ROCKTEQ
Pyroprocessing

AF Booster System®

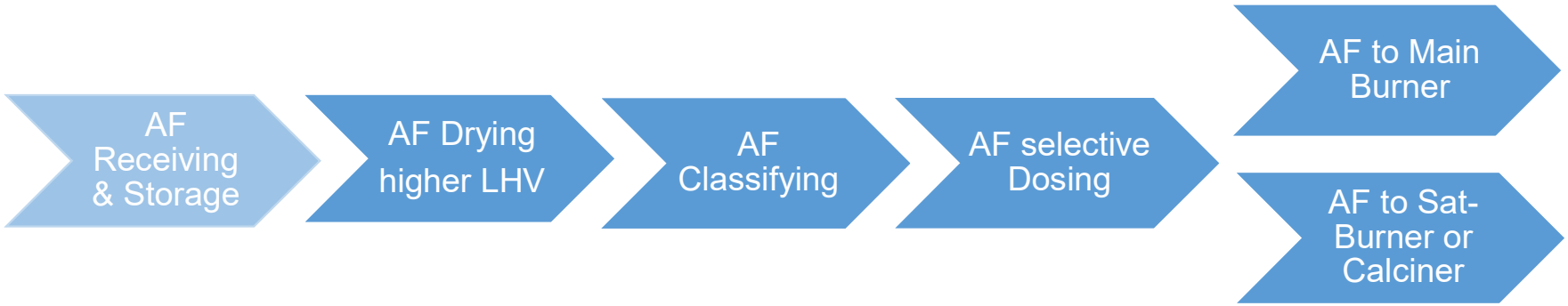
The increase of AF utilization over 80% at the kiln, with reduced CO_2 emissions

AF–Booster System® Concept:

ROCKTEQ Pyroprocessing

A system that enlarges the RDF utilization on the kiln for over 80% TSR:

Technical Solution:



AF–Booster System® Concept:

ROCKTEQ Pyroprocessing

A system that enlarges the AF utilization on the kiln for over 80% TSR:

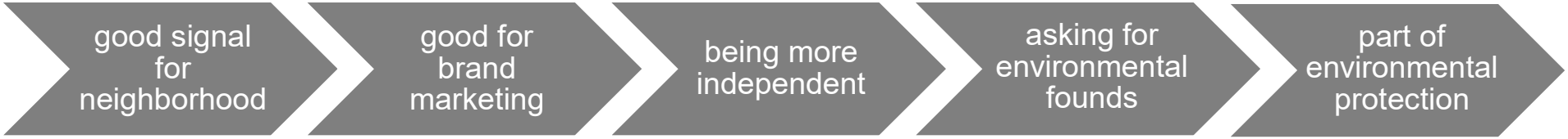
Commercial Cost Reduction:

AF–Booster System® Concept:

ROCKTEQ Pyroprocessing

A system that enlarges the AF utilization on the kiln for over 80% TSR:

Environmental- & Political Advantages:



AF-Booster System®

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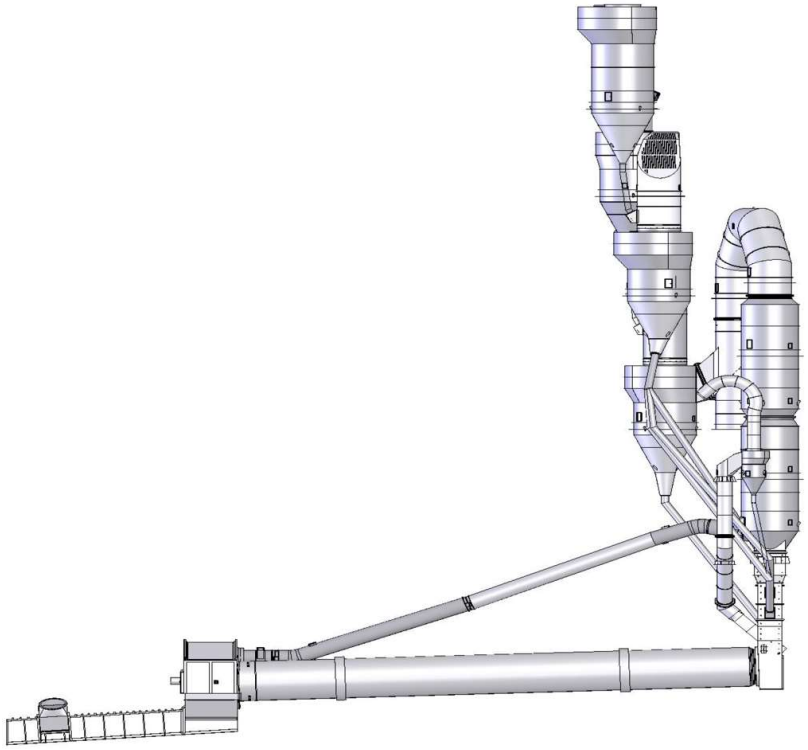
Is a new system to dry and classify the RDF & SRF for an improved pyroprocess at the kiln.

The AF-Booster System is designed to:

- Reduce fuel costs & increase TSR
- Stabilize kiln operation
- Avoid problems with main-burner design
- Reduce CO_2 certificates
- Increase clinker quality
- Less exhaust gas volume
- Higher flexibility in the fuel market (more biomass)



Increase of alternative fuel rate with AF–Booster System®

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- The moisture content of AF is limiting the use at the main burner of a rotary kiln.
- By drying the AF in a flash dryer the moisture is reduced significantly.
- Drying takes place in a closed system - no effects on the environment (fuel-moisture removed from kiln)
- Reliable removal of impurities.
- Dividing the AF in 2 fractions by classification is improving the burning conditions.
- The coarse AF fraction is separated and can be either used at a satellite burner or in the precalciner.
- The fine AF fraction is prepared for the main burner.

Troubles with Conventional AF Combustion System

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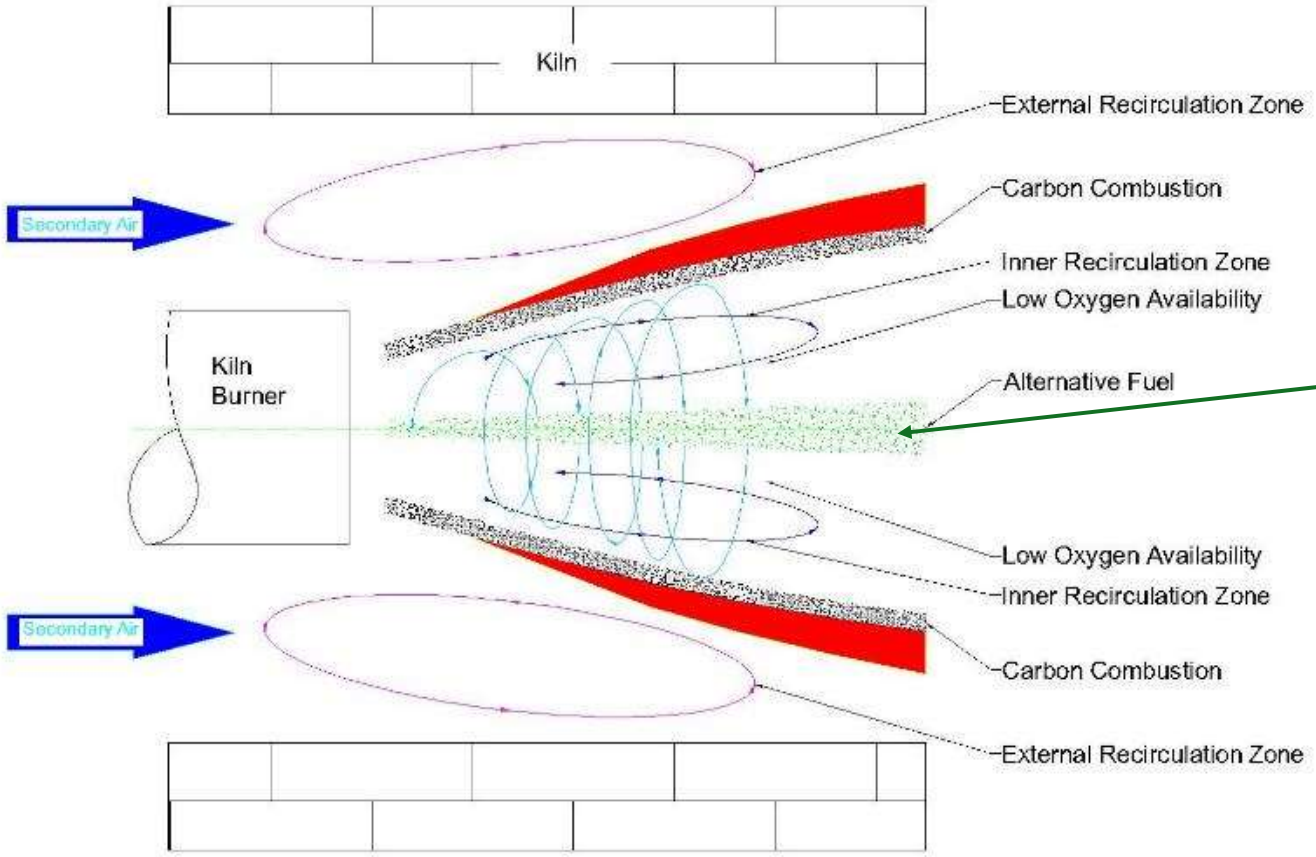

DISADVANTAGES:

- low oxygen availability
- drying of moisture delays fuel-ignition
- too less burnout time
- high fuel density
- tendency of heavy fuel particle fallout
- prolongation of low radiant flame
- flame not fully under control
- increase of kiln inlet temperature
- tendency of higher build-ups

