



WⁱC

COMBUSTION MANAGER

Working principles and applications of next generation state controller for combustion optimization on forward moving reciprocating grates.



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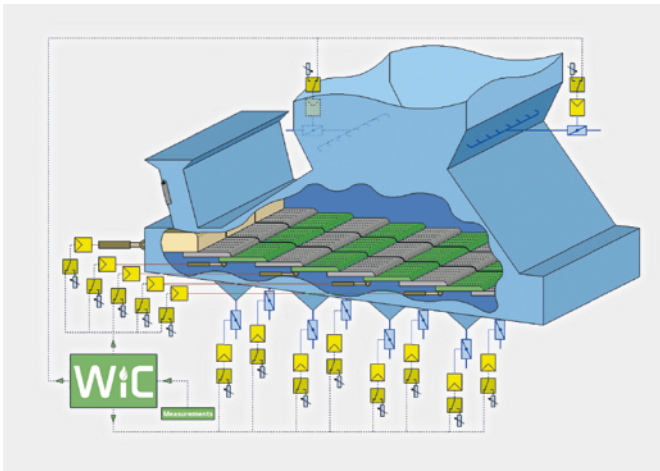
The development of the WiC (Waste incineration Control) is based on more than 25 years of experience in optimization on forward moving reciprocating grates. TG has optimized grates of different grate manufacturers and collected great experience in the field of combustion technology.

TG is an Austrian engineering company with 40 employees having international experience and worldwide engagement. Due to its long experience in Energy-from-Waste and biomass TG also acts as an independent consultant for technical and commercial issues.

Please contact us for any question. We are happy to exchange our experience.

Matthias Lukic C.E.O

Basics



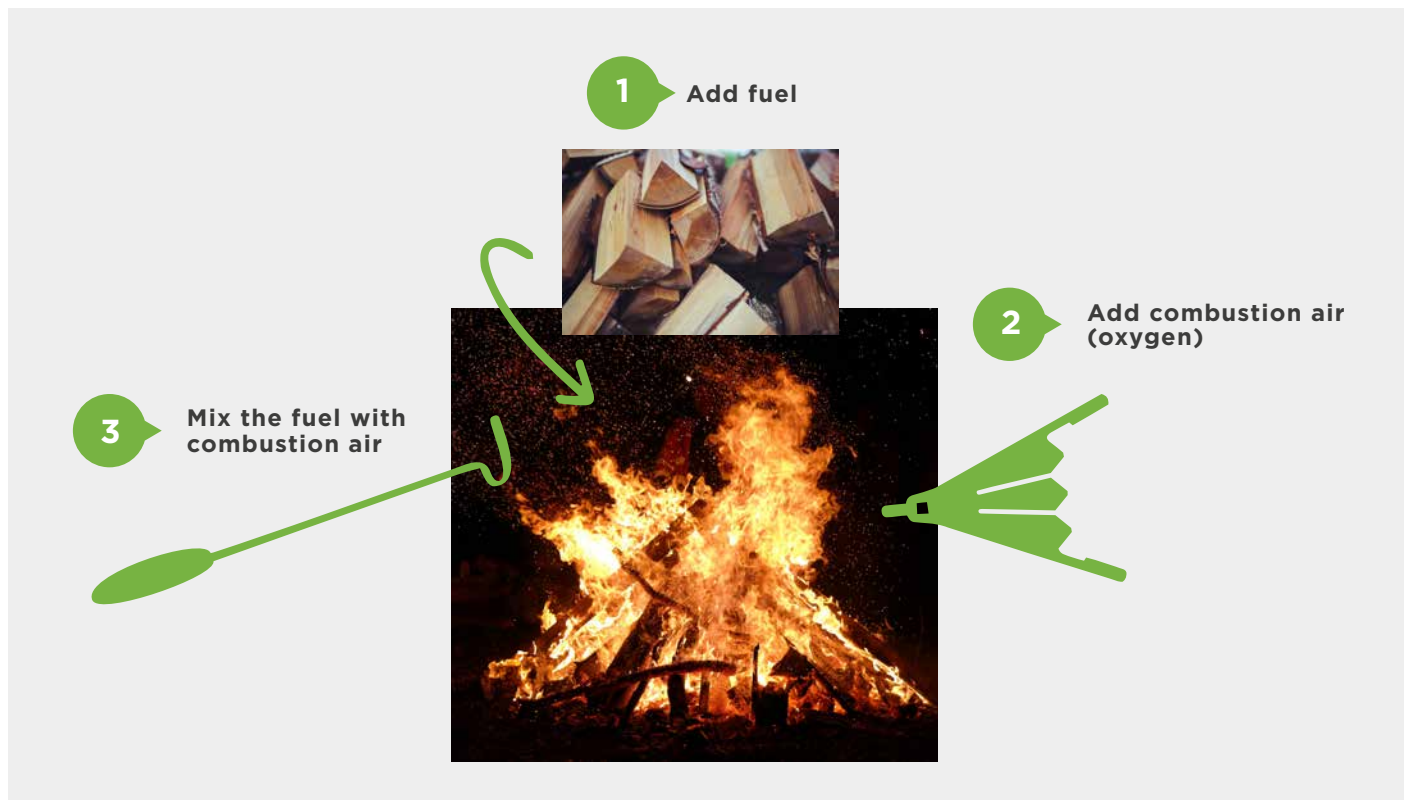
The combustion process on forward moving reciprocating grates is very complex and the quality of combustion has considerable influence on the profitability, reliability and availability of Energy-from-Waste plants. Good combustion will lead to financial benefits. There are many different combustion control systems on the market using different principles for combustion control with different results.

