Enhancing Alternate Fuel in Cement Manufacturing Process :

A Sustainable Technological approach

13th Green Cementech 11th - 12th May 2017

Balesh Kumar Singh

get more out of your plant.

Content

Introduction

Indian Cement Industry is on 350 MTPA mark with more than 190 Large Plants and 350 small units.

Cement Despatch remains as consistent always except few slow-downs which gives thrust to cost competitiveness and subsequently innovative reforms.

Indian Cement Industry is operating at Lowest Specific Heat consumption of Average 725 Kcal/ kgcl against world Average 850 Kcal/ Kgcl.

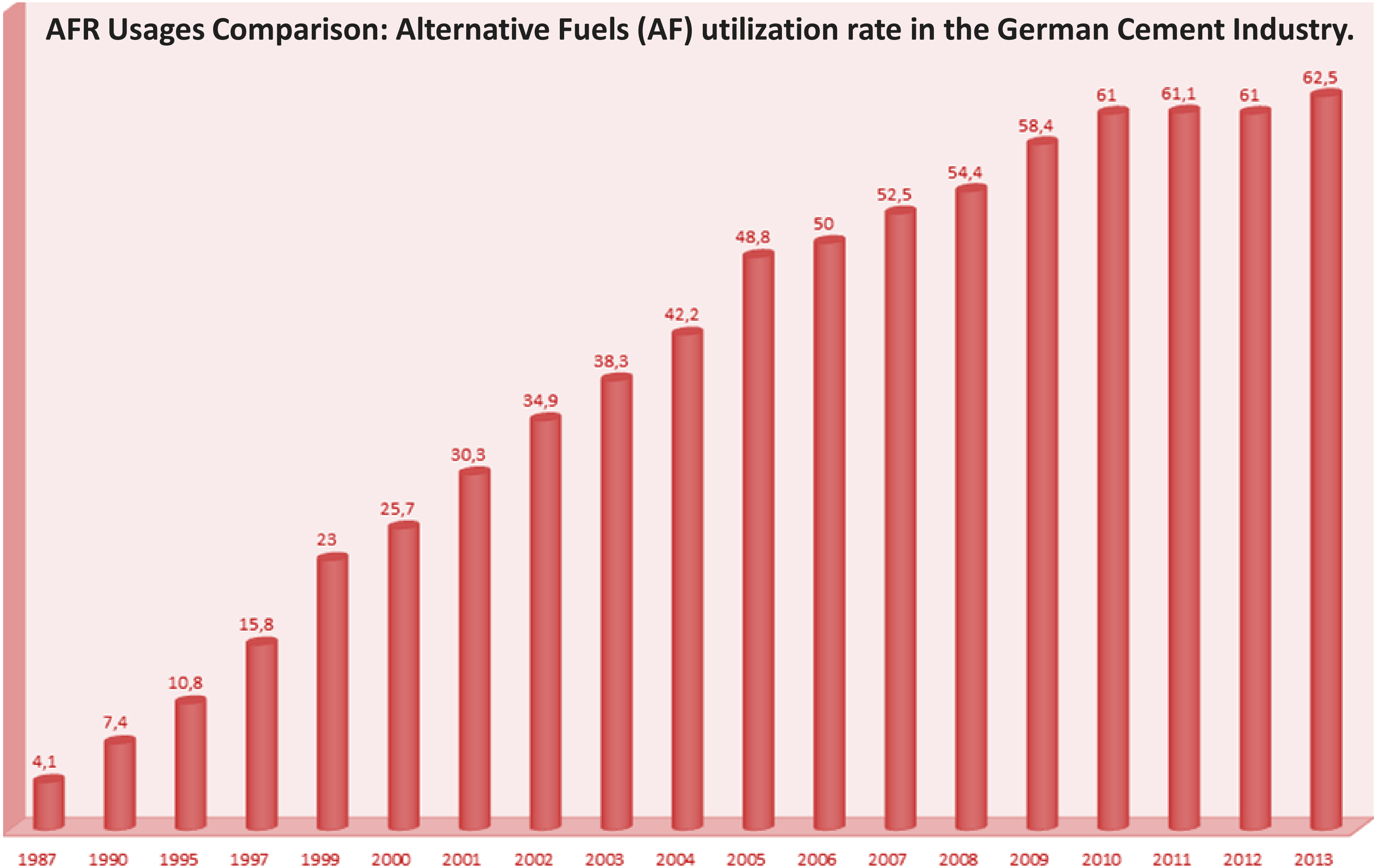
Similarly Sp. Power consumption is Lowest in the world as 82 Kwh/T Cement against 100-110 Kwh/t Cement in World average.

Despite Efficient operation the average AFR Usage In Indian Cement Industry is below 2-3 % TSR which is far lower than Developed countries.

KHD continuously worked upon enhancement of Alternate fuels and Raw materials in the cement Plants Hence few important equipment invented/ developed to fulfil this requirement.

(Data from IBM & CII 2013-14 & 2014-15)

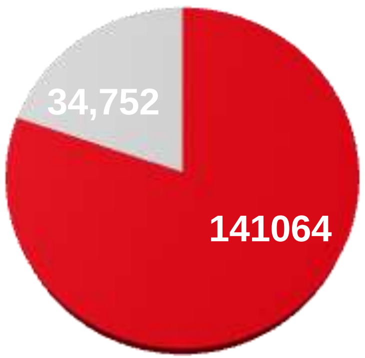
AFR : Today‘s Demand and Challenges



Waste Generation Statistics: India

States	Generated (TPD)	Treated (TPD)
Andhra Pradesh*	4760	6402
Chhattisgarh*	1896	168
Delhi	8370	3240
Gujarat	9988	2644
Haryana	3103	188
Jammu & Kashmir*	1792	320
Jharkhand*	3570	65
Karnataka	8697	3000
West Bengal	9500	851
Madhya Pradesh	6678	-
Maharashtra	22,570	5,927
Punjab*	4105	350
Rajasthan*	5037	490
Tamil Nadu	14500	1607
Telengana	6740	3016
Uttar Pradesh	19180	5197
Other	10578	1287
Total	1,41,064	34,752

(Data of CPCB Annual Report 2013-14 & 2014-15)



Only 25 % of Generated Waste is Treated,

AFR : Today's Demand and Challenges

Global Demands:

- Saving of natural resources
- Reduction of CO2 emissions (Emission trading)
- Thermal Recycling
- Material Recycling

Individual Demands:

- Earning of disposal fees
- Reduction of fuel costs "negative fuel costs"
- Stronger market position

Challenges:

- Identifying of new (fuel) sources for consistency in fuel supply.
- Preparing of waste to alternative fuel.
- Installation of AFR handling equipment.
- Plant up-grade.