Conventional AF Combustion System – flame length

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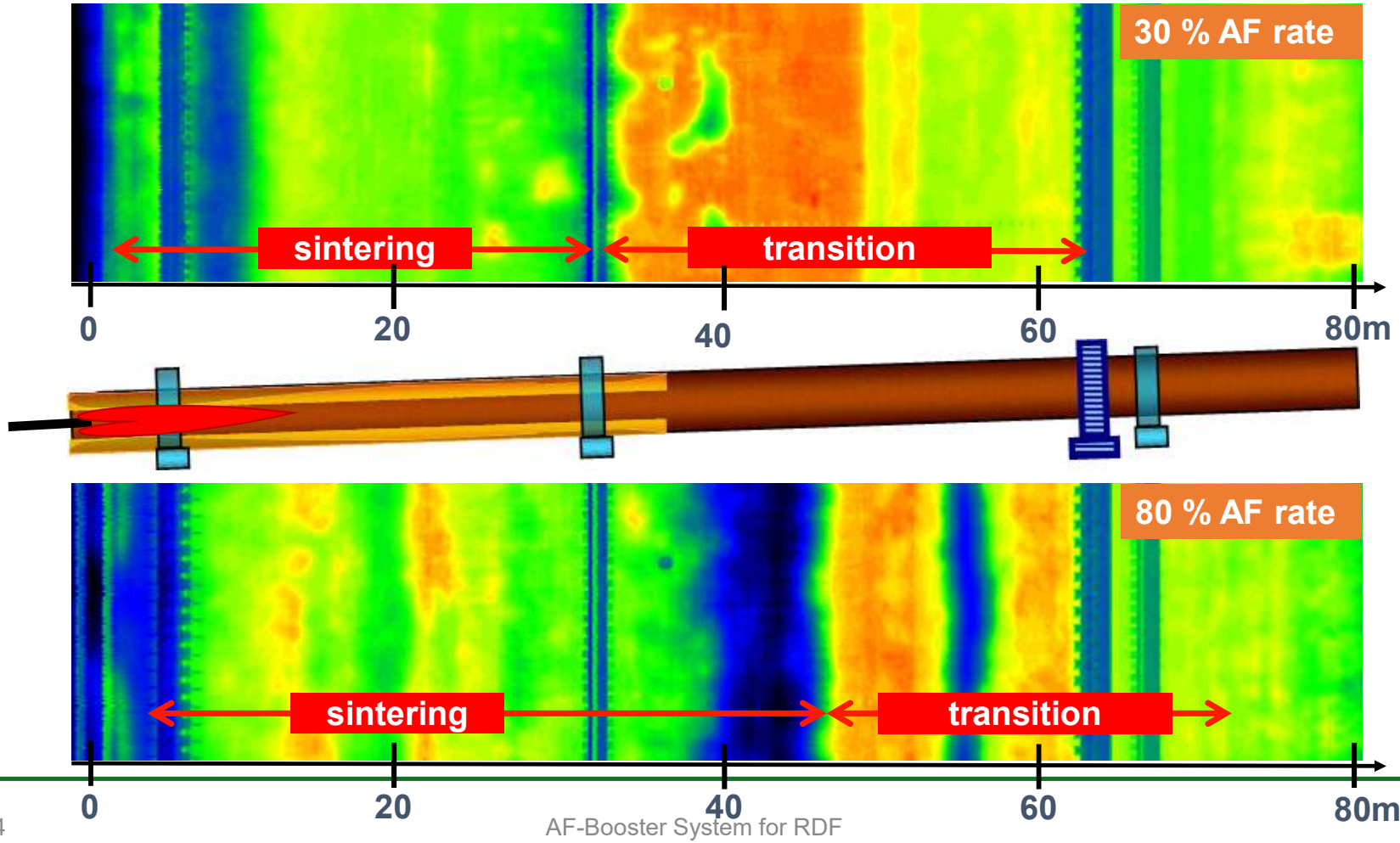

Targets of AF-Booster System®

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- Increase of solid alternative fuel rate.
- Increase the organic components in fuel (biomass is CO_2 neutral)
- Better integration of SO_3 into the clinker due to shortened sintering zone.
- Reduction of local reducing combustion conditions in sintering zone.
- Optimization of kiln and mill performance.
- Improvement of product quality.
- Reduction of production costs.

clinker badly burned

clinker well burned

AF-Booster System®

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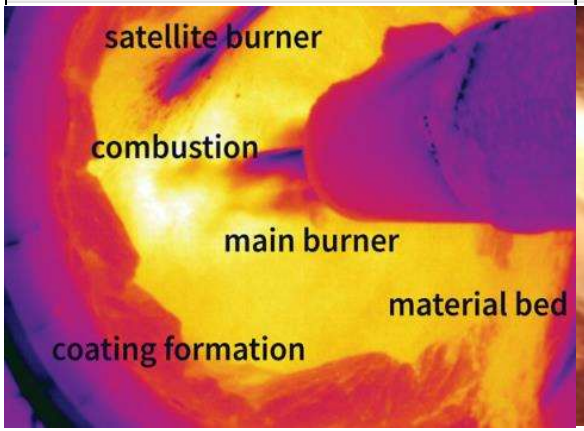
- Typical AF-mix is not burning homogeneous
- Classifying of AF provides a higher combustion control
- The combustion of AF can be individually controlled for each AF-fraction at the relevant combustion point at the kiln

AF- pyroprocess characteristics	small & light AF fraction	coarse & heavy AF fraction
AF-weight	40 - 500 mg	500 - 1590 mg
AF-surface	0-500 mm²	400-1200 mm²
high conveying air speed	no	yes
sensitive for swirl air	no	yes
long flying in gasstream	no	yes
combustion reaction time	short	long
sensitive for aerodynamic drag	high	low



Comparing the Developments

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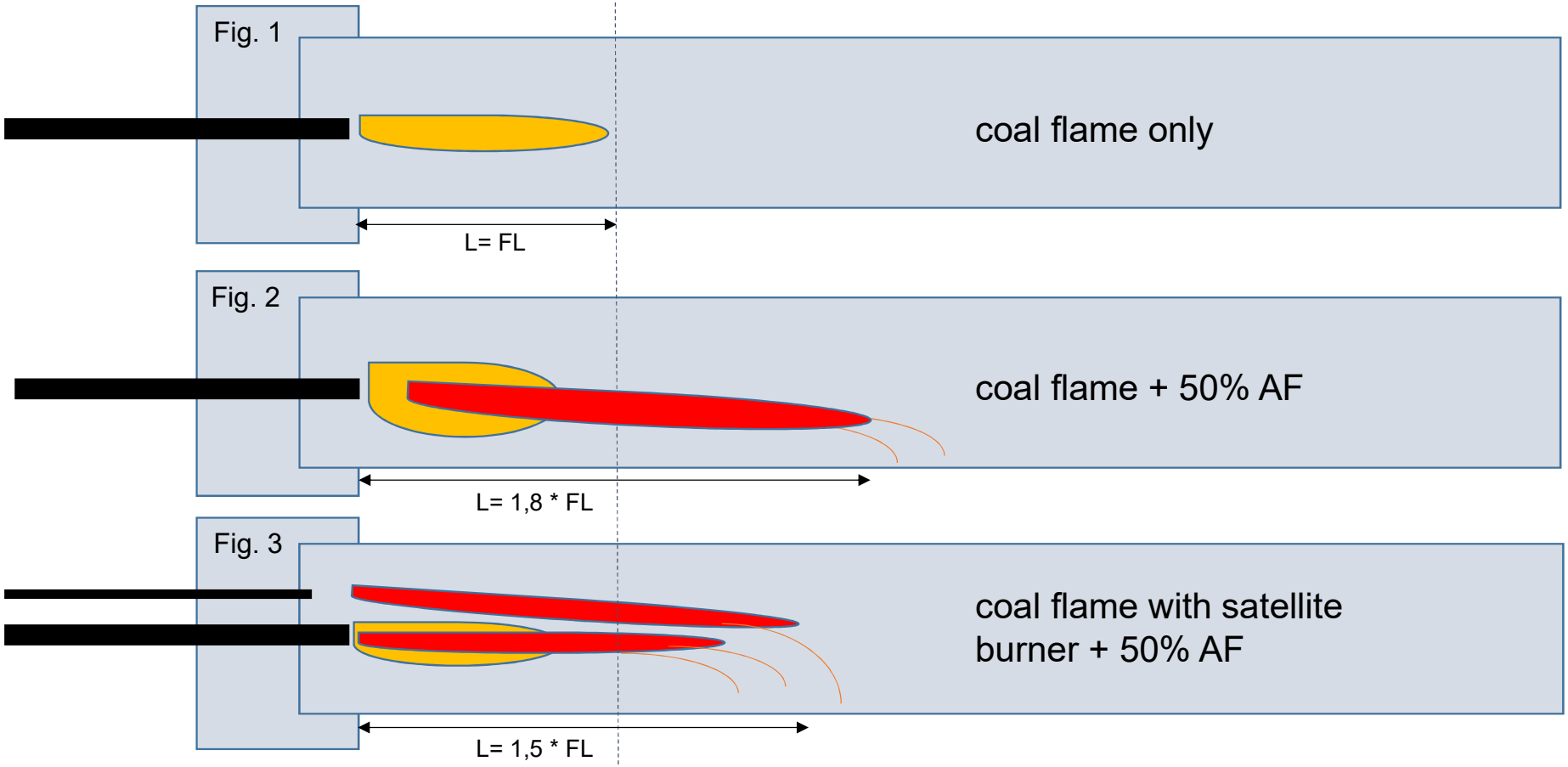

