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Intelligent automation modules in AAC production plants – part 4: Energy Management System

Some previous articles issued in AAC Worldwide highlighted suitable components to ensure a consistent and perfect quality of AAC production, such as the dosing and mixing control WECOMIX, autoclave control WACO and the product control and information system PCI.
Besides the production of AAC products of highest possible quality, the production costs are a core issue as well. In this article, Wehrhahn introduces suitable means to monitor, reduce and optimise energy consumption. Energy costs are expected to increase year by year. They have, in addition to costs for raw materials, the second main impact on production costs in plants around the globe.

It is generally understood, that the function of Energy Management is to record the consumption of electrical energy of the entire plant or specific sections in 5-minute intervals. In contrast, the Wehrhahn Energy Management System (WH-EnMS) measures and stores energy data from nearly each machine and section, every second. Additionally, the system records the consumption of air, water and gas (or oil) for steam production. Various energy meters measure the consumption continuously and transfer the data to the Energy Data Manager. The recorded energy data can be used in advanced evaluation tools to monitor and control the entire production process. The Energy Data PLC works as a router-transferring all data, such as pressure, speed, temperature, product type, or productivity from the machine control systems to the Energy Data Manager.

The system facilitates a visual comparison of all relevant parameters, supporting operators and management, in order to find correlations and to create KPIs (Key Performance Indicators). The KPIs enable a comparison of efficiency, between different production lines, for an easy and comprehensive benchmarking.

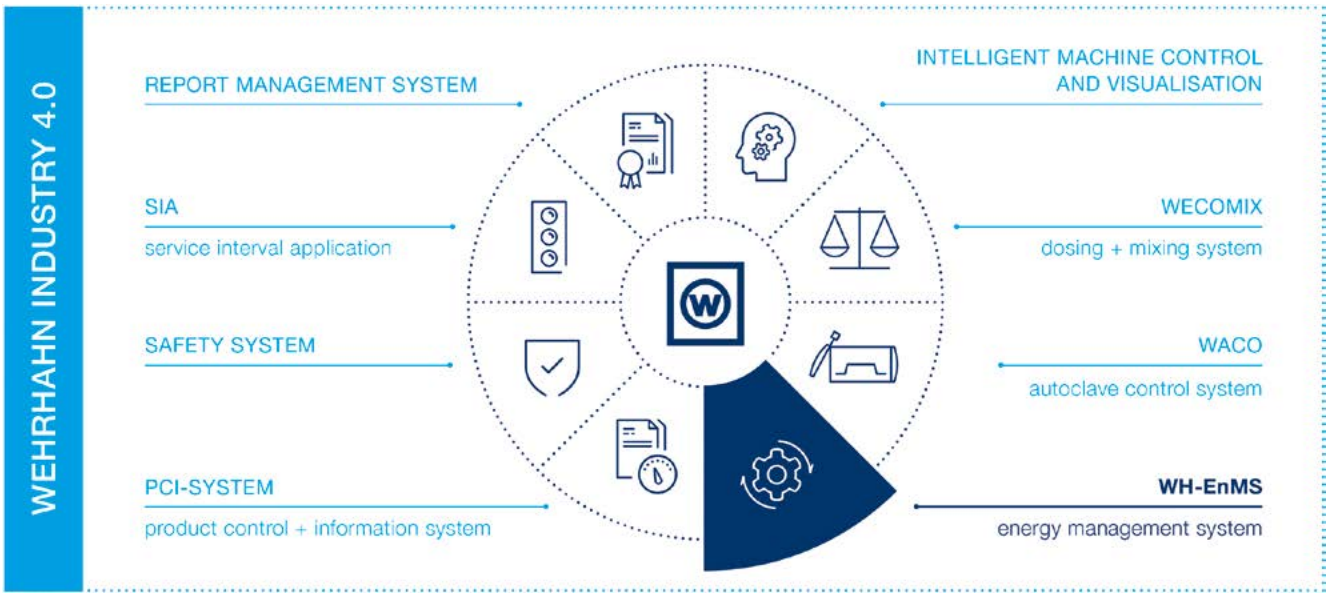


Fig. 1: AAC - Automation modules for a precisely coordinated Automation Control System.