(Data of CPCB Annual Report 2013-14 & 2014-15)

AFR : Today's Demand and Challenges

Challenges on energy balance, increase of specific heat consumption.

- Increased waste gas volumes (higher fuel moisture, fuel chemical composition, higher excess air demand, more fuel to maintain hot sintering zone).
- Higher amount of primary air (transport air) and leakage air, decrease of recuperation air from clinker cooler.
- Increased heat losses by radiation (shifting temperature profile of kiln to kiln inlet chamber).
- In case of Bypass System losses due to bypass gas extraction.

Challenges on plant operation stability

- High demands on fuel dosing equipment, continuous fuel feed.
- Formation of build-ups in case of Cl- and S-rich alternative fuels in the area kiln inlet, riser duct, bottommost cyclone. ➔ More manual cleaning efforts or Bypass System necessary

Challenges on clinker quality

- "Raining" of un-burnt fuel out of the kiln flame to the clinker bed => reduced burning conditions.
- Cooling down of the sintering zone.
- Possible enrichment of harmful elements in clinker, e.g. MgO, P_2O_5 (depending on Alternative Fuel ash composition).
- Adaption of raw mix, e.g. high Fe-content in Alternative Fuel.

Challenges on emissions

- Influence on avoiding NOx formation and / or NOx reduction.
- CO formation in case of inadequate calciner technology or unsuitable secondary fuels.
- Saving of primary fuel related CO_2 emissions.

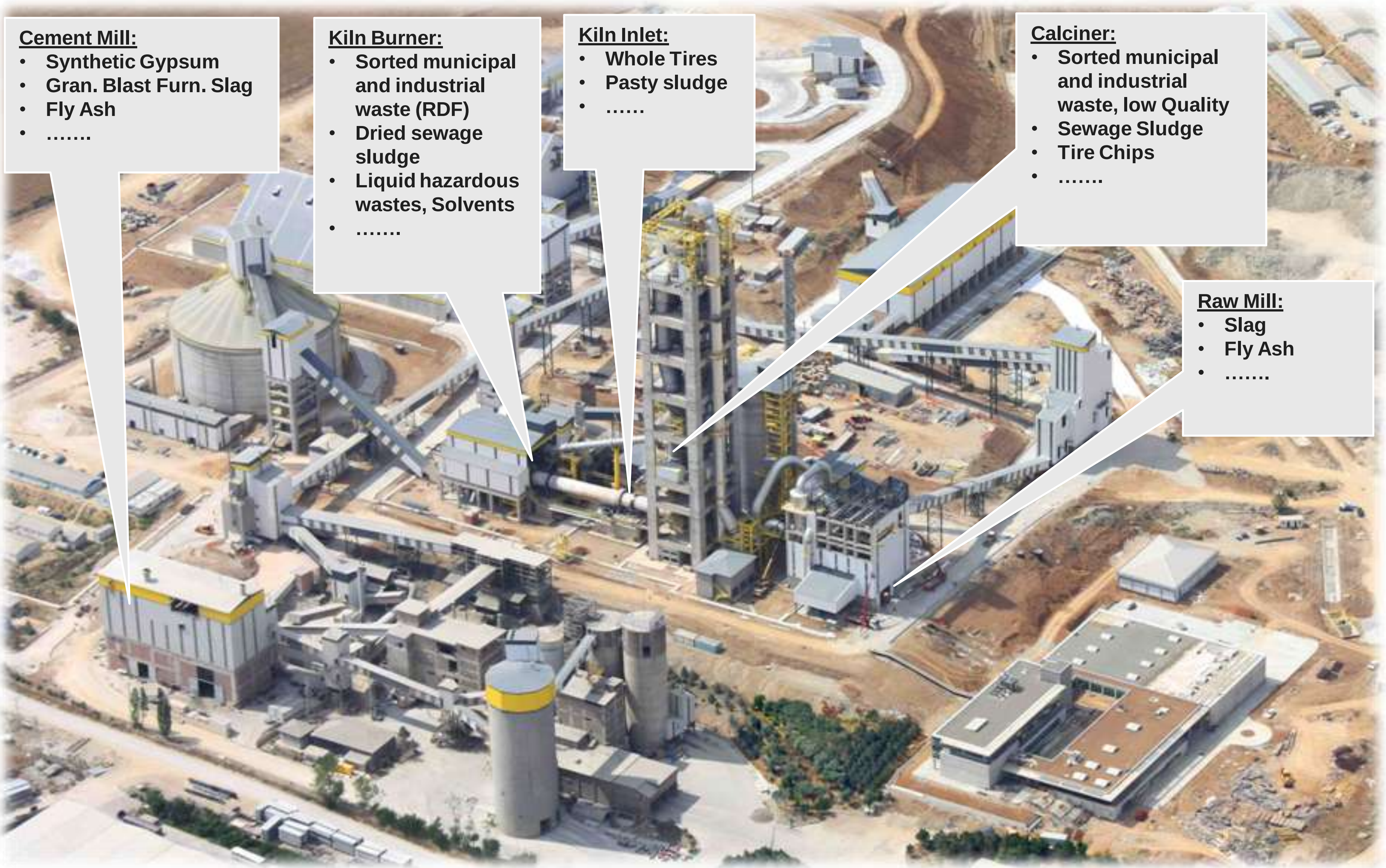
AFR : Today's Demand and Challenges

Challenges and Sustainable Innovative approach:

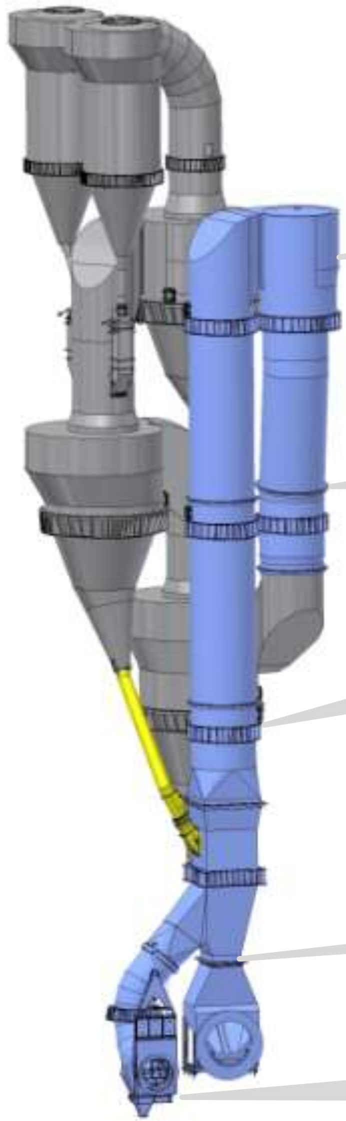
It's not easy to add AFR without deeper analysis and knowledge as process related impacts can cause big problems!

