



Petra Mühlen

SpectraFlow Online Analyzer

Real Time analysis of Alternative Fuels

SpectraFlow Online Analyzer

Alternative Fuels in Cement Industry



RDF



Wood Chips



Rice husk



Tyre Chips



Palm waste



Sewage sludge

SpectraFlow Online Analyzer

Challenges in feeding alternate fuels

- High variability in quality
- Continuous supply of required quantities
- Some material is seasonally available
- High range of bulk densities
- High moisture content

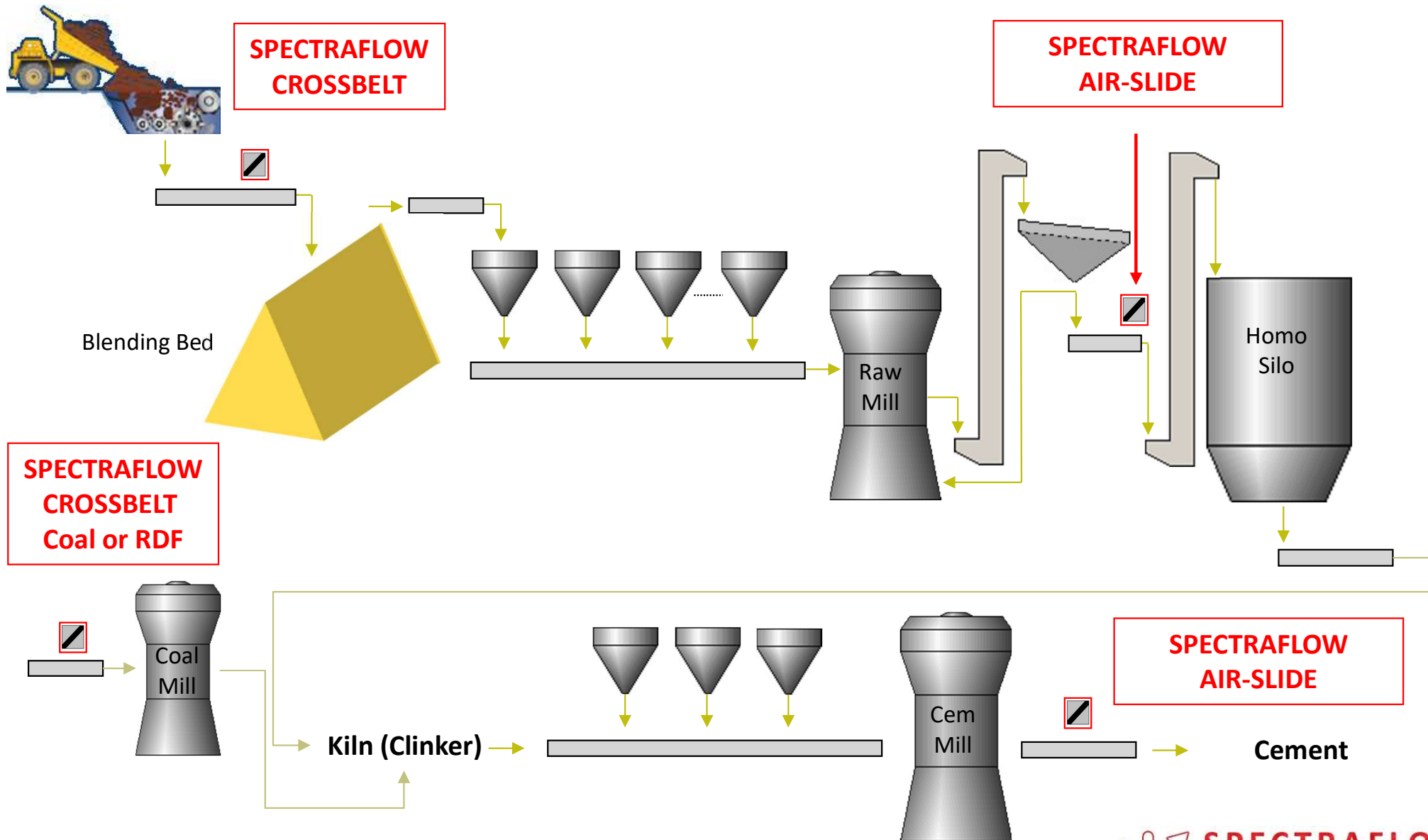
Online analysis will facilitate handling of some of the challenges

SpectraFlow Online Analyzer Timeline

- 2006:** ABB started development for **near infrared** online Crossbelt Analyzer
- 2007 - 2010:** First test and commercial installations in Cement & Iron Ore applications in Europe & USA
- 2010:** Development of Airslide Application
- 2011 - 2012:** Commercial installations around the globe
-
- 2013:** **SpectraFlow Analytics** incorporated as an independent company & management buy-out of the NIR Online analyzer technology from ABB
- 2013 - today:** > 70 orders received for Cement, Iron Ore and other clients globally since 2016 approved supplier with FLS

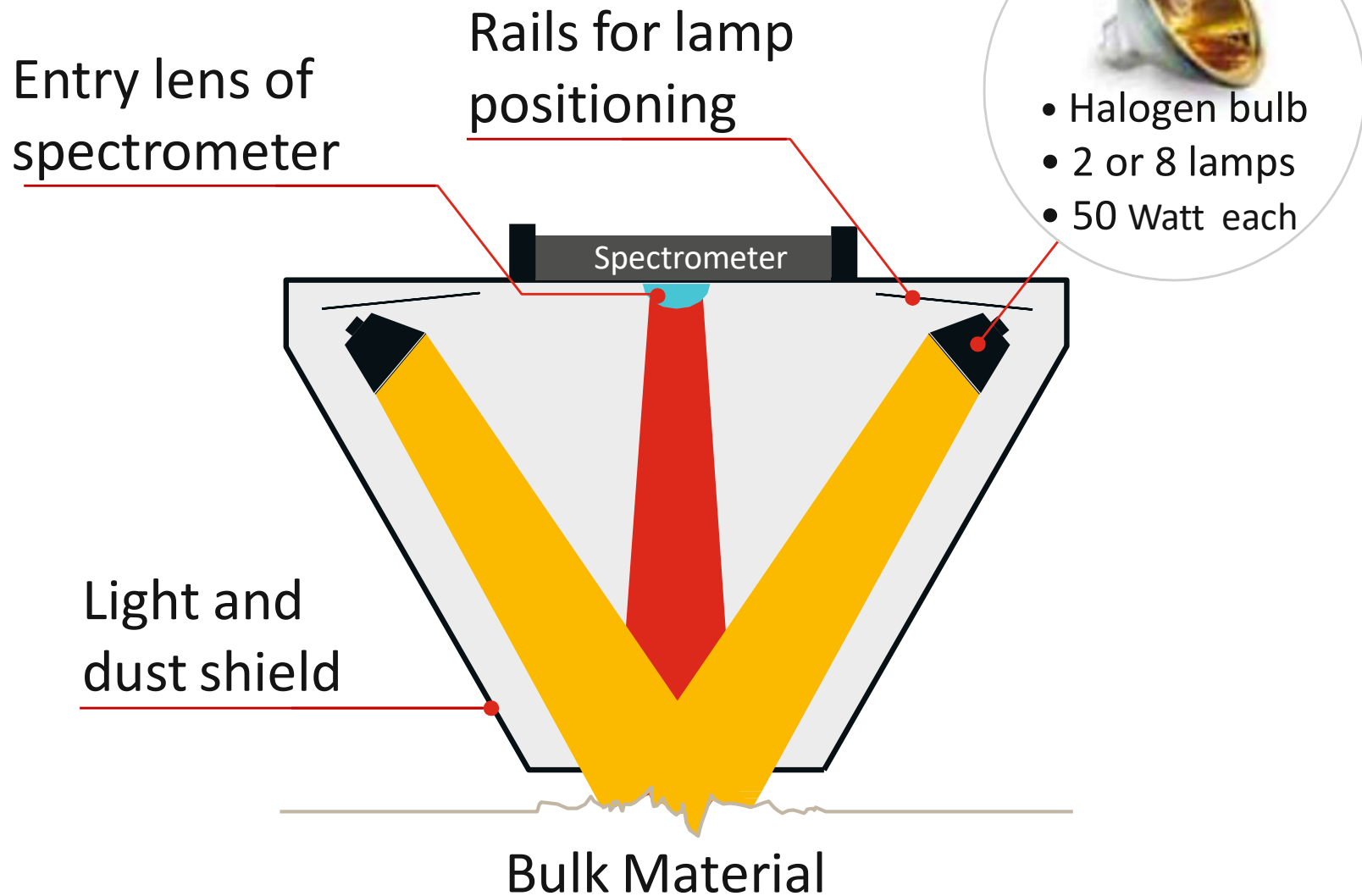
SpectraFlow Cement Analyzer

Position in Cement Production Process



SpectraFlow Cement Analyzer

NIR Analysis Technology



SpectraFlow Cement Analyzer

Minerals have a NIR signature

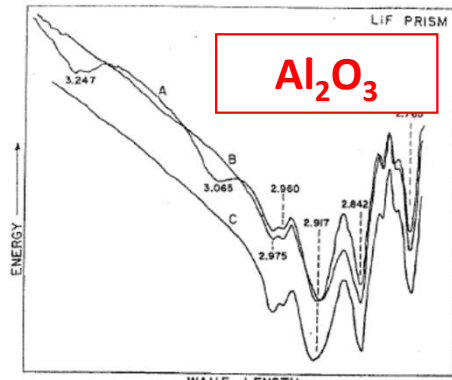
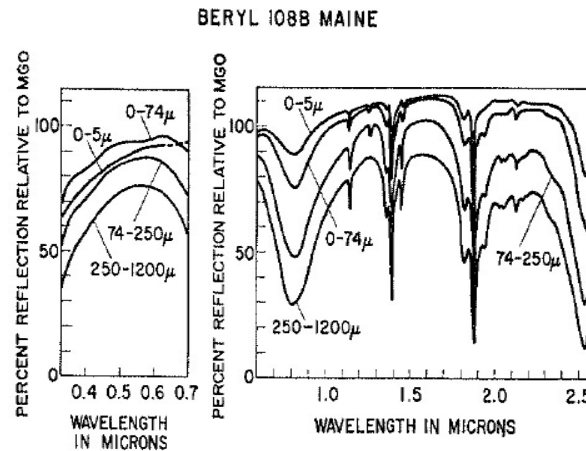
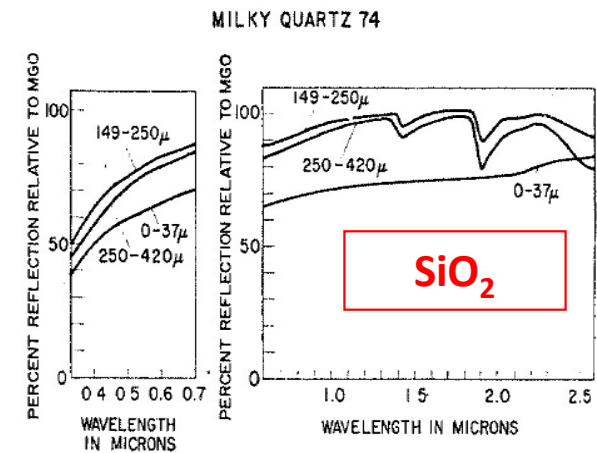


Figure 5. O-H Spectra, Aluminas in Bauxite Ore, Stretching Region, Lithium Fluoride Prism

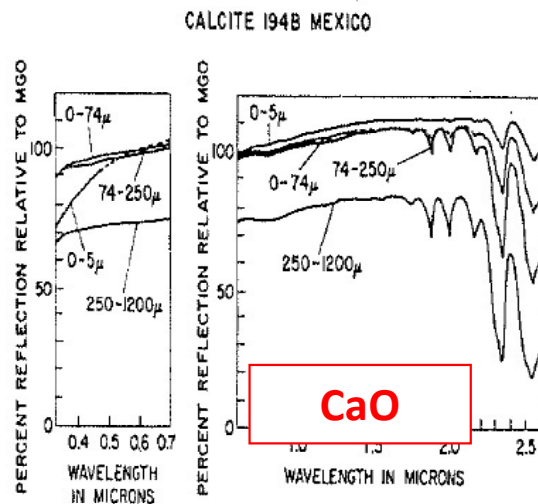
A. Arkansas No. 3
B. Arkansas No. 2
C. Arkansas No. 1



