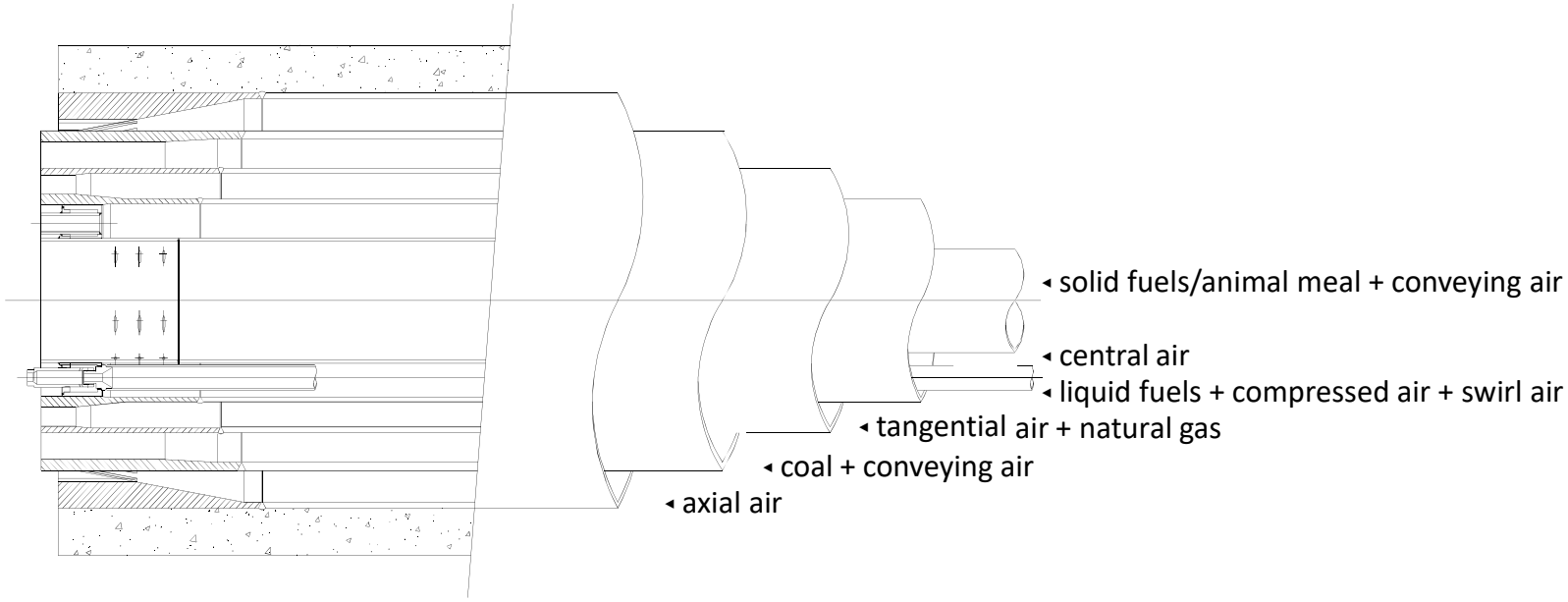
- Flexibility (flame shaping)
- High burner momentum
- Low Pressure Drop
- Main fuels
- Alternative fuels
  - solids
  - liquids
- Energy efficiency
- Environment
  - low NOx emissions
  - low CO emissions

