INDREC
industrial recovery

Your partner for sustainable energy management

How to turn a threat into an opportunity – EU ETS phase IV scheme

Czech cement association conference

Artem Kozinets, Jochen Aigner

Seč, 18.06.2019

The team

Jochen Aigner

Jochen Aigner holds an **MBA in International Management from the Viennese University** and has many years of international industry experience in the energy supply area, gained at one of the world's construction material multinationals. He is a specialist in demand-oriented planning and the management of fully integrated energy generation production plants for industrial clients. He founded INDREC GmbH in 2016 with the aim of using waste residues even more efficiently as a sustainable energy producer in order to make a contribution to the energy transformation and to thereby improve our quality of life.

Artem Kozinets

Senior Process Expert

Artem Kozinets holds an **MSc in Physical Geography and Environmental Science from the Lomonosov Moscow State University.** For more than eleven years he held various senior positions in the cement industry, primarily focused in the process performance area. Artem has been involved in many projects, both on local- and group level. Before joining the INDREC team, he was involved in capacity and process improvement, troubleshooting of clinker lines and grinding in 9 countries. Further, beside others, Artem supported the commissioning of new clinker lines in Russia

Agenda

The company

EU ETS (IV) impact on the cement industry

TF and AF and the impact on the carbon footprint in Czech Republic

Main drivers of CO2 emission reduction

BioCemFuel® : what is it and how to co-process it

Kiln optimization to burn RDF

Conclusion

The company

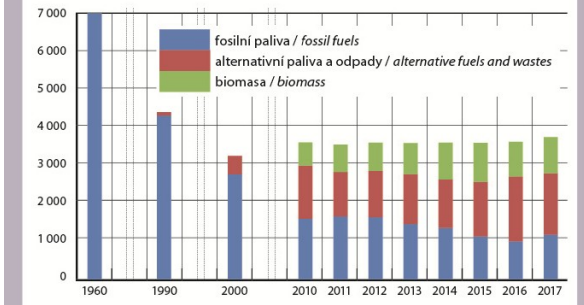
INDREC is an international, Central Europe - based **company specializing in the cement and related product industries**

- our core team has **longstanding expertise** gained through more than 50 years within the world industry leader
- as an environmental and energy specialist, INDREC is a reliable partner that delivers practical **solutions for the reduction of greenhouse gases** and the efficient use of energy
- since its creation, INDREC has provided **tailor-made products, services and solutions** for highly demanding customers including top cement producers but also for small and medium sized cement companies

TF and AF and the impact on the carbon footprint in Czech Republic

Spotřeba tepla na výpal slínku
Heat consumption for clinker burning

1960 | 1990 | 2000 | 2010–2017

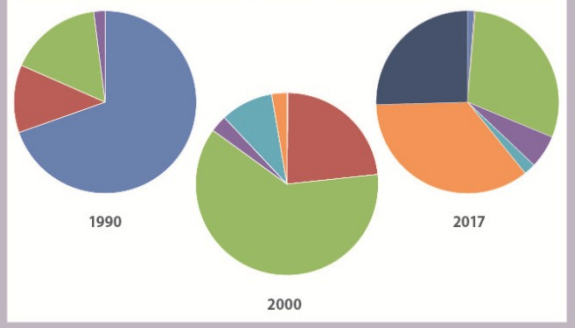


rok / year	1960	1990	2000	2010	2011	2012	2013	2014	2015	2016	2017
HC (MJ.t^{-1})	7 001	4 446	3 281	3 660	3 596	3 653	3 636	3 647	3 644	3 675	3 761
FF (MJ.t^{-1})	7 001	4 357	2 789	1 614	1 681	1 654	1 473	1 375	1 141	1 014	1 188
AF (%)	0	2,0	15,0	38,9	33,0	34,1	36,8	35,5	40,2	47,1	43,8
BF (%)	0	0	0	17,0	20,3	20,6	22,7	26,8	28,5	25,3	25,7

HC celková spotřeba tepla / *total heat consumption*
FF spotřeba fosilních paliv / *fossil fuels consumption*
AF podíl alternativních paliv a odpady / *alternative fuels and wastes ratio*
BF spotřeba biomasových paliv / *biomass fuels ratio*