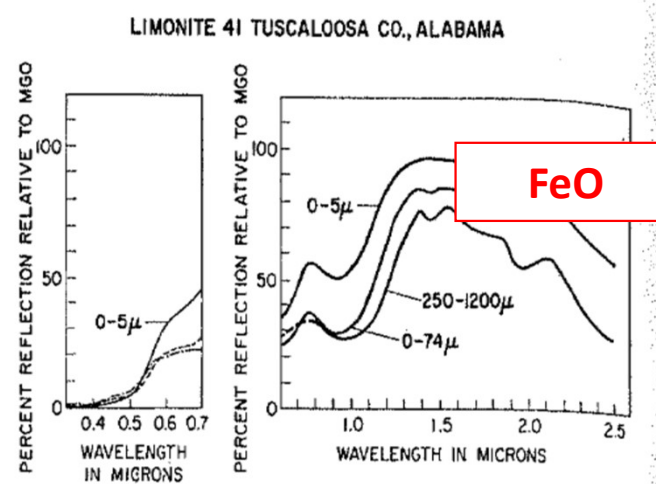
BERYL 108B MAINE



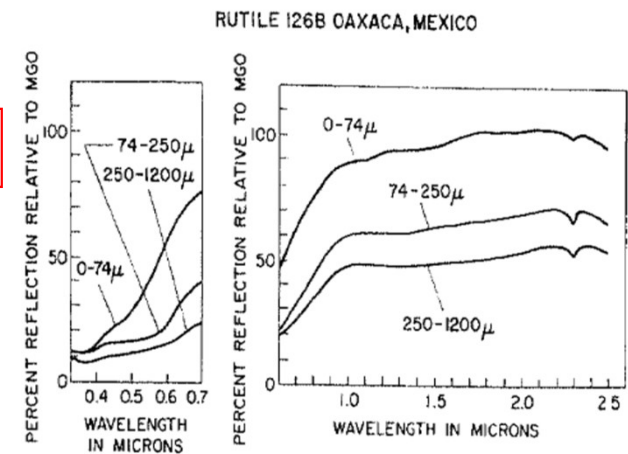
MILKY QUARTZ 74



CALCITE 194B MEXICO



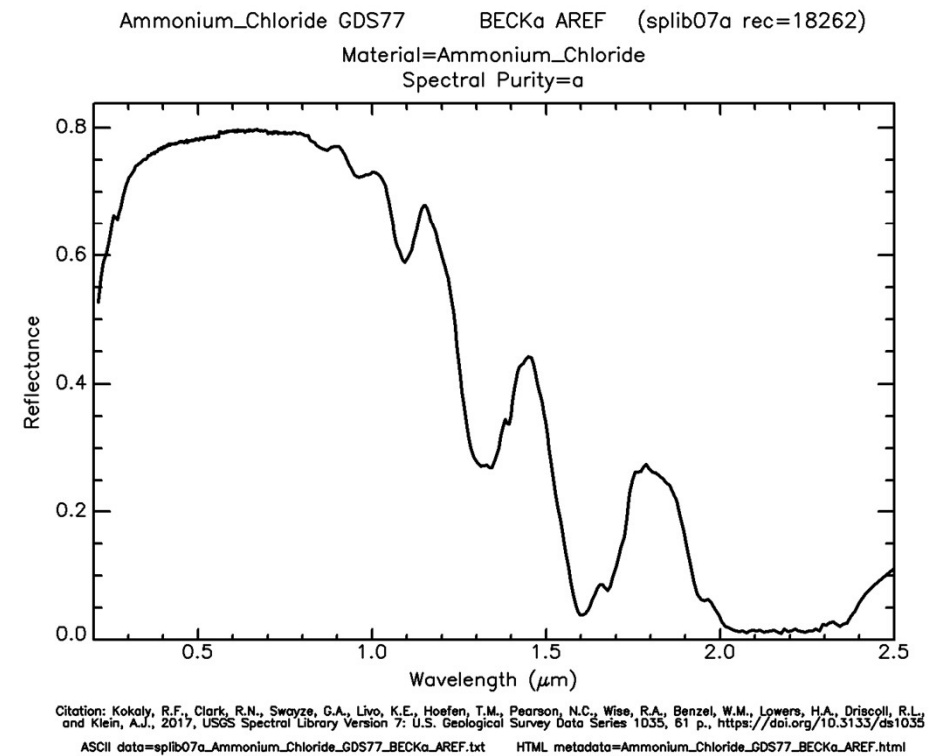
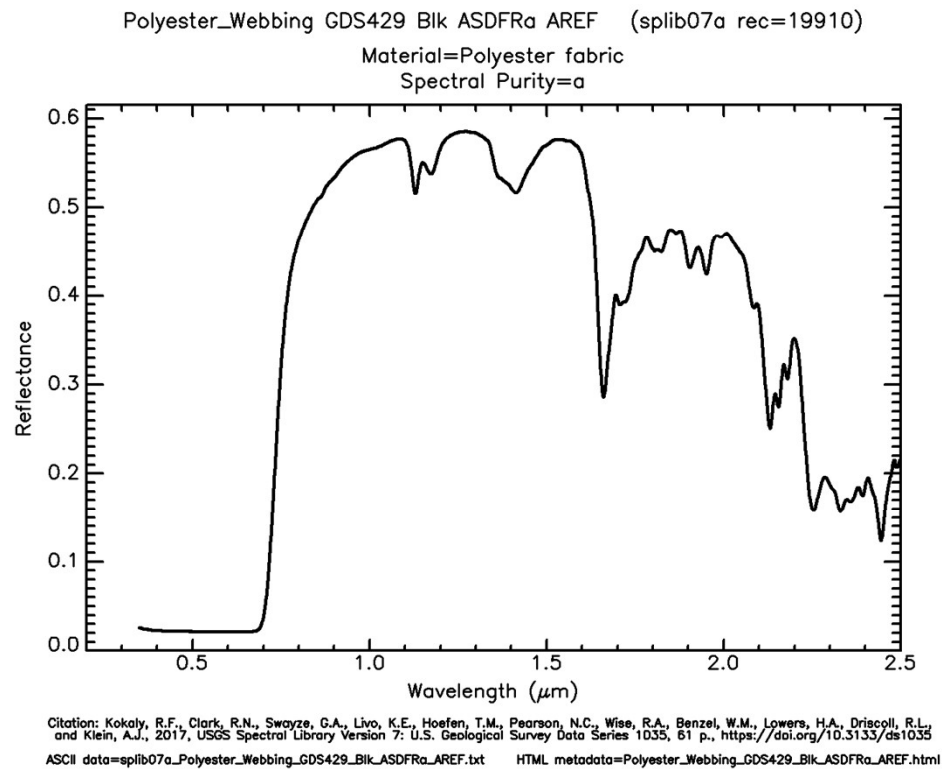
LIMONITE 41 TUSCALOOSA CO., ALABAMA



RUTILE 126B OAXACA, MEXICO

Hunt, Salisbury: Visible and Near Infra Red Spectra of Minerals and Rocks 1970

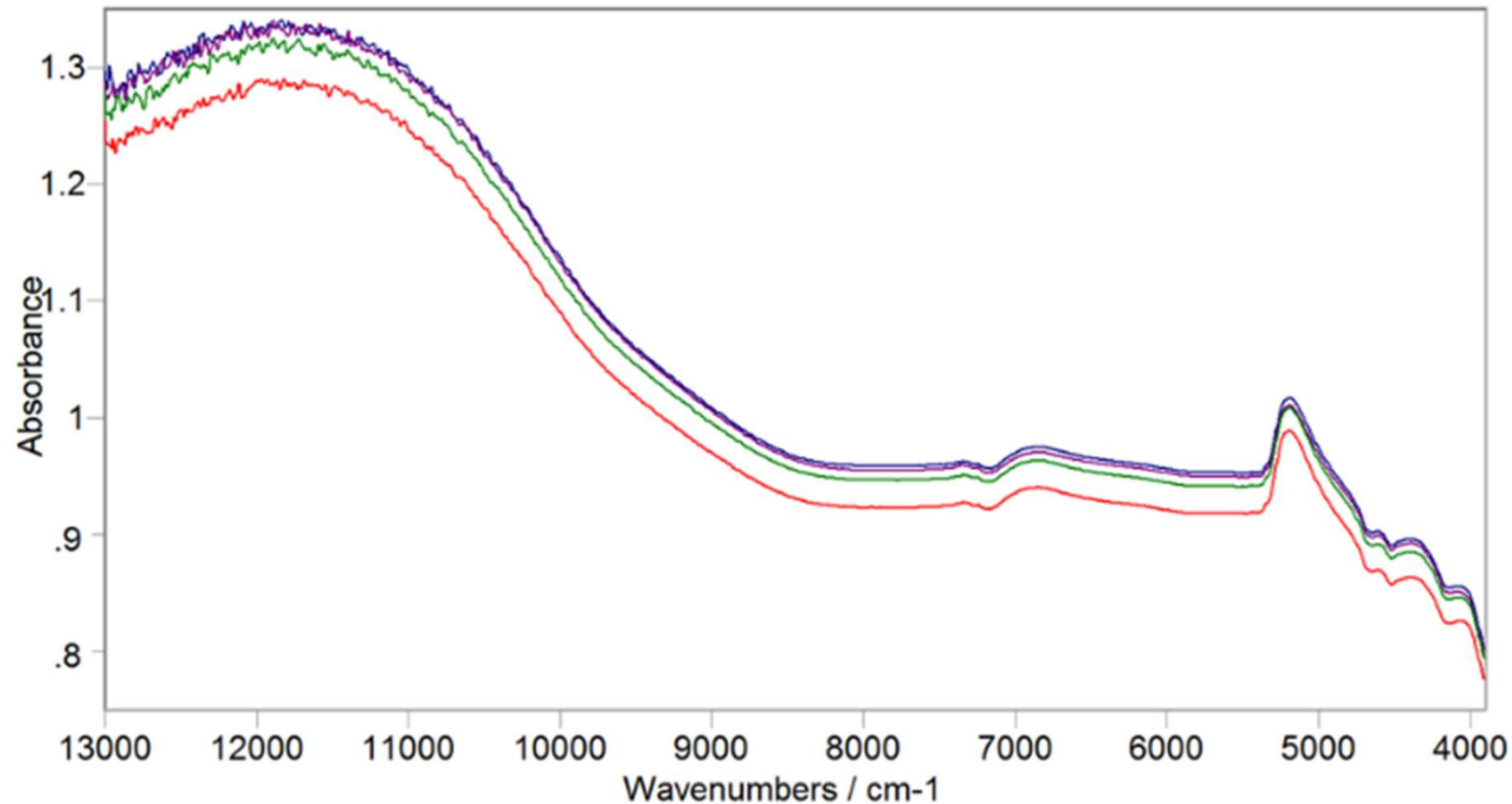
SpectraFlow Analyzer



USGS SpectraLib

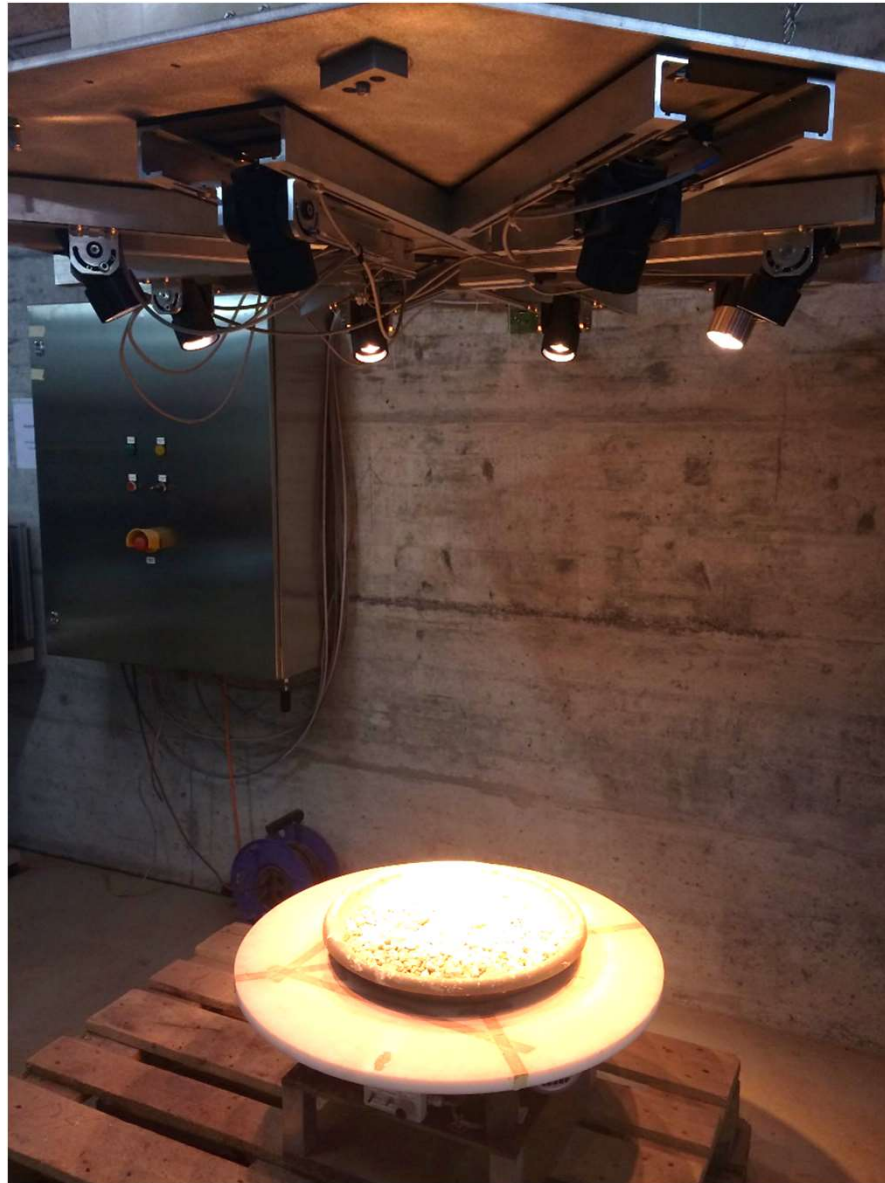
SpectraFlow Minerals Online Analyzer

NIR Analysis Technology



Typical Wide-NIR Spectra of Iron Ore from samples

SpectraFlow Cement Analyzer Laboratory set-up





SpectraFlow On-Line Analyzer Crossbelt Application

SpectraFlow Cement Analyzer

Crossbelt Application – Analyzer Installation



Spectrometer
compartment

Illumination
unit and dust
protection
cover

Electronic
cabinet and
communication
unit

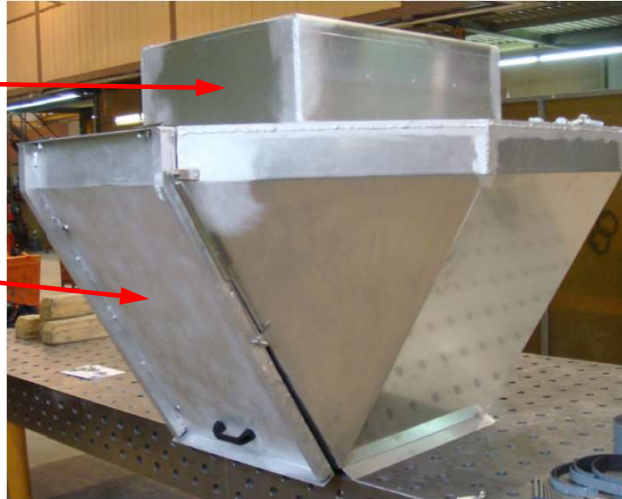
Mounting frame
supplied by the
customer

SpectraFlow Cement Analyzer

Crossbelt Application – Analyzer Pictures

Spectrometer
Compartment

Service
Flap which
can be
opened to
access the
lights



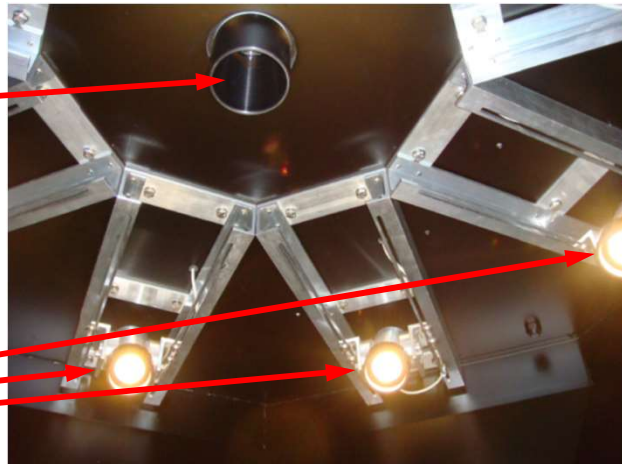
Overall view



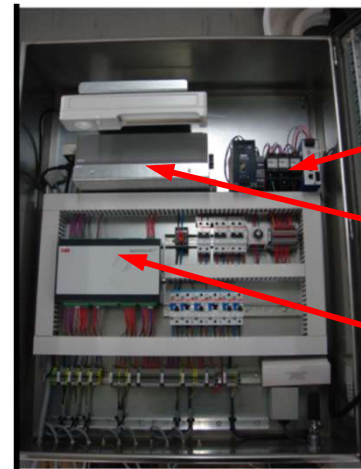
Inside view during operation

Entry for the
reflected
Infrared into
Spectrometer

Spots as
Infrared
Sources



View on rails and lamps



Electronic cabinet

Interfaces

Power Supply
for the spots

Industrial PC (IPC)