AF–Booster System®

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Fig. 3

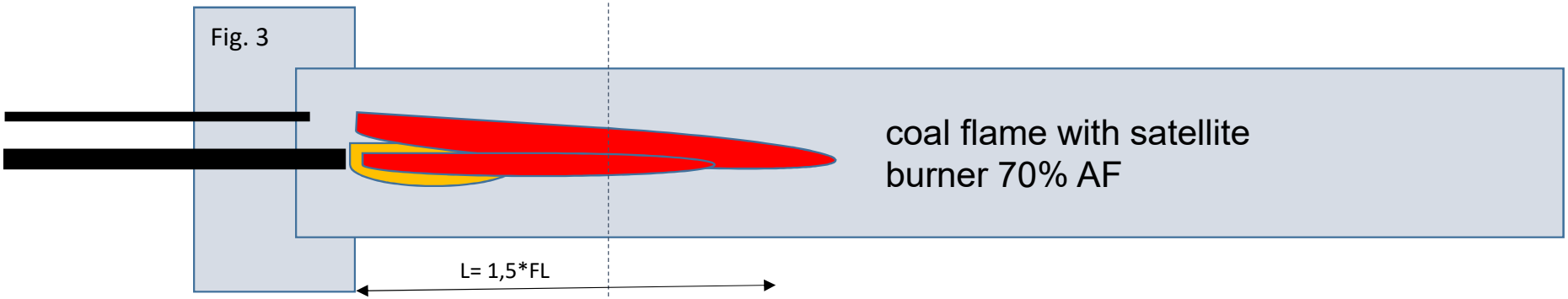
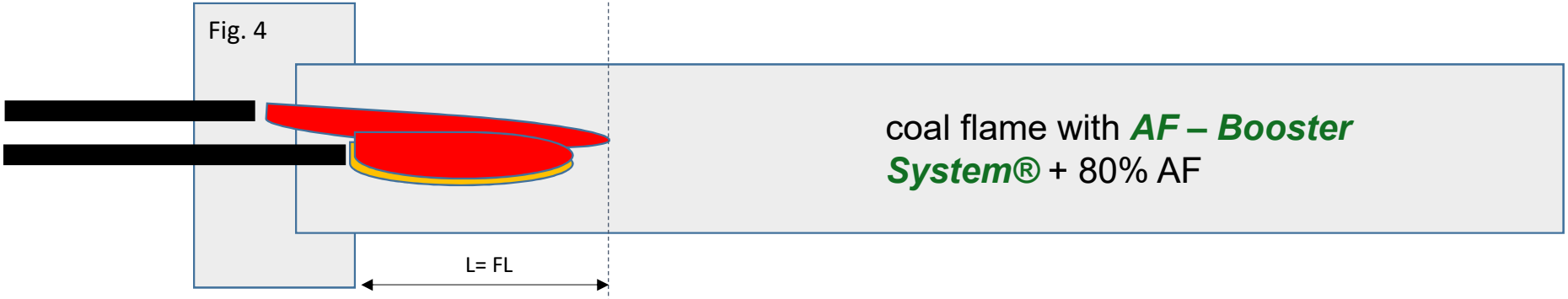


Fig. 4



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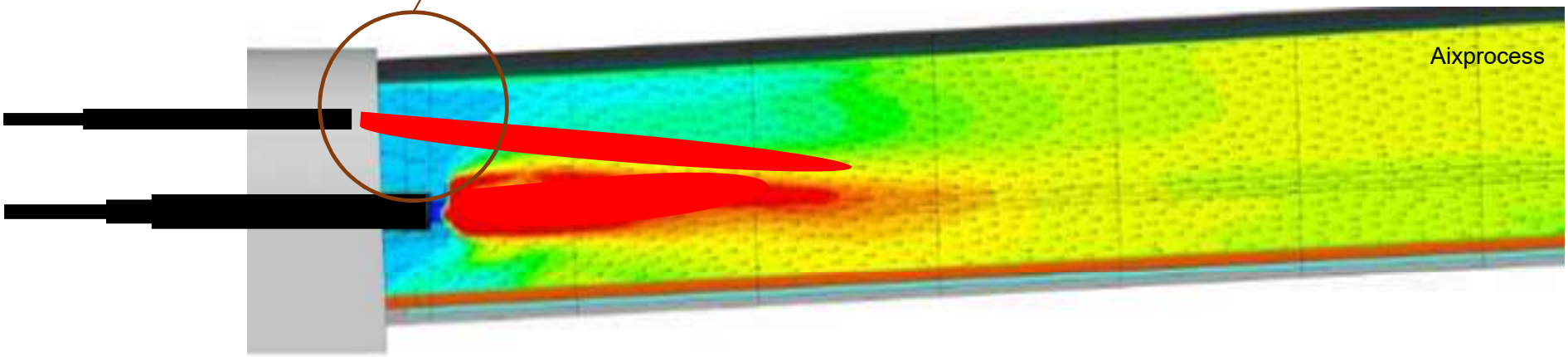
Increased availability of oxygen by secondary air flow pattern, is
- increasing the ignition reaction
- shortening the ignition distance (pre-dried AF)
- accelerating the carbon burning reaction (shorter flame)



Simulated coal flame with enhanced AF-combustion by AF Booster System

AF–Booster System®

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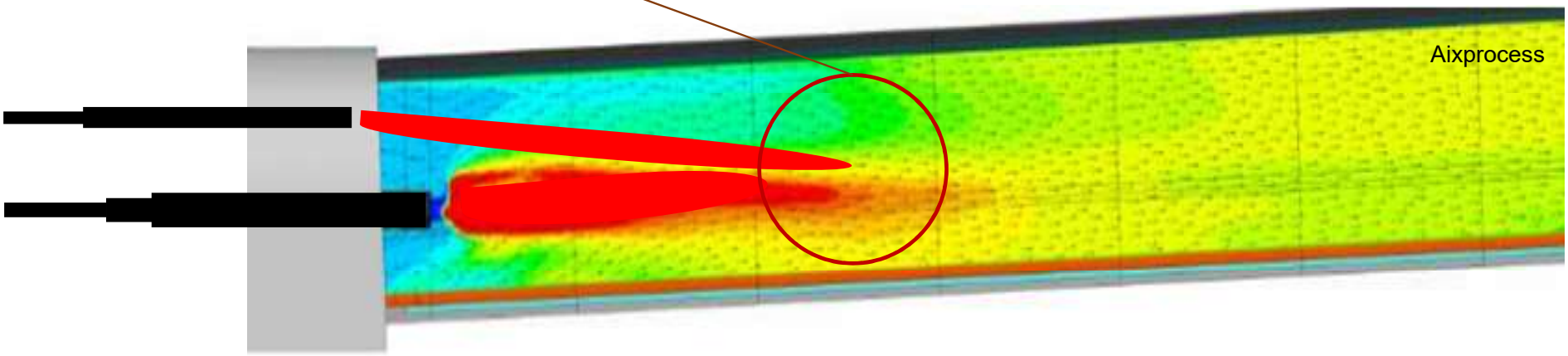
- less tendency of particle fall out of flame
- higher clinker quality
- maintain sintering zone length



Simulated coal flame with enhanced AF-combustion by AF Booster System

AF–Booster System®

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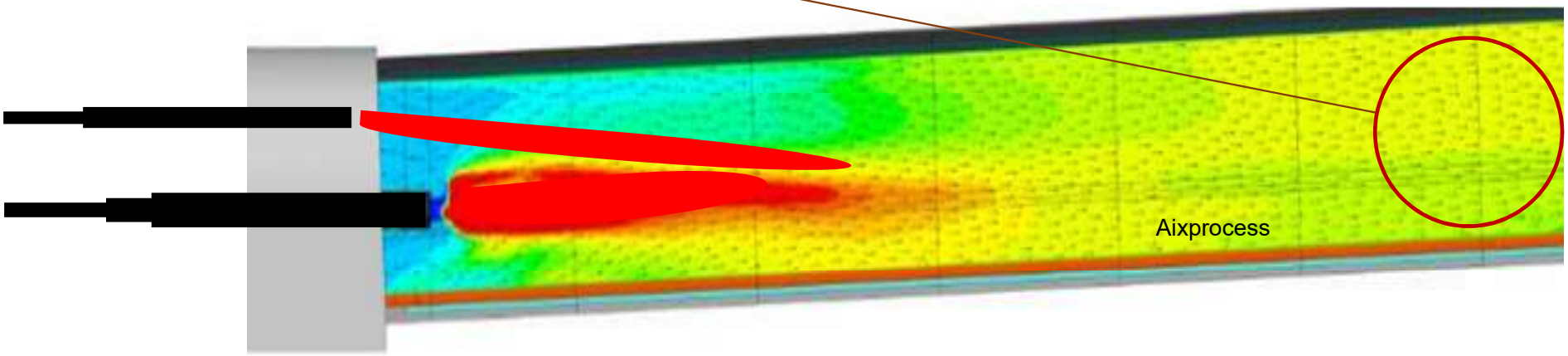
- Lower kiln inlet temperature
- Less Sulphur circuits
- Lower tendency for build-ups at kiln inlet



Simulated coal flame with enhanced AF-combustion by AF Booster System

AF-Trajectories (practical example)