Some systems have HI TECH measurement equipment and provide additional information about the combustion process, but in most cases such information has little or no effect on the enhancement of combustion stability.

For a better understanding of the assessment of the quality of the combustion system it is essential to analyze:

- Which actions have an influence on the combustion?
- Which process values are relevant for the assessment of the combustion system?

The control of the combustion process is based on 3 main actions:



Just 3 main actions

The basic working principle of the WiC combustion manager is based on 3 main actions:

WiC has influence on feeding of fuel (**feeder**), adding in combustion air (**primary and secondary air**) and mixing

the fuel with combustion air (**movement of grate**).

Modern systems have about 30 actuators at their disposal. These 30 actuators allow **billions of combinations** for controlling the combustion process.



30 actuators » billions of combinations

The main task in modern combustion control is:

- to calculate the appropriate combination – one out of billions
- to find out the relevant process values for checking the quality of combustion control

Modern measurement systems in Energy-from-Waste plants provide more than 100 process values for the combustion process. These 100 process values are the fingerprint of the combustion process.



Process data
from
combustion
system



Fingerprint
of current
combustion
status

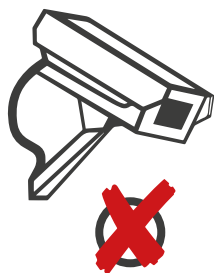
Selecting „The One“ out of billions



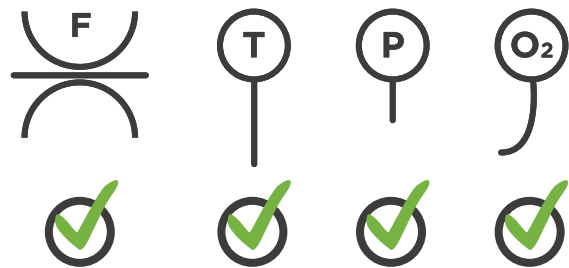
With appropriate algorithms, utilizing the fingerprint, it is possible to calculate an optimum combination (one of billions) and thereby optimize the combustion process. These algorithms are all integrated in the WiC-combustion manager, relying on more than 25 years of experience.

According to process values from the combustion process TG developed algorithms to calculate appropriate combinations and in that way optimize the combustion. These calculations are very robust and proven in many EfW plants.

Just standard instrumentation



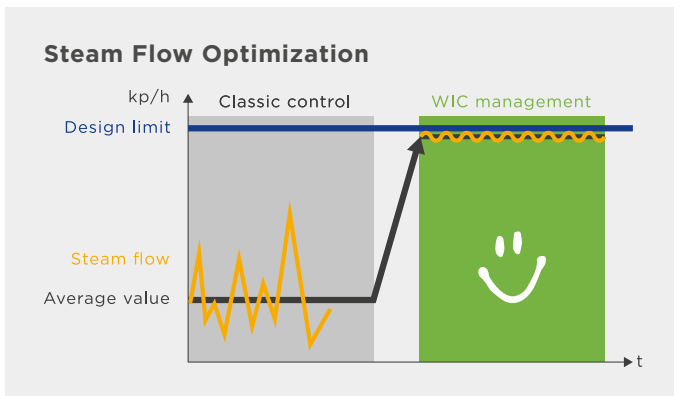
The algorithms used by WiC do not need any implementation of pyrometers or thermal cameras. The implementation of a thermal camera can provide additional information, **but this information is not used** (because too inexact and therefore not needed) **in WiC algorithms for combustion optimization**. It may only be utilized for detecting bad burn out and as a trigger for counter measures.



The WiC just needs standard process instrumentation, no „tricky equipment“ like thermal cameras or pyrometers is required.