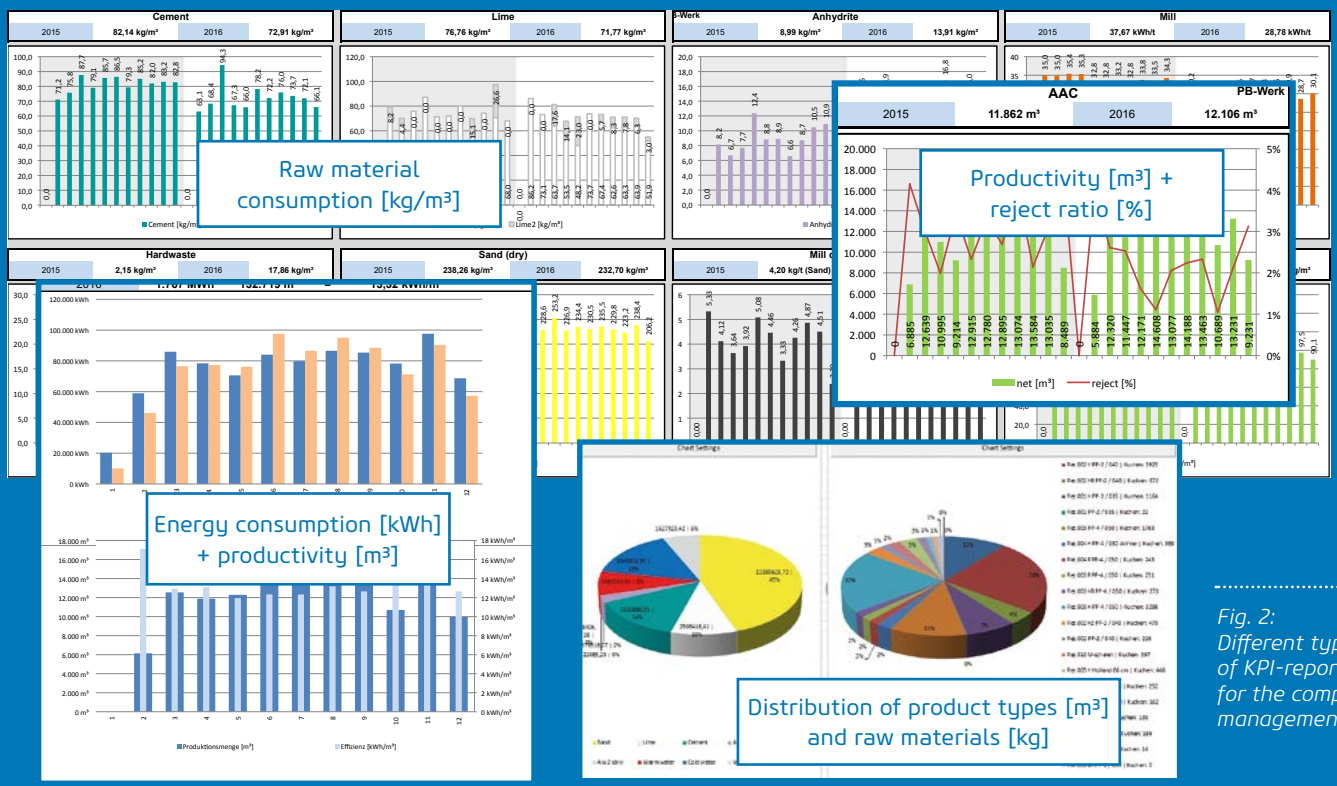


Fig. 2: Different types of KPI-reports for the company management.

The Energy Management System considers the company as a whole

The Wehrhahn-Energy Management System (WH-En-MS) does not only measure the energy consumption of the production line (e.g. AAC or sand lime brick plant), but considers all sections of the company, such as office buildings, lighting, heating systems, workshops, managers' apartments and even other production lines.

The benefits are:

- The company management receives clear production and energy reports for the reduction of energy consumption.
- The production manager is able to monitor various production processes in real time and can detect potential process optimisations.
- The maintenance technicians are provided with detailed energy curves for the detection of preventive maintenance requirements.