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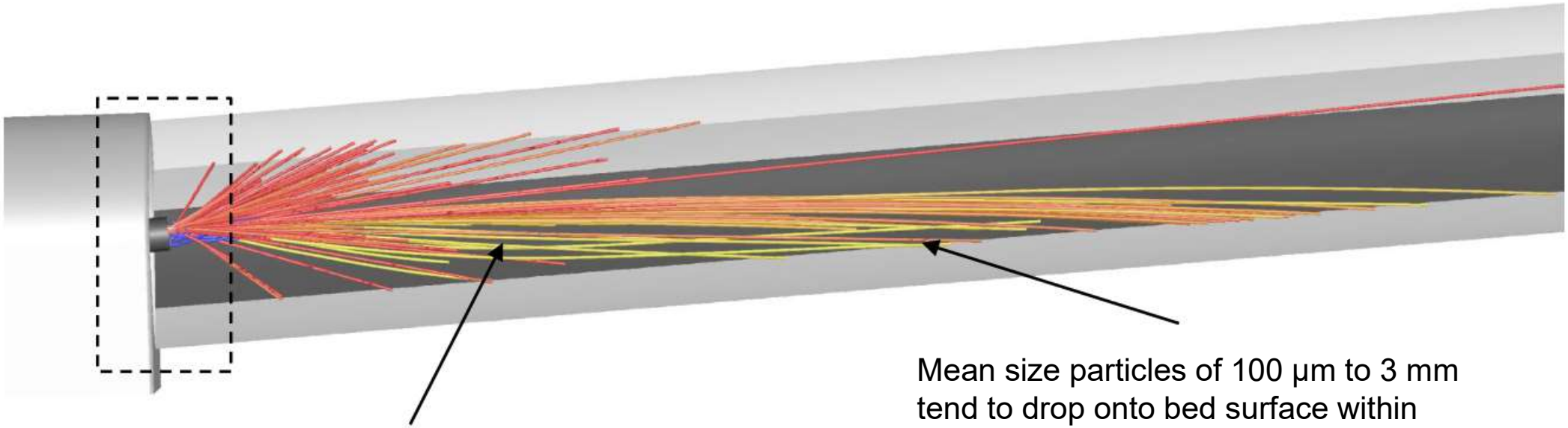

Particles settle into the bottom region of the kiln quite close to burner

Mean size particles of 100 µm to 3 mm tend to drop onto bed surface within the first 15 m of the kiln. Char of these particles is rather unburnt, since they passed mostly regions of low oxygen concentrations

Improved combustion with AF–Booster System® leads to:

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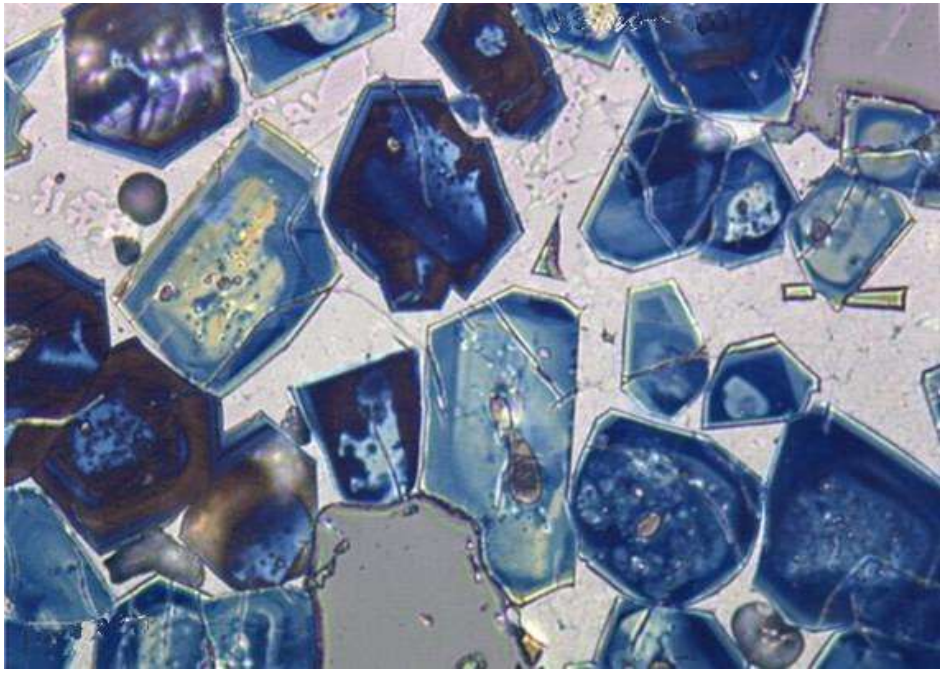
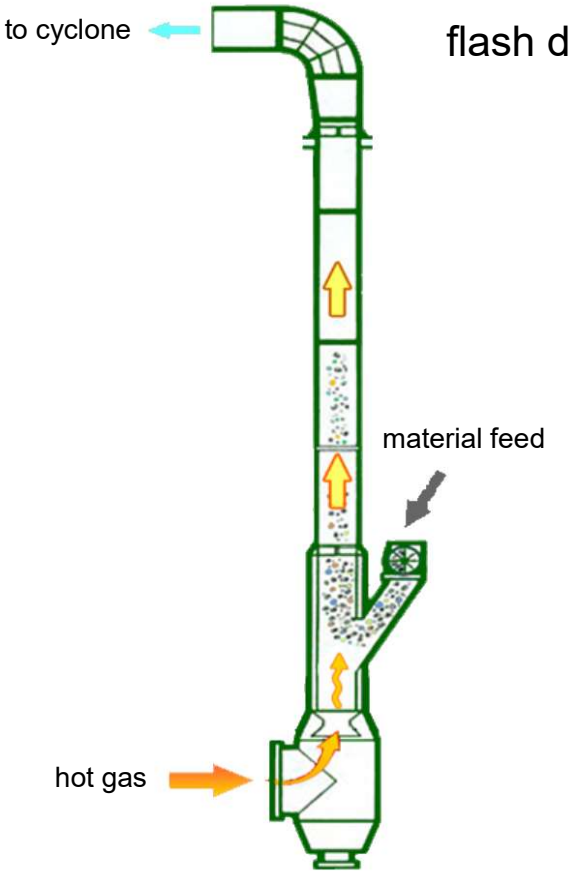
- improved control of flame shape and burning process
- shorter sintering zone – reduction of double cooking effect
- reduction of sulfur volatilization in burning zone
- increase of the sulfur purge with clinker
- higher consumption rates of alternative solid fuels
- better overall kiln performance