*Overview of a **ROCKTEQ** burner*

ROCKTEQ Pyroprocessing

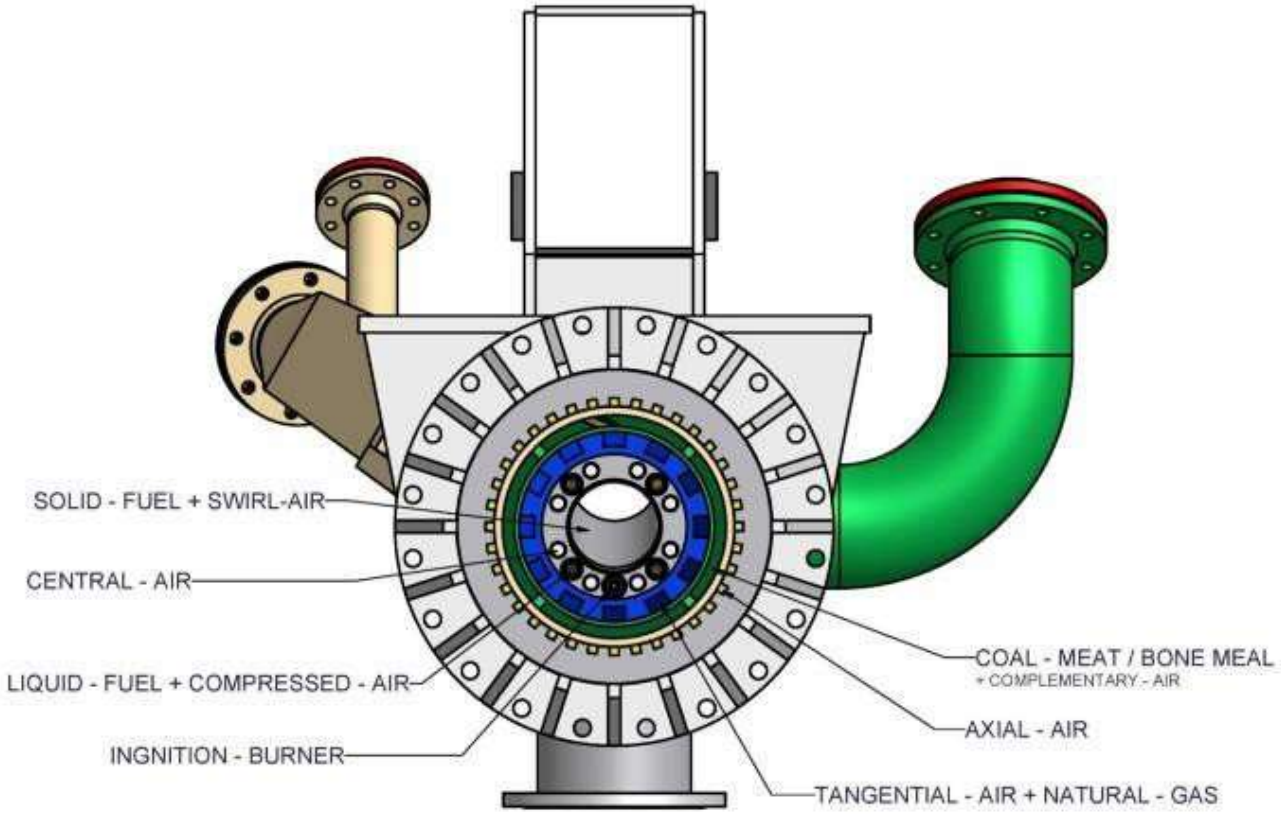


*Overview of a **ROCKTEQ** burner*



Overview of a ROCKTEQ burner

ROCKTEQ Pyroprocessing



ROCKTEQ's Design Philosophy:

ROCKTEQ Pyroprocessing

- Enhanced recirculation through individual air jets
- Utilizing single air jets, we achieve heightened recirculation with the inclusion of hot secondary air.
- Concentric Injection of Fuels and Primary Air Components
- Our approach involves the concentric injection of all fuels and primary air components. This strategy ensures optimal control over the combustion process.
- Primary air supplied via rotary blowers with high momentum
- We employ rotary blowers to deliver primary air, generating substantial momentum. These blowers offer adjustable high-pressure levels through concentric channels. These channels encompass:
  - Axial air
  - Tangential air
  - Central air
  - Swirl air
- Measurement of primary air mass flowrates and pressure
- We measure both the mass flowrates and pressures of primary air. This practice guarantees reproducible burner conditions, fostering consistent operating conditions.

ROCKTEQ's Design Philosophy:

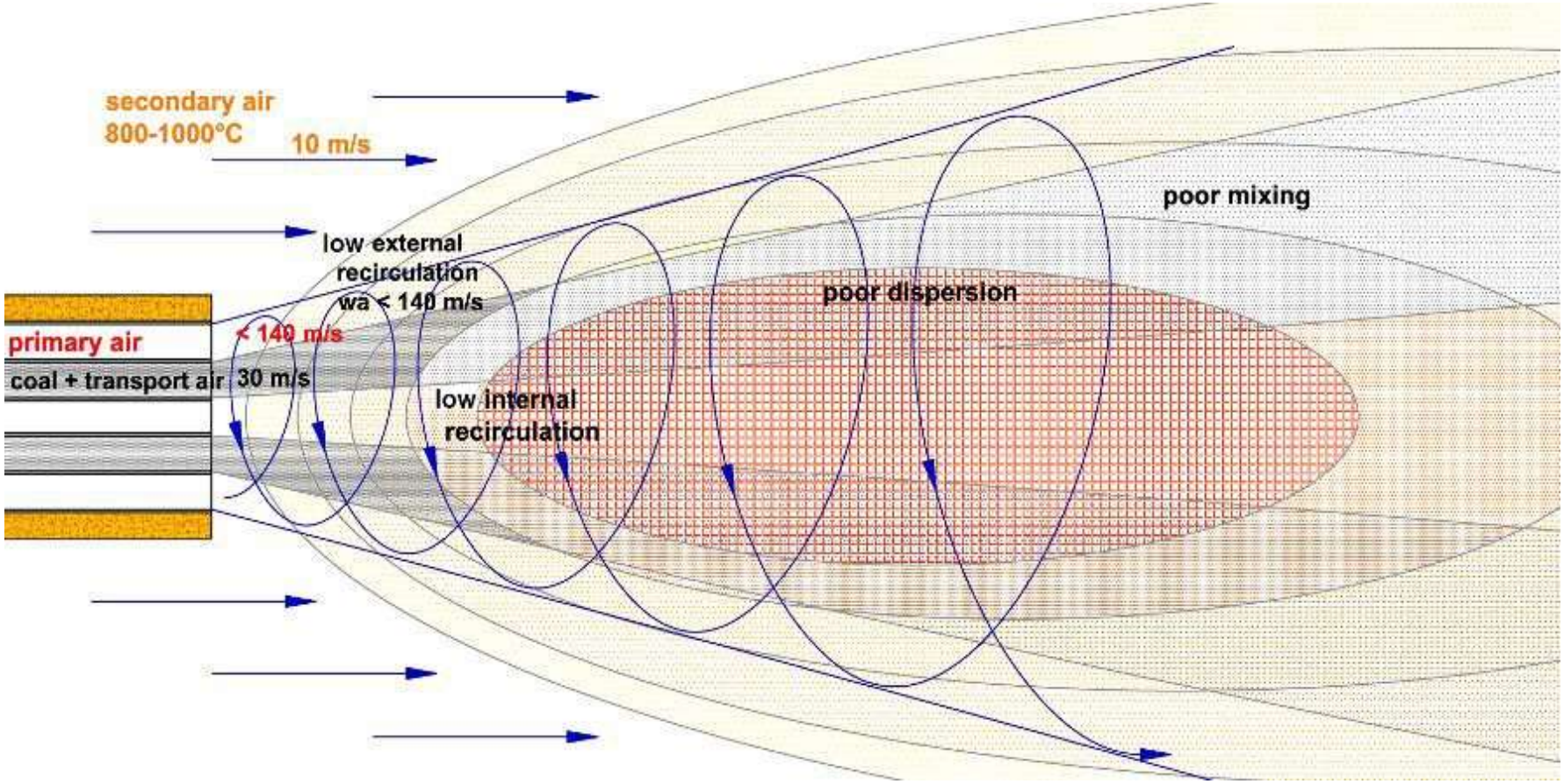
ROCKTEQ Pyroprocessing

High-momentum and turbulence-driven combustion results in several outcomes:

- Elevated consumption rates of alternative solid fuels
- Shortened sintering zone, mitigating the double cooking effect
- Diminished sulfur volatilization in the burning zone
- Enhanced expulsion of sulfur with clinker
- Enhanced flame shape control and burning process management
- Reduced emissions of NOx, CO, TOC, and more
- Better overall performance

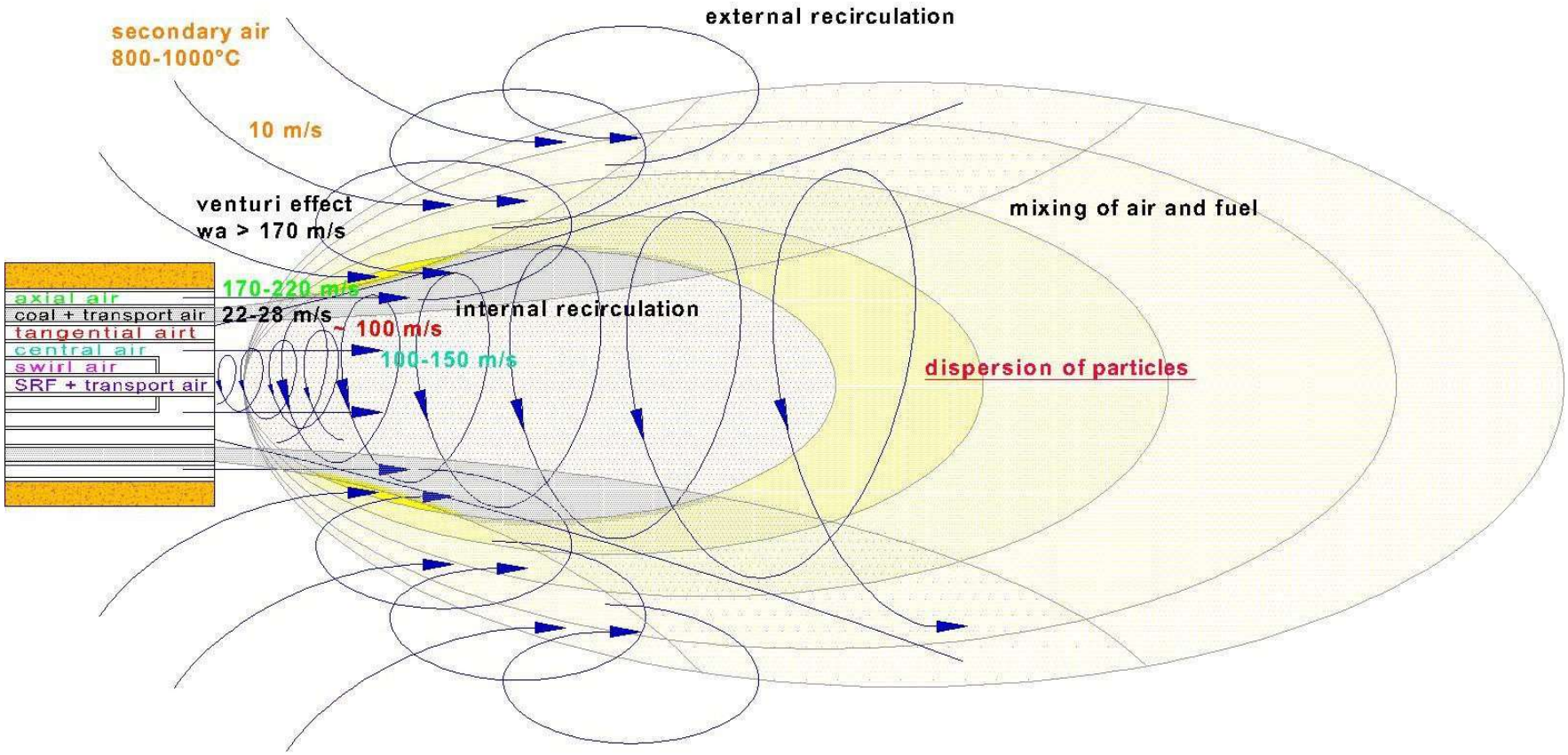
Conventional Burner Flame

ROCKTEQ Pyroprocessing



ROCKTEQ's Multi-Channel Burner Flame

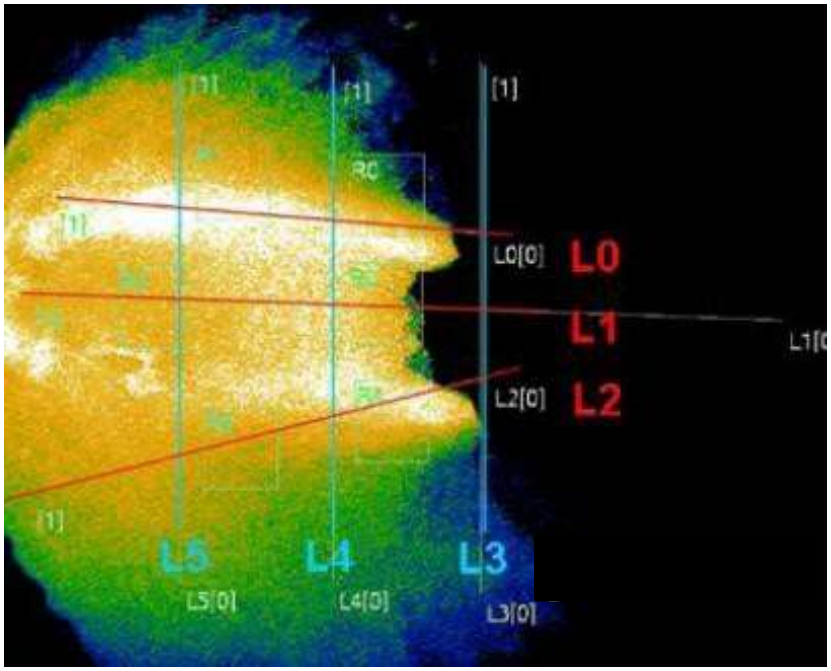
ROCKTEQ Pyroprocessing



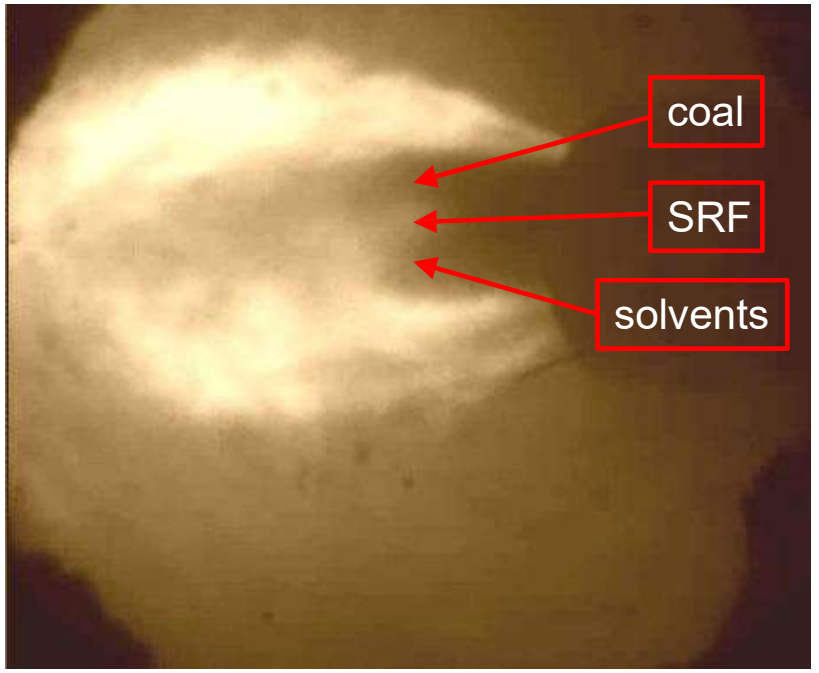
ROCKTEQ's Multi-Channel Burner Flame

ROCKTEQ Pyroprocessing

Design **with** concentric fuel injection



Thermography



Video Screenshot

Comments from plants regarding flame control:

ROCKTEQ Pyroprocessing

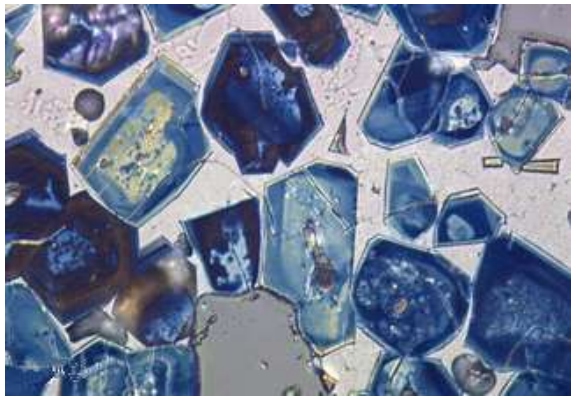
- „It is a must for the kiln operators to use the thermography due to the fact that process and fuel deviations and the related burner adjustments are daily business for us“.

- „Finally, clarity whether we have less energy entry in the kiln or we only burn deeper in the kiln“.