KHD with 160 years of industrial history has the experience and process knowledge to identify and to solve these challenges to reach high and stable AFR firing rates.

Introduction – Feed points for Alternative Fuels and Raw Materials



KHD Pyro Equipment for Burning AFR – PYROCLON® Calciner



KHD PYROCLON® Calciner Technology – Overview

PYROTOP® Mixing Chamber for complete fuel burn-out

Design of Calciner length to reach suitable residence time (6-10 sec) for complete burn-out

High velocity to ensure lifting of coarse fuels, avoidance of thick coatings

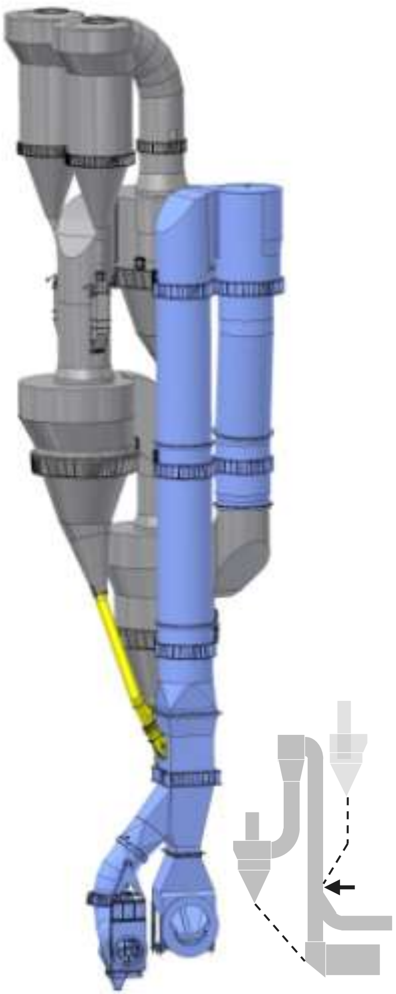
Orifice to maintain gas balance and avoidance of coarse fuel fall through

Tertiary Air Duct with Dust Settling Chamber or extended Kiln Hood to reduce clinker dust recirculation

Calciner - Pyroclon® Technology

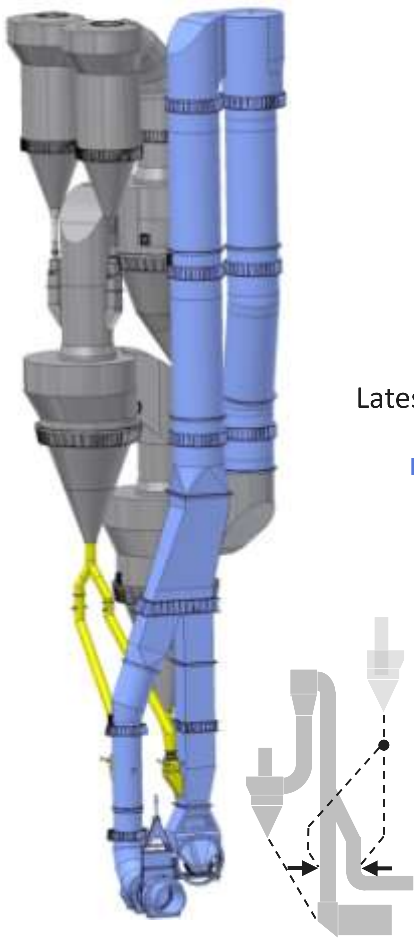
Pyroclon-R

In-line calciner (ILC)