Reduction of energy consumption

The company management receives a clear picture of the entire distribution of energy costs, according to the cost-by-cause-principle. Specific tools can be used to automatically and periodically report consumption figures, compare them with historical data and then provide trend curves to show the development of consumption and costs. Instead of only reacting to energy gobblers - that have been detected more or less incidentally - a specific search for consumers, benchmarking and also pursuing economic benefits can be performed. This enables effective decision-making processes for the investment in new equipment or technologies and allows a precise "before/after" comparison.

Process optimisation

The production management receives detailed data in real time. The energy consumption of each consumer is visualised during the production cycle. Energy peaks during machine operations allow the measurement of the run time and the cycle time, precisely second by second. Motor workloads and power reserves, as well as bottlenecks can be identified. Waiting times can be used to reduce peak loads. This enables the identification of effective cost saving measurements which simultaneously lead to an increase in productivity.

Predictive detection of maintenance requirements

Service engineers are furnished with detailed trend curves and can even be actively alerted in case of irregular circumstances (see fig. 4). Consequently, the maintenance team can "read" and evaluate the machine's condition, which allows the identification of maintenance requirements well before difficulties may appear. An example would be a worn out coal brush in the motor of a ball mill that could be detected in good time by the automatic comparison of phase currents. Repair works can then be executed preventively, reducing the risk of a break down. Energy-saving measurements can be implemented into every single plant. However, without suitable measuring devices and an intelligent energy monitoring system, this energy saving potential is difficult to detect. Once the shortcomings have been

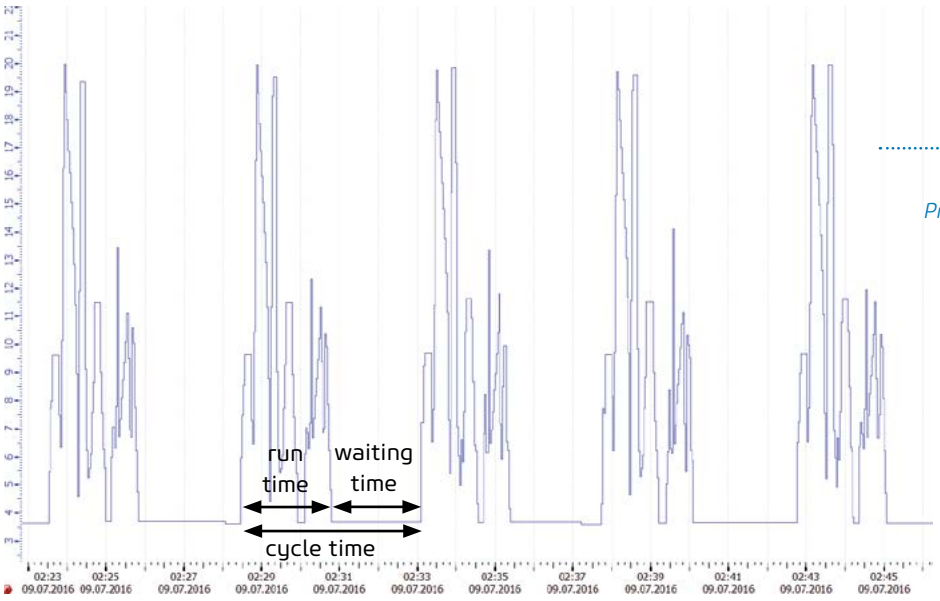
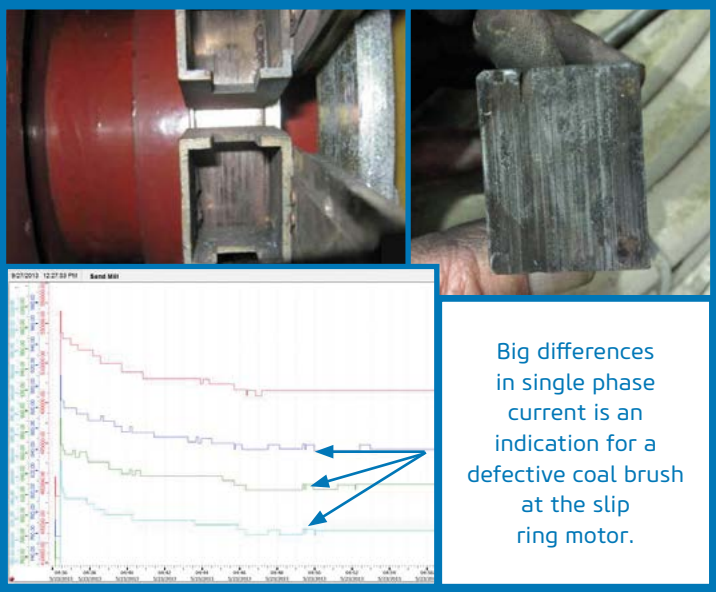