- „If the sinter zone temperature has sunk, we have often directly added fuel. Today we look at the ignition point of the fuel. If this has gone away from the burner tip and the secondary air temperature has changed, we don’t intervene today, but save our fuel.“

- „We recognize low quality alternative fuel now certainly and early“.

well burned clinker



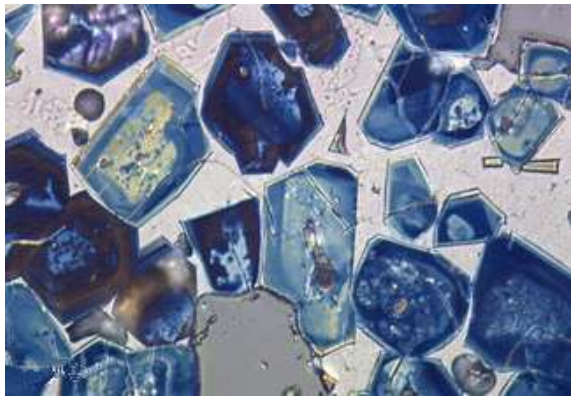
high clinker quality

Comments from plants regarding flame control:

ROCKTEQ Pyroprocessing

- "It is imperative for kiln operators to utilize thermography as a result of the continuous necessity to manage process and fuel deviations, along with the corresponding burner adjustments – all of which constitute our daily operations."
- "Ultimately, thermography provides clarity on whether there is reduced energy input into the kiln or if we are simply achieving deeper combustion within it."
- "In the past, when the sinter zone temperature decreased, our response was often to add fuel directly. Nowadays, we assess the ignition point of the fuel. If it has shifted away from the burner tip and there are changes in the secondary air temperature, we refrain from immediate intervention. Instead, we conserve our fuel resources."
- "We are now adept at identifying and addressing low-quality alternative fuels promptly and with certainty."

