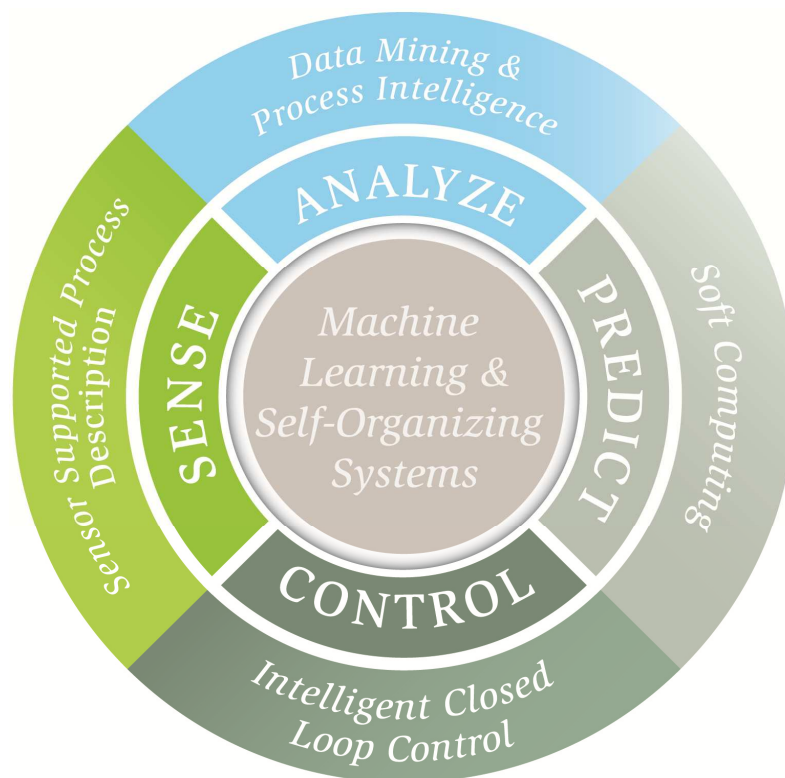


Powitec solutions for Waste-To-Energy Plants



Upgradable intelligent solutions for process optimisation

SENSE *Sensor Supported Process Description*

Generation of high resolution on-line process characteristics

PiT Indicator

ANALYSE *Data Mining and Process Intelligence*

Mathematical-statistical correlation analysis via intelligent algorithms

PiT Data Mining

PREDICT *Soft Computing*

On-line computation of expected development for selected process values

PiT Predictor

CONTROL *Intelligent Closed Loop Control*

Auto-optimising closed loop control for complex processes

PiT Navigator

PiT = Powitec Intelligent Technologies

for

◆ Boiler

◆ Flue Gas Cleaning

Boiler

SENSE

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Flue Gas Cleaning

CONTROL

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Solutions for the Boiler

SENSE:

PiT Video

Video camera for permanent visual flame inspection.

Benefits:

- ◆ Flame inspection allows for in time reaction
- ◆ Visual supervision of burn out line

Features:

- ◆ Rugged German design
- ◆ Endoscope: Electronic is temperature protected
- ◆ Air or water cooling
- ◆ Supervision of temperatures and cooling media supply
- ◆ High availability



PiT Indicator

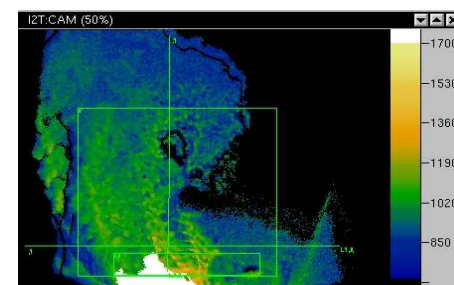
Intelligent Thermography for indicating temperature and flame variations in their transient behaviour

Benefits:

- ◆ Chronological display of location and volume of flame body and slagging = [Active flame control and slagging detection](#)
- ◆ Temperature Analysis = [Information direct from the boiler inside](#)
- ◆ Integration of Process Control System data = [Correlation of temperatures and slagging with process data](#)
- ◆ Possible upgrade to PiT Navigator = [fully automatic combustion optimisation by closed loop control of the air/fuel ratio](#)

Features:

- ◆ RGB Camera = [Reliable temperature analysis](#)
- ◆ Adaptive Electronic Dust Filter = [Clear pictures](#) even in dusty situations
- ◆ Robust German design = [Low Maintenance](#)
- ◆ Freely definable Regions of Interest and Polylines = [permanent information](#) from decisive areas
- ◆ Output from and Input to the PCS = [Correlations](#) show variations



PiT Indicator Burn Out Line

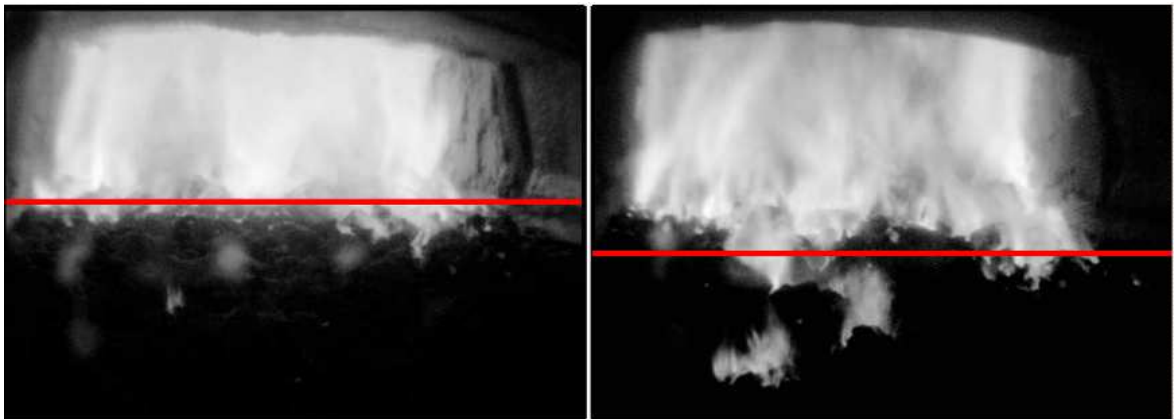
Permanent indication and automatic analysis of the Burn Out Line position

Benefits:

- ◆ Full automatic analysis of Burn Out Line position
- ◆ Alarming of unwanted situation with percent-indication and/or traffic light
- ◆ Avoidance of unburned material in the slag

Features:

- ◆ RGB Camera = **Reliable temperature analysis**
- ◆ Adaptive Electronic Dust Filter = **Clear pictures** even in dusty situations
- ◆ Robust German design = **Low Maintenance**
- ◆ Freely definable Regions of Interest and Polylines = **permanent information** from decisive areas
- ◆ Output from and Input to the PCS = **Correlations** show variations



PiT FluxStylus

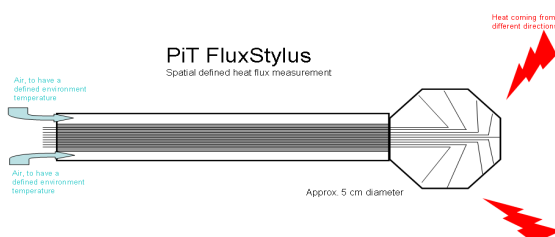
Spatial defined heat flux measurement

Benefits:

- ◆ Spatial temperature resolution even from mounting positions at confined spaces
- ◆ Temperature Analysis = **Information direct from the boiler inside**

Features:

- ◆ Measurements 9 to 5 from different positions
- ◆ Robust German design = **Low Maintenance**
- ◆ Sophisticated data processing, sophisticated data displaying tools
- ◆ Output from and Input to the PCS = **Correlations** show variations

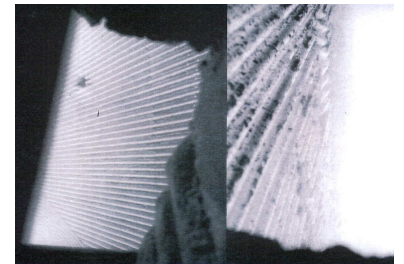


PiT SlaggingDetector

Detect the amount of slagging at the steam generator walls and at the super-heater with Powitec's advanced picture analysis tool on basis of optical information in correlation with temperature information. Gained information can be used for alarming function.