Paliva používaná při výrobě cementu
Fuels used in cement production

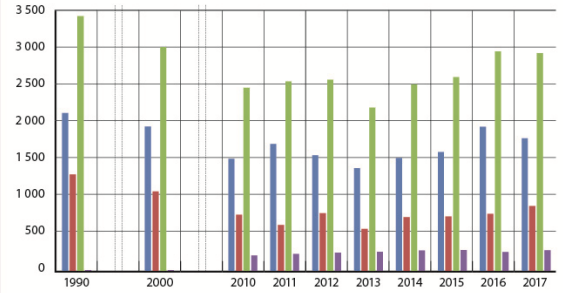
1990 | 2000 | 2017



rok / year	1990	2000	2017
zemní plyn / *natural gas*	69,6 %	0,2 %	1,2 %
těžký topný olej / *heavy fuel oil*	12,0 %	23,1 %	0,2 %
černé uhlí / *coal*	16,4 %	61,7 %	30,2 %
použité pneu / *used tyres*	2,0 %	3,0 %	5,9 %
jiná kapalná paliva / *other liquid fuels*	-	9,3 %	2,1 %
jiná tuhá paliva / *other solid fuels*	-	2,7 %	35,8 %
biomasa / *biomass*	-	0,0 %	25,7 %

Emise CO_2 cementáren
Cement industry greenhouse gas CO_2 emissions

1990 | 2000 | 2010–2017



rok / year (kt)	1990	2000	2017
z kalcinace / *from calcination*	2 121 kt	1 937 kt	1 740 kt
z fosilních paliv / *from fossil fuels*	1 296 kt	1 064 kt	849 kt
biomasa / *biomass*	8 kt	2 kt	269 kt
celkem / *summary*	3 425 kt	3 003 kt	2 858 kt

What has changed between 2000 and 2017:

- Cement production increased from 3,6 to 4,0 mio tons
- Clinker factor improved
- Heat consumption increased and more AF used
- Biomass increased but stays on low level of 25%
- **CO2 emissions from fuels stays on the same level (from 296 □ 280 kgCO2/t cem)**

Data source : Czech Cement Association

EU ETS (IV) impact on European the cement industry

- Cementitious materials account for approximately 8% of global emissions of which Europe represents 5% of the worldwide market and has been stable for nearly a decade now. Demand likely not to increase in the future
- Carbon neutrality is particularly challenging for the cement sector as less than 40% of emissions come from the energy used to produce cement. More than 60% of emissions come from the chemical breakdown of limestone - calcium carbonate (CaCO3) – into CO2
- Latest estimation is that Phase IV HAL[1] and emission factor benchmark will be substantially reduced from HAL III.
- Compared to 2017 the price of the EU Emission Allowances nearly quintupled to more than 25 EUR / ton in 2019.

However

Considering all the stages in the value chain, reductions of up to 80% CO2 emissions compared to the 1990 values is achievable by 2050 without using carbon capture and storage technologies[2]

- Based on proven technologies, several areas among the value chain, such as
  - Process optimization / alternative fuels / alternative raw materials / alternative binders / concrete mix design, etc have to be considered

- In INDREC we focus mainly on **Process Optimization** and **Industrial fuels and raw materials**

Article in magazine "Trend" from 2019, June 9th

Die top CO_2-Sünder Österreichs

Rang	Unternehmen	Mio. Tonnen
1	Voest	11,3
2	OMV	4,2
3	Wienstrom	2
4	EVN**	1,1
5	Verbund	1
6	Lafarge Perlmoser	0,9
7	Austrian Airlines AG	0,9
8	Veitsch Radex	0,5
9	Wietersdorfer	0,4
10	Sappi Gratkorn	0,4
11	Laudamotion	0,4
12	Gmundner Zement	0,3
13	Zementwerk Leube	0,3
14	Agrana	0,3
15	Zementwerk Wopfing	0,3

* Teilnehmer Emissionshandelssystem inkl. Konzerntöchter
** ab 2020 fallen 0,6 Mio Tonnen aus dem KW Dürnrohr weg
Quelle: Emmissionshandelsdatenbank, Umweltbundesamt

PRICE FOR CO2 EUROPEAN EMISSION ALLOWANCES[3]

1. Historical Activity Level; 2. Extracted from: Favier, Aurelie/De Wolf, Catherine/Scrivener, Karen/Habert, Guillaume (2019): A sustainable future for the European cement and concrete industry. Zurich. P. 6; 3. https://markets.businessinsider.com/commodities/co2-emissionsrechte