Pyroclon-R LowNOx

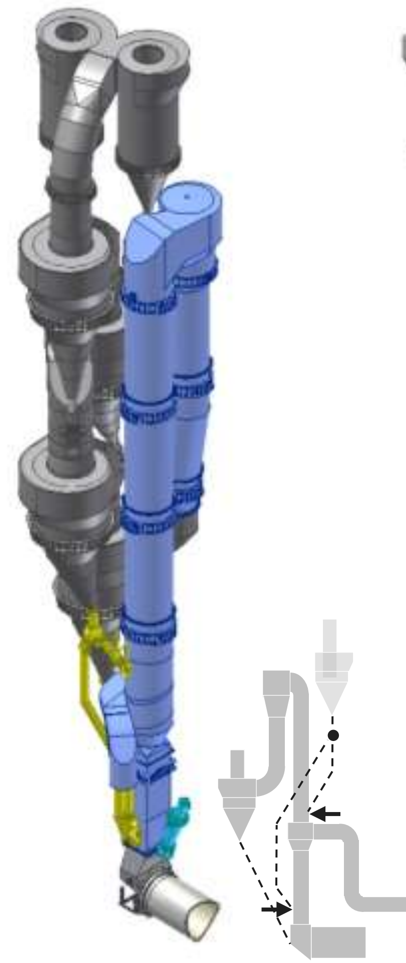
ILC with staged combustion



Latest generation

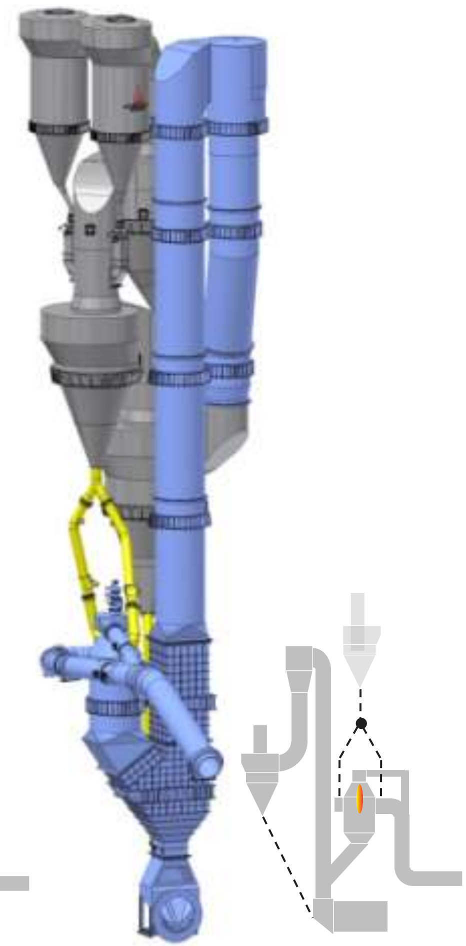
Pyroclon-R LowNOx AF

ILC with staged combustion



Pyroclon-R with Combustion Chamber

ILC with CC

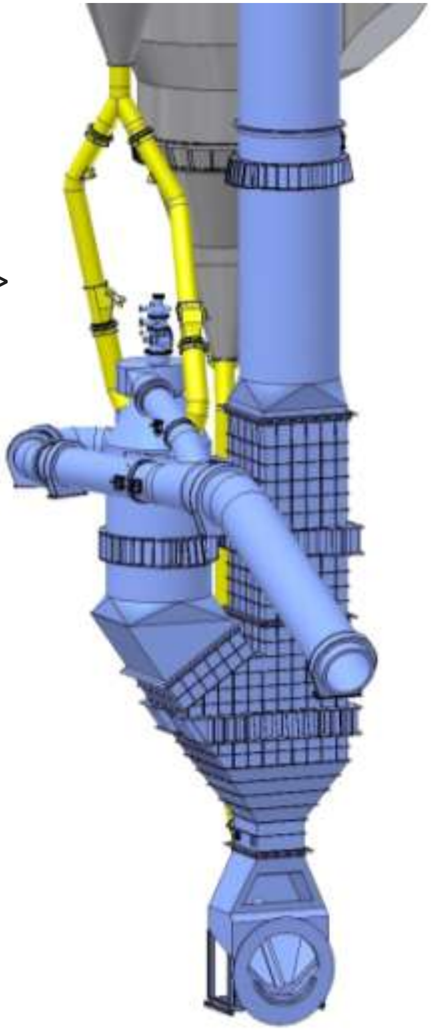


KHD Pyro Equipment for Burning AFR – PYROCLON® Calciner

KHD PYROCLON® Calciner Technology – Combustion Chamber

- Utilization of coarse fuels with extremely poor ignition and burning properties like coarse anthracite, petcoke and coarse secondary fuels or waste derived fuels.
- Ignition and start of combustion in pure air at high temperature (T > 1200°C).
- Calciner retention time > 7 sec.
- High efficiency and flexibility.
- Lower demand on fuel quality and preparation efforts.

➔ Saving of alternative fuel costs.

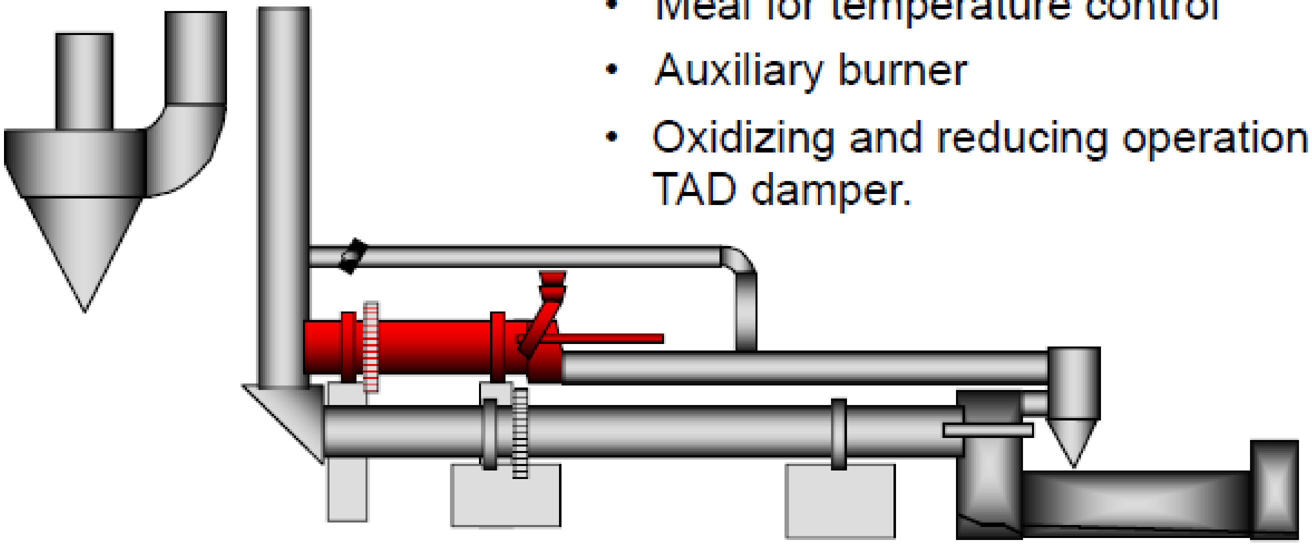


KHD Pyro Equipment for Burning AFR - PYROROTOR®

KHD AFR BURNING TECHNOLOGY – PYROROTOR®

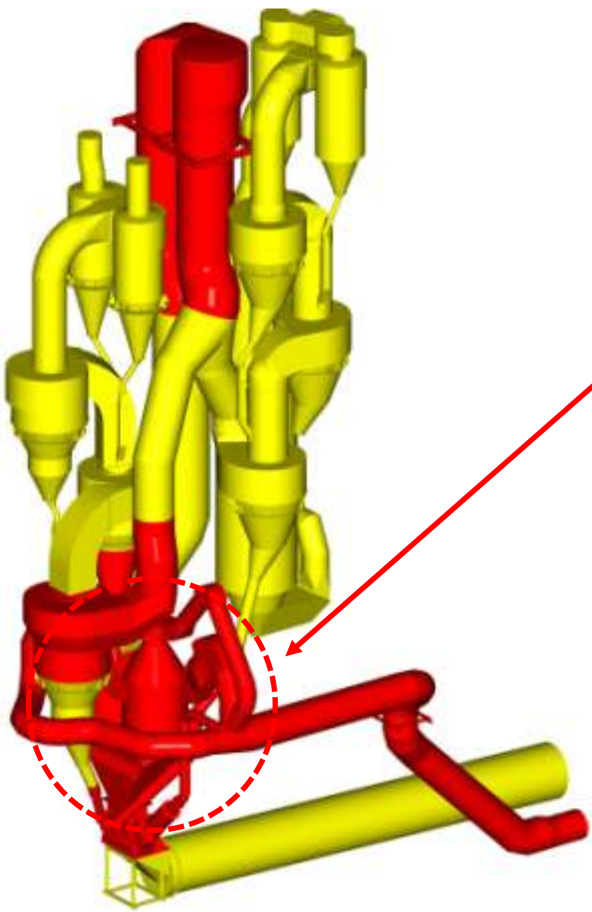
PYROROTOR®

- ∅ 3,4 m x 25 m or ∅ 4,4 m x 18 m
- 0,2 - 1,0 U/min
- Filling degree max. 25%
- Meal for temperature control
- Auxiliary burner
- Oxidizing and reducing operation by TAD damper.



KHD Pyro Equipment for Burning AFR - PYROCLON® Calciner

KHD PYROCLON® Combustion Chamber – Norway, 3 500 tpd



KHD Combustion Chamber: 60 % of total fuel (thermal)

- Coal / Petcoke / **Animal Meal** mix: 10 th-%
- **Solid Hazardous Waste: 27 th-%**
- **Fluff RDF: 63 th-%**

Typically **16 to 18 t/h** of solid hazardous waste and Fluff RDF are fed into the KHD Combustion Chamber.