Benefits:

- ◆ Chronological display of position and volume of slagging = **Active supervision of slagging**
- ◆ Temperature Analysis = **Information direct from the combustion chamber and the super heater**
- ◆ Displaying data of process control system = **Visual correlation of temperatures and slagging with process data**
- ◆ Possibility to upgrade to PiT Navigator = **Reduction of slagging by auto-optimising and air-/ fuel-ratio**



Features:

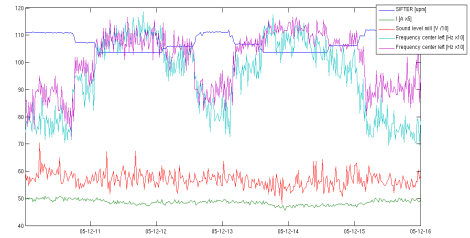
- ◆ RGB camera (see page 4)= **reliable temperature analysis**
- ◆ Adaptive Electronic Dust Filter = **clear pictures even in dusty atmospheres**
- ◆ Robust German design = **low maintenance**
- ◆ Air or water cooled
- ◆ Optionally: Retraction Unit or Anti Slagging Unit
- ◆ Free definable Regions of Interest and Polylines = **permanent information** from decisive areas
- ◆ Bi-directional PCS connection = **Correlation analysis**

PiT Data Mining

Analysis of historical DCS/PCS data towards optimisation potential with the aid of statistical software and neural nets; recommendations for hardware modifications; on site test measurement with mobile optical sensor

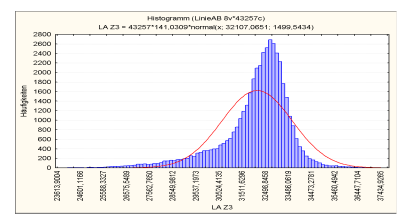
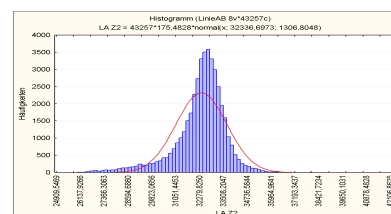
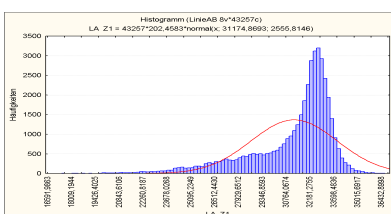
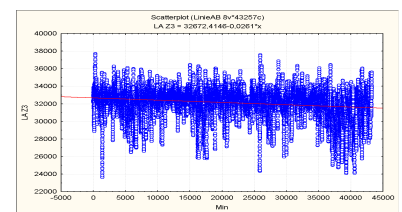
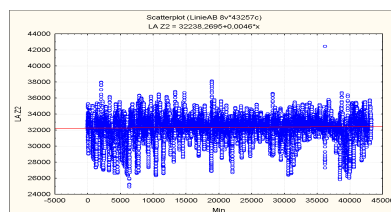
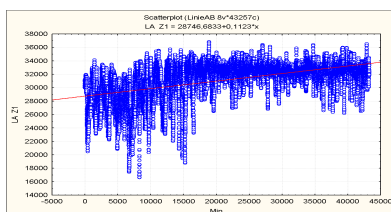
Benefits:

- ◆ Optimisation potential with calculated amortisation time
- ◆ Information about priorities depending performance
- ◆ Comparability of different production lines
- ◆ Findings of new significant correlations
- ◆ Discovering new optimisation potentials



Features:

- ◆ Data mining supported with mobile sensors (PiT Indicator)
- ◆ Data significance analysis with
 - Classification and cross correlation
 - Deviation Analysis
 - Dependence Analysis
 - Multidimensional regressions
 - Clustering
 - Impact Prognosis
- ◆ Identification of the most important process channels or process information
- ◆ Elimination of idle time through the process sequence
- ◆ Recognition of interdependencies
- ◆ Generation of models representing the behaviour of processes
- ◆ Finding potential areas for optimisation and drafting solution strategies
- ◆ Explanation of unusual situations and phenomena of the processes