SpectraFlow Cement Analyzer

Installation Example – CBA after crusher



SpectraFlow Cement Analyzer Installation Example – CBA after crusher

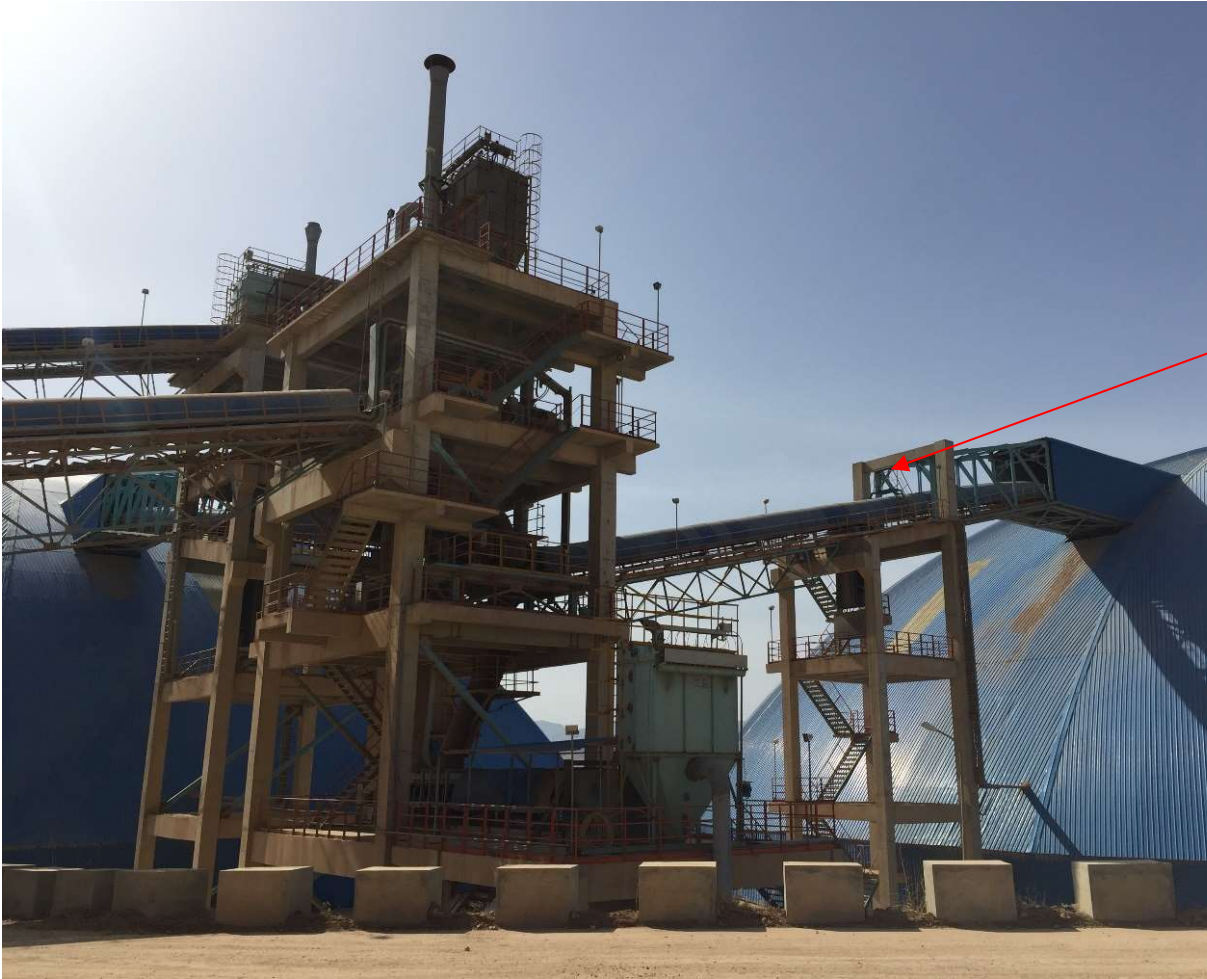


SpectraFlow Cement Analyzer Installation Example – CBA before stockpile



SpectraFlow Cement Analyzer

Installation Example – CBA before stockpile



SpectraFlow Cement Analyzer Installation Example – CBA before stockpile



SpectraFlow Cement Analyzer Installation Example – CBA on RDF



SpectraFlow Sinter Analyzer Installation Overview



Rails to remove the
analyzer from the
running belt

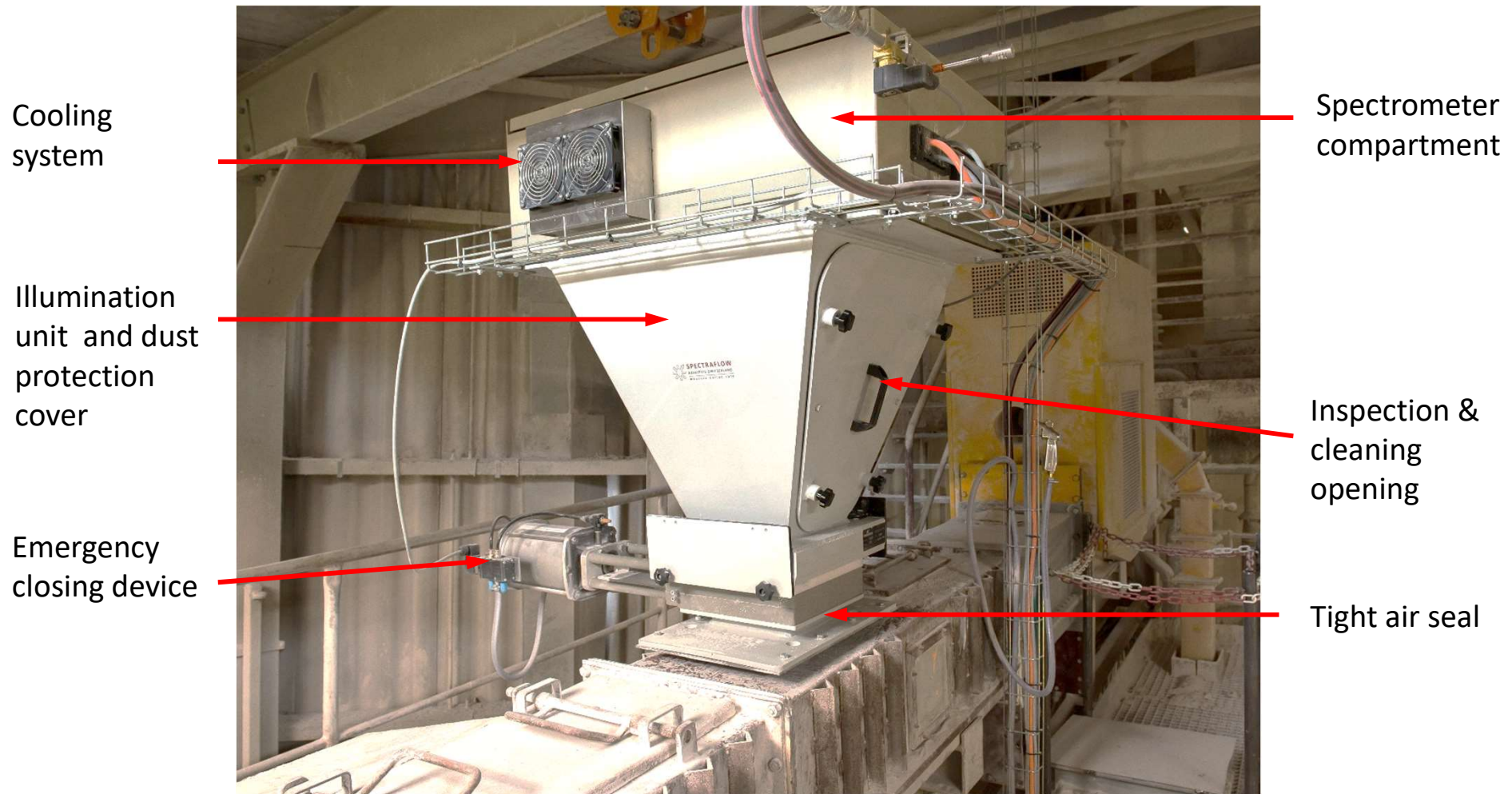




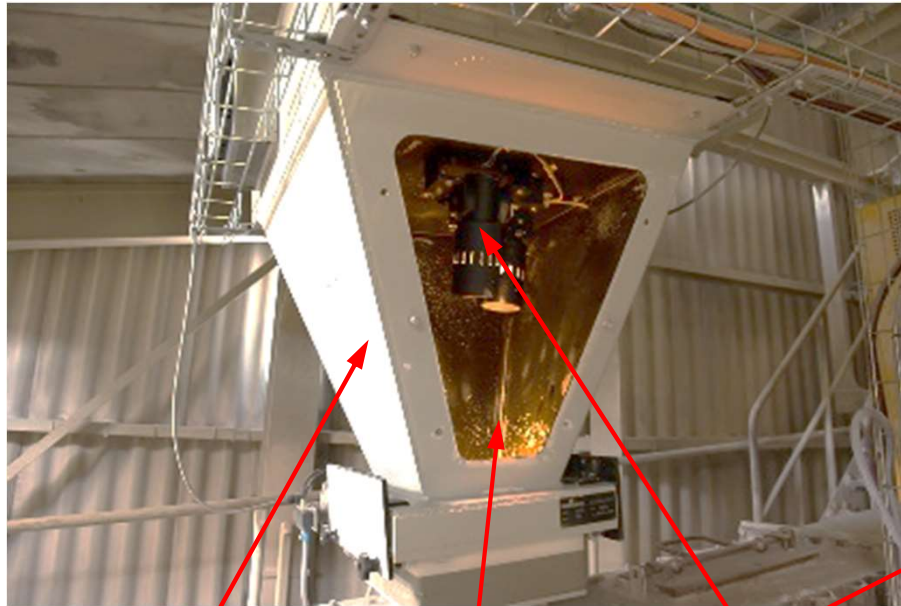
SpectraFlow On-Line Analyzer Air-Slide Application

SpectraFlow Cement Analyzer

Analyzer Installation



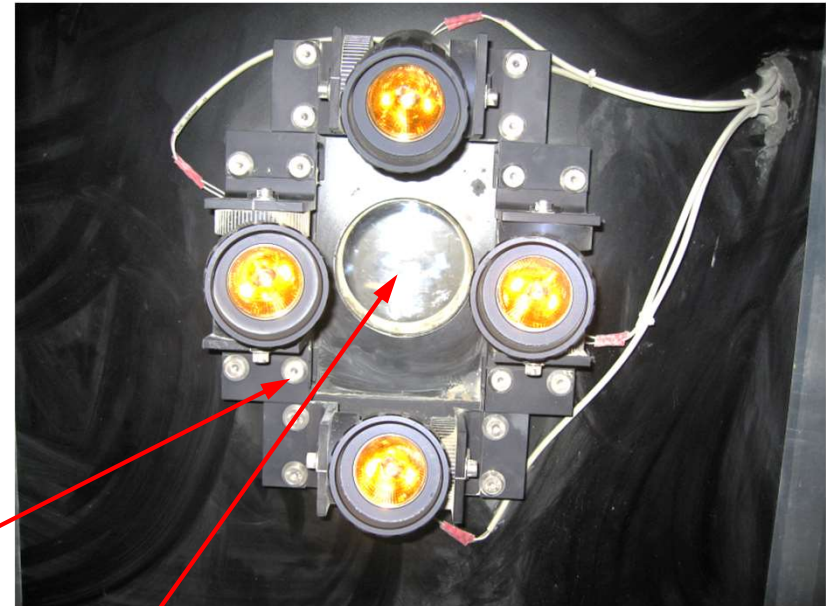
SpectraFlow Cement Analyzer Analyzer Pictures