In 2014, after 10 years in operation

Calculation Example:
16 t waste/h ➔ **384 t/d** ➔ assumed plant run time of **310 d/y**
119 040 t/y ➔ **1 190 400 t** waste in **10 years**.

Waste Density:	**0,3 t/m³**
Waste Volume:	**3 968 000 m³** (in 10 years)

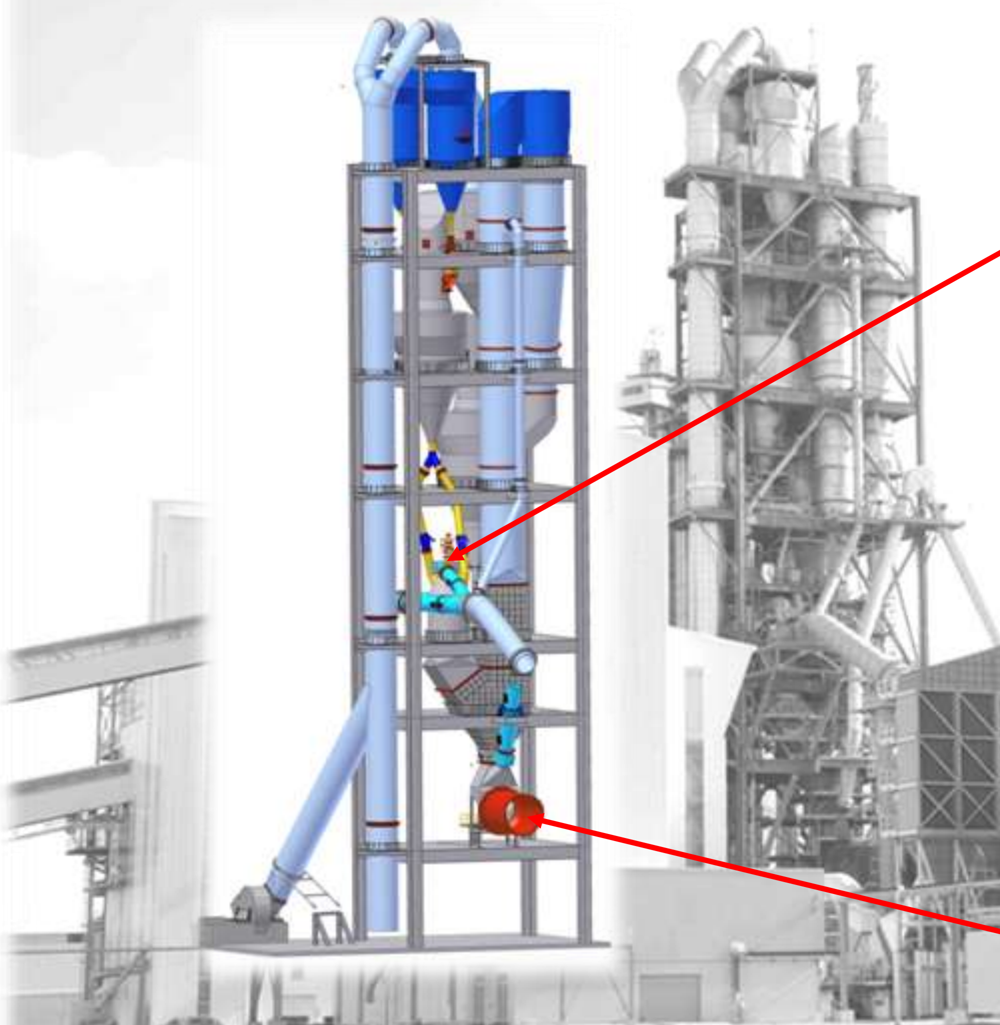
In Other Numbers

Storage Height:	**5 m**
Storage Area:	**891 m x 891 m** !!!!

Result = Stable feeding of approx. **90 th-%** of **alternative fuels** to the calciner.

KHD Pyro Equipment for Burning AFR - PYROCLON® Calciner

KHD PYROCLON® Combustion Chamber – Latvia, 4 000 tpd



KHD Combustion Chamber: 60 % of total fuel (thermal)

- Coal (as stand-by for fast response): 3 th-%
- Solid Residue Fuel: 70 th-%
- Waste Wood Chips: 2 th-%
- Tyre Chips and Fluff: 15 th.-%
- Neutralized Sulphuric Acid Tar: 10 th.-%

Typically 20 t/h of Alternative Fuels are fed to the KHD Combustion Chamber.

Main burner: 40 % of total fuel (thermal)

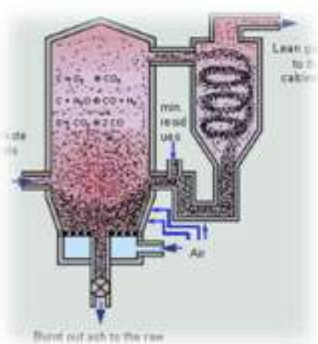
Coal: 78 th-%
Solid Residue Fuel, fine: 22 th-% (= 2,5 t/h)

Result = Stable feeding of approx. **68 th-%** of **Alternative Fuels** to the kiln / calciner.

Cemex Rüdersdorf, Germany – 6.000 tcli./d

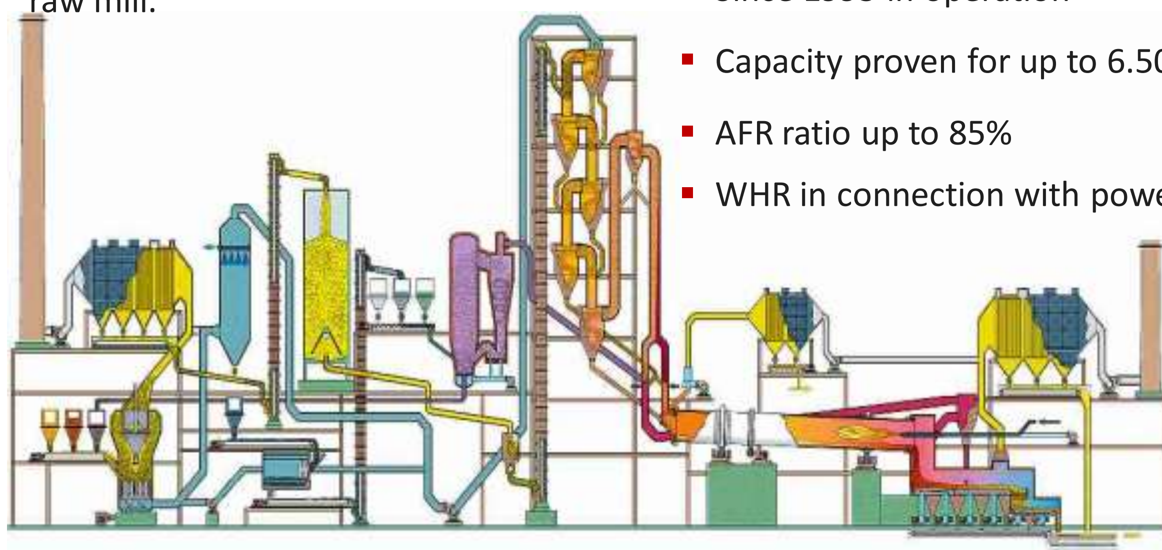
Worlwide unique Plant Concept
Clinker Pyroline combined with CFBR

Circulating **F**luidized **B**ed **R**eactor



A gasifyer operating on the principle of circulating fluidized bed to extent the options for using a wide range of different secondary materials.