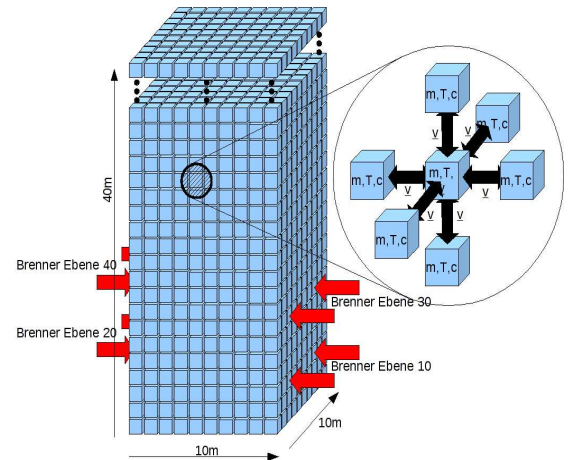


PiT Online CFD

Online CFD (*Computational Fluid Dynamics*): Determination of temperature, convection, heat radiation, flue gas mass flow every 15 seconds.

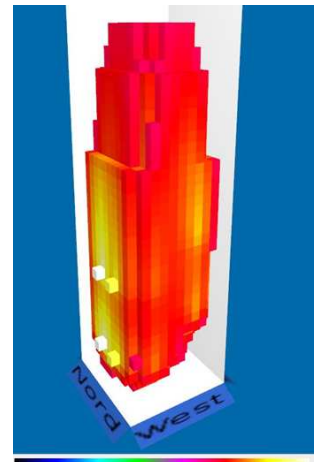
Benefits:

- ◆ Online inside view of heat allocation (and/or NOx) in the first draft according to the current process status (waste type, slagging)
- ◆ Fast manual interventions
- ◆ Discovering new optimums
- ◆ Analysis of cause of damage
- ◆ Analysis for optimising changes (i. e. SNCR lances/nozzles and spray amount)
- ◆ Online analysis in different operating states

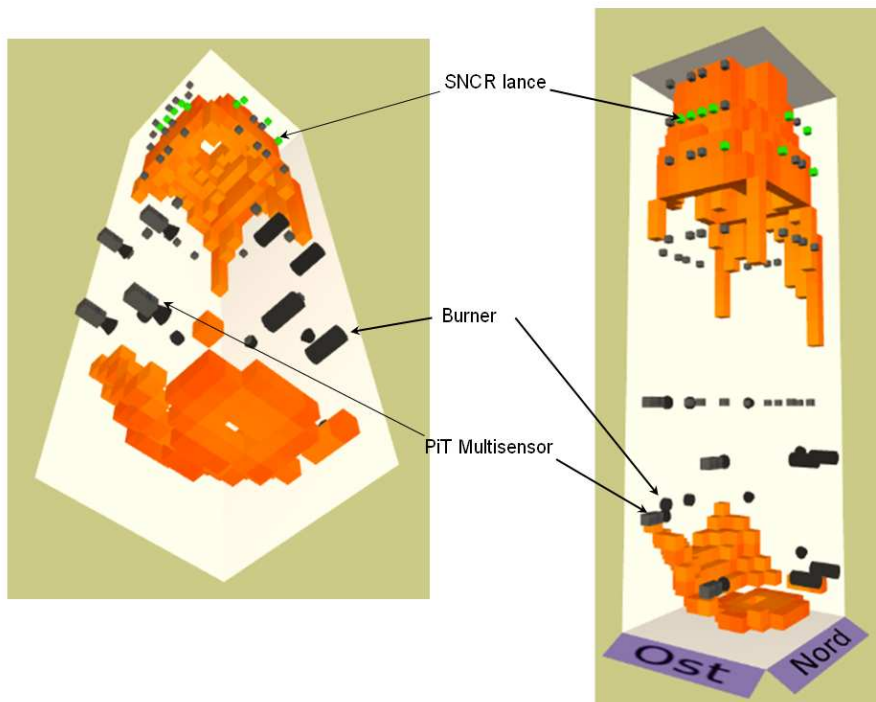


Features:

- ◆ Modelling of the boiler, online modelling of convection and heat radiation, online calibration against existing measurements
- ◆ Refresh rate: Every 15 seconds
- ◆ Free definable viewing angles, temperature areas
- ◆ Manual or full automatic reporting
- ◆ Export-Function