Light and dust
shield

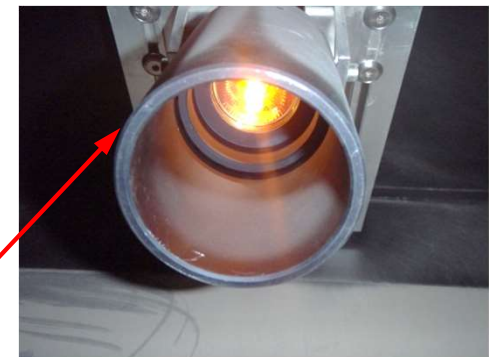
Service opening

Lamp mounting



Spectrometer
entry with lens

Lamp with dust
protection



SpectraFlow Cement Analyzer

Installation Example – 2 ASA on parallel airslides



Note: rain and sun roof will be installed

SpectraFlow Cement Analyzer

Installation Example – ASA after vertical raw mill



SpectraFlow Cement Analyzer Installation Example – ASA



SpectraFlow Cement Analyzer Installation Example – ASA



SpectraFlow Cement Analyzer Installation Example – ASA



SpectraFlow Cement Analyzer

Installation Example – AS calibration sampling procedure





SpectraFlow On-Line Analyzer RDF Feasibility Study

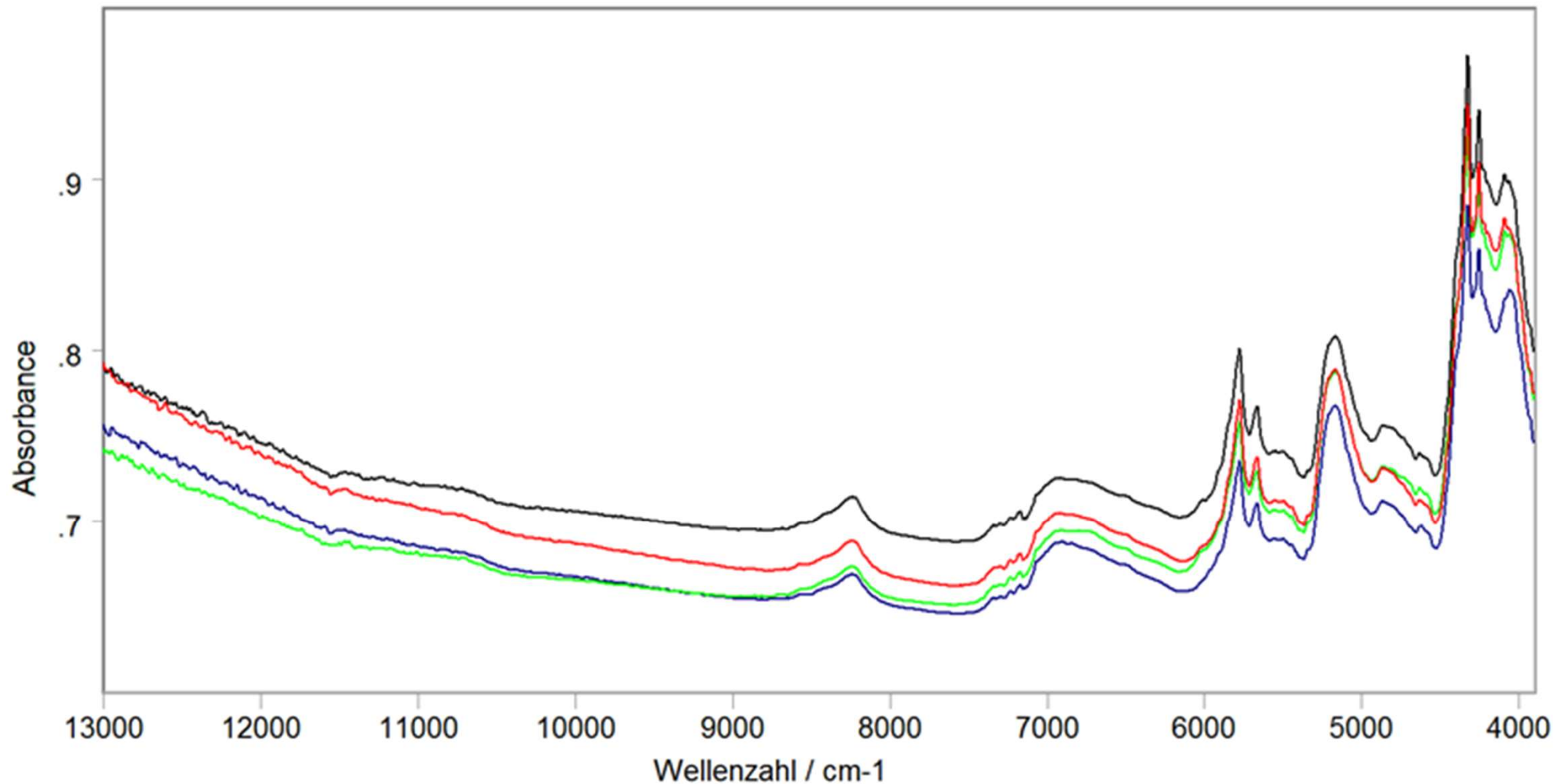
SpectraFlow Online Analyzer

RDF Samples

Labor-Nr.		30562-15	30563-15	30564-15	30565-15	30566-15	30644-15	30645-15	30646-15	30647-15
Vers.		1	1	1	1	1	1	1	1	1
Probenbez.	Einheit	Probe 1 Kunststoffreste	Probe 2 Kunststoffreste 0,86 % Cl	Probe 3 Kunststoffreste 0,98 % Cl	Probe 4 Kunststoffreste 1,55 % Cl	Probe 5 Kunststoffreste 0,64 % Cl	Probe 6 Kunststoffreste	Probe 7 Kunststoffreste	Probe 8 Kunststoffreste	Probe 9 Kunststoffreste
Störstoffe (nichtbrennbar)	%	1.32	keine				0.12	keine	0.33	0.32
Grobe Feuchte	%	10.5	14.6	17.8	11.1	10.3	13.6	23.5	16.6	14.5
Cl (i.an.) - Brennstoffe	%			0.98	1.55	0.64	0.61	0.36	1.82	1.59
Schwefel (CS-Analysator)	%	0.30	0.08	0.09	0.07	0.85	0.66	0.10		
Cd-ICP	mg/kg	3.58		0.51	0.29	0.24	2.81	0.50	3.48	
Cr-ICP	mg/kg		21	58		9	105	21	35	112
Hg-AMA	mg/kg	0.151	0.042	0.049		0.029	0.170	0.030		0.180
P-ICP	mg/kg	422			319	17	434	197	305	401
Ti-ICP	mg/kg	<0,740	<0,750	<0,730	<0,720	<0,710	<0,730	<0,750	<0,740	<0,740
Bemerkung		ICP: Ti-Wert unterhalb der Nachweisgrenze	ICP: Ti-Wert unterhalb der Nachweisgrenze	ICP: Ti-Wert unterhalb der Nachweisgrenze	ICP: Ti-Wert unterhalb der Nachweisgrenze	ICP: Ti-Wert unterhalb der Nachweisgrenze	ICP: Ti-Wert unterhalb der Nachweisgrenze	ICP: Ti-Wert unterhalb der Nachweisgrenze	ICP: Ti-Wert unterhalb der Nachweisgrenze	ICP: Ti-Wert unterhalb der Nachweisgrenze