The produced lean gas is burned in the calciner firing system while the reaction residues are discharged at the reactor floor and finally used in the raw mill.



Core *equipment*

- 5 Stage Cyclone Preheater WT PRZ 7648/3
- PYROCLON R® Low NOx Calciner w. PYROTOP
- 2-Pier Rotary Kiln, PYRORAPID® Ø 5,2 x 61 m
- 15% Bypass
- 3-Grate Cooler with hammer crusher

Result

- Since 1995 in operation
- Capacity proven for up to 6.500 t/d
- AFR ratio up to 85%
- WHR in connection with powerplant

Heidelberger Cement Teutonia, Germany – 2.500 tcli./d

Core equipment

- 1-String Pre-Heater, 4-stage. Type 7346/4
- PYROCLON® R LowNOx with PYROTOP®
- Tertiary Air Duct with Dust Setting Chamber
- Bypasssystem, design for 14 %
- 2-Station Rotary Kiln PYRORAPID® 4,2 x 50 m
- Kiln Burner PYROJET® HPJ/230
- Clinker Cooler IKN 3000/52/56/5/3 P, Grate Area 55 m²

Alternative Fuel Rate	Alternative Fuel	Fossil Fuel
Kiln	15 % Animal Meal	85 % Coal
LowNOx Calciner	70 % RDF	30 % Coal
Total	48 % Alt. Fuel	52 % Foss. Fuel

Result

- Since 1996 in operation
- Capacity proven for up to 2.500 t/d
- AFR ratio up to 50 %

KHD Pyro Equipment for Burning AFR - PYROCLON® Calciner

KHD Combustion Chamber – Reference List

Customer	Country	Year	[t/d]	Preheater / Dimensions	Kiln	Fuel
Cimentos Liz S.A.	Brazil	2011	5000	PR 9067 / 5, PYROCLON R	5,0 x 69 PYRORAPID	Coal
Maras II	Turkey	2011	4500	PR 8864 / 5,PYROCLON R	4,6 x 54 PYRORAPID	Coal
Sengelejewski	Russia	2007	3000	PR 7950 / 4,PYROCLON R	4,4 x 52 PYRORAPID	Gas
Cimpor Yibitas Hasanoglan Plant	Turkey	2007	2500	PR 7648 / 5,PYROCLON R	4,2 x 50 PYRORAPID	Petcoke, Local Waste Derived Fuels
OAO Mordowzement, Komsomolski MORDOW 3	Russia	2006	6000	PRZ 7950 / 5,PYROCLON R	5,2 x 65	Gas
Holcim Campulung Cement	Romania	2006	4000	PR 8861 / 5,PYROCLON R	4,8 x 66	Coal / Petrol Coke Natural Gas, Oil Sludge, Fluff RDF
Cemex Broceni Latvia plant, Broceni Line V	Latvia	2006	3500	PR 7650 / 4,PYROCLON R	4,6 x 54 PYRORAPID	Coal / Petrol Coke, Local Waste Fuels, Wood, Shredded tyres
Cimenterie National S.A.L.	Lebanon	2005	3800	PRZ 6442 / 4,PYROCLON R a	4,4 x 64	Oil Petrol Coke Alternative Fuels
Guangzhou Heidelberg Yuexiu Cement	PR China	2003	6000	PRZ 7950/5,PYROCLON R	5,2 x 70 Pyrorapid	Hard Coal, Anthrazite, Sewage Sludge
Norcem A.S., Brevik Dalen plant Line VI	Norway	2003	3500	PRZ 5635/4,PYROCLON R Bypass	4,4 x 68	Coal Alternative Fuels, Waste Fuel

KHD Pyro Equipment for Burning AFR - PYROCLON® Calciner

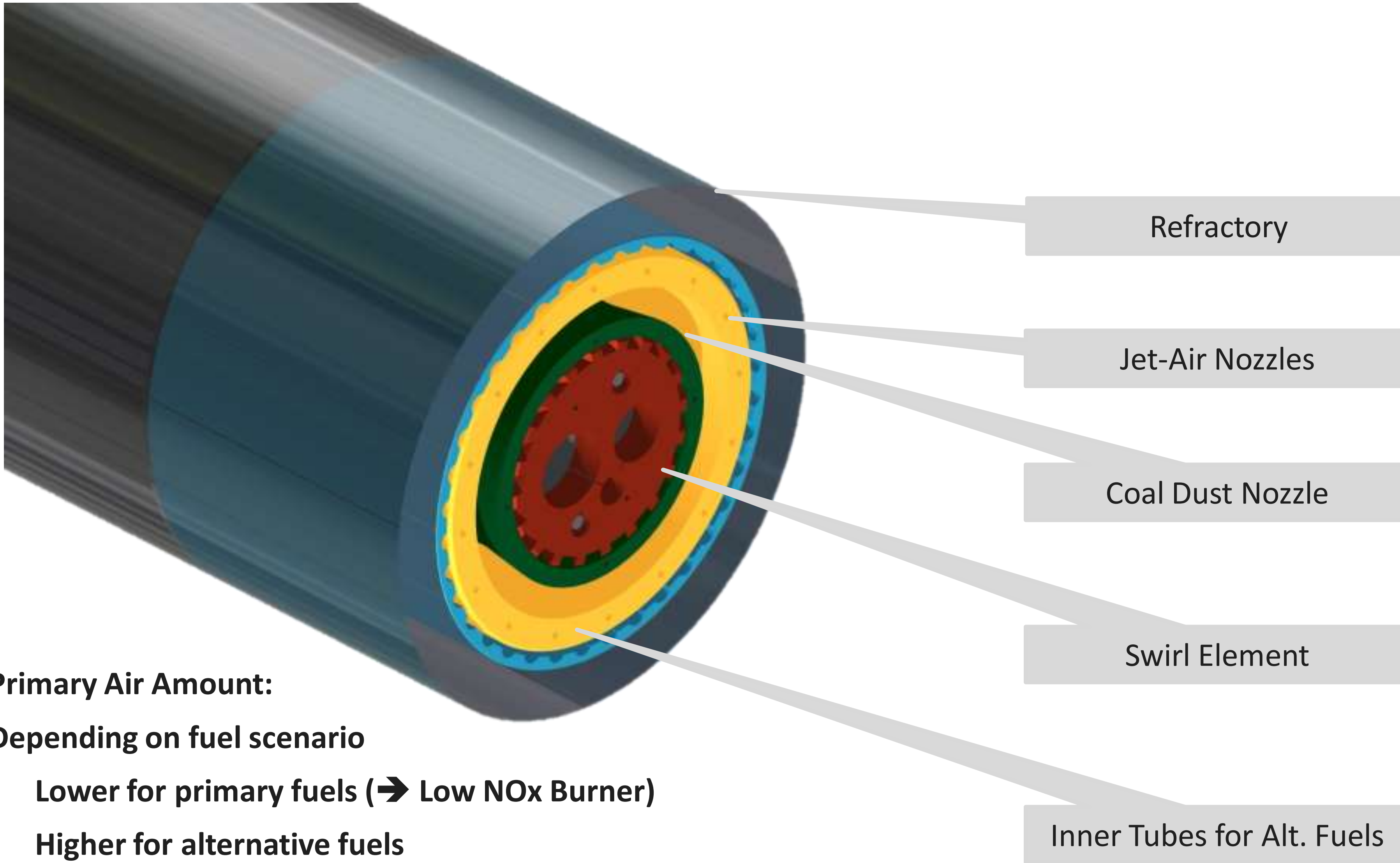
KHD PYROCLON® Combustion Chamber – Global Cemfuel Award