Main drivers of CO2 emission reduction

- **Reduce clinker factor**
  - more mineral components into cement
- **Reduce fuel consumption**
  - optimize energy efficiency
- **Reduce RM CO2**
  - minimize CKD, use alternative RM, less limestone

- **Increase alternative and biomass fuels**
  - cost efficient, CO2 credit/lower factors

"Rule of thumb" (varied for each plant):

Change of	Make the change of CO2
1% Clinker factor	1%
1% of clinker heat consumption	0.40%
1% of Alternative Fuel	0.40%

BioCemFuel®

Definition BioCemFuel®

- Quality assured alternative fuel with biomass, content TCB >50%
- Independently produced for each application
- Remains waste

Why BioCemFuel®

- The use of alternative fuels (AF) is of major importance for the industry
- Today's average AF contain relatively low biomass content (TCB 20 - 30%)
- Phase IV allowances will be reduced
- High price for CO2 allowances is expected to even grow in the future
- Moderate investment distributed across the different actors (producer & consumer)

Characteristics BioCemFuel®

- TCB: > 50%
- CV: 16 – 23 GJ
- Chlorine: < 1%

Main quality parameters are similar to current fuel mixes used at the plants

How to co-process BioCemFuel®

Proper feeding systems	• Unloading • Storage • Extraction, Transport and Dosing
Ensure calciner stability	• Proper calcination degree (92-94%) • Calciner temperature control in place and well tuned, Expert systems used • Long residence time • Cleaning of the preheater (cardox, manual) • Tight preheater (low false air)
Manage burning zone	• Optimize burner primary air and fuels injection settings • Burner alignment and insertion • Kiln torque and freelime control in place
Ensure quality stability	• Stable raw mix • Proper LSF, SR, AR, Liquid phase targets • Proper alkali / sulfur ratio • Adequate frequency of sampling and testing
Skills	• Operators, Production, Maintenance, Quality teams • Master kiln availability and performance

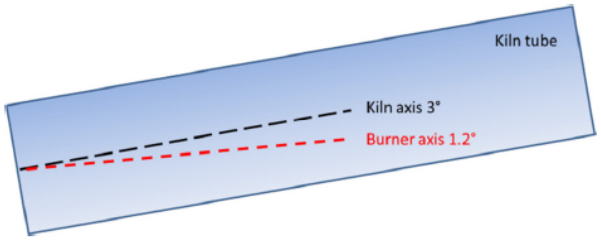
Kiln optimization to burn RDF 1/3

Burner

		Before	After optimization
Impulsion (axial+radial+central)	N/MW	6.9	9.9
% primary air (excl. transport)	%	8.1	10.4
Primary air pressure	mbar	380	600

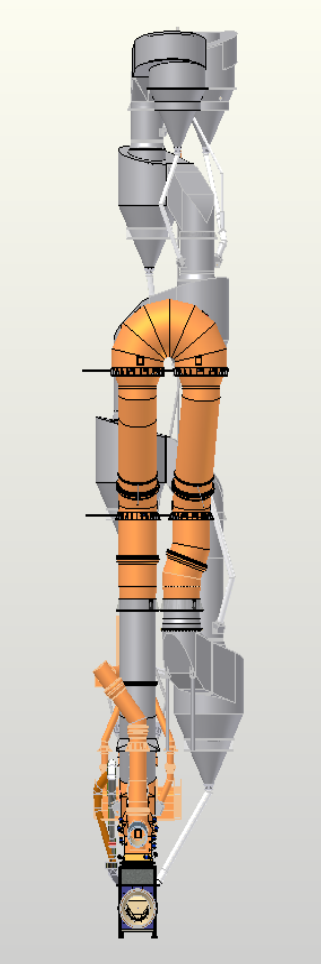
Other issues :

High Sulfur volatility	0.76 – 0.82
Lower tertiary and secondary air temperature	600°C
Long residence time and high filling degree	11% - 40min
Burner inclination	