Alite crystals at normal size, Burning at high temperature & fast cooling

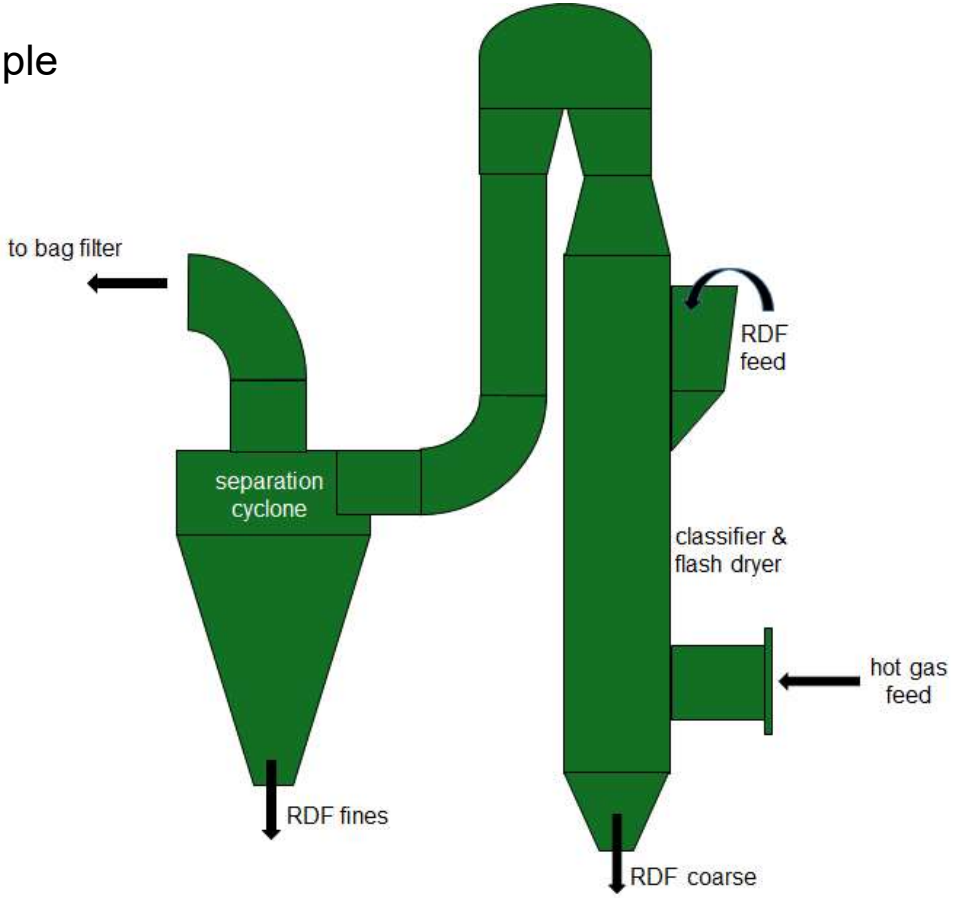


AF-Booster System®

ROCKTEQ Pyroprocessing



flash dryer principle



AF–Booster System®
how it works

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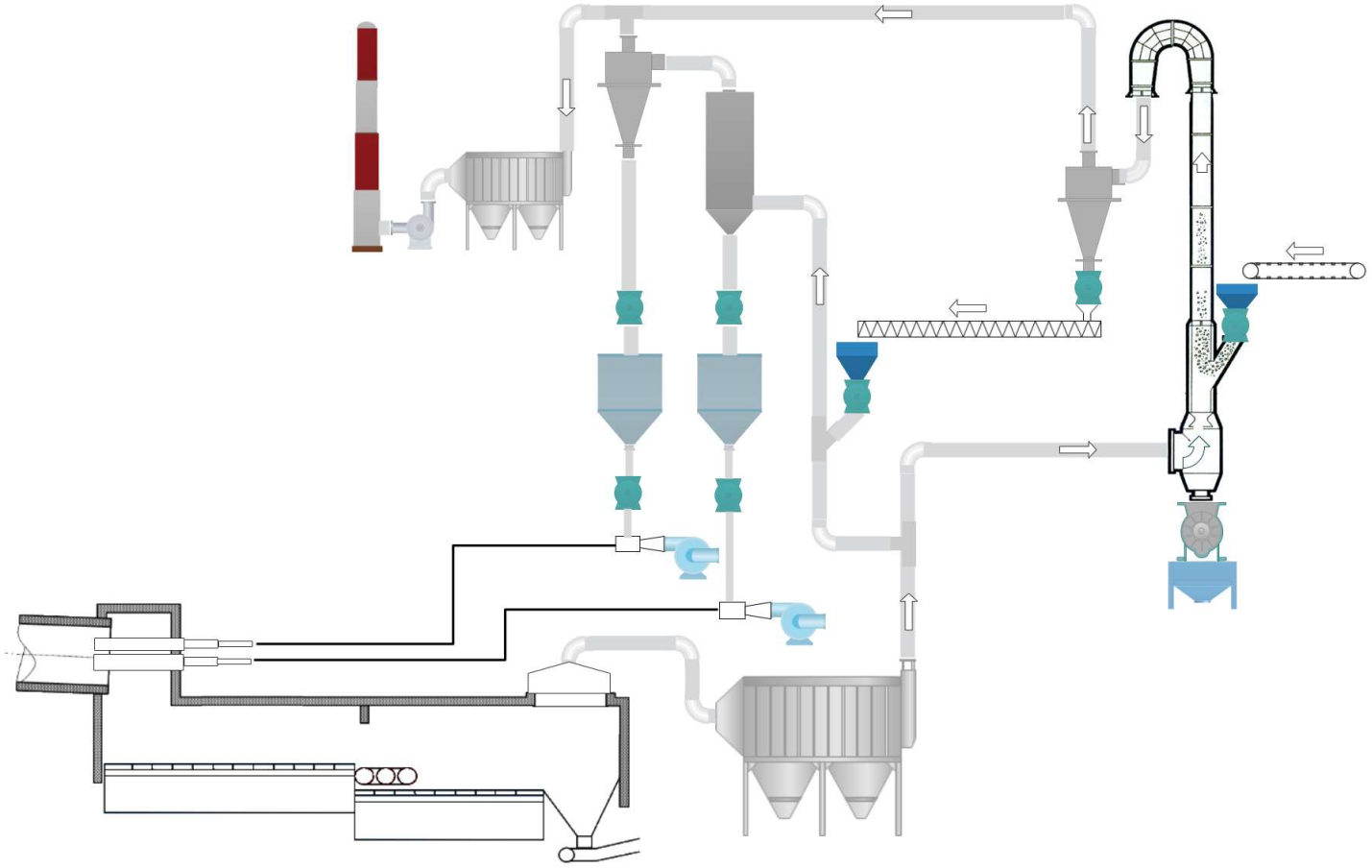

HIGHLIGHTS:

The system is flexible adjustable to the real AF-fuel qualities and allows a better control of combustion while increasing the AF-rate by:

- two step drying process
- two fractions of dry AF
- precise AF dosing
- easier to control combustion process
- AF fractions can be adjusted

AF-Booster System®

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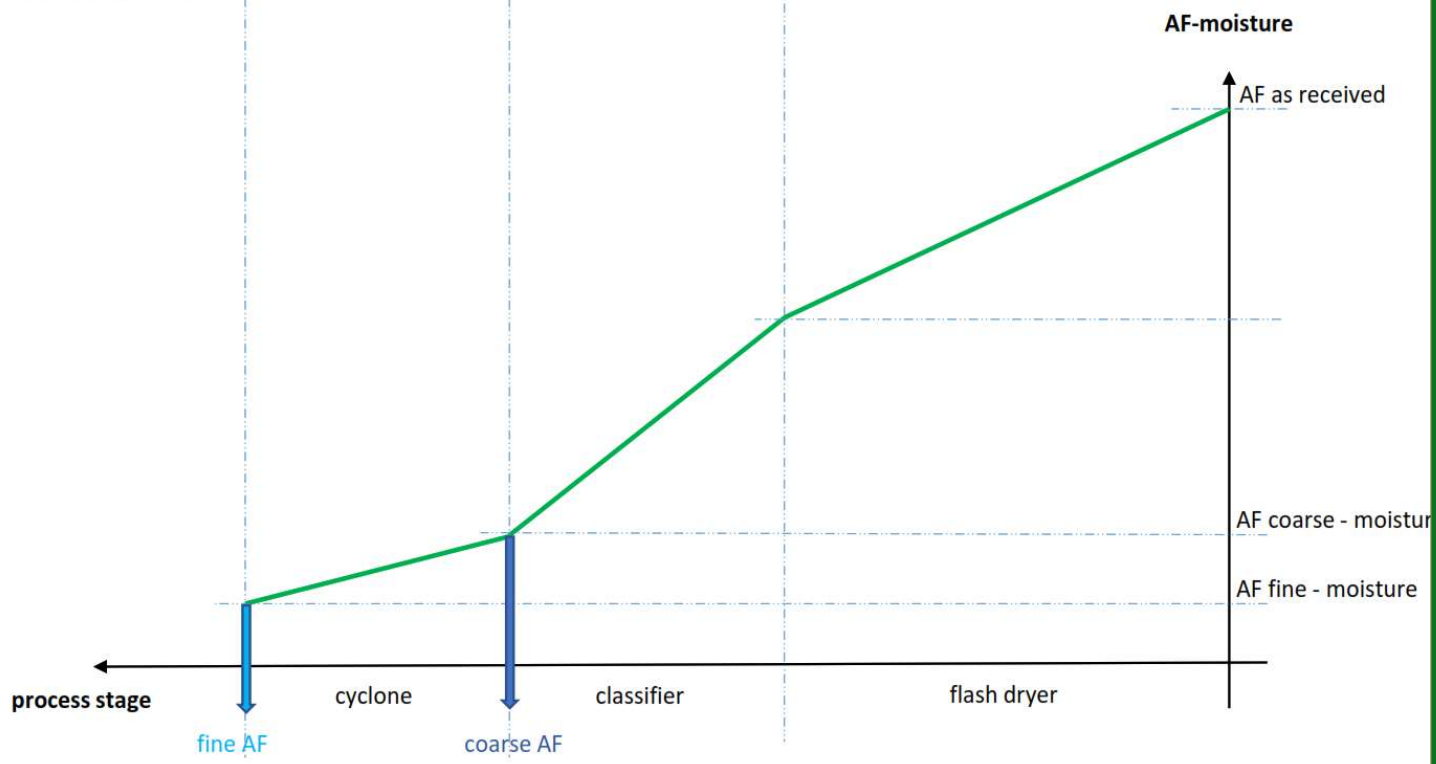
Drying diagram



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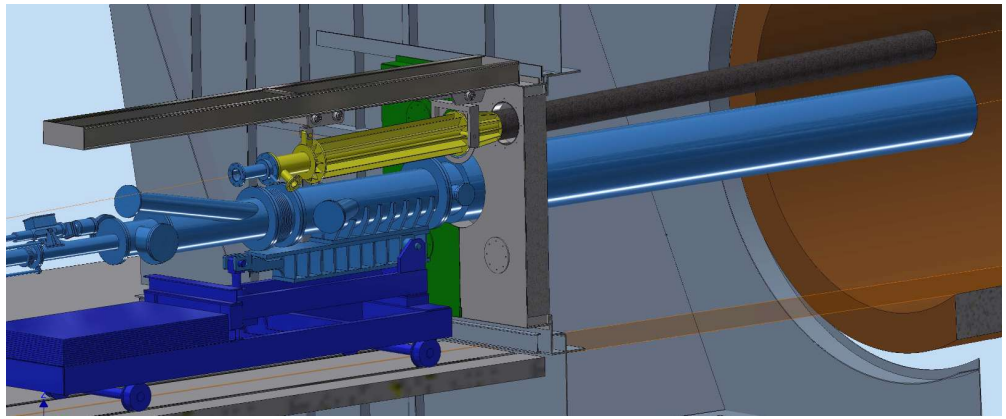
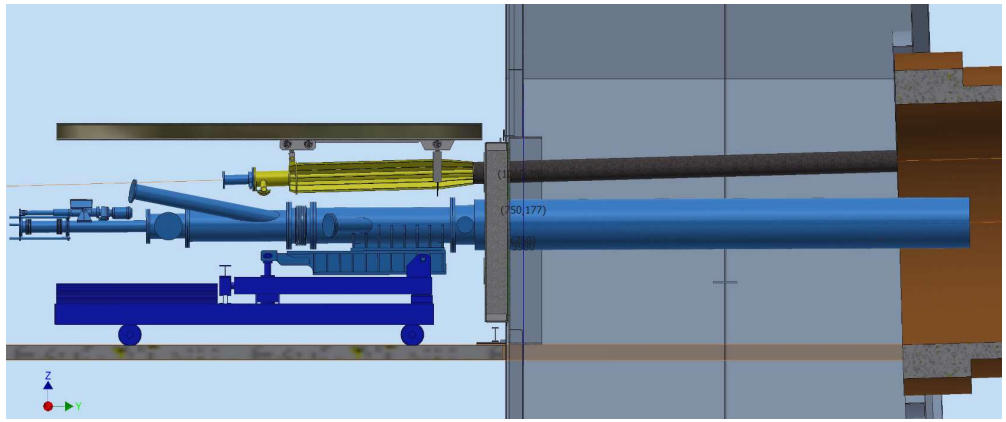
ROCKTEQ SAT burner