6th Global Cemfuels Conference 2012, in Aachen, Germany.

KHD Combustion Chamber

KHD wins the award for the most innovative technology for alternative fuel use.

KHD Pyro Equipment for Burning AFR - PYROJET® Kiln Burner



Primary Air Amount:

Depending on fuel scenario

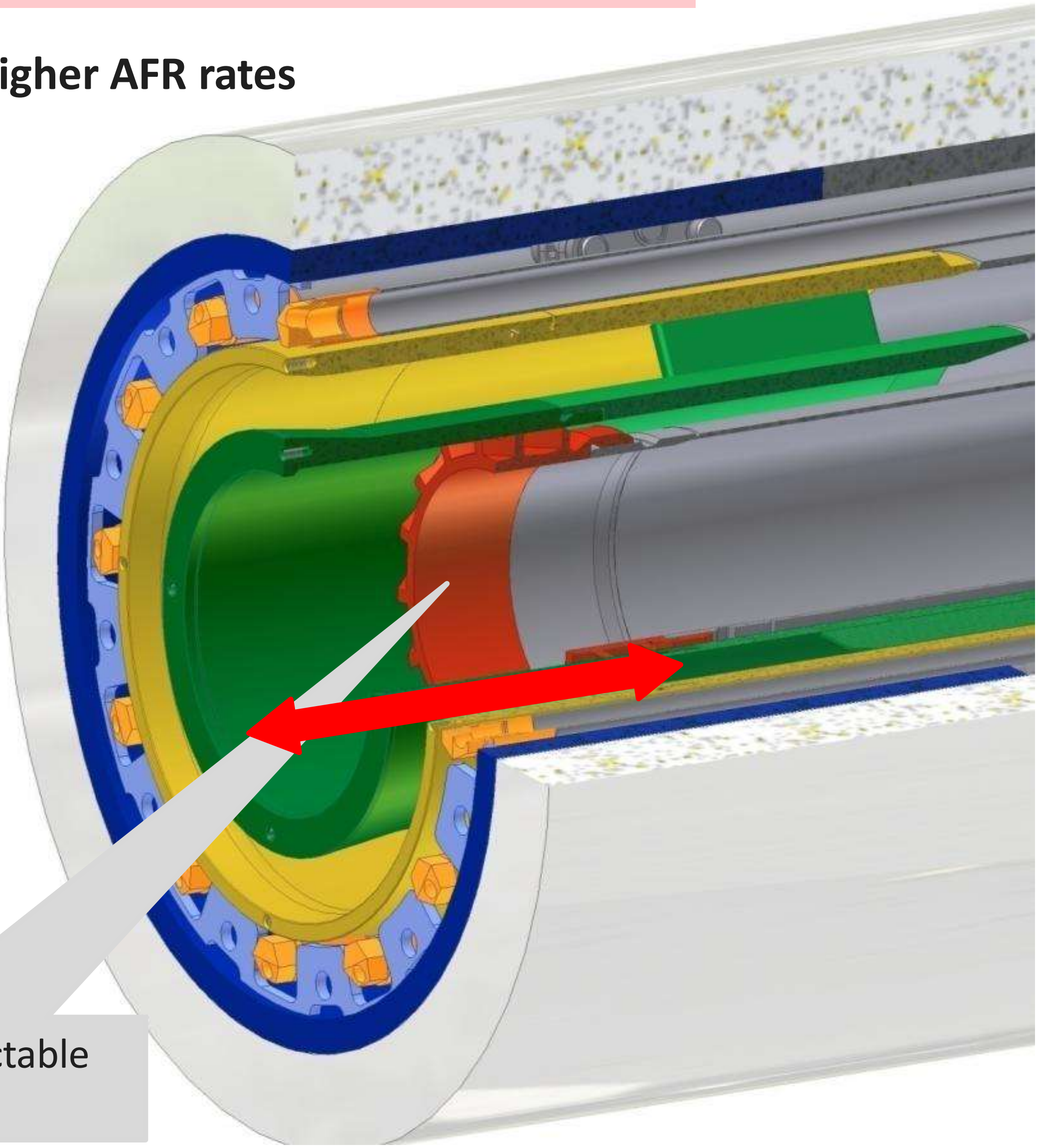
- **Lower for primary fuels (➔ Low NOx Burner)**
- **Higher for alternative fuels**