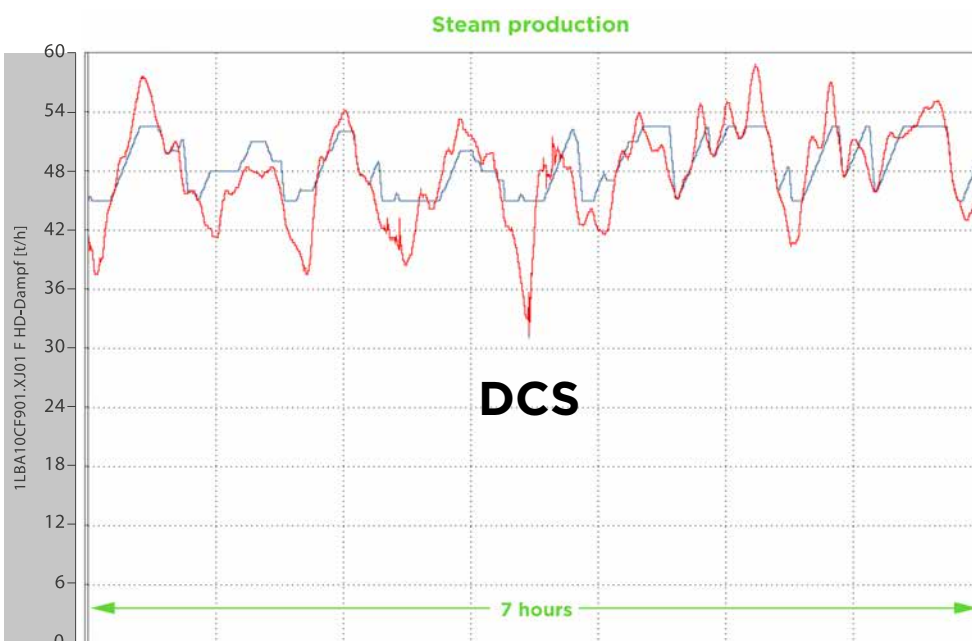
Which combustion parameters have to be analyzed and why?

1 KPI Steam production

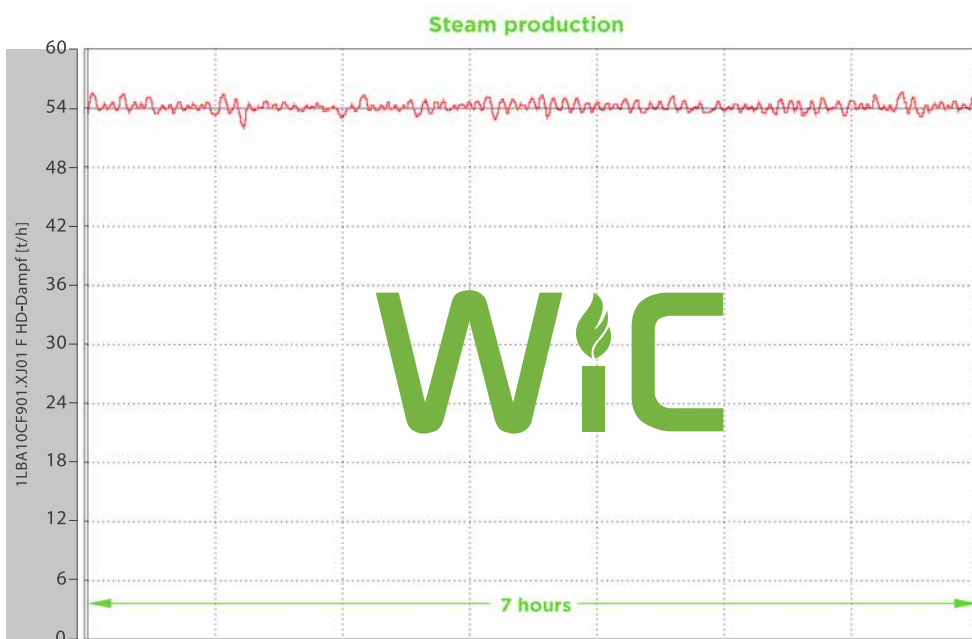


Stabilization of steam causes:

- increased steam production
- increased waste throughput
- increased electricity production
- better burn out quality



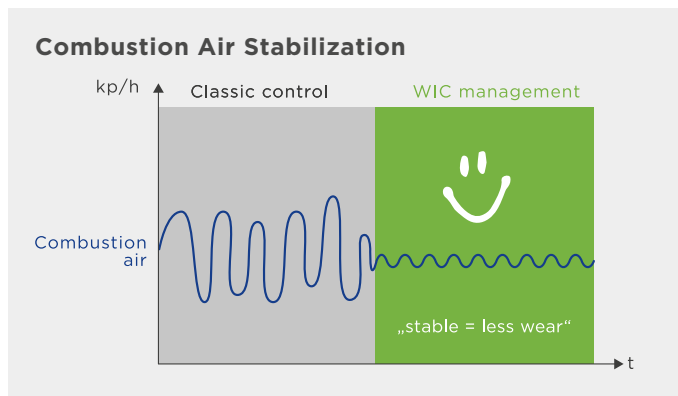
Steam production diagram with **DCS** combustion control.



Steam production diagram with **WiC** combustion control.

