

How Digital Twin Technology Can Be Implemented for Biomass Boilers?

Nowadays as climate change is becoming a challenge, new directives and social initiatives are enforced to reduce CO₂ emissions. Sustainable approach is used to reach CO₂ goals. On one hand, the solutions is to move to cleaner renewable energy sources. On other hand, use of Digitalization solutions to increase sustainability of existing systems and increase efficiency. Here we are going to talk about digital transformation for biomass boilers. At first glance it might seem that there is no possibility to maintain biomass boiler in more efficient way but with new technologies like digital twin, biomass boiler operation goes to next level.

The next step for biomass boiler efficiency is digital twin technology

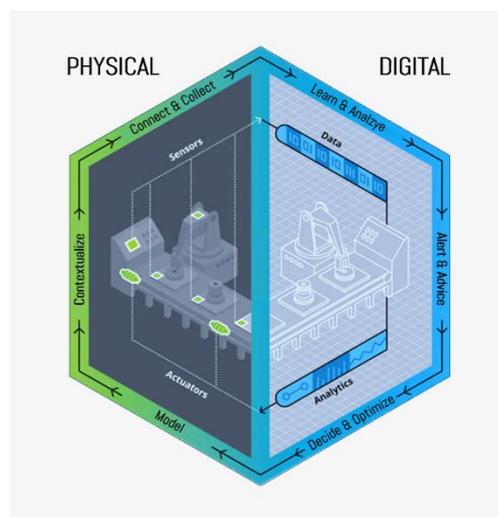
The concept of a digital twin has been around since 2000 but only thanks to the Internet of Things (IoT) that it has become cost-effective to implement and it is getting used in many sectors from Aerospace to manufacturing companies.

What is Digital Twin technology? It is a virtual model of a process and equipment. It is like a bridge from physical to digital world.

Talking about digital twin technology implementation for biomass boilers we are going to present analytical system [EA-SAS Boiler](#). It analyses real-time biomass boiler

data to ensure efficient maintenance, optimal production and ensure safety. EA-SAS Boiler collect real-time data to create simulations that can give optimal set point how to control Biomass Boiler in most efficient way. It is digital representation of biomass boiler and all related processes. Installing EA-SAS Boiler is the final step of digitalization – using all the collected data to simulate how complex processes for example burning process behave and how to control it. Such simulations allow us to understand how to increase the fuel burning efficiency in real-time.

In essence a digital twin is the physical object simulated using a vast amount of mathematical expressions to simulate the working process and find optimal working set points to deliver to the existing Control System.



Source: in style of Deloitte ([link](#))

How to use digitalization to increase the efficiency of the burning process?

As biomass boilers are too complex to be efficiently handled by a human, a Control System is used. The installed system already increases a biomass boiler's efficiency to a certain degree, but it can go higher. The Control System is not able to analyze fuel calorific value and water content of the fuel in the furnace, so it cannot effectively manage the burning process, but it does store the data needed to calculate what is happening in real time. Control System does not cover and does not guarantee maximum efficiency in full range of Boiler operation and conditions.

Therefore, dedicated analytical systems based on Digital Twin and data analytic technology are used to simulate the burning process and find not only the optimal working conditions at any given time, but also gather data such as fuel calorific value and moisture content in fuel that is being burned right now.

Digital transformation benefits

Data reliability or blind spots

The existing boiler Control System is only able to see data that is being collected by installed meters. The existing Control System uses data for Boiler control.

However, Control System relies on metering data and does not understand precision deviation over time. So, the data quality depends on characteristics like are the meters installed correctly, is the meter functioning correctly, is it worth to install another meter to see more data?

EA-SAS Boiler analyzes measured data and provides estimation of measurement precision, also it calculates parameters that have not been collected, because metering device is not available.

For example, what is the current quality of fuel that is being burned in the furnace? In practice, sample of a batch are taken just before the fuel goes into the furnace, so the test results arrive after the fuel has been burned. This means that lab tests cannot be used to effectively manage the burning process in real-time.

Using EA-SAS Boiler it is possible to calculate the parameters of the fuel being burned in real time. Using already measured data fuel calorific value and moisture content can be analyzed, thus allowing to operate boilers in most optimal way in real-time.

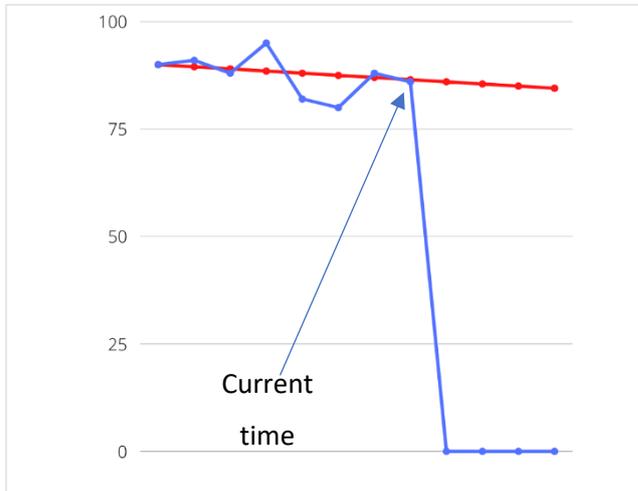
Same heat output using less fuel – Lower CO2 emissions

Most boilers do not have a dedicated system to weigh fuel input or have it near boiler but not inside the furnace. This means that usually it is impossible to know amount of fuel being burned right now. Digital transformation makes it possible! EA-SAS Boiler calculates it by analyzing the burning process also as heat output and reports what is the optimal amount of fuel to produce the same heat amount.