well burned clinker



high clinker quality

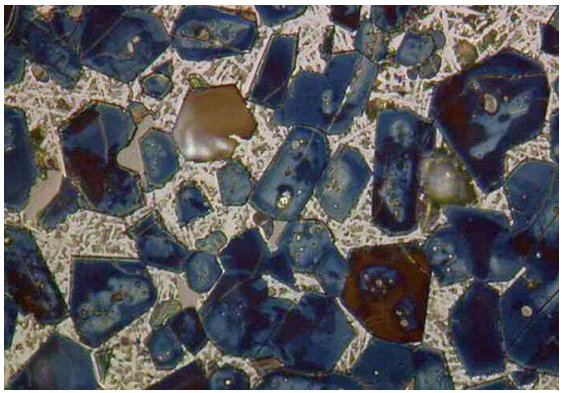
Comments from plants regarding flame control:

ROCKTEQ Pyroprocessing

- "With a delayed ignition point and an additional reduction in the flame diameter during its initial stages, we experience a loss of energy being introduced into the kiln. However, today we are able to promptly adjust and rectify this issue. In laboratory testing, we would have only identified this problem an hour later!"

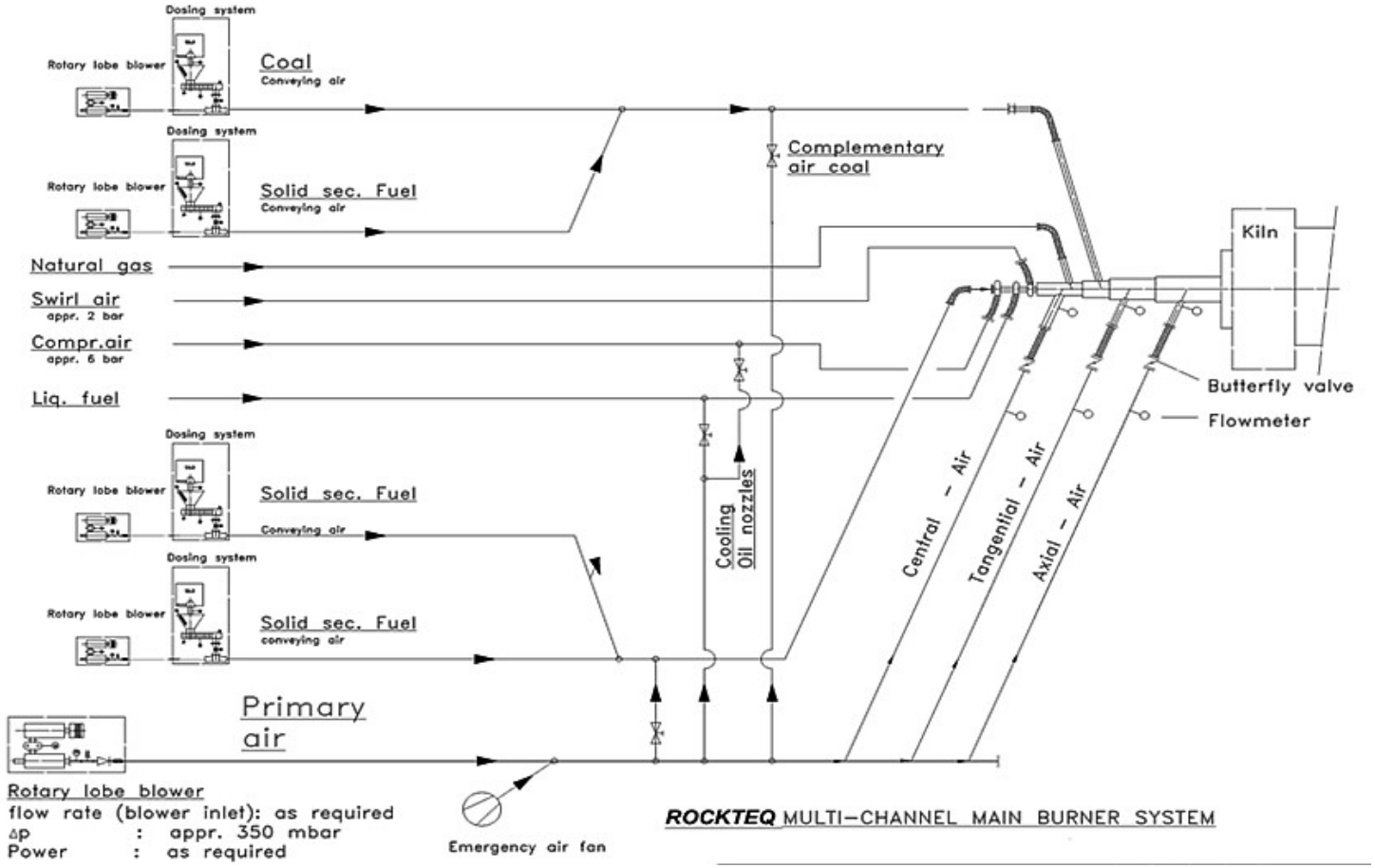
- "Short-term fluctuations in the flame diameter have a more profound impact on brick quality than previously anticipated. On the other hand, variations in the ignition point and the resulting shifts in the sintering zone have been overestimated, as they exert considerably less influence on product quality than previously assumed. Armed with this understanding, we now have increased confidence in our ability to optimize kiln operations."