Heat distribution in a boiler



Orange boxes only displaying temperatures between 900 and 1000°C, the optimal temperature window for SNCR spraying

PREDICT:

PiT Predictor

Timely knowledge of process changes through permanent on-line information on process values like NO_x, SO_x, CO

Benefits:

- ◆ Accurate prediction of i. e. NO_x, SO_x, CO
Prediction accuracy worldwide unbeaten
- ◆ Timely knowledge of process changes through permanent on-line
- ◆ Process stabilisation

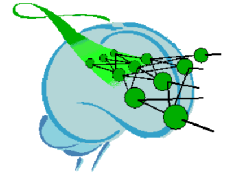
Features:

- ◆ Continuous Online-Prediction of key process parameters
- ◆ Self learning adaptive software based on Neural Nets
- ◆ Integration of additional Information from the process (PiT Indicator, PiT FluxStylus) where helpful
- ◆ High availability, security features
- ◆ Upgradeable to PiT Navigator = Full Automatic Combustion Control

CONTROL:

PiT Navigator

Advanced Auto-Optimiser for a permanent optimisation of the air/fuel ratio and distribution. Digital image processing and model predictive control optimise Waste To Energy plants. A combination of sophisticated optical sensors with self learning neural nets reduces steam variations and increases throughput

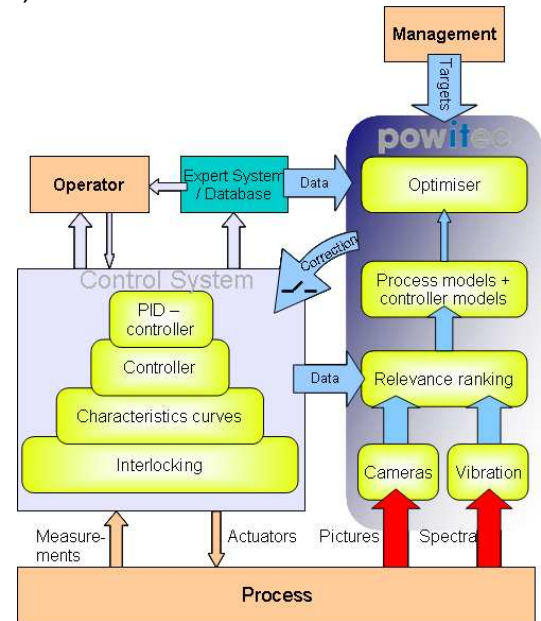


Benefits: (depending on individual target combination)

- ◆ 3 – 7 % production increase (same or better emission levels)
- ◆ Less than +/- 2 % steam variation
- ◆ Significant saving of supportive fuels
- ◆ 70% less CO
- ◆ Uniformisation from shift to shift
- ◆ Fast reaction to changing heat values
- ◆ Permanent self learning (automatic re-adjusting)
- ◆ Easy to handle, targets easy to change
- ◆ Up to 99% fully automatic operation

Features:

- ◆ High-Speed cameras observe the combustion and - through a patented pattern recognition process - extract significant features of the ignition-, combustion- and burnout- behaviour, temperatures, position and emissions
- ◆ Process data from the PCS are permanently correlated with optical information through a software based on neural nets
- ◆ Self learning adaptive software based on Neural Nets, adapting themselves to changing process situations
- ◆ Integration of expert knowledge and improving this knowledge self-learning
- ◆ Easy changes in optimisation targets without reprogramming or re-parameterisation of software
- ◆ Fast installation (2 to 3 weeks on site with 5 to 10 man days of customer involvement)
- ◆ Round the Clock, 24-7 closed loop control optimisation of the air / fuel ratio
- ◆ Results guaranteed



Solutions for the Flue Gas Cleaning

CONTROL:

PiT Navigator SNCR

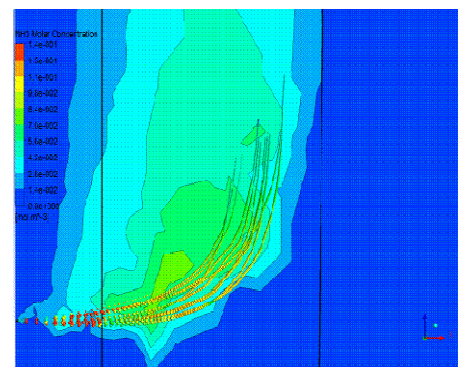
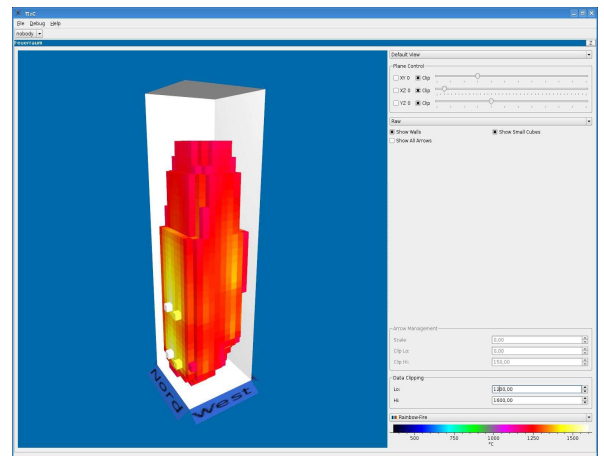
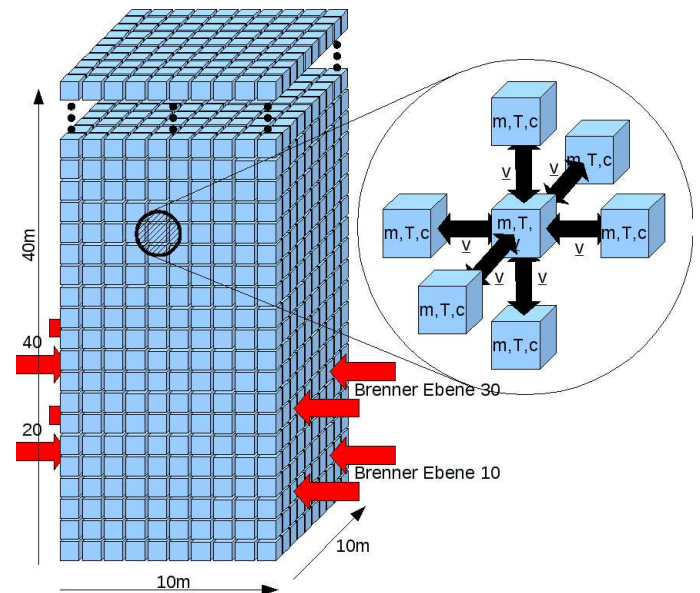
Advanced Auto-Optimiser for permanent optimisation of spray amount, slip and NOx peaks; suitable for Urea or Ammonia.

Benefits:

- ◆ Save NOx and slip compliance
- ◆ Reduced spray amount and reduced slip
- ◆ NOx and slip limits compliance
- ◆ Reduced primary NOx
- ◆ Reduced NOx peaks
- ◆ Less temperature tilts
- ◆ Fast adaptation to waste changes
- ◆ Better measurement, better control

Features:

- ◆ Step 1: Combustion Optimisation for primary NOx reduction
Step 2: Optimising control of SNCR (Powitec SNCR or 3rd party)
- ◆ Integration of additional sensors (PiT FluxStylus: Heat flux radiation sensor measuring from 9 different directions; PiT Indicator: Intelligent Thermography)
- ◆ On-line CFD (computational fluid dynamics) every 15 seconds: Determination of temperature, convection, heat radiation, flue gas mass flow.
- ◆ Automatic feature selection and extraction (significance ranking) of existing process data
- ◆ Automatic model generation (regression, neuronal networks, probabilistic nets, Gray-Box-Models)
- ◆ Set point integration into the DCS/PCS
- ◆ Advanced signal processing on acoustic measurements
- ◆ Modular system: Upgradeable to Boiler-Optimiser