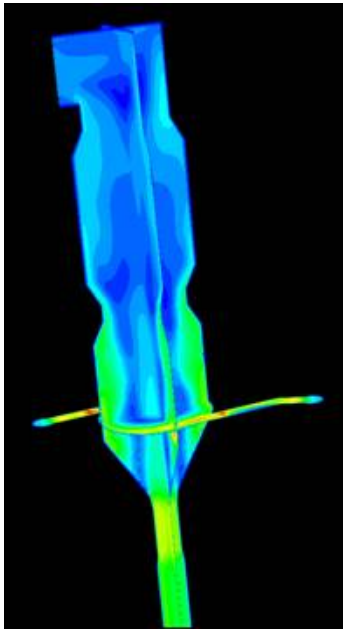
Burner is inserted 500 mm inside the kiln. Velocity of the air from the cooler into the kiln is 5-6 m/s.

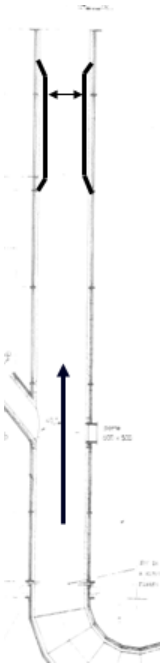
Calciner



Removal of combustion chamber

Extension of the calciner and increase of retention time

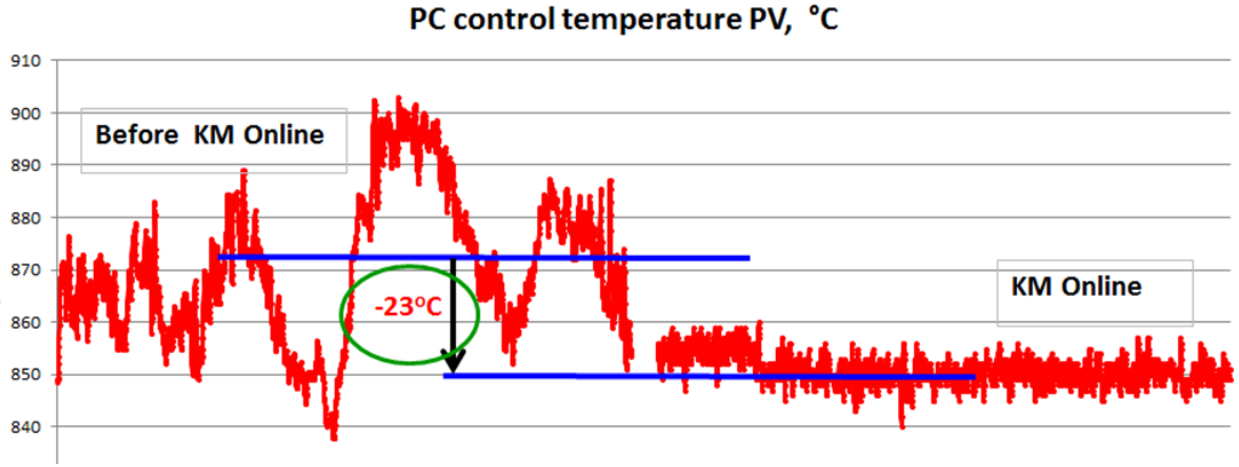




Orifice in tertiary air duct to increase speed and prevent fall of the fuels

Increase gas speed in riser duct (below calciner to prevent drop of the fuels to the kiln inlet)

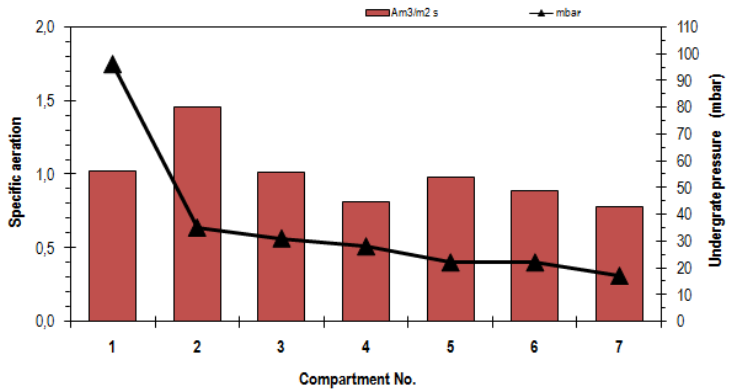
Calciner control



Introduction of expert system (FLS, ABB, Powitec, KIMA)