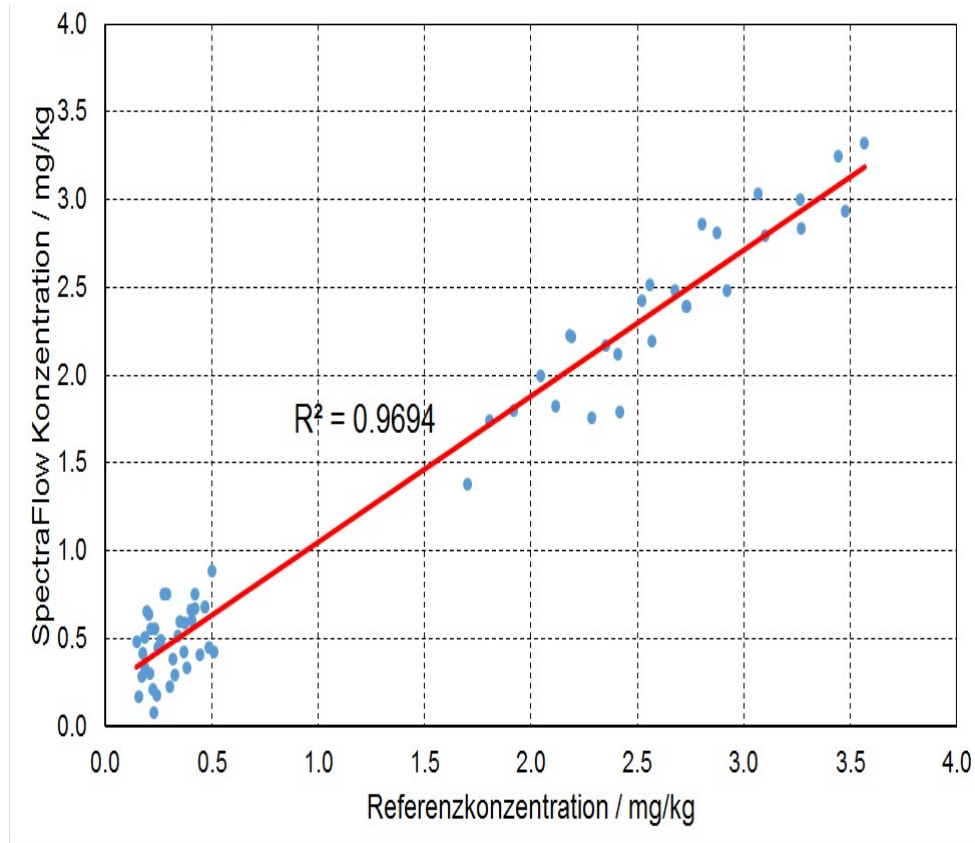
SpectraFlow Online Analyzer

RDF Samples – 4 Spectra of a sample

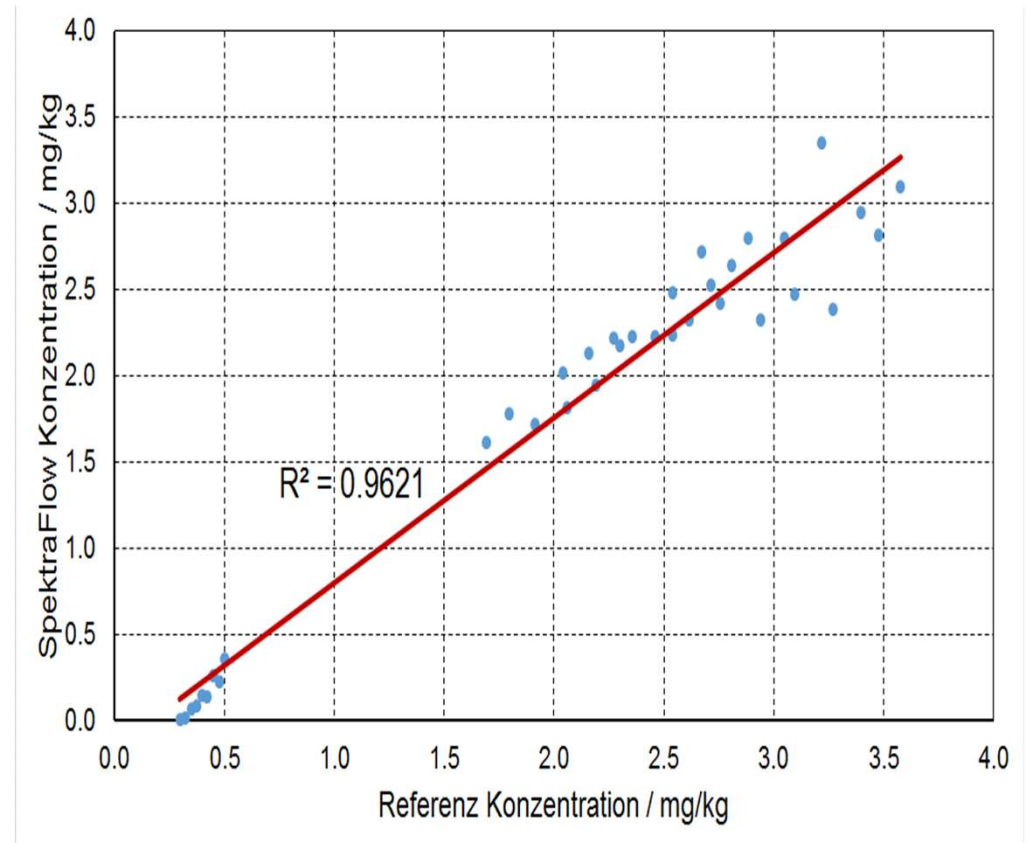


SpectraFlow Online Analyzer

RDF Samples – Kalibration für Cadmium



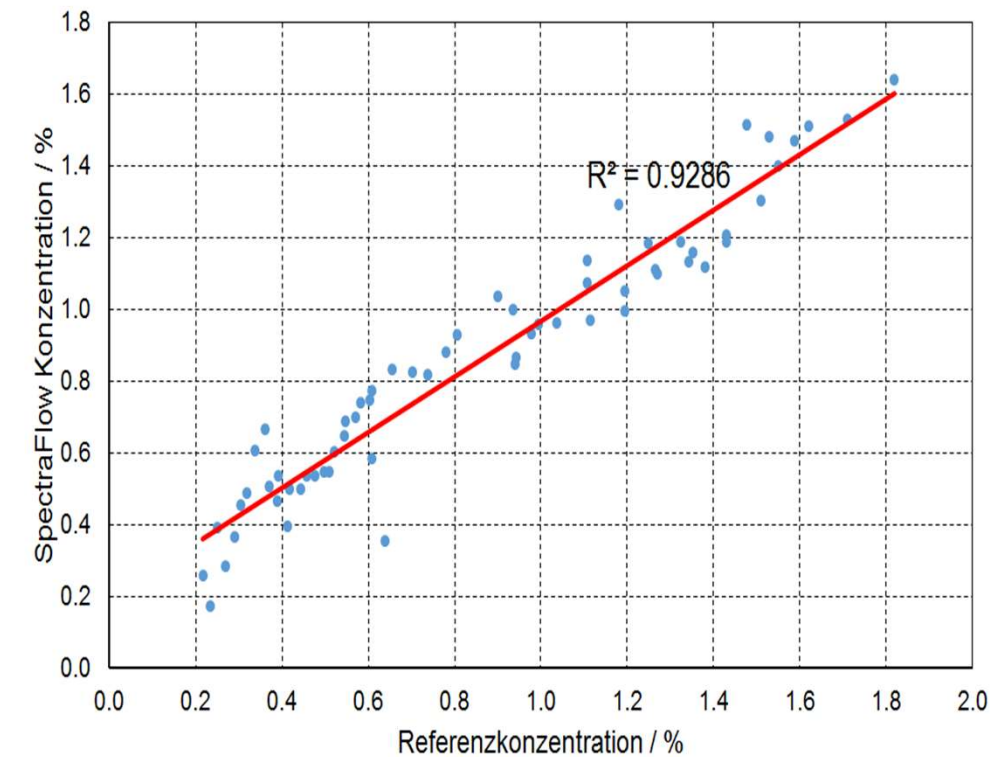
Calibration curve



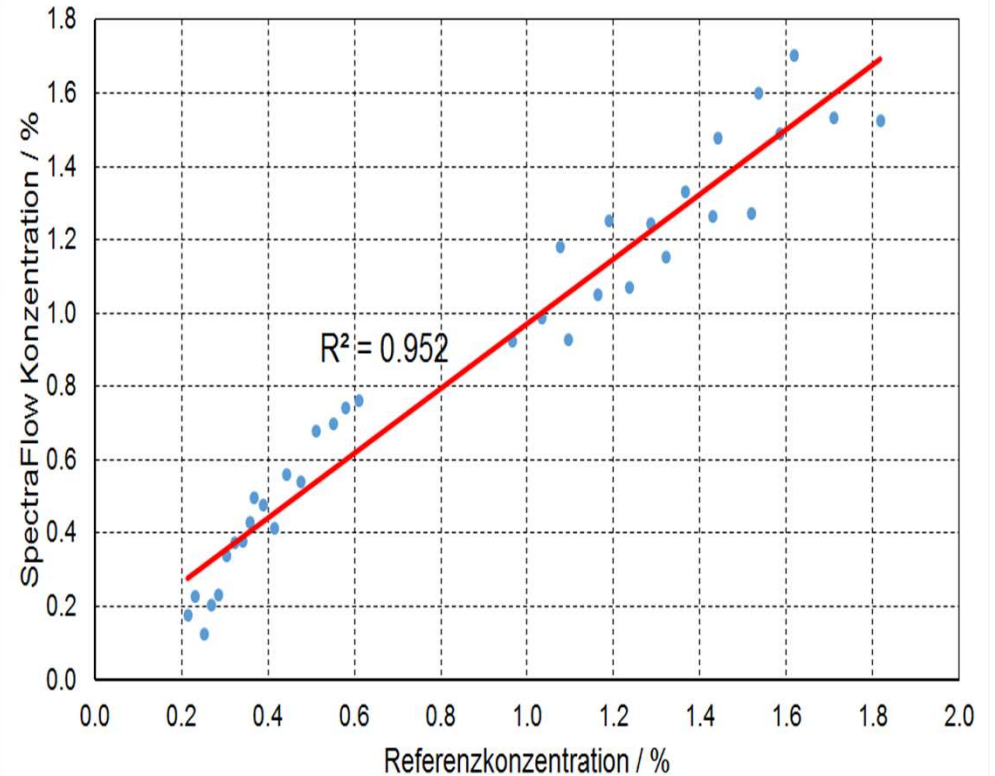
Validation set

SpectraFlow Online Analyzer

RDF Samples – Kalibration für Chlor



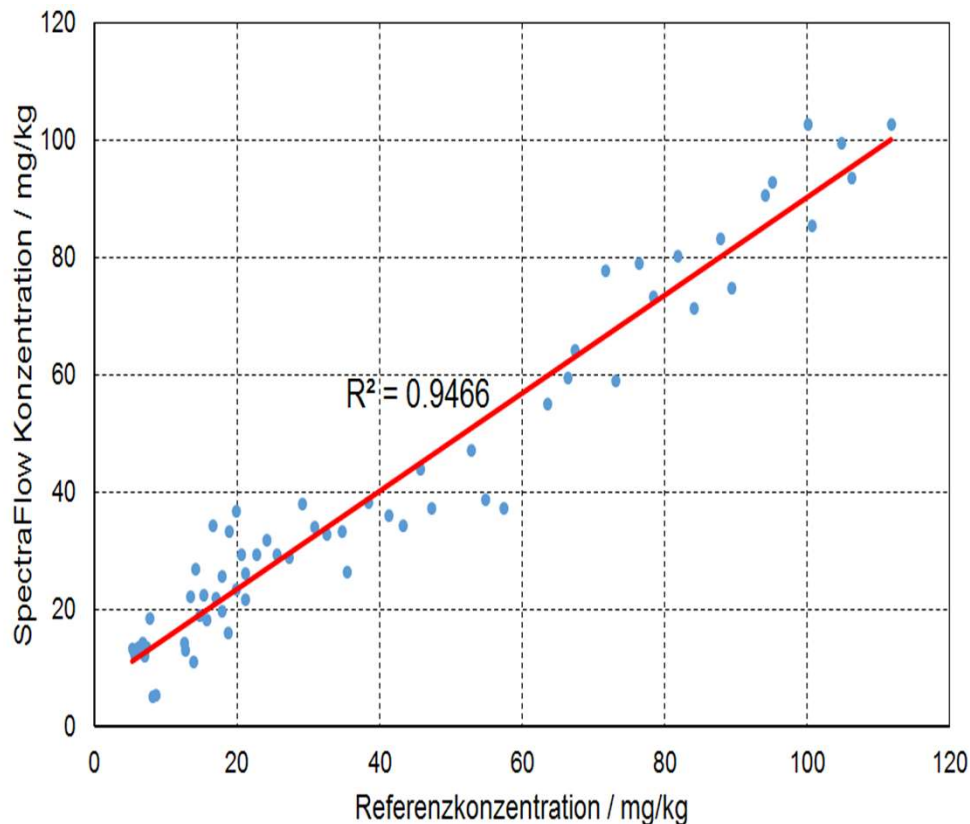
Calibration curve



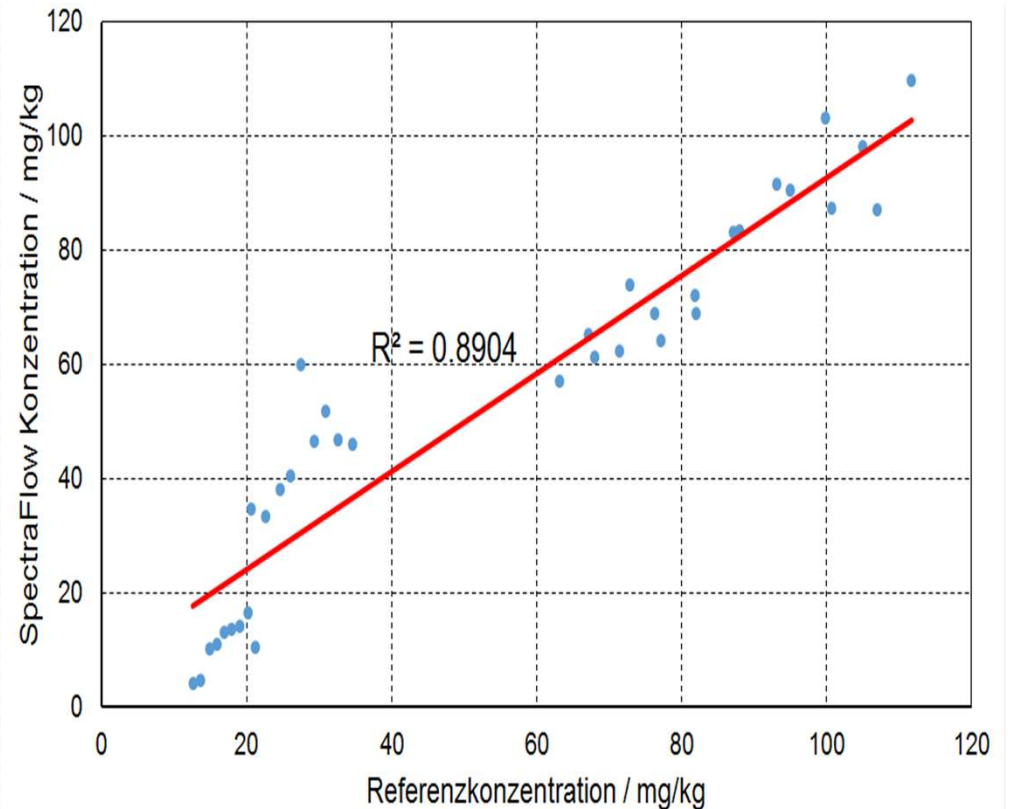
Validation set

SpectraFlow Online Analyzer

RDF Samples – Kalibration für Chrom



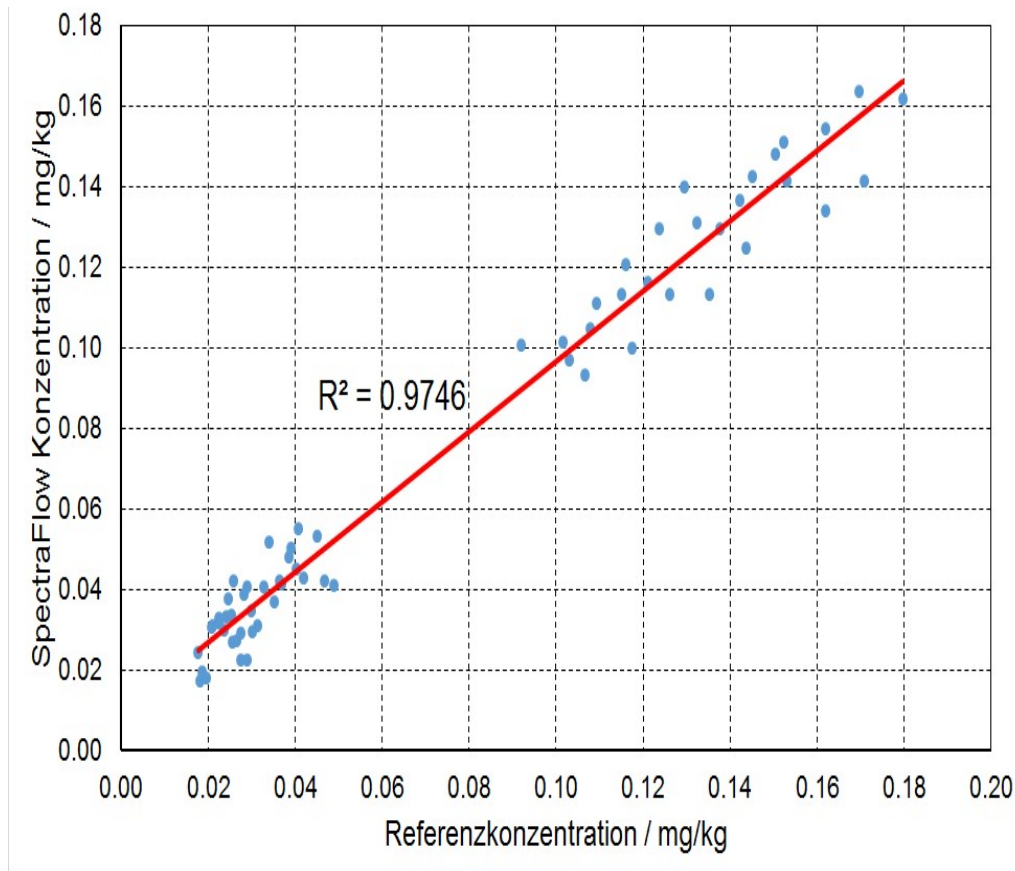
Calibration curve



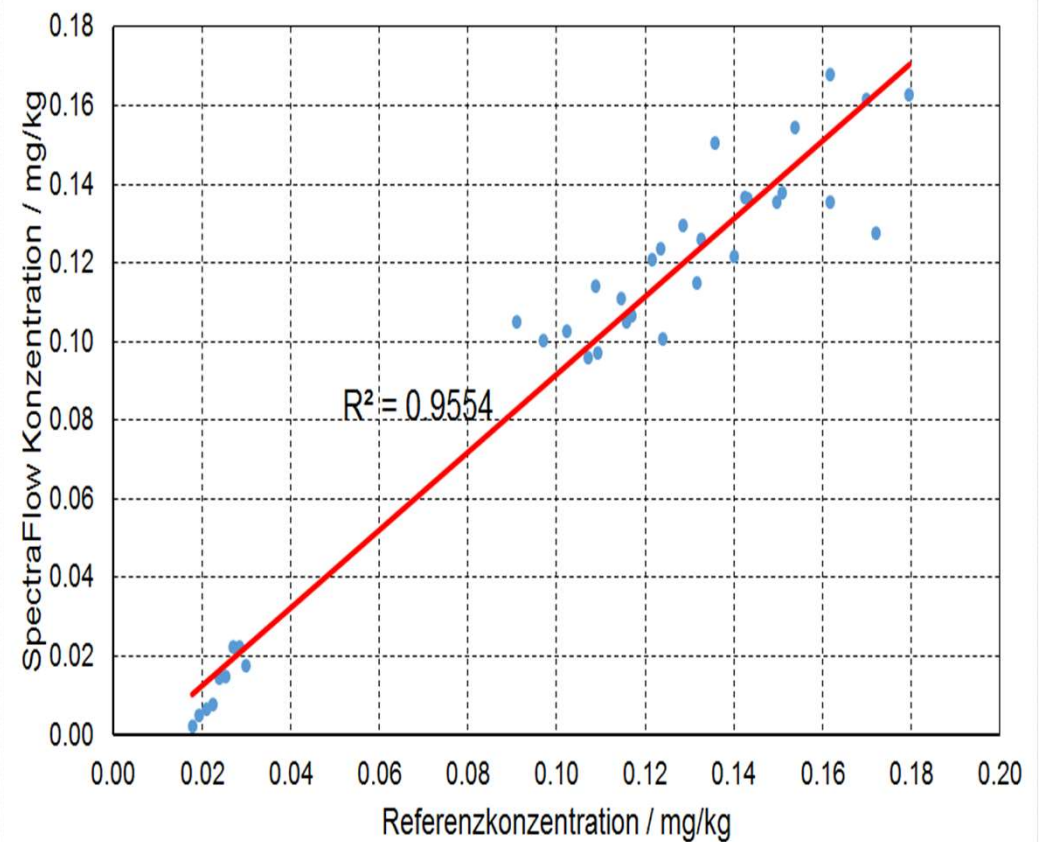
Validation set

SpectraFlow Online Analyzer

RDF Samples – Kalibration für Mercury



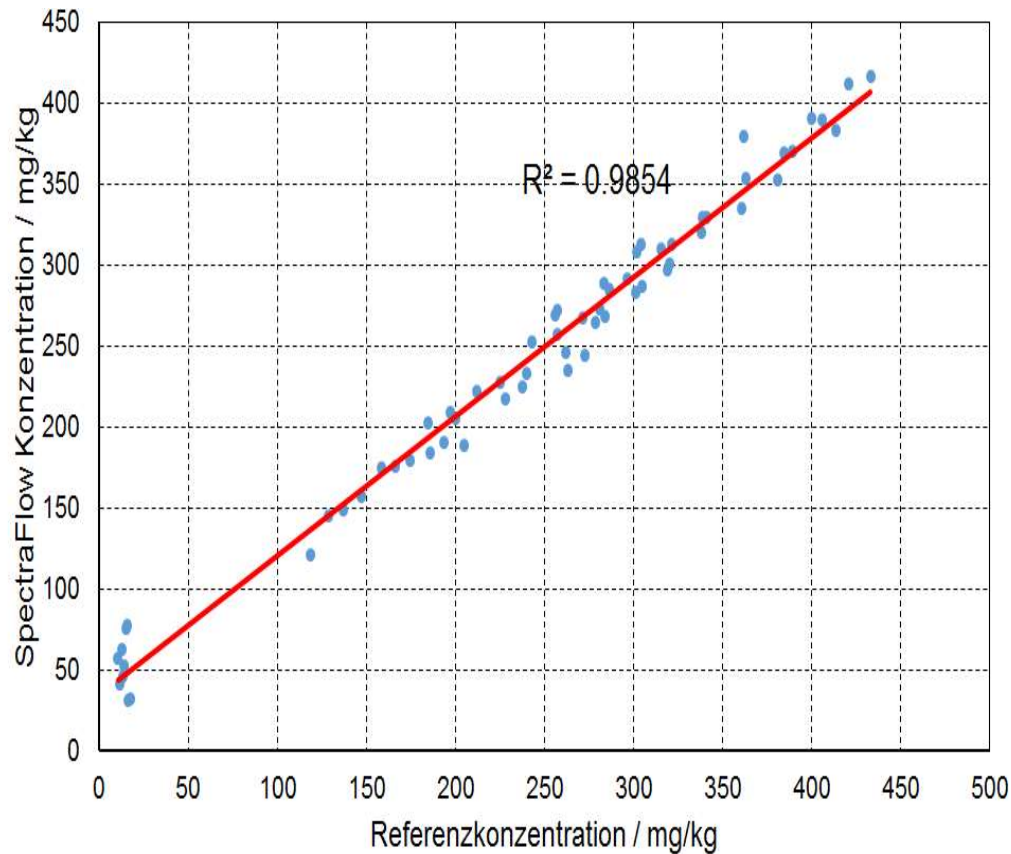
Calibration curve



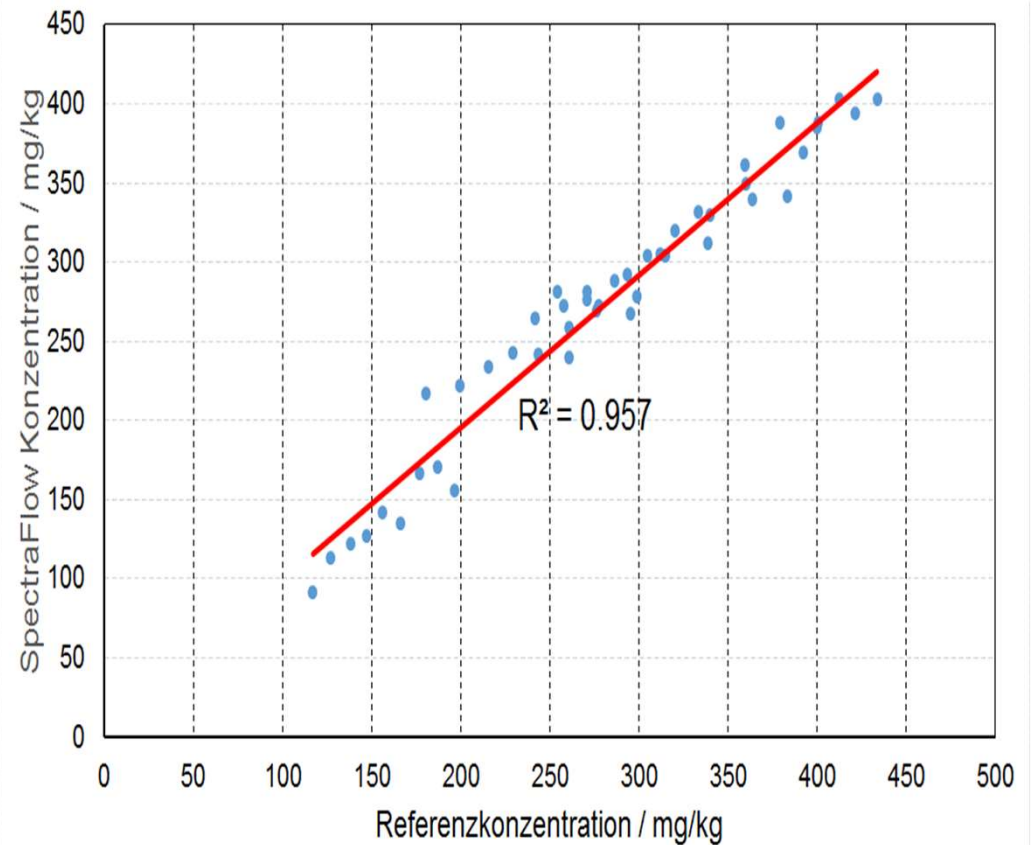
Validation set

SpectraFlow Online Analyzer

RDF Samples – Kalibration für Phosphor



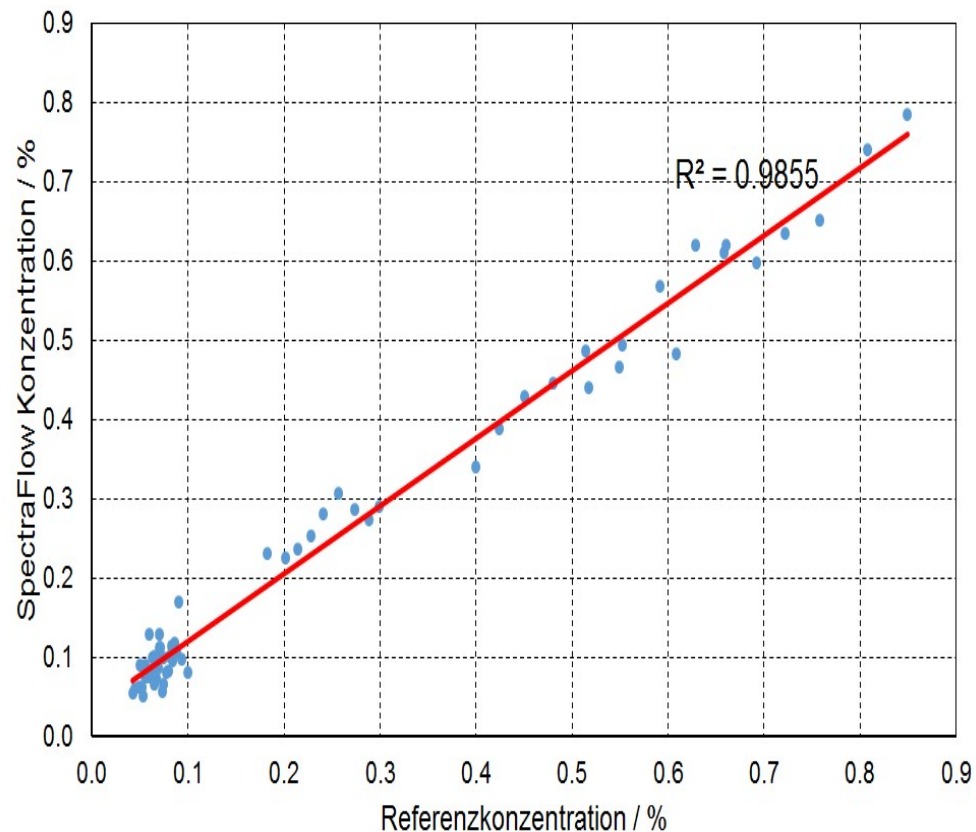
Calibration curve



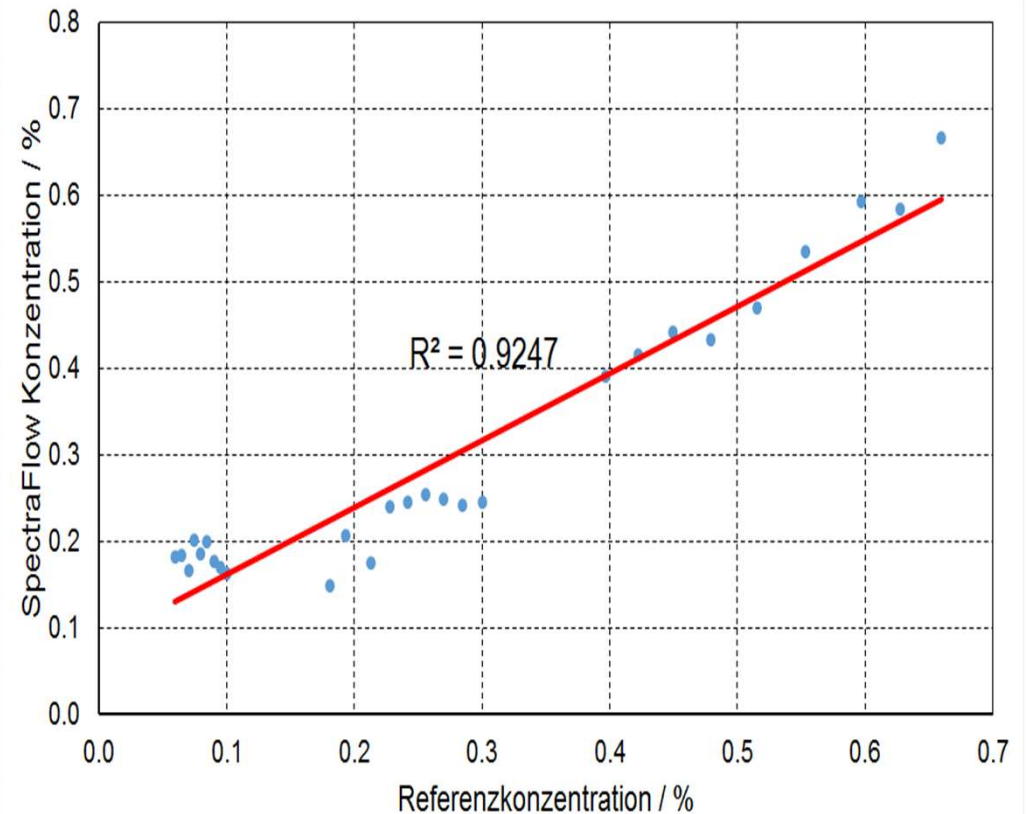
Validation set

SpectraFlow Online Analyzer

RDF Samples – Kalibration für Schwefel