PiT SNCR

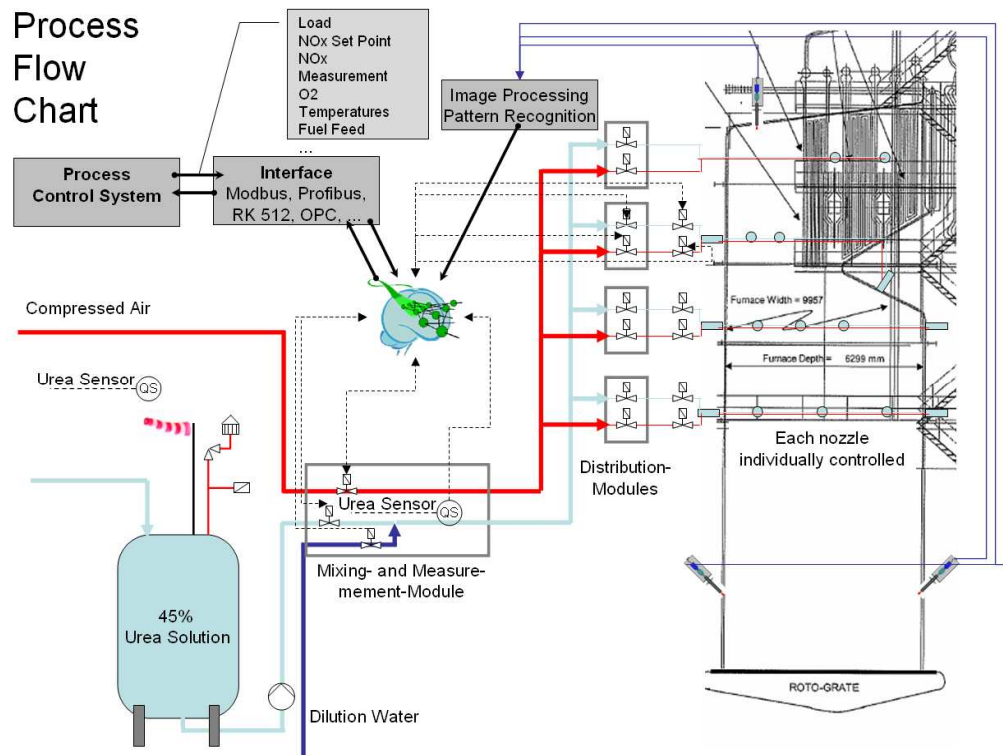
Complete SNCR with advanced Auto-Optimiser for permanent optimisation of spray amount, slip and NOx peaks; suitable for Urea or Ammonia

Benefits:

- ◆ Reduced investment costs (compared to SCR)
- ◆ Save NOx and slip compliance
- ◆ Reduced spray amount
- ◆ Reduced primary NOx development
- ◆ Reduced NOx peaks
- ◆ Less temperature tilts
- ◆ Fast adaptation to waste quality changes
- ◆ Reduced steam variations
- ◆ Complete solution from a single supplier

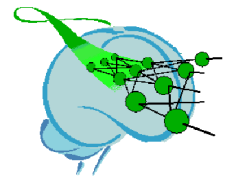
Features:

- ◆ 'PiT Navigator SNCR' - Optimising-Software-Licence (adaptive, multidimensional and self learning control on basis of neural nets; Nonlinear Model-Predictive-Control, NMPC)
- ◆ Optical sensors for image processing
- ◆ Urea / Ammonia storage, handling and injection
- ◆ Automatic control of reacting agent injection and combustion air using NMPC
- ◆ Engineering and commissioning including parameterisation
- ◆ Modular system: Upgradeable to Boiler-Optimiser



PiT Smart Box

Optimised spray amount in the dry sorption process. Suitable for white fine lime only or (2-stage MKT-process) combination of white fine lime with activated carbon and hydrate with high surface for the 2nd stage (dry sorption):