Note: WiC at the same time provides also stabilization of primary and secondary air flow!

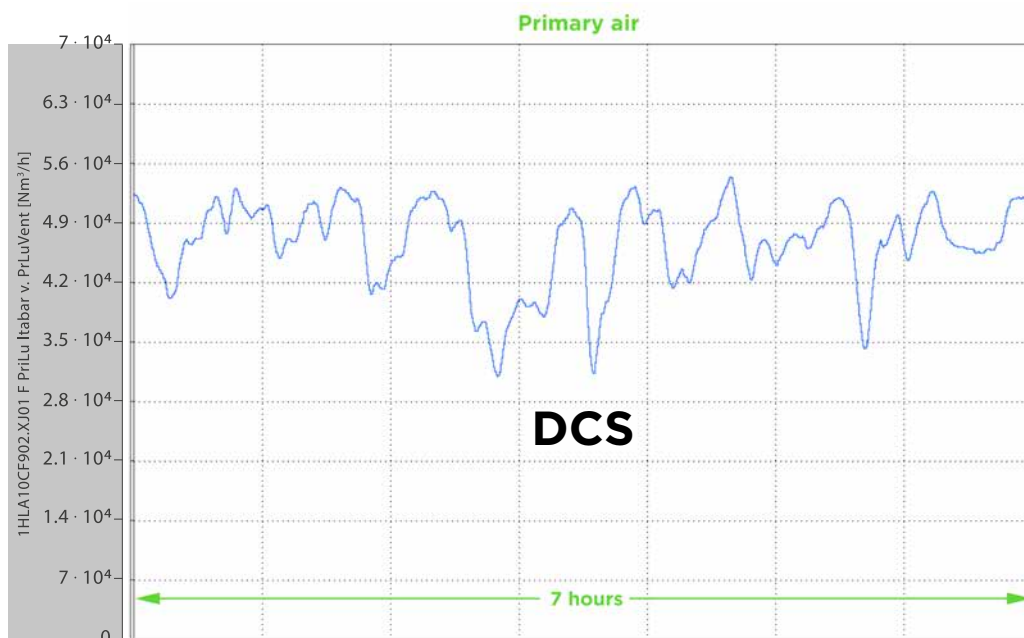
2 KPI Combustion Air



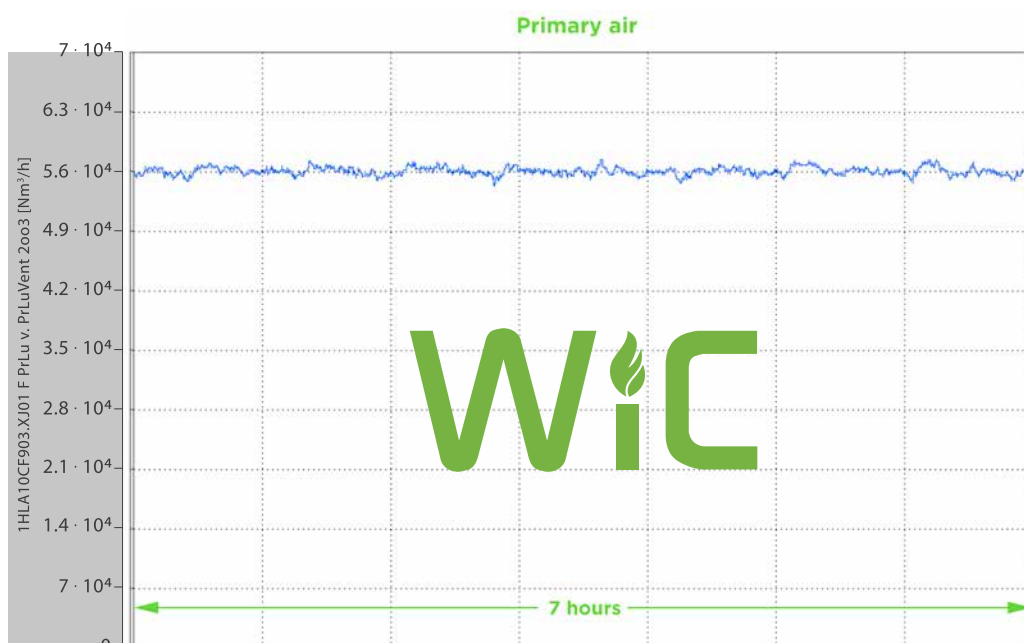
Stabilization of combustion air causes:

- less additives for flue gas cleaning
- less energy and mechanical forces on fans
- higher burn out rate

Note: the higher amount of primary air is related to an increase of waste throughput/steam production.