Fig. 3: Production managers can measure the cycle time in energy curves.

Fig. 4: Important for service engineers: WH-EnMS is not only monitoring, but also reacting to irregular circumstances.



Big differences in single phase current is an indication for a defective coal brush at the slip ring motor.

identified, they have to be processed in an intelligent control system: It turns a simple monitoring system into an intelligent management system. Due to machine-to-machine communication, energy saving methods can be realised, like:

- Unnecessary energy consumers can be detected, unexpected energy consumption during production breaks may, for example indicate leakage of air-pipes or valves.
- An intelligent start/stop function in the automatic mode prevents motors from unnecessary run times, saving around 25% of energy and prolongs maintenance sequences. Intelligent stops switch off consumers, like fans or hydraulic pumps, provided by the fact that they are not needed within the next minutes.
- Break resistors of frequency inverter drives, which transform the generated energy into heat, can be exchanged against power recovery or power storage devices. This feature saves up to 40% of energy of an automatic loading crane with a motorised lifting unit.
- Slurry agitators can be frequency controlled, depending on the slurry level in the tanks.
- Operator errors can be discovered and positively used to carry out staff training and to increase their awareness for energy consumption.
- Evaluations of saving potential, for instance for the replacement of a standard motor by an energy-saving motor.
- Energy supply fees can be reduced by a peak load management system, which switches off energy consumers, that are currently not needed, for several minutes.

Finally, the Energy Management System enables the management to comply with the requirements of DIN EN ISO 50001.

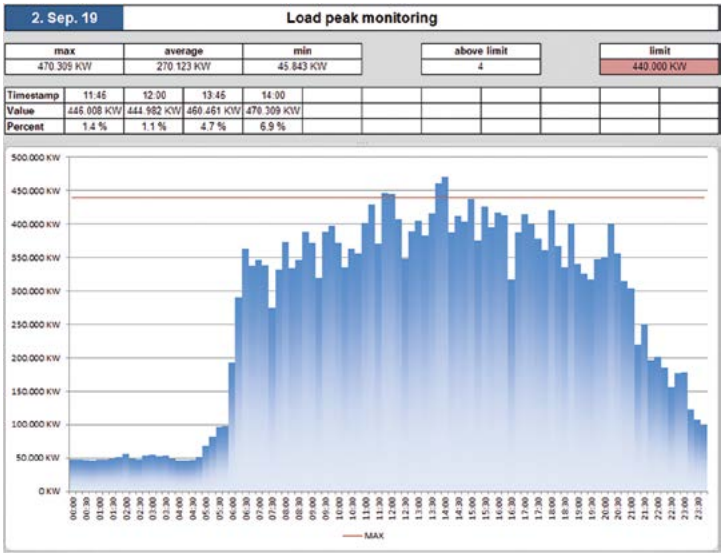


Fig. 5:
Peak load management reduces the cost by reducing the peaks.

Mr. Bernd Kanne
(Production Manager at Emsländer Baustoffwerke, AAC plant in Germany) about the WH-EnMS reporting system which was already implemented in 2014

For Bernd Kanne, one of the benefits of the Wehrhahn system are the specific key performance indicators: "The specific energy consumption of the sand mill in "kWh per ton sand" can be used to identify changes of the sand quality. It allows us to keep the sand fineness at a constant quality level by making adjustments to mill charge. We can even detect wear-and-tear on monitor windings at an early stage by electricity figures, provided for the individual phases. Also, in other production sections, the continuously measured data of the WH-EnMS, such as kWh/m³ or kWh/cake, provides useful information. We use it for process optimisation and to evaluate the wear of drive systems."