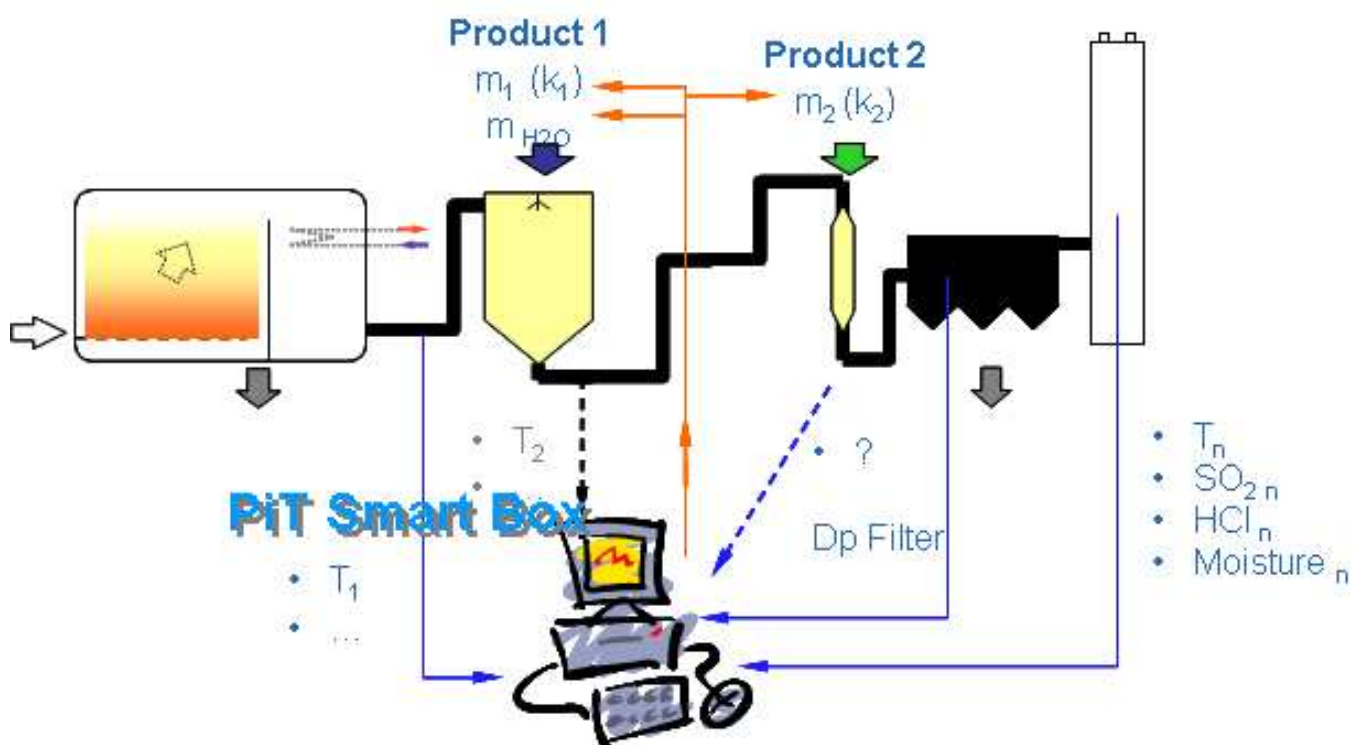


Benefits:

- ◆ Reduced consumption of reduction additives (5% to 10%)
- ◆ Shift towards cheaper additives (15% to 30%)
- ◆ At the same time emission improvement (-30% HCl, -20% SO₂)

Features:

- ◆ Works on the basis of self learning adaptive neural nets
- ◆ Permanently analyses different plant values
- ◆ Permanent optimising variables are integrated in the DCS
- ◆ No fixed control rules or formulas
- ◆ Reacts continuously and autonomously to the current plant situation
- ◆ Reaches the optimum operation mode



References:

- ◆ BKB TRV Buschhaus (Alstom, 3 PiT Navigator),
- ◆ Haz. Waste: AVG Hamburg (rotary kiln, Blohm & Voss, 2 PiT Navigator)
- ◆ L90 Esbjerg (Babcock & Wilcox Vølund, 1 PiT Navigator),
- ◆ Vattenfall WTE MVB Borsigstraße (Fisia Babcock, 2 PiT Navigator)
- ◆ Vestforbraending (Babcock & Wilcox Vølund, 2 PiT Navigator),
- ◆ ZAW Coburg (Martin, 1 PiT Navigator),
- ◆ MVA Bonn (VonRoll, 3 PiT Navigator)
- ◆ ACS Urbaser Cantabria (LurgiLentjes, 1 PiT Navigator)

Approved Competency:

2010: German Innovation Award Climate and Environment for Outstanding and Sustainable Technology. Powitec prevailed against a 145 companies field. Scientific evaluation through Fraunhofer-Institute for System and Innovation Research (ISI).



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Dr. Schnappauf: CEO BDI, Prof. Töpfer: Former German Environment Minister and Director UN Environmental Program*

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