ROCKTEQ Pyroprocessing





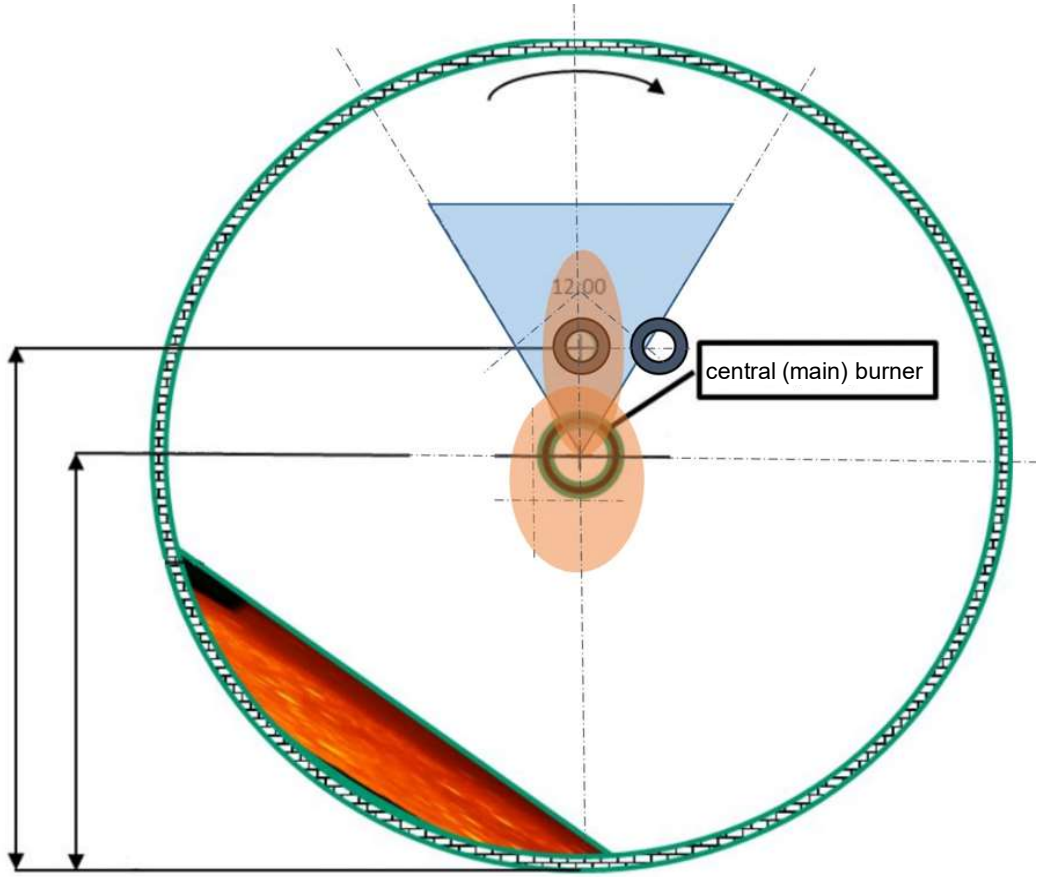
The ROCKTEQ SAT-Burners encompass the following attributes:

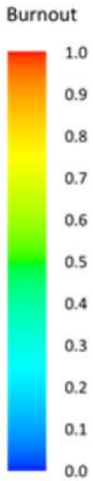
- Burners are available with refractory linings.
- Burners are equipped with axial air ducts and lifting air nozzles.
- The burner configuration includes a practical trolley feature.
- Enhanced mobility with horizontal movement capability for the burner.
- Burner tilting flexibility facilitated by the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

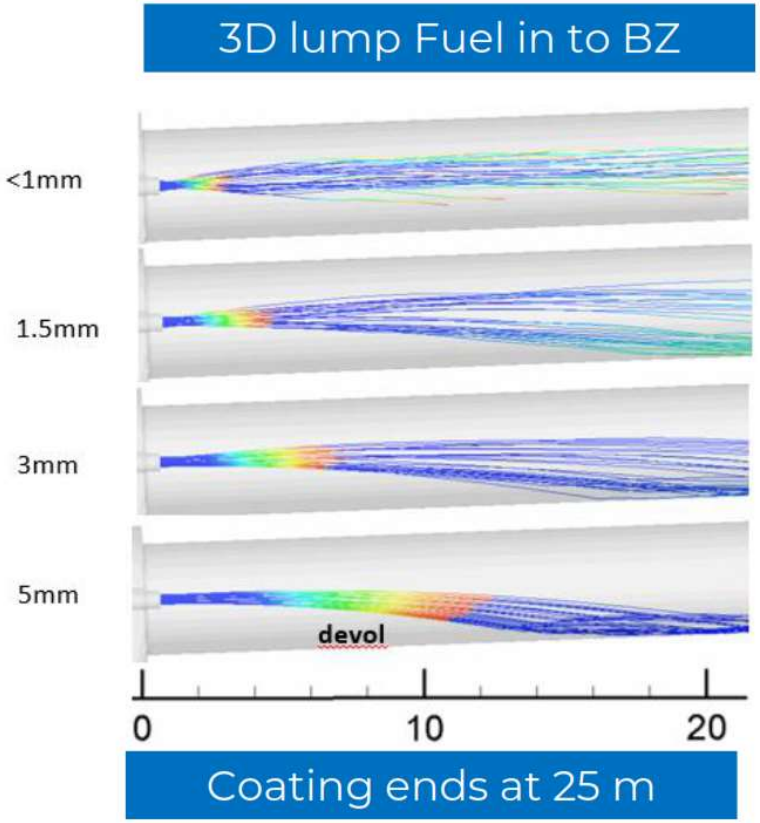
When coupled with the AF-booster, the ROCKTEQ SAT-Burners enable the implementation of an exceedingly adaptable fuel concept.