weak burned clinker



well burned clinker

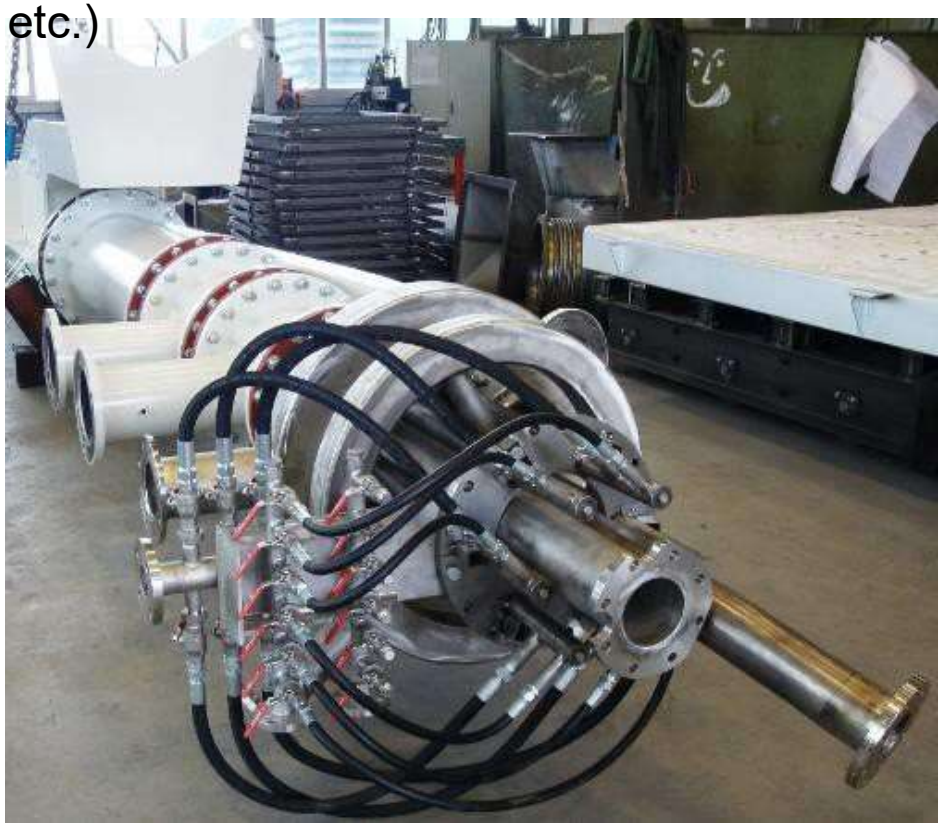
ROCKTEQ multi-channel burner flow sheet:

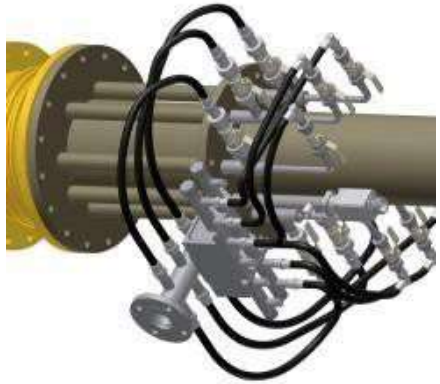


ROCKTEQ multi-channel burner

ROCKTEQ Pyroprocessing

Liquid fuels (fuel oil, solvents, waste oil etc.)





ROCKTEQ multi-channel burner

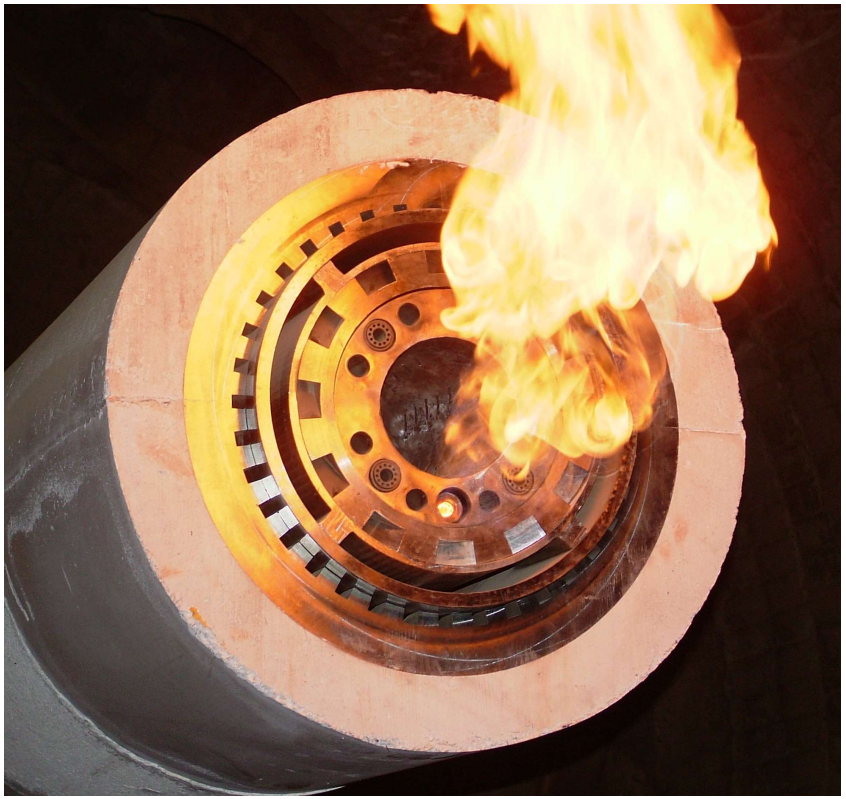
ROCKTEQ Pyroprocessing

Solid fuels (coal, lignite, SRF, meat and bone meal, wood, etc.)