Proper tuning of calciner temperature control to make is stable

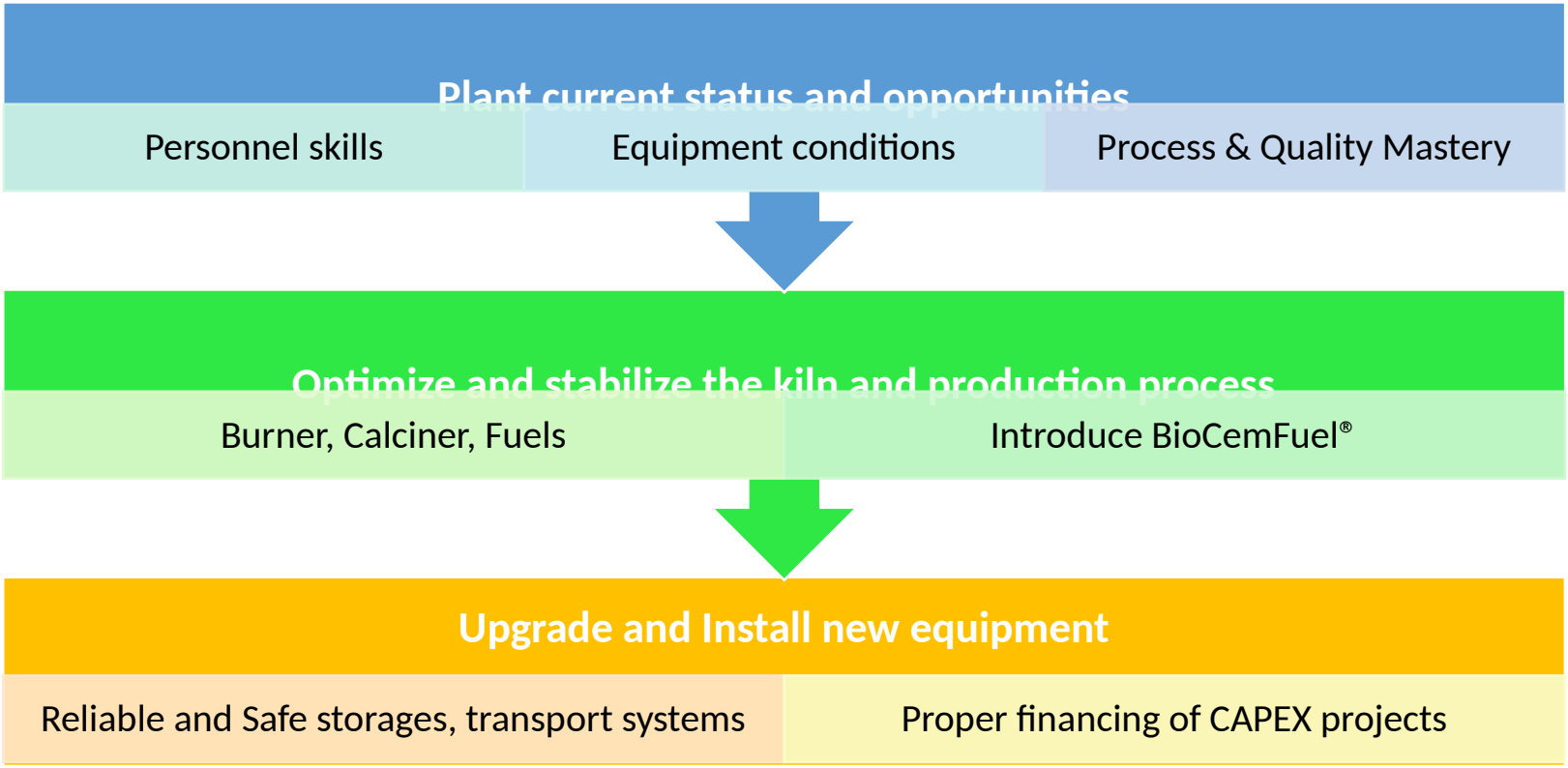
Cooler aeration



Not adequate aeration of the chambers low secondary air temperature

Conclusion

- Financial impact from CO2 emissions is constantly increasing
- BioCemFuel® is the alternative fuel with high biomass content
  - lower CO2 impact
  - better production costs
- However - before introduction of BioCemFuel® plant needs to do homework :



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Legal notes
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