KHD Pyro Equipment for Burning AFR - PYROJET® Kiln Burner

AFR Swirl Nozzle – Special Feature for higher AFR rates

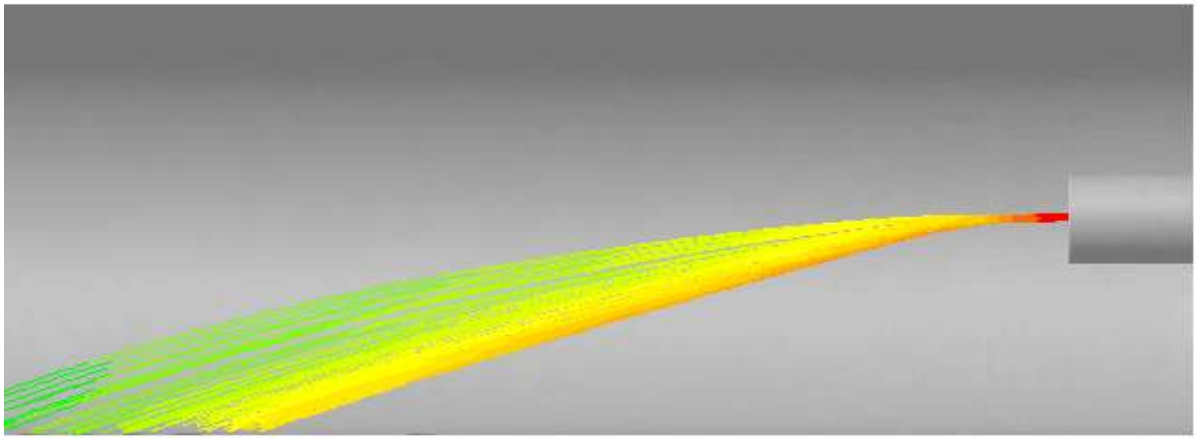
- Retractable swirl element.
- No additional primary air necessary for AFR nozzle.
- Adjustable during operation.
- Fracturing, mixing of the AF flow shortly before entering the kiln (spraying angle).
- Improving the mixture within the flame core and with oxygen.
- Oxygen enrichment is also possible.

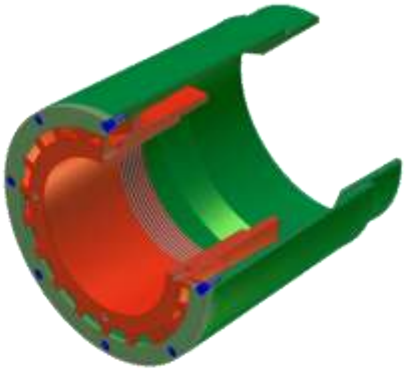
➔**Increase of alternative fuel firing rate**



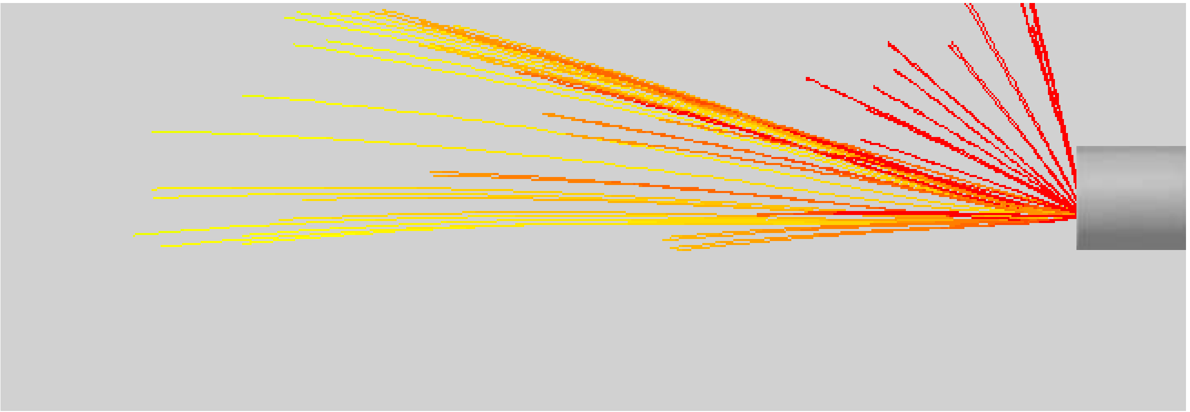
AF Channel with retractable Swirl Nozzle

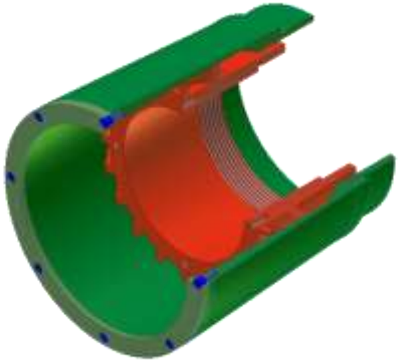
KHD Pyro Equipment for Burning AFR - PYROJET® Kiln Burner





AFR Swirl element in front position ➔ Poor AFR distribution





AFR Swirl element in back position ➔ Good AFR distribution into the flame

KHD Pyro Equipment for Burning AFR - PYROJET® Kiln Burner

Reference List for Burner Modification with newly developed AFR Nozzle

Plant	Company	Clinker Production [t/d]	AFR Rate Kiln Burner [%]	AFR Fuel Type	Project
Burglengenfeld, D	Heidelberger Cement	2000	50-60	Plastic and paper foils	Existing Burner, retrofit with AFR Nozzle
Outão, PT	SECIL	3500	40-50	RDF, Sawdust, Wood Chips	Existing Burner, retrofit with AFR Nozzle
Erwitte, D	Spenner Zement	2000	Commissioning started		Existing Burner, retrofit with AFR Nozzle
Lampang, Thailand	Siam Cement	5500	Future intention to burn AFR		New Burner

AFR : Alternative Raw materials

Use of Alternative Raw Materials

Novotroizk, Russia, 2 x 3 000 $t_{cli.}$/d

Slag Dump as raw material source

Special Feature:

Up to 30% of raw material: Blast Furnace Slag

Fe-corrective component: Siemens Martin Slag

Source:

Slag dump from nearby steel works

Result:

Spec. Heat Consumption only ~ 600 kcal/kg_{cli}.

A successful project as an example of using

<u>Alternative Raw Materials.</u>

AFR : KHD‘s References [India]

Plant	Type of Fuel
UTCL Reddipalayam	Tyre Chips, Municipal Waste, Paint Sludge, Agro Waste
UTCL Vikram Cement	Tyre Chips, Municipal Waste, Agro Waste
UTCL Tadipatri	Pharmaceutical Waste
Lafarge Sonadih	Agricultural Waste, Municipal & Industrial Waste
UTCL Aditya Cement	Paint Sludge

Introduction

AFR : Today‘s Demand and Challenges

KHD Pyro Equipment for Burning AFR – PYROCLON® Calciner

KHD Pyro Equipment for Burning AFR – PYROJET® Kiln Burner

AFR : Alternative Raw materials

AFR : KHD‘s References [India]

Conclusion

Conclusion

AFR - Alternative Fuels and Raw Materials

Utilization of alternative fuels is a state-of-the-art technology for cement plants.

Alternative fuels reduce fossil fuel consumption hence conservation of natural resources.

Broad variance in alternative fuels leads to many influences on the clinker process which have to be known and taken into account.

Different technical solutions exists for the utilization of secondary fuels in cement plants.

Due to steadily rising prices for primary fuels, the utilization of alternative fuels will become more and more a possibility for decreasing or maintaining the operational costs.

➔ **KHD's 160 years of industrial history and experience helps our customers to implement alternative fuel projects into their process.**

HUMBOLDT WEDAG

get more out of your plant.

THANK YOU!