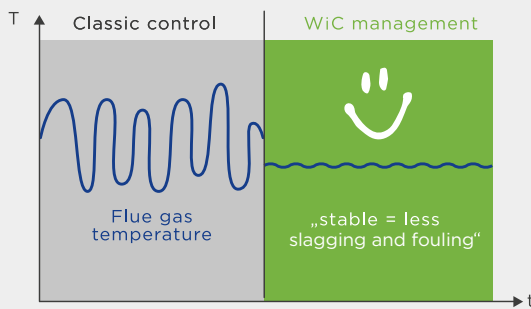
Primary air flow controlled by **DCS**.



Primary air flow controlled by **WIC**.

3 KPI Flue Gas Temperature

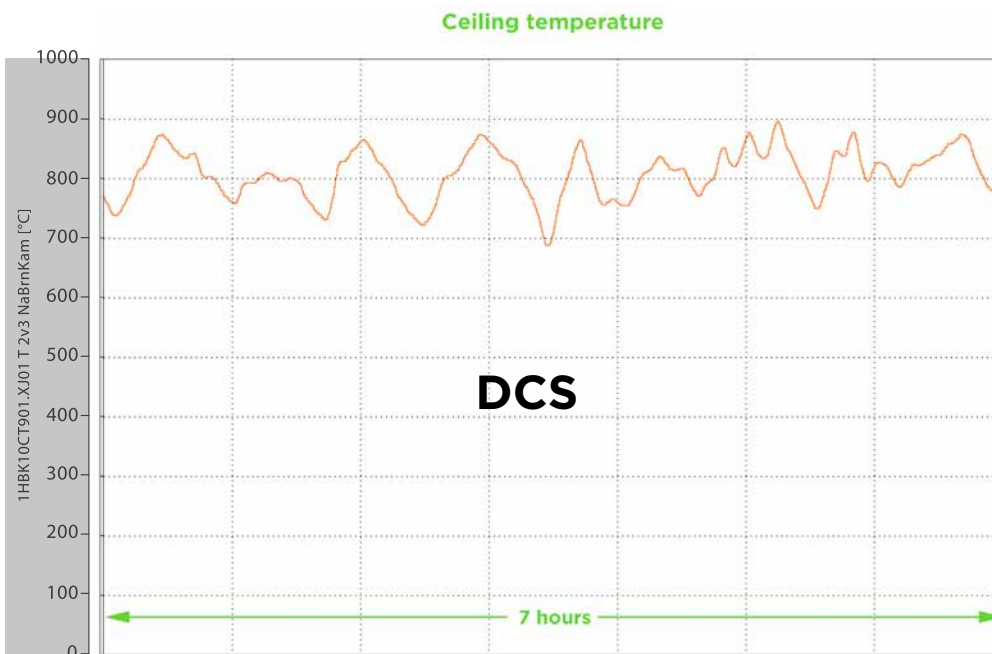
Flue Gas Temperature Stabilization



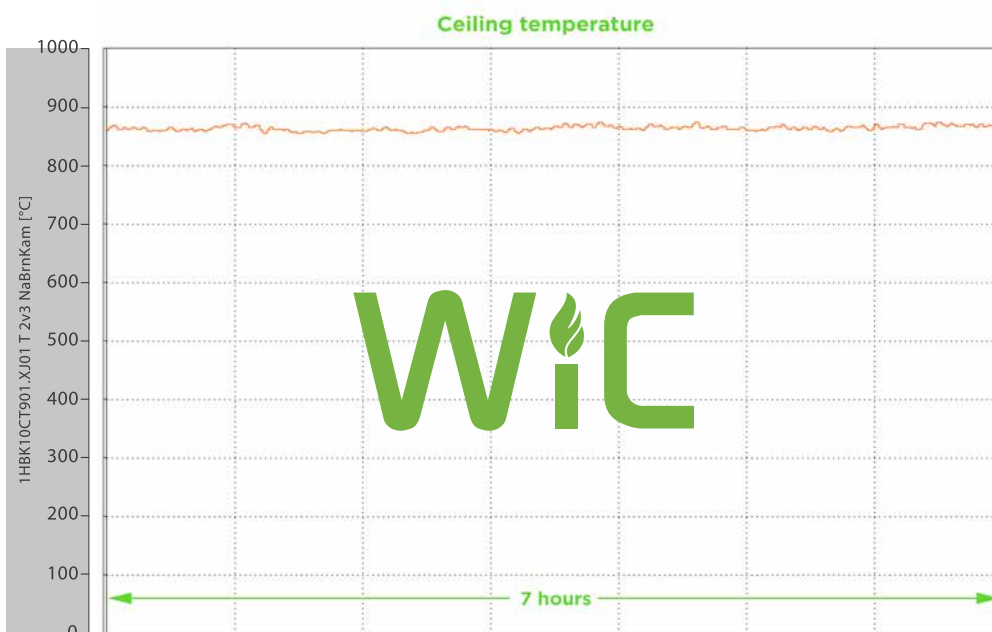
Stabilization of flue gas temperature causes:

- less slagging and fouling
- less wear on refractory
- less corrosion
- less cleaning effort
- lower ceiling temperature
- better heat transfer

Note: the average temperature is, of course, higher because of enhancement of waste throughput/steam production.