SAT-Burner position

ROCKTEQ Pyroprocessing







SATELLITE-Burner adjustable

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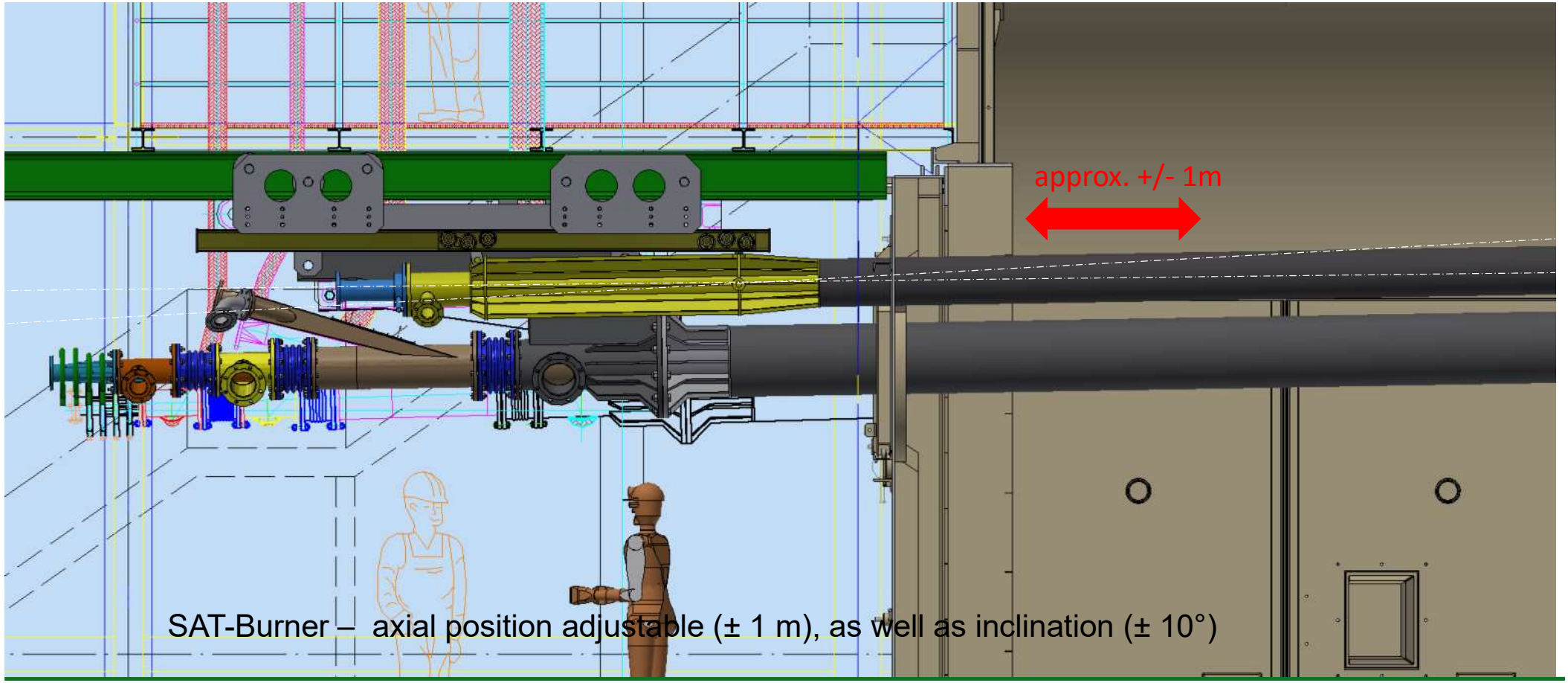
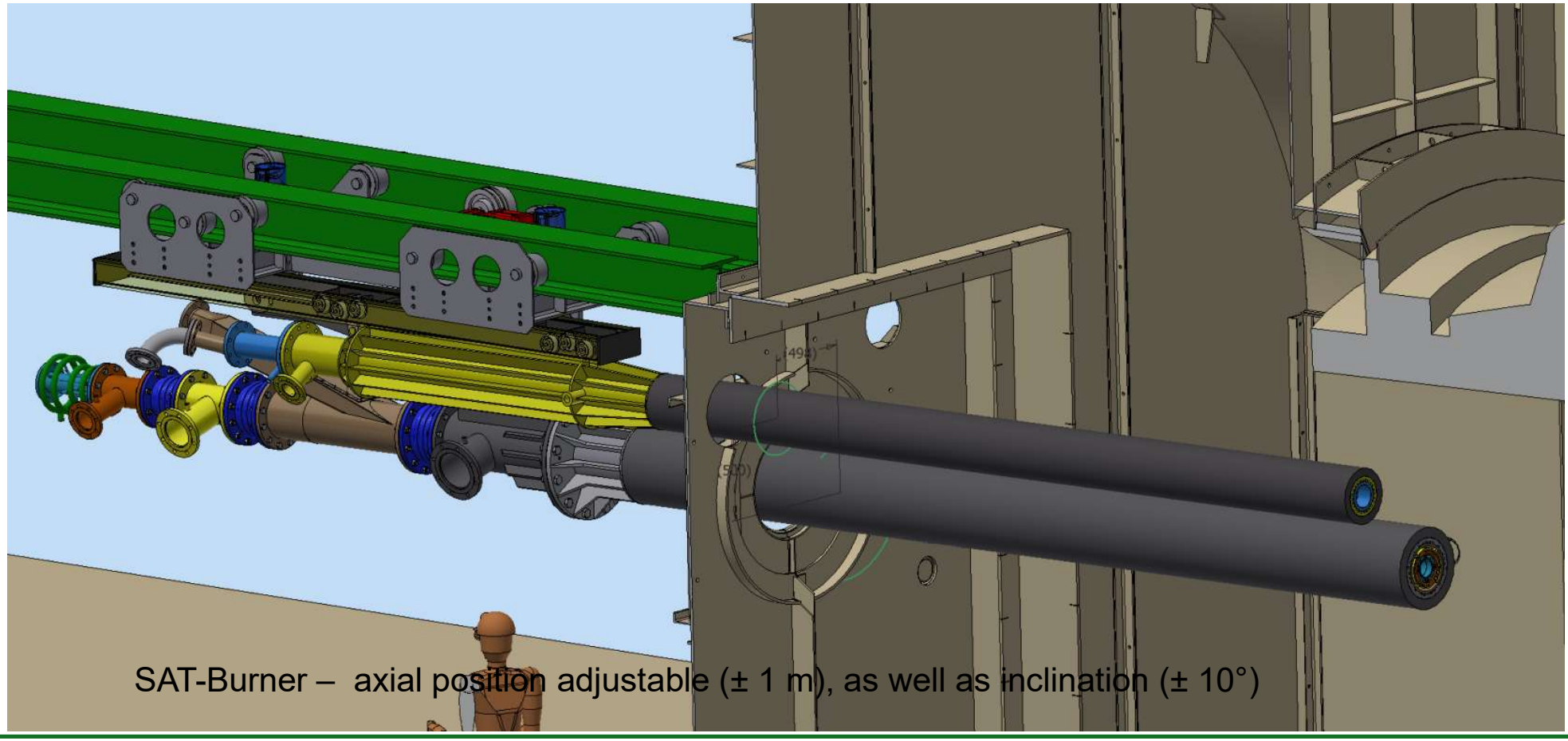


SATELLITE-Burner adjustable



SAT-Burner – axial position adjustable (± 1 m), as well as inclination (± 10°)

SATELLITE-Burner

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A satellite burner can handle alternative fuels with different combustion properties to the fuels of the main burner.

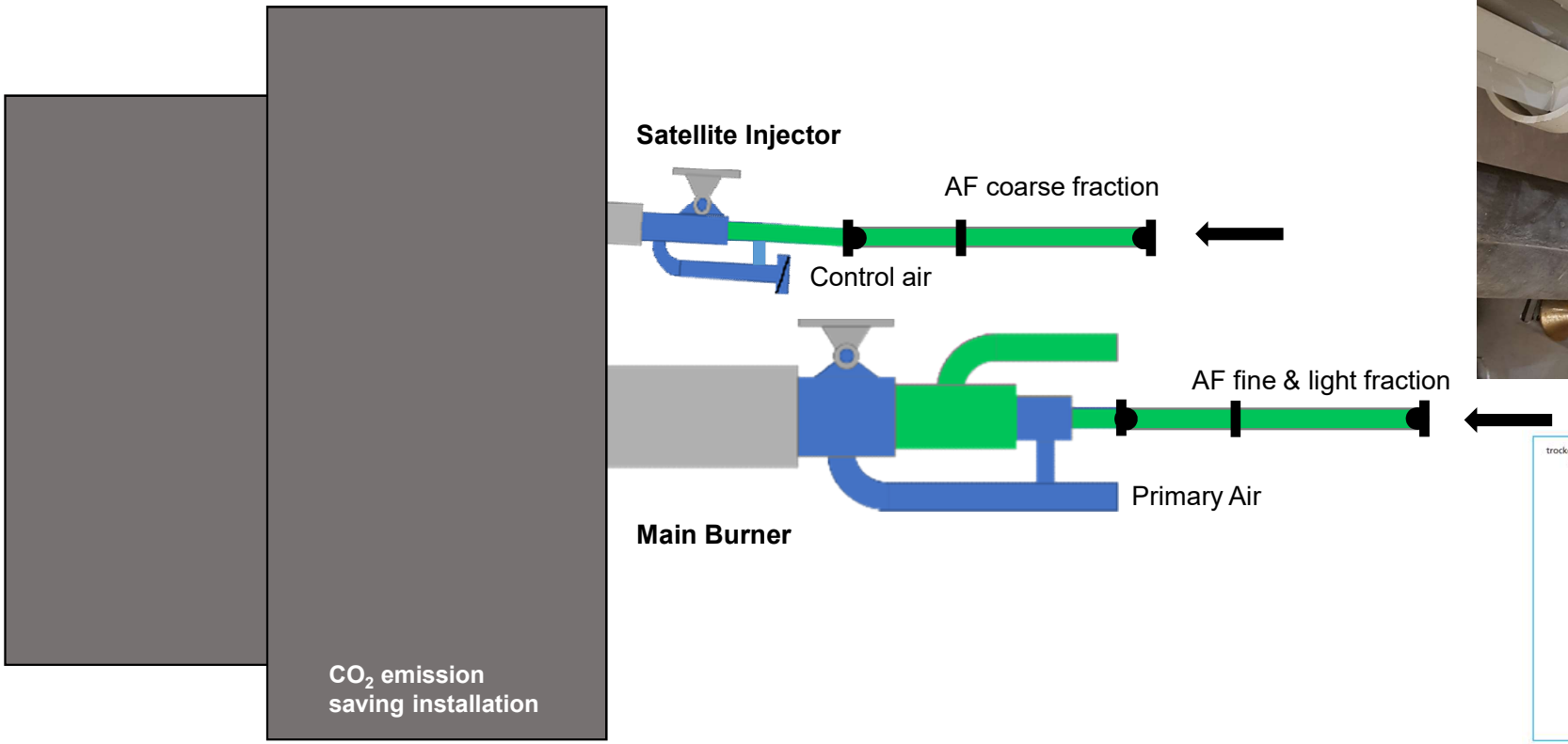
Ignition- & burnout behavior of alternative fuels can be individually adjusted at the satellite burner, to generate a more uniform flame together with the main burner.

A further flexibility for operators on a fast-changing fuel market.