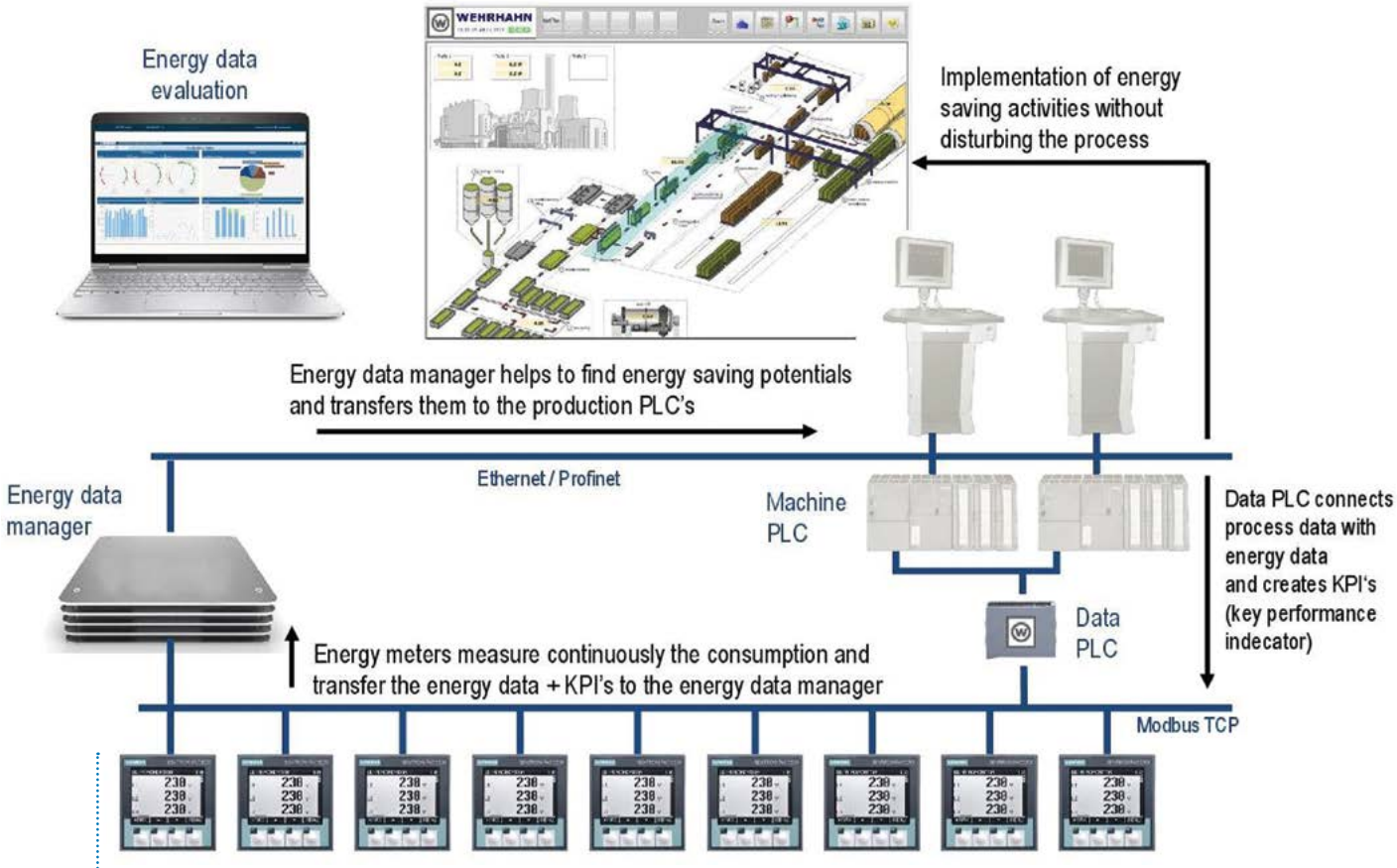


Fig. 6: Energy management is a kind of a PDCA-Cycle (plan-do-check-act).