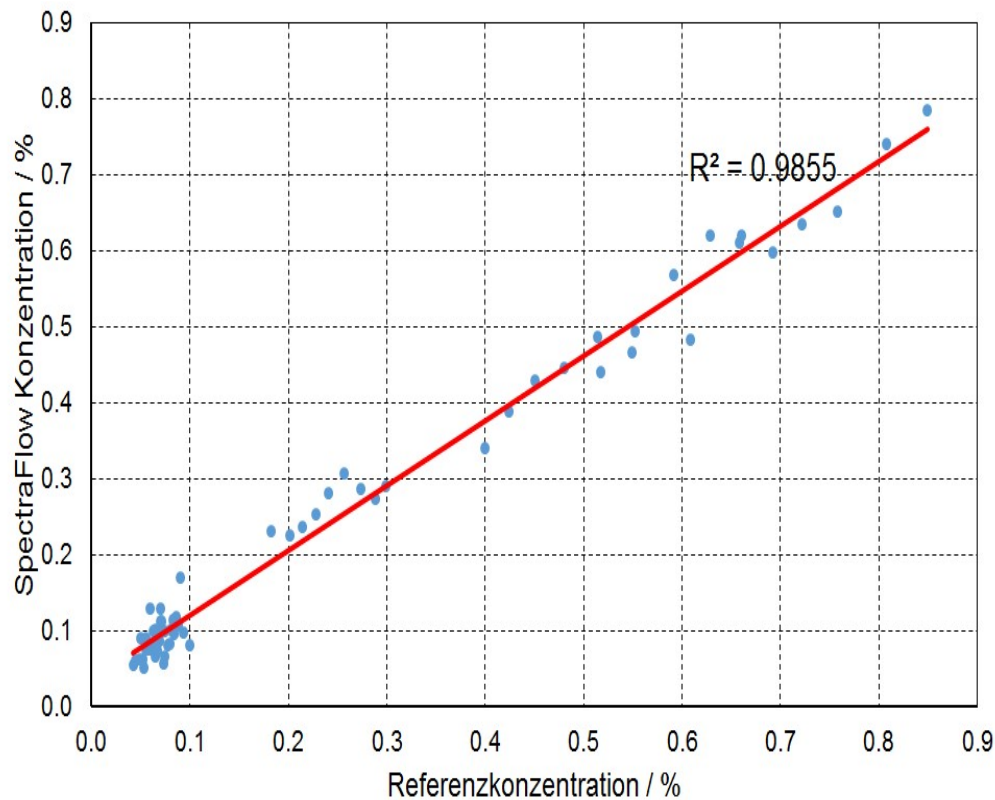
Calibration curve



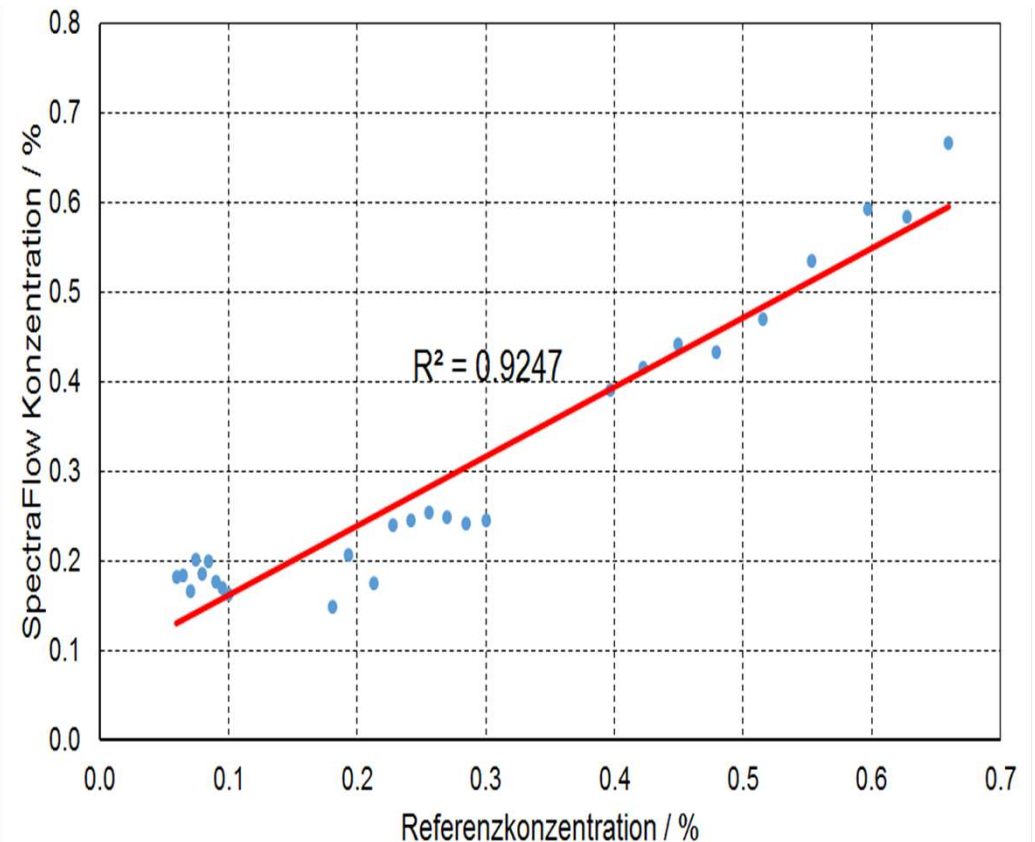
Validation set

SpectraFlow Online Analyzer

RDF Samples – Kalibration für Schwefel



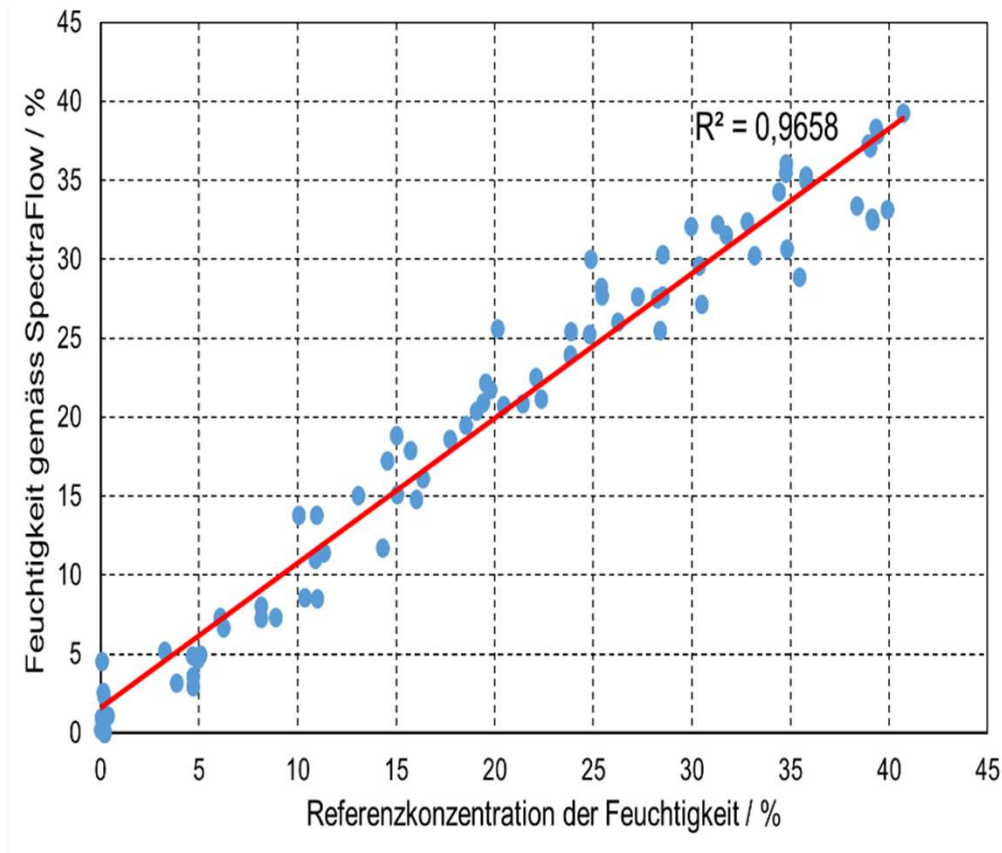
Calibration curve



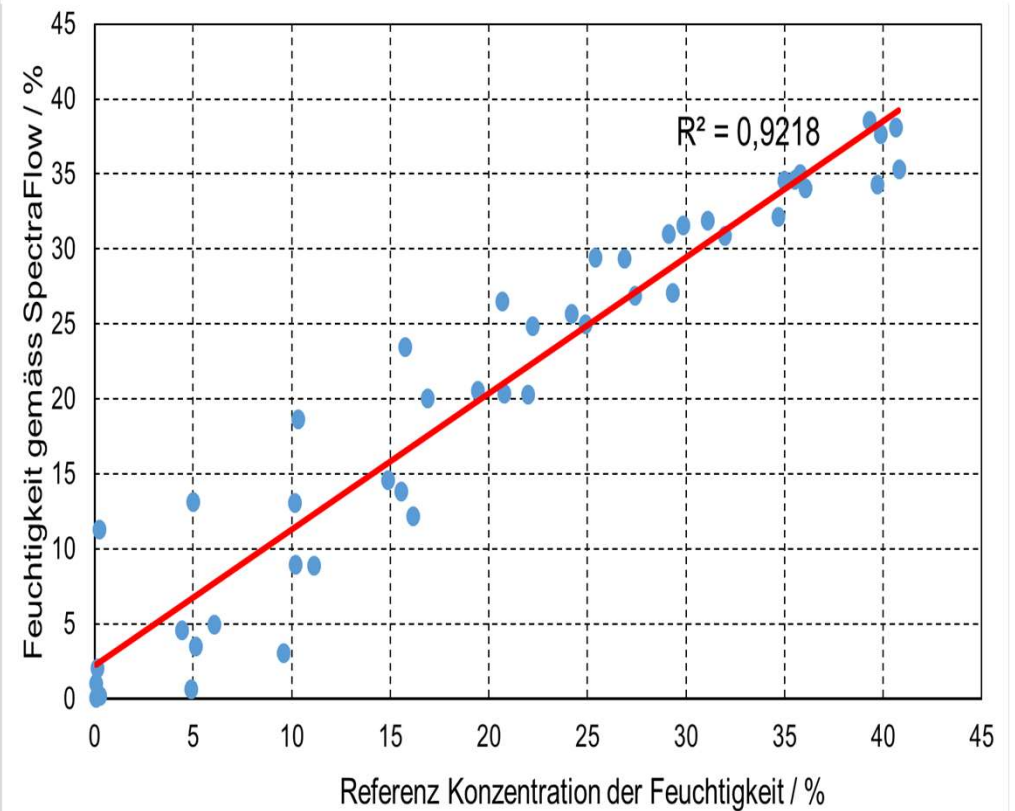
Validation set

SpectraFlow Online Analyzer

RDF Samples – Kalibration für Feuchte



Calibration curve



Validation set

SpectraFlow Online Analyzer

RDF Samples – Ergebnisse der Blindproben

Probe	Cd / mg/kg	Cl / %	Cr / mg/kg	Hg / mg/kg	P / mg/kg	S / %
Probe 1_1		1.126	104.48			
Probe 1_2		1.079	92.91			
Probe 2	0.564	1.066			323.36	
Probe 3					280.16	
Probe 4			39.47	0.072		
Probe 8_1				0.08		0.083
Probe 8_2				0.089		0.085
Probe 9_1	1.805					0.219
Probe 9_2	1.75					0.279

Vorhersage
mittels dem
SFA Modellen

Probe	Cd / mg/kg	Cl / %	Cr / mg/kg	Hg / mg/kg	P / mg/kg	S / %
Probe 1_1		1.24	84			
Probe 1_2		1.24	84			
Probe 2	0.86	0.86			267	
Probe 3					359	
Probe 4			34	0.070		
Probe 8_1				0.13		0.15
Probe 8_2				0.13		0.15
Probe 9_1	1.98					0.32
Probe 9_2	1.98					0.32

Kundendaten

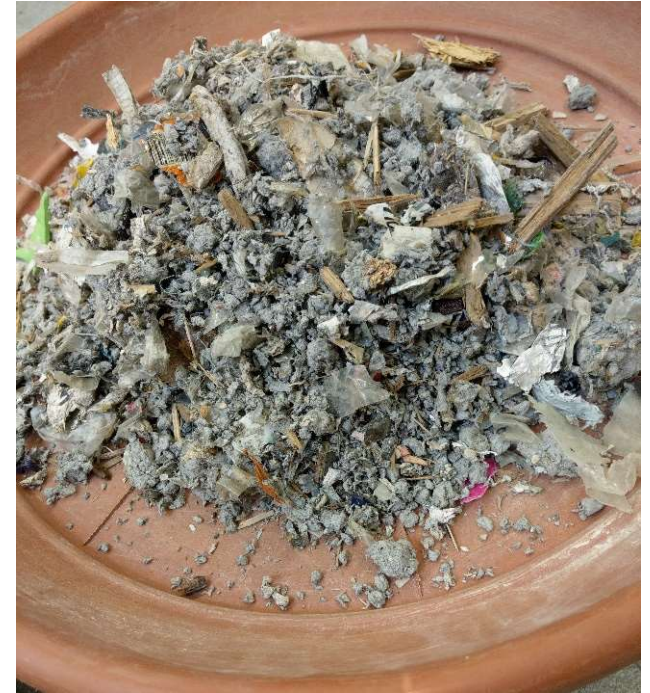