ROCKTEQ multi-channel burner

ROCKTEQ Pyroprocessing

Ignition burner (natural gas, propane, etc.)



ROCKTEQ multi-channel burner

ROCKTEQ Pyroprocessing

Support & carriage (suspension or floor rails)

ROCKTEQ multi-channel burner

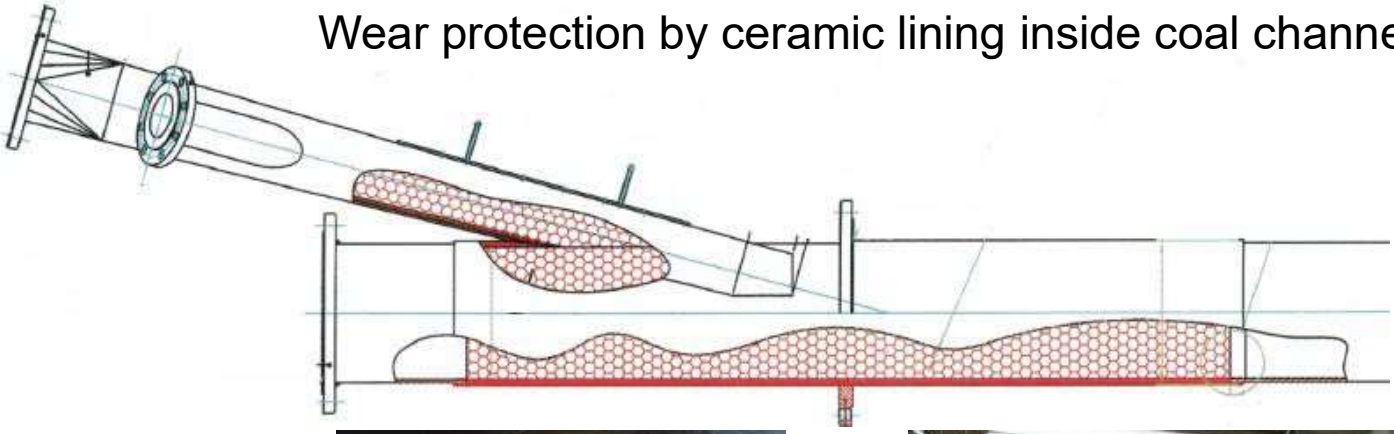
ROCKTEQ Pyroprocessing

Primary air control (separate flow meters and valves to allow a reproducible flame setting

ROCKTEQ multi-channel burner

ROCKTEQ Pyroprocessing

Wear protection by ceramic lining inside coal channel



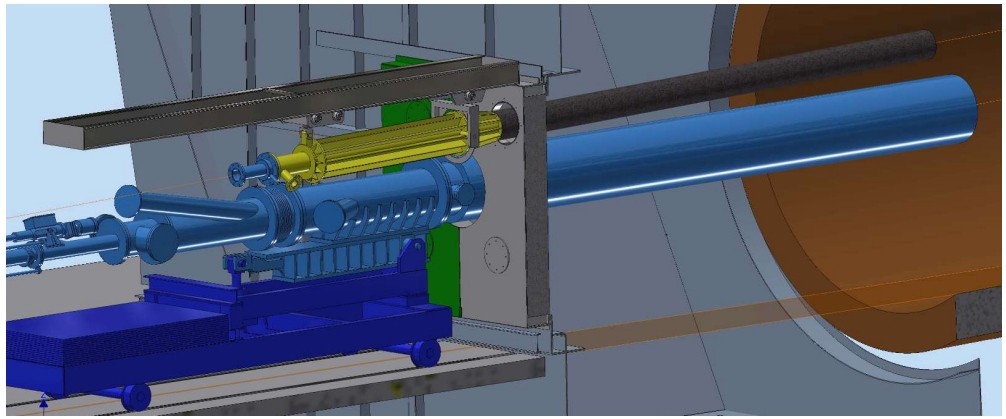
ROCKTEQ multi-channel burner

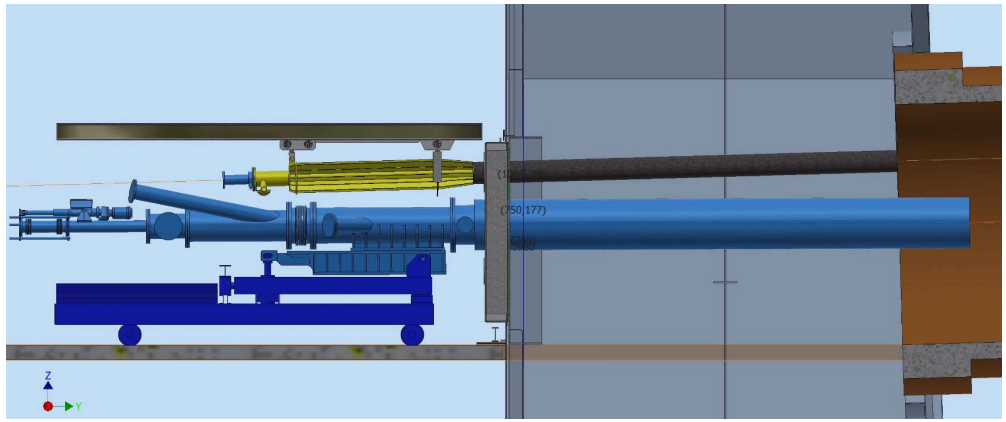
ROCKTEQ Pyroprocessing

Individually designed with wear protection - hard facing of tube surface for SRF

Hard facing of central pipe with tungsten carbide (inside) and welding at burner tip

ROCKTEQ SAT burner





The ROCKTEQ SAT-Burners encompass the following attributes:

- Burners are available with refractory linings.
- Burners are equipped with axial air ducts and lifting air nozzles.
- The burner configuration includes a practical trolley feature.
- Enhanced mobility with horizontal movement capability for the burner.
- Burner tilting flexibility facilitated by the utilization of a calotte mechanism.
- Incorporation of motorized throttle valves for precise air volume regulation.
- Measurement and visualization of both axial and radial air volumes and pressures within the central control room, providing comprehensive air volume management.