Flue gas temperature with **DCS** control.



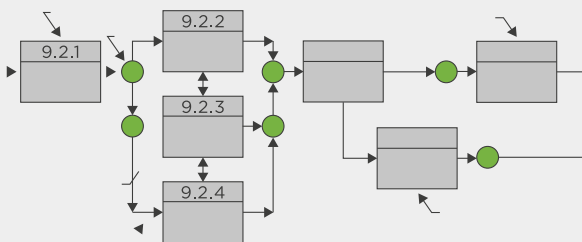
Flue gas temperature with **WiC** control.

Technical benefits of the WiC Combustion Manager

KPI, combustion parameter	benefit
stable steamflow	• increased waste throughput • increased incineration capacity • increased electricity production • enhanced process and energy quality
stable combustion air flow	• higher burn out rate in slag (no rejected transports and no penalty) • less emissions • less additives (bicar, ammonia, lime ...) for legal emissions • less wear • higher burn out rate in flue gas
stable flue gas temperature	• less corrosion • less slagging and fouling • better heat transfer to boiler tubes • less cleaning effort • lower ceiling temperature
less operator interventions, less unplanned stoppages, less operating costs, more profit	

Summing up: more profit

Traditional systems 50

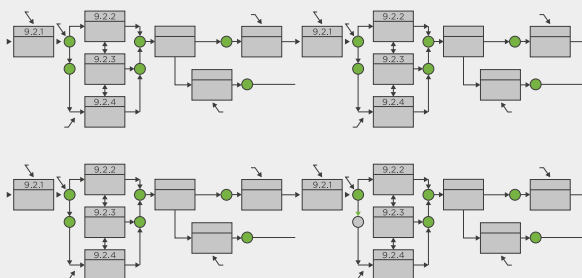


WiC uses real-time data processing, far more data than traditional systems, utilizing some 6500 functional diagrams instead of typically 50.

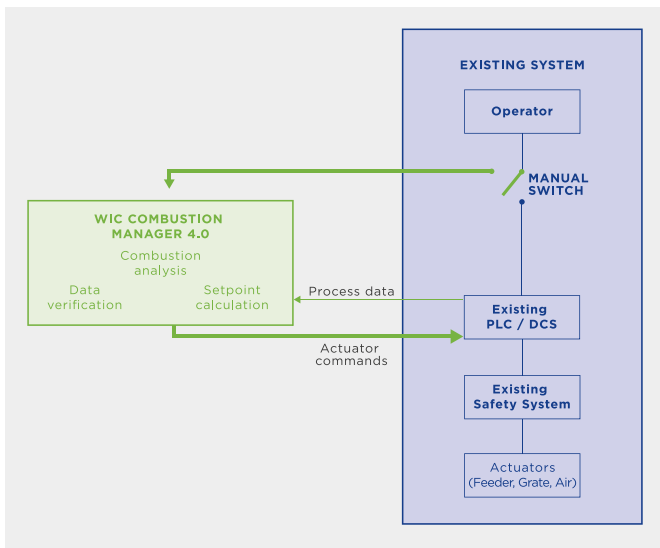
Every plant system is unique and for every particular plant the control calculations must be done thoroughly. In the combustion control process it is necessary to calculate many equations simultaneously in real time.

With its 6500 functional diagrams, WiC provides a quality and accuracy which is not possible to reach with classic controllers and classic control strategies.

WiC system 6500



How is the WiC connected to existing automation systems?



In most applications the WiC is a bypass or an „add-on“ system to the existing combustion control system. It may also be integrated from project start up. The WiC usually comes in a cabinet of 600D x 800W x 2000H mm (24D x 31W x 79H inch) and is placed in the DCS room.

The basic working principle of the WiC is to “listen” to process signals coming from the DCS, calculate appropriate set points for combustion parameters and send them back to the DCS to control the actuators in the combustion system (air dampers, feeder- and grate-hydraulics).

Note:

- WiC does not replace the existing system.
- WiC is a bypass/add-on system for exact process set point calculations
- WiC does not interfere with the existing safety system
- With a single switch (software and/or hardware) the operator may define the source of set points, utilizing WiC-set-points or DCS-set-points. This is essential for the operators to gain confidence in a „new combustion philosophy“. The operators can, at any time, switch back to their familiar existing system and they can directly compare with the new WiC Combustion Manager.

The installation of WiC takes about 4 weeks. The WiC does not interfere with ongoing operation; there will be no disturbance or plant shut down.