SpectraFlow Online Analyzer

RDF Samples – Re-Analyse der Blindproben

Sample		Probe 2				Probe 3				Probe 4			
Laboratory		Client	SFA	Client	Client	Client	SFA	Client	Client	Client	SFA	Client	Client
Analysis		A	B	C	D	A	B	C	D	A	B	C	D
Cl (i.an.)	%	0,86	1,07	1,40	0,50								
Cd-ICP	mg/kg	0,86	0,56	0,66	0,80								
Cr-ICP	mg/kg									33,80	39,50	40,40	15,90
Hg-AMA	mg/kg									0,05	0,07	0,11	0,08
P-ICP	mg/kg	267	323	1045	223	359	280	259	425				

SpectraFlow Online Analyzer

RDF Installation example @ UPM Germany







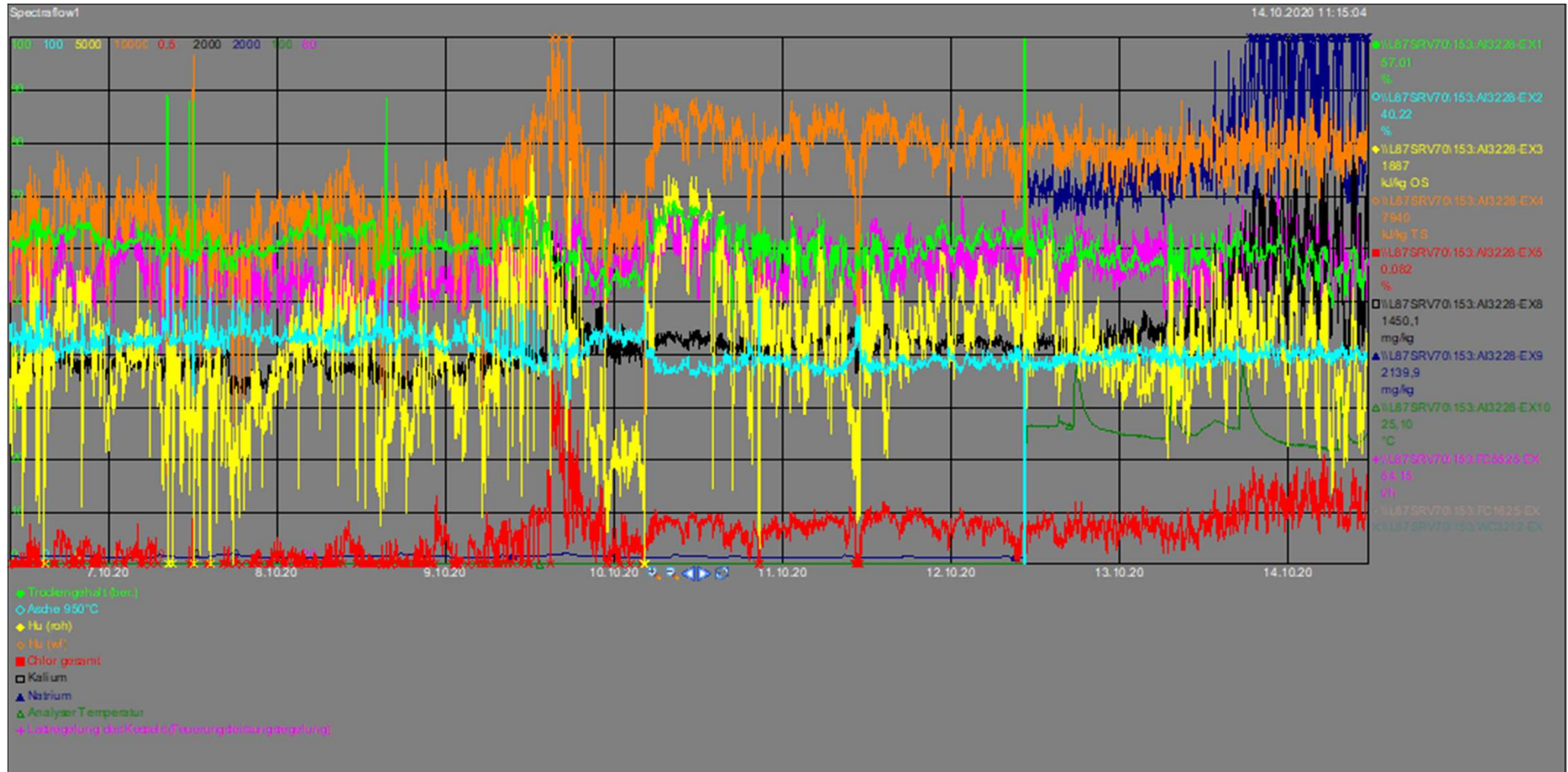
SpectraFlow Online Analyzer

RDF Installation example @ UPM Germany

		Min	Max	Min	Max	± absolut 1 Sigma	± % deviation*	Target range
		Measurement range (for calibration)		Typical measurement range		Performance guarantee		± 1 Sigma
Chlor, ges.	%	0,00	1,50	0,00	0,60	0,06	10,0	0,04
Lower heating value _{raw}	kJ/kg OS	1.800	10.000	2.500	6.500	360	9,0	250
Dry mass	%	40,0	80,0	55	75	2,0	10,0	1,5
Ash 950°C	%	25,0	55,0	25	50	2,0	8,0	1,5
C(total)	%	20,0	40,0	20	40	1,5	8,0	1,5
CaO	%	10,0	50,0	15	45	3,0	10,0	
Potassium	mg/kg	0	6000	300	5.000	250	5,0	200
Sodium	mg/kg	0	3000	500	2.600	250	12,0	