Predictive maintenance – Increase sustainability

Another benefit of using a digital twin based technologies is simulating and tracking the efficiency of the boiler. This allows to see the optimal point for scheduling maintenance and evaluate completed maintenance effect on Boiler working conditions. The graph below shows calculated efficiency using real time data in blue and forecasted efficiency in red

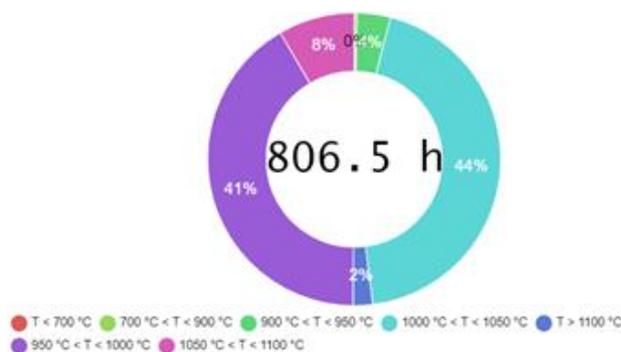
over a period of time. Fluctuations are caused by inefficient control of boiler, optimally it should be as close to calculated optimal values.



Example of inefficient biomass boiler control

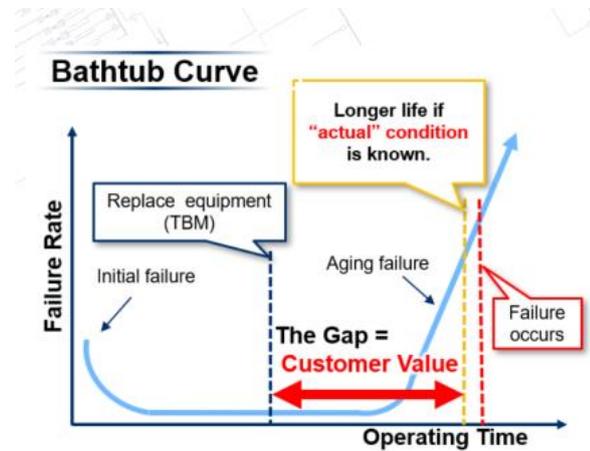
- calculated efficiency using real time data
- forecasted efficiency

An additional benefit is being able to analyze the burning process is possibility to find out how flue gas in furnace temperature affects the lifetime of biomass boilers.



Seeing the effects of flue gas in furnace on the boiler also allows to find the optimal time to schedule maintenance. Most of the time equipment is replaced before there is real need to, other times the lifetime can extend so far it leads to failure, the time between these points

is the value the customer gets as illustrated in the picture below.



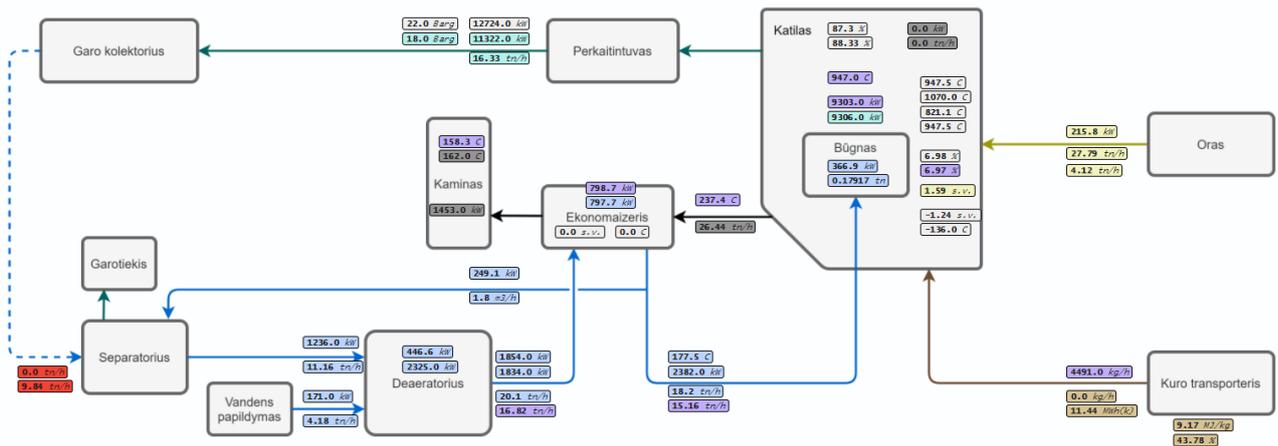
How to achieve benefits in practice

Digital twin solutions simulate how the boiler works in real-time by running complex analytics on gathered data. By basing calculations on data collected 5 minutes ago, it is possible to estimate the current burning process and forecast it.

Most of the time essential parameters are already being measured and collected in the database - steam/water flow, flue gas temperature, steam temperature, oxygen level in flue gas and others. To integrate digital transformation solutions only access the Control System database is required.

Conclusions

New technologies like digital twin is the new trend which is powerful masterminds to drive innovation. The physical implementation of digital twin technology for biomass boilers can be easily achieved with such analytical tool like [EA-SAS Boiler](#). It is increasing the efficiency of burning process, thus reducing fuel consumption and increasing boiler operation sustainability.



Article prepared by Energy Advice www.energyadvice.lt/en

More about EA-SAS Boiler <https://www.energyadvice.lt/en/biomass-boiler-operation-analytical-system/>