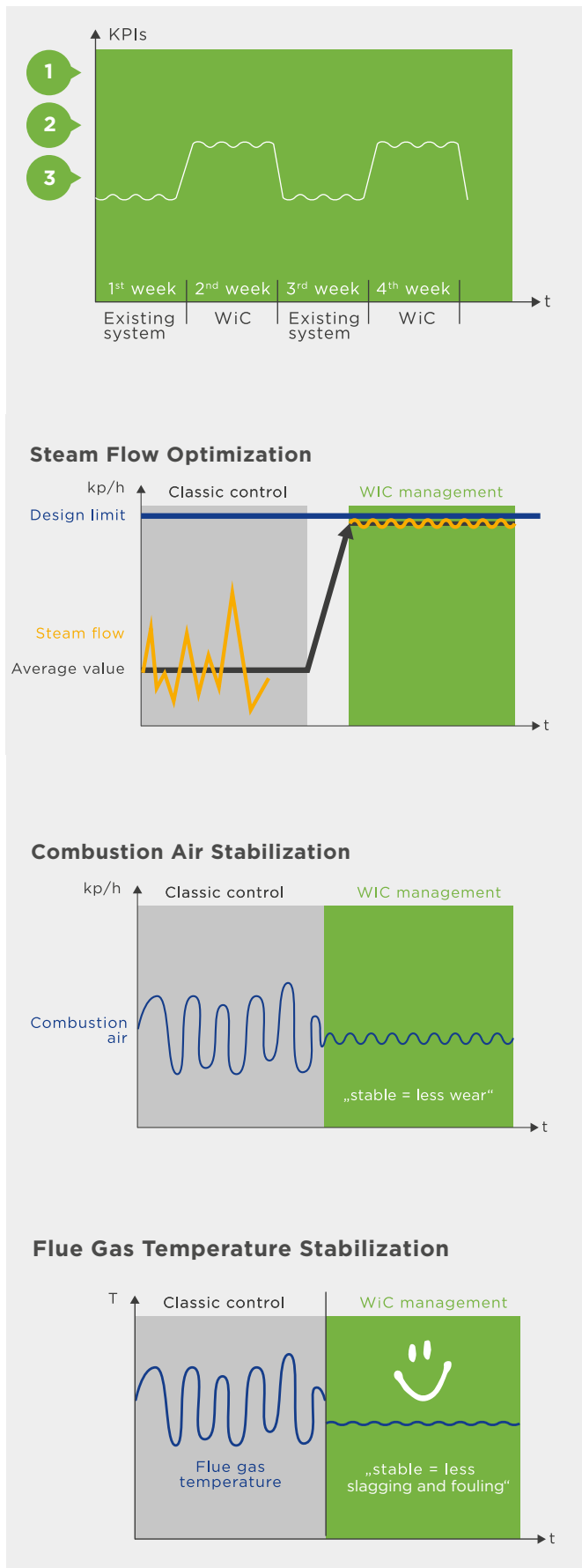
The commissioning of the WiC is finished within 10 minutes. Roughly 30 minutes after commissioning, it is possible to see first benefits of the WiC-system.

Note:

The WiC can also work as an add-on for any 3rd party combustion optimization system the customer might have implemented in the past.



Measuring the benefit of the WiC



After the installation of the WiC, one important question comes up: “What is the benefit of the WiC Combustion Manager?” For answering this question, the following procedures will work as simple and reliable testing methods.

It is necessary to have approximately the same waste quality and check the KPI's under WiC combustion control, and under DCS combustion control.

With a simple switch plant operators can move between the existing system und WiC.

The periods under comparison may be selected according to similar waste conditions.

The commercially most important criteria are:

- stability of steam production
- amount of steam production
- waste throughput
- amount of additive consumption
- stability of flue gas temperature
- stability of primary and secondary air
- O2 concentration
- amount of operator interventions

Some criteria are short term, being relevant for a fast initial assessment of the WiC benefits. Long term benefits can be assessed on the basis of process signals over a period of several months after WiC installation.

The WiC is a fully automated system and provides operation without permanent observation (OWPO). Besides that, WiC is also a great help for operators in case of disturbances.

Note:

For the WiC implementation there is no need for mechanical modifications of the existing combustion system. WiC is an add-on system utilizing the existing equipment.

WiC on New Plants



TG also delivers complete DCS installations for new EfW plants. In this case the savings in standard DCS engineering and DCS hardware are as high as the costs for the WiC. So the WiC can be delivered without any additional costs. Combustion systems on new plants can be commissioned in 1 day with the WiC.