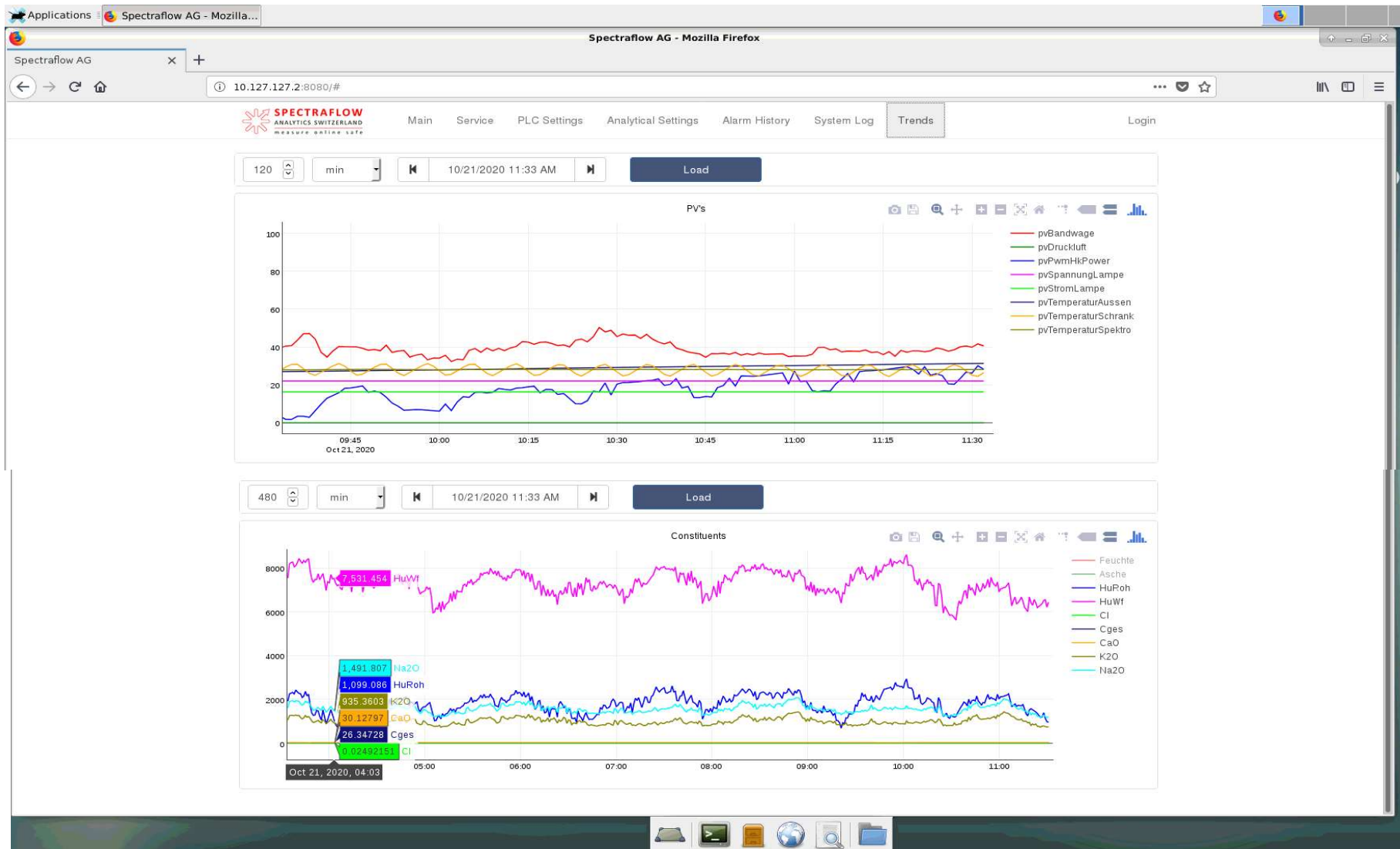
SpectraFlow Online Analyzer

RDF Installation example @ UPM Germany



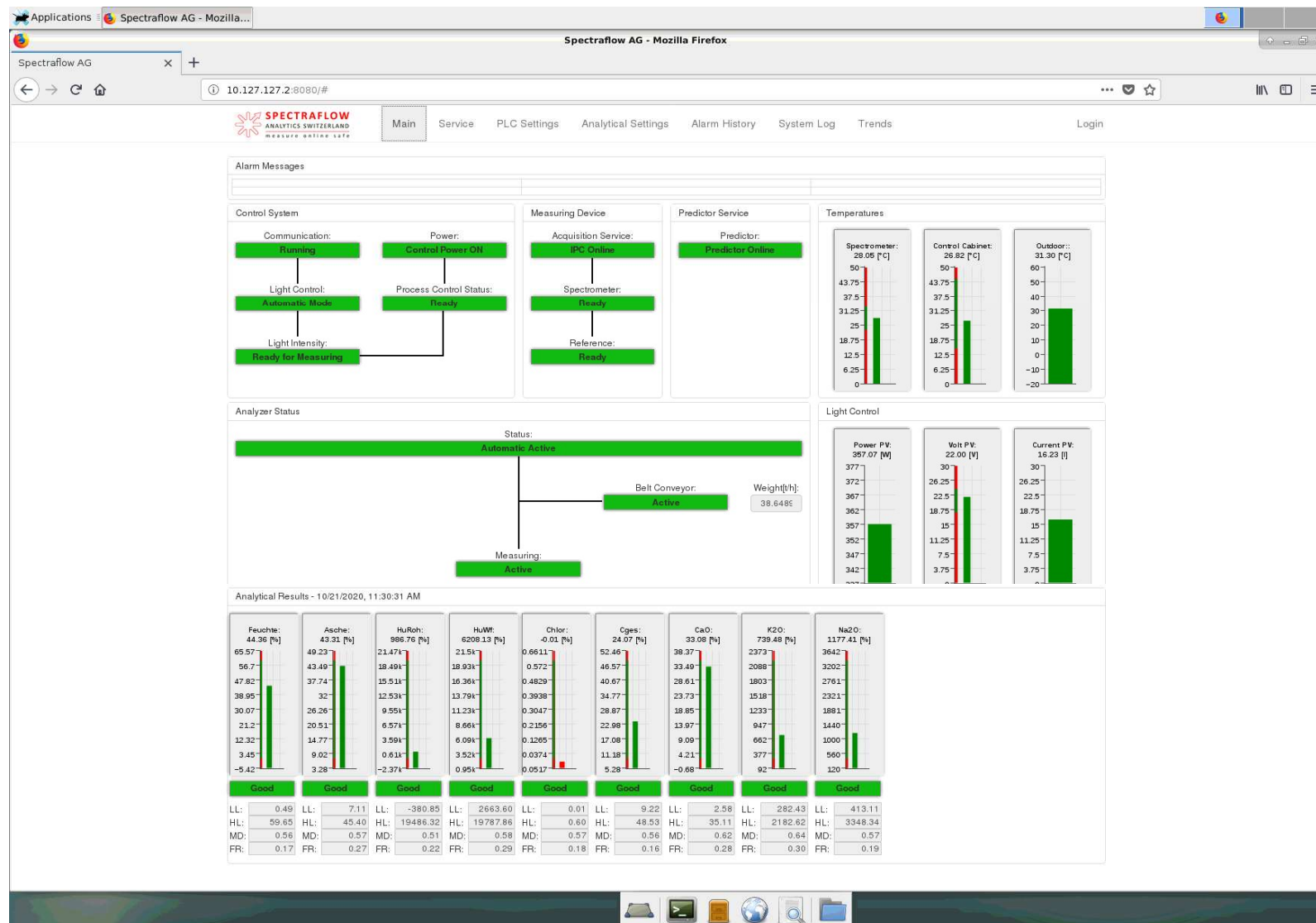
SpectraFlow Online Analyzer

RDF Installation example @ UPM Germany



SpectraFlow Online Analyzer

RDF Installation example @ UPM Germany



SpectraFlow Online Analyzer

UPM Germany – Technical paper

International Cement Review – March 2023

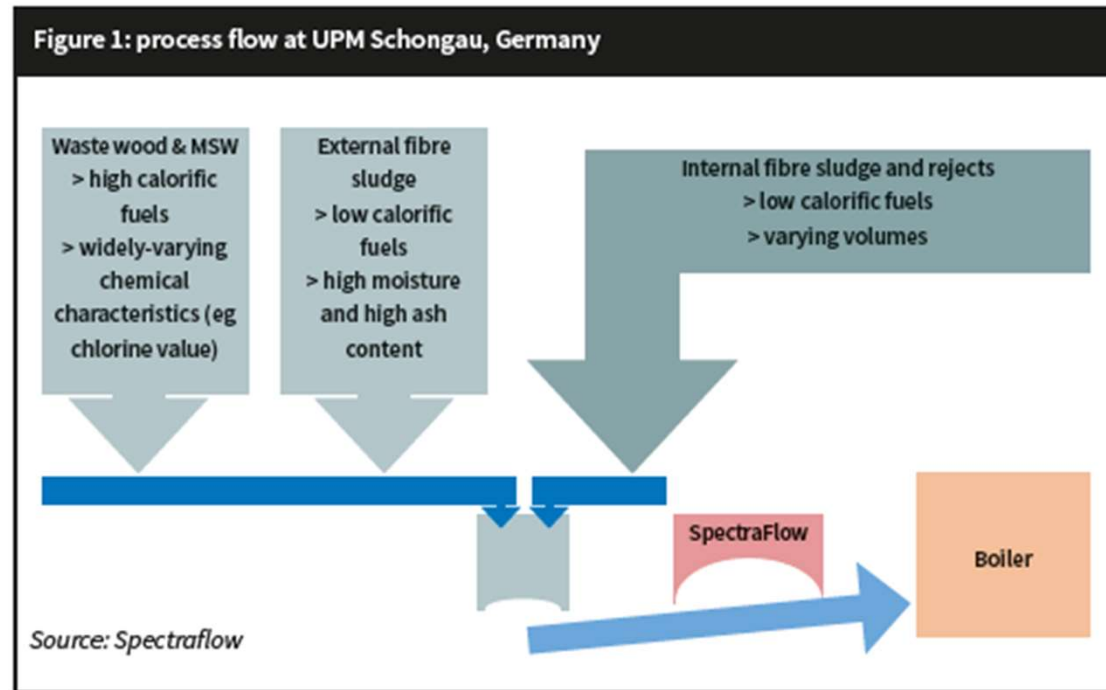
Real-time AF analysis

The wider range of alternative fuels (AFs) used has led to an increased need for real-time online fuel analysis, both by cement plants and AF suppliers. To help balance AF variations, UPM Schongau Paper Mill installed a SpectraFlow near-infra red crossbelt analyser.

■ *by **Katrin Sturm**, UPM Schongau, Germany, and **Petra Mühlen**, SpectraFlow Analytics Switzerland*

SpectraFlow Online Analyzer

UPM Germany – Technical paper



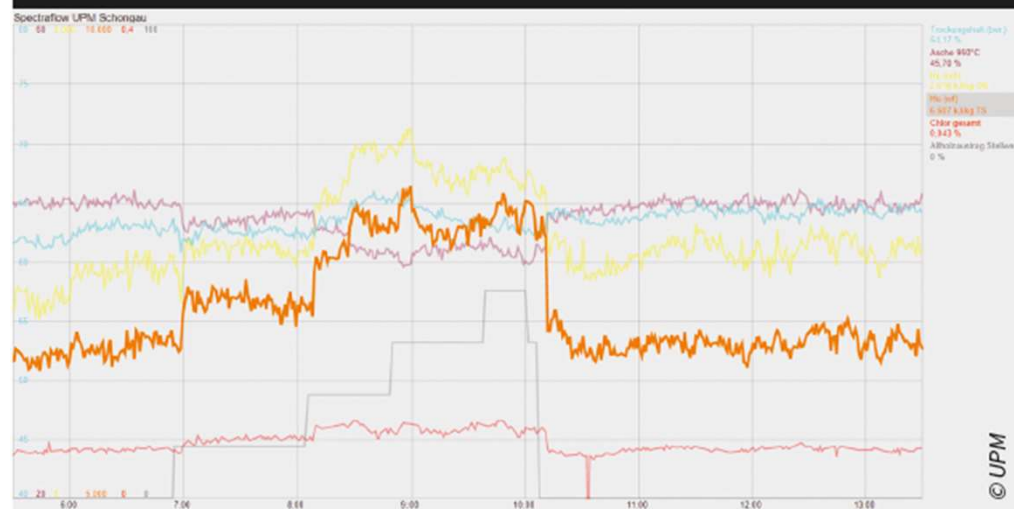
SpectraFlow Online Analyzer

UPM Germany – Technical paper

Figure 5: ash measurement during the on-off alternation of waste wood supply



Figure 8: online heating value measurement during increased waste wood supply





SpectraFlow On-Line Analyzer Reference List

SpectraFlow Cement Analyzer

Applications – Reference list

REFERENCE LIST: over 70 Analyzers in 26 countries, 6 Analyzers on delivery in 3 countries

<u>Customers</u>	<u>Country</u>	<u>Installation</u>
<u>Crossbelt Analyzer</u>		
Khoy Cement	Iran	Oct 10
Jura Cement (3 Anal.)	Switzerland	2010 - 2016
Yanbu Cement (2)	Saudi Arabia	2011 & 2015
Dillinger Huette	Germany	Dec 10
City Cement Co	Saudi Arabia	Jan 12
Cimsa	Turkey	May 17
Cemex	Spain	May 17
Baumit	Austria	Jul-17
Iron Ore Client (7 Anal.)	Japan	2017-2018
Mass Cement	Iraq	Jul-17
Cherat Cement	Pakistan	Jan-19
South32 (Bauxit)	Australia	Jun-19
Ciments Beni Saf	Algeria	Dec 19
AngloAmerican (4)	var.	2020
UPM	Germany	May 20
IberPotash	Spain	Oct 20
Ramco	India	Jan-22
Najran (2)	Saudi Arabia	Dec 21
National Cement	Kenya	Jul-22
Emirates Global Aluminium	UAE	Apr-21
Vale	Brazil	Jul-22
Bao Steel	China	Sep-21
01-02-2022		

<u>Customers</u>	<u>Country</u>
<u>Airslide Analyzer</u>	
Intercement	Brazil
Kahramanmaras (2)	Turkey
China (2)	China
Sanko	Turkey
Cimsa (3)	Turkey
Limak	Turkey
Oman Cement	Oman
South Korea (4)	S. Korea
Barrick Gold (2)	USA
Nuh Cimento	Turkey
Cherat Cement	Pakistan
Taheiyo Cement	Japan
Heidelberg	France
LafargeHolcim	El Salvador
Heidelberg	Morocco
Ramco	India
National Cement	Kenya
Ciments du Sahel (2)	Senegal
LafargeHolcim	El Salvador

SpectraFlow Cement Analyzer Applications – Reference list