When coupled with the AF-booster, the ROCKTEQ SAT-Burners enable the implementation of an exceedingly adaptable fuel concept.

ROCKTEQ SAT burner

Our support

ROCKTEQ Pyroprocessing

Studies & Preprojects

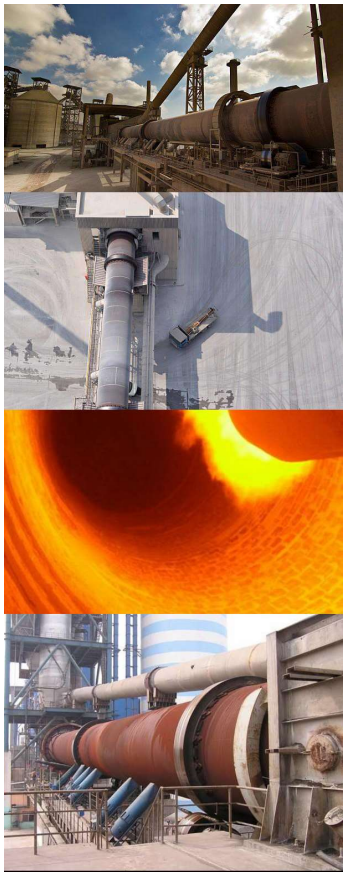
- We provide studies to increase Solid Recovered Fuels (SRF)

Plant Visit – Data Gathering

- Analysis of fuels
- Check of dosing equipment
- Analysis of clinker quality
- Check of kiln inlet, gas circles, emissions
- Check of kiln shell and sintering zone

Concept Report

- Guideline on how to increase the thermal substitution rate (TSR) on the kiln
- Commercial calculations of ROI



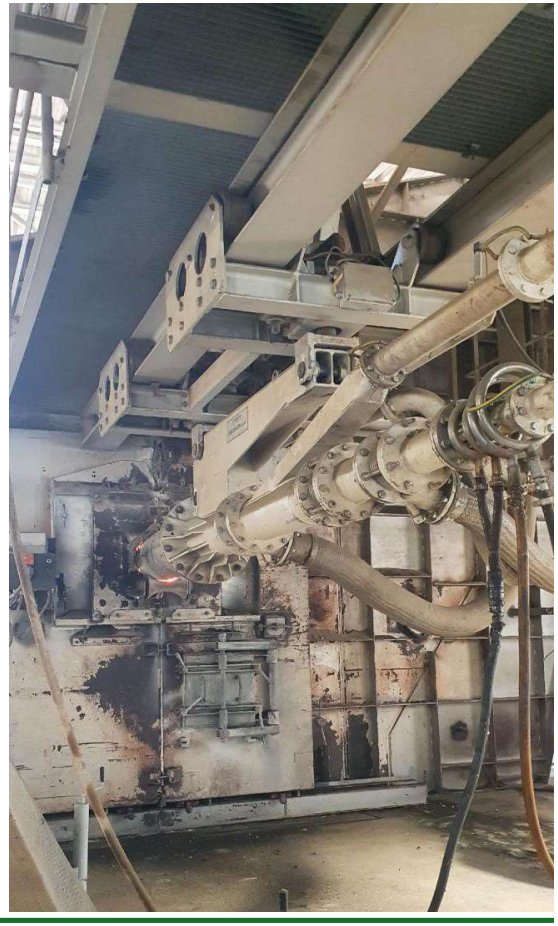
KEY-ADVANTAGES

- Achieving thermal substitution rates exceeding 80%
- Enhancing the heating value of SRF
- Decreasing fuel moisture content
- Implementing SRF air classification analysis and simulation of particle suspension and trajectories
- Enhancing the entirety of the pyro process and elevating clinker quality
- Lowering overall fuel expenses and CO_2 certificate expenditures

Reference List

ROCKTEQ Pyroprocessing

- Leube GmbH – Gartenau bei Salzburg, Austria
- Wietersdorf GmbH – Klein St. Paul, Austria
- Dyckerhoff AG, Neubeckum Plant – Neubeckum,
- Wopfing GmbH – Waldegg, Austria
- Schretter & Cie. – Vils, Austria
- Märker Zement GmbH – Harburg, Germany
- Castle Cement Ltd. – Ketton, United Kingdom
- Zement- und Kalkwerke Otterbein GmbH – Großenlüder, Germany
- Górażdże Cement S.A. – Opole, Poland
- Dyckerhoff AG, Geseke Plant – Geseke, Germany
- Dyckerhoff AG, YUGCement – Nikolayev, Ukraine
- Dyckerhoff AG, Deuna Zement GmbH – Deuna, Germany
- Dyckerhoff AG, Nowiny Plant – Nowiny, Poland
- Cimalux – Rumelange Plant - Esch-sur-Alzette, Luxembourg
- Leube GmbH, Gartenau bei Salzburg, Austria
- Dyckerhoff AG, Göllheim Plant - Göllheim, Germany
- Zementwerk Volyn Zement, Dyckerhoff AG, Ukraine
- Zementwerk Göllheim, Ofen I, Dyckerhoff AG, Deutschland
- PJSC Podilskyi Cement, CRH Ukraine LTD, Ukraine



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