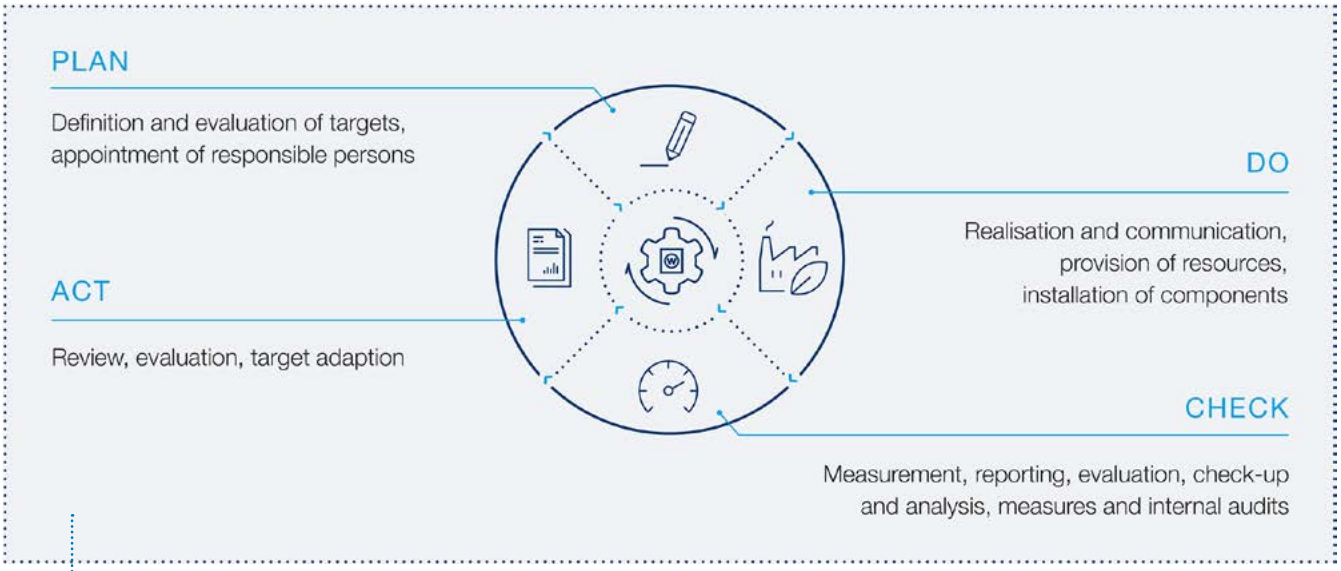


Fig. 7: Plan-Do-Check-Act cycle for continuous improvement process.

The effective and beneficial implementation of Energy Management Systems depends on the quality of the collected data and the reasonable transformation in the control systems to use the data intelligently. Simple Energy Monitoring Systems which are not interacting with the plant's PLC system may only provide data from the past and can hardly be used to optimise overall plant efficiency.

The key difference between the Energy Monitoring System and the Energy Management System is the "ACT" from the PDCA-Cycle (Plan-Do-Check-Act). An Energy Management System actively evaluates the data, indicates irregularities and sets off alarms or suggestions of improvement.

Furthermore, the WH-EnMS provides information for process optimisation and predictive maintenance. Therefore, an Energy Management System should not run as a separate unit, but should rather be an integrated part of the Industry 4.0 automation control concept.

An intelligent safety system which provides safe working conditions without compromising on practical production conditions has to be part of an Industry 4.0 Automation System. Stay tuned for Wehrhahn´s next part of the article series in AAC worldwide.

Frank Pottin studied automation engineering in Bremen. Immediately after completing his studies, he began with the electrical design, programming and commissioning of Wehrhahn AAC production plants. Today he has over 27 years' experience in AAC production. As Director Electric and Automation, with his team of more than 30 automation specialists, he continually develops new innovations for AAC production.
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See here a video about Wehrhahn automation. Scan the QR-code with your smartphone.

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