Operator Training



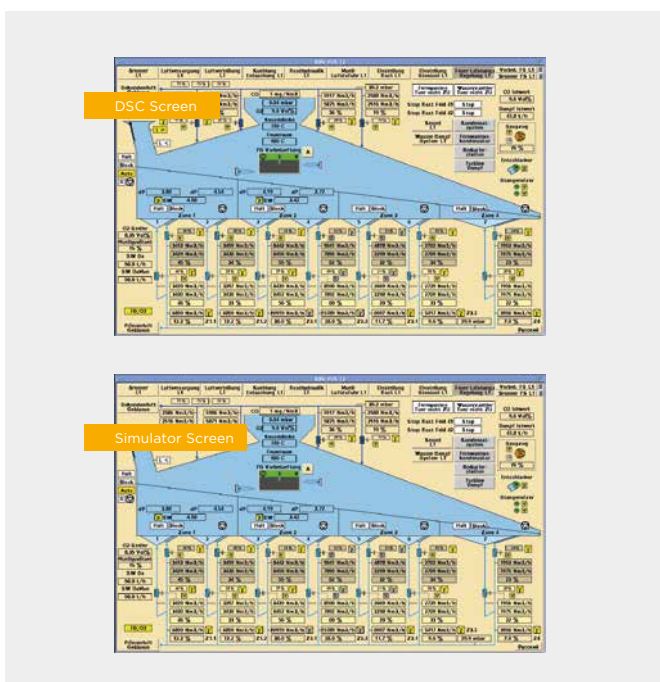
Well-trained operators are the key to reliable production in any EfW plant. New plants cost hundreds of millions, and most of the tricky activities are in the hands of the plant operators, crane operators and maintenance staff.

TG offers professional tailor-made training courses for

- operators
- maintenance personnel
- EIC engineers

The staff may be trained on tailor made **TG 1:1-Simulators**, which correspond a 100% to the plant and the plant's DCS.

These 1:1-Simulators have identical screens like the real DCS just with simulated process in the background. Our experienced trainers confront the staff with numerous different plant disturbances and process scenarios to solve. The training on the 1:1-Simulator allows to develop operator skills before working on the real plant.



What about the financing model for the WiC?

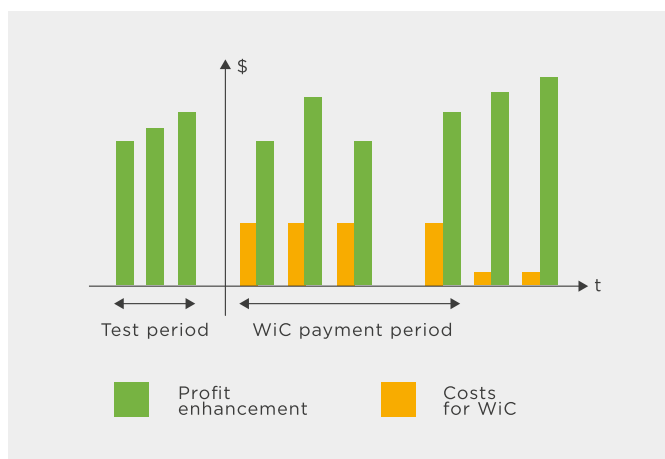
Besides the benefits mentioned above, the WiC provides a considerable additional advantage: profit enhancement from the beginning of installation. In general, WiC offers more than all other systems on the market, also in terms of financing.

After TG's feasibility study TG can assess the possibilities of the WiC system and its advantages for your particular EfW plant.

So, if the outcome of the feasibility study is positive, TG is able to offer the installation and commissioning free of charge.

- **no upfront investment needed**
- **test installation and commissioning free of charge**

WiC generates additional profits from the beginning of installation



TG has great experience in reliably assessing the possibilities of a WiC system on a particular plant.

After commissioning, the customer can immediately measure the short-term benefits of the WiC (financial benefits). At that point the customer can decide freely, without any obligations, whether to go on with a contract for the WiC. The entire risk is on TG. The customer can monthly quit the contract for whatever reason without any further obligations.

If a leasing model with monthly fees is chosen, the fees are in most cases less than the short-term profit enhancement. After a certain time the customer becomes the owner of the WiC and pays only for the software licence and optional maintenance.

Commercial benefits of the WiC Combustion Manager

Every plant and every incineration line is a unique system. Good result on one line in a particular plant does not automatically mean good result on the other line. TG's basic purchasing model provides a Combustion Management System without any commercial and technical risks. The implementation of the WiC is totally financed by TG. Our tested

and proven methods provide simple and reliable comparison between „before“ and „after“ WiC installation.

Finally, only a test run and evaluation will provide a real picture of the system quality.

What is included in the WiC services?



- 24/7 service
- Remote support
- Monitoring and data archiving
- Permanent monitoring of combustion process
- Reporting of inconsistencies
- Disturbance analysis
- Improvement suggestions
- Consultancy during planned shut downs
- WiC-maintenance (1 week/year on site)
- Cyclic WiC-Updates

Our data acquisition system, integrated in the WiC, enables our engineers to efficiently analyze the plants combustion process.

TG offers 24/7 support with daily analysis of the combustion process. Our engineers provide reports for your plant and inform you about possible improvements. In case of disturbances, we are able to analyze the collected data to find the source of problems. Our service contract includes full WiC maintenance (including spare parts) and inspection of your plant for one week once a year.