AF–Booster System®

ROCKTEQ Pyroprocessing

Two different AF fractions at special designed injection systems



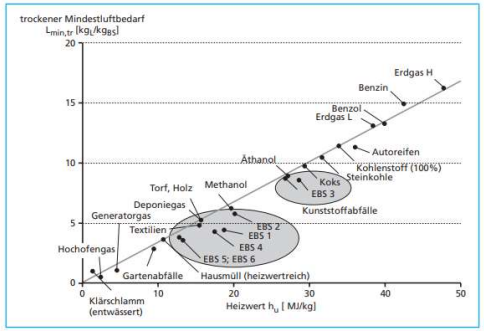


Bild 7: Trockener Mindestluftbedarf in Abhängigkeit vom Heizwert für verschiedene Brenn- und Abfallstoffe

AF–Booster System® in Comparison

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clinker production issues concerning AF co-combustion on kiln with high TSR-rate	Kiln Burner with internal RDF Pipe(s)	Kiln Burner with RDF Pipe + Satellite Burner	Kiln Burner with RDF pipe + RDF Booster System
co-combustion of solid AF-Fuels	x	x	x
controlled AF-Fuel dispersion in main flame	~	x	x
reduction of kiln inlet temperature	-	~	x
increase of TSR on kiln over 50% (without limitations)	-	x	x
oxygen availability while devolatilization of AF	-	x	x
reduction of ignition distance for RDF	-	x	x
flame length with AF similar to coal	-	-	x
drying of AF by -15% moisture before ignition	-	-	x
increase of LHV for AF	-	-	x
short hot flame on kiln burner	-	-	x
strong reduction of AF fallout of flame	-	-	x
high clinker quality with low free-lime	-	-	x
less evaporated water in kiln = reduced kiln gas volume	-	-	x

Fuel CO_2 Emissions can be reduced by AF:

CO_2 Emissions compared:		**% reduction**	
related to Heating Value LHV	[kgCO2/GJ]	against coal	
Coal	95	--	
Light Fuel Oil	78	-17,89	%
Diesel	74	-22,11	%
RDF	64	-32,63	%
LPG	63	-33,68	%
Natural Gas	56	-41,05	%
RDF with biomass	33	-65,26	%

Solid biofuels (generally called biomass) include

- wood, charcoal and yarns;
- farm wastes such as coffee husks, straw, sugarcane leaves, sugarcane bagasse, rapeseed stems, palm nut shells, rice husks, etc.
- rice husk, corn stover, hazelnut shells, coconut husks, coffee pods, and palm nut shells are among the many varieties of biomass currently being burned in cement kilns
- non-agricultural biomass such as animal fat, dung, meats and bonemeal;
- household or industrial biological degradable wastes
- dry sewage sludge

CO_2 increase clinker price by +15%, increasing of AF-Rate is reducing CO_2 certificates- & fuel costs.

Optimization of kiln and mill performance

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- Short and hot flame at the main burner supports incorporation of alkaline sulfates in clinker.
- Better and more stable burning conditions help to reduce free lime content in clinker.
- As a result, higher clinker reactivity leads to lower grinding cost because of adapted product fineness.
- Stable coating in rotary kiln helps to avoid damages of refractory and thus increases the availability of the kiln system.

Commercial Fuel Cost Reduction

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The calculation is based on typical fuel prices and on average AF qualities:

- Increase of Alternative Fuels with lower quality
- Increase of Biomass
- Reduction of CO_2 Emissions
- Reduction of CO_2 Certificates

Commercial Fuel Cost Reduction

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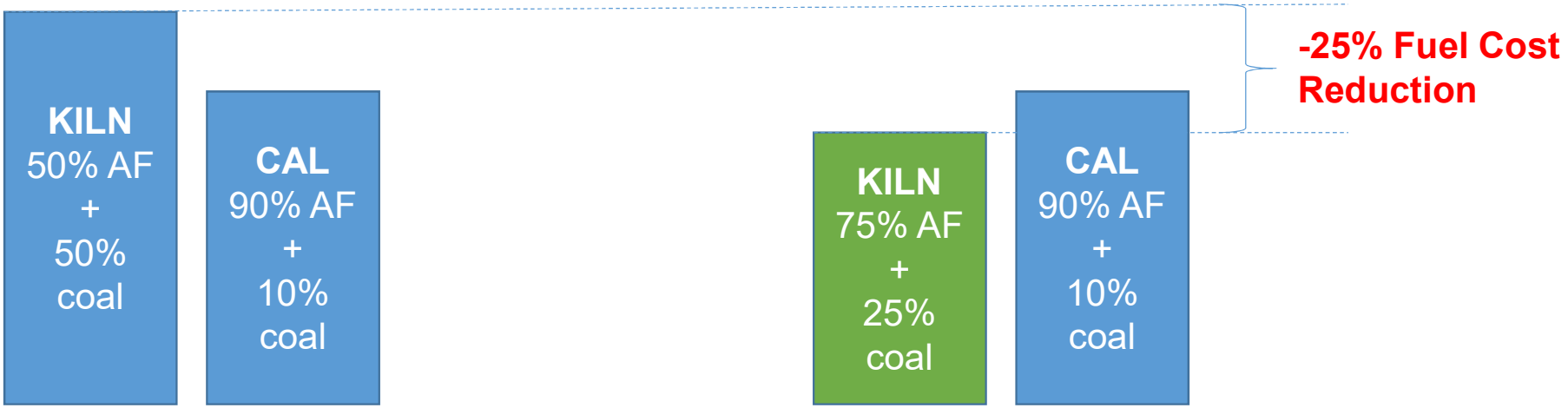
Fuel Costs at Precalciner Kiln

Fuel Costs at Precalciner Kiln with AF – Booster System®



Example for a 3000 t/d precalciner kiln

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Reduction of fuel costs calculation:

kiln capacity		**3.000,0**	T/D								
specific heat consumption		**840,0**	kcal/kg	3519,6 kJ/kg Kli							
required energy		**105,0**	Gcal/h								
heat split to kiln		**50,0**	%								
Main Burner		**52,5**	Gcal/h	**61,1**	MW						
CALCINER		**52,5**	Gcal/h	**61,1**	MW						
LHV Coal		**30.000**	kJ/kg								
LHV SRF (RDF) 30% organics		**19.000**	kJ/kg								
				present fuel mix				future fuel mix			
Q´Coal @kiln	Q	**3.850**	kg/h	50%	Kiln	➡		**25%**	Kiln	**1.875**	kg/h
Q´SRF @kiln	Q	**5.830**	kg/h	50%	Kiln	➡		**75%**	Kiln	**8.750**	kg/h
Q´Coal @calciner	Q	**750**	kg/h	10%	CAL			10%	CAL	**750**	kg/h
Q´SRF @calciner	Q	**10.500**	kg/h	90%	CAL			90%	CAL	**10.500**	kg/h
Coal price		**145**	EUR/to								
SRF price		**15**	EUR/to								
CO2 cost per tonne of clinker		**12**	EUR/to								
Fuel costs - Kiln		€ 4.950.000	per year			➡		€ 3.100.000	per year		
Fuel costs - Calciner		€ 2.050.000	per year			=		€ 2.050.000	per year		
FUEL COST SAVINGS						**-€ 1.850.000**					
CO2 CERTIFICATE SAVINGS						**-€ 425.000**					
TOTAL SUM OF SAVINGS						**-€ 2.275.000**					

-26,4% Fuel Cost Reduction for Kiln Line

Commercial Fuel Cost Reduction

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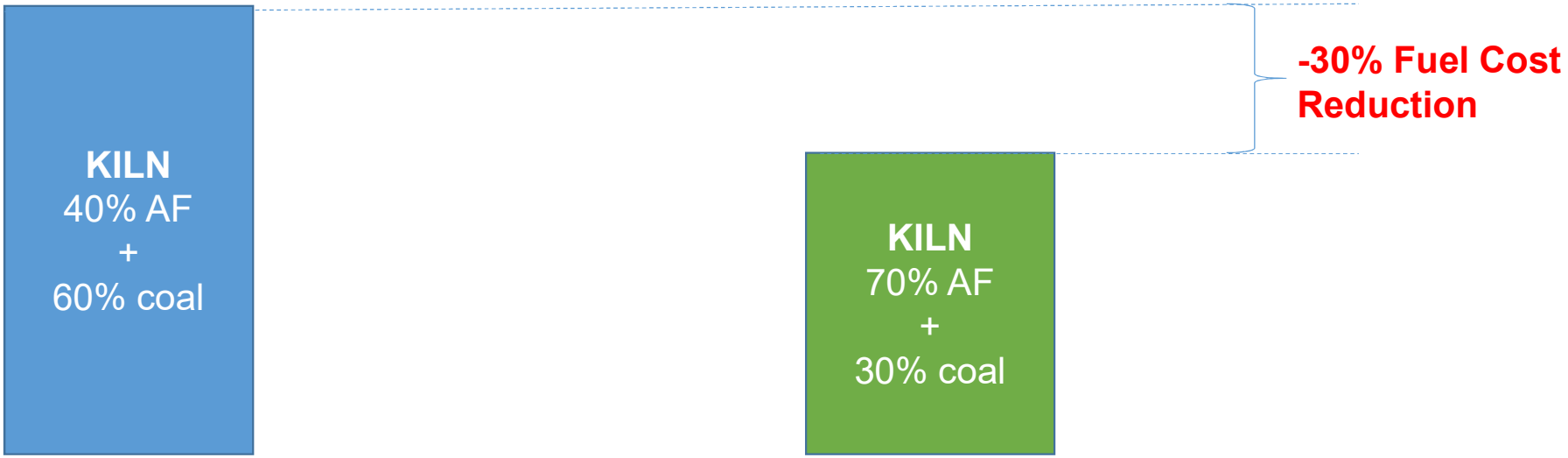
Fuel Costs at Preheater Kiln

Fuel Costs at Preheater Kiln with AF – Booster® System



Conclusion

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- Increase of AF substitution rate with AF – Booster® System
- Reduction of fuel costs
- CO_2 reduction through higher organic fuel components
- Increase of LHV by drying AF
- Shorter Main-Flame by using 2 AF fractions with satellite burner
- Maintain of kiln inlet temperature by shorter flame
- More fuel flexibility on the market by drying and classifying AF
- Higher clinker quality, lower free lime content
- Reduction of CO_2 emissions + CO_2 certificates

RETURN ON INVESTMENT → WITHIN ~1 YEAR

Link: Over €1 billion for the EU climate transition (europa.eu)

Our Service

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We provide the AF Booster project which includes:

- Concept
- Basic Engineering
- Detail Engineering
- Tendering of Equipment
- Support at Purchase
- Full Project Management
- Support for Installation and Erection
- Commissioning

Contacts

ROCKTEQ Pyroprocessing

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