

Efficient Manufacturing through Machine Connectivity

Processes Transparency in Blown-Film Extrusion

In mid-2020, the film manufacturer Duo Plast of Hessen in Germany and Enlyze, a spin-off of RWTH Aachen University, Germany, launched a digitalization project to develop a data-based method for increasing productivity. They considered the entire machine park along the value-creation chain. After two years, the partners are taking stock of the successes so far.

Digitalization has developed into the prerequisite to future-proof extrusion companies. However, the integration of IT solutions into manufacturing is complex because of the many interfaces, and requires high investment to achieve an added value that is difficult

Customer from the Start: Duo Plast

Duo Plast AG was one of Enlyze's first customers (**Fig. 1**). The stretch-film manufacturer from Lauterbach, Germany, is highly innovative and a pioneer in

sites on nine blown-film coextrusion lines. The Duo Earth film, honored with four sustainability awards, is characterized by its high content of PCR (post-consumer recycled material), while maintaining the customary high performance.



Fig. 1. Clemens Hensen and Henning Wilms (Enlyze), Mike Kieschnick and Alexander Kaunath from Duo Plast and Deniz Saner from Enlyze (from left) with the Enlyze Gemba Board in the background. © Enlyze/Duo Plast

to quantify in advance. Enlyze GmbH has therefore developed a solution for standardizing connectivity of heterogeneous machine parks on one software platform. In addition, Enlyze combines ERP, ME and QM systems to model the full manufacturing context for analyses.

sustainability. Duo Plast offers a complete solution for load unit securing by means of a combination of innovative stretch films, packaging machines and the options for simulating transport conditions in the Duo Lab technology center. Production takes place at two

Connectivity of Extruder, Ancillary Equipment and Quality Assurance

Duo Plast's machines are between two and 20 years old. Extrusion is performed on extruders from Dolci, Macchi and Reifenhäuser. Ancillary equipment, such as dosing, cooling rings or pellet feed, is from Plast Control, Doteco or Maxcess. Modern web-tension controls from Gefran or visual inspection cameras from Keyence were integrated into the extrusion lines. Secondary processing of the film by cutting, stretching and a four-color printing machine complete the overall range.

Enlyze was able to demonstrate its strengths in connectivity here. The connection to the systems is performed via Enlyze's own Edge Device (**Fig. 2**). This is integrated into the automation systems and reads the process data from the extruder and ancillary equipment. Integration is performed within a few hours during running production.

The Enlyze solution is cloud-based and comes as a managed service. The digitalization company takes care of the entire infrastructure, so that the customers' IT resources are not further impacted. The data can be transferred to other systems, such as energy man-

Five Questions to ...

... **Detlef Kaase, chairman and COO of Duo Plast AG.**

Mr. Kaase, your team has been using Enlyze for almost two years. What effects have you been able to ascertain so far.

Everyone in the company appreciates the intuitive usability. With a complex product, it is not so easy to get this right, but Enlyze achieves a balance between analytical depth and practical relevance. That is why the software is very well accepted. At the same time, we are further improving our understanding of the process.

Can you elaborate on that?

Enlyze gives us an entirely new perspective on productivity. For example, we very quickly see the throughput deviations of our articles on the different extrusion lines, which may be as high as 15 %. Once we take into account all the process parameters, we can very rapidly exploit potentials without endangering process stability. We also see opportunities in our material efficiencies and the quality parameters. At every level – from the production manager to the operator – the software makes it easier to concentrate on the relevant parameters and to quickly implement the findings from the analyses.

Did the Enlyze solution work so well from day one?

There was good collaboration with our project leader Alexander Kaunath and the Enlyze team from the beginning. At first, it took a little time until the first extrusion line was online. For the subsequent lines, the team was only on site for a few hours and we could see the results online the next day. The main factors that convinced us to use Enlyze as a digitization partner



Detlef Kaase. © Duo Plast

were the low entry barrier in the form of initial investment as well as Enlyze' steep learning curve.

What was crucial for you in making the purchasing decision?

Until our collaboration we weren't aware of any solution that would be able to deal with our complex machine park at a reasonable cost-benefit ratio. Enlyze won us over with its experience in linking different systems in the RWTH Aachen University labs. Of course it was a risk to set up such a system with a startup that was not yet established on the market. The flexible subscription model persuaded us from the start.

How would you sum up the collaboration today?

The Enlyze team listens carefully, quickly understands and then comes up with innovative solutions out of the box. As soon as another step is implemented, an explanatory video is available for all users – simply and pragmatically explained. Additional extensions, such as connections to visual inspection systems were live within an extremely short time. Of course, the subscription business model from Enlyze only works with long-term customer relationships. I have hardly ever seen so much customer focus before.

agement, or consumed directly via an OPC-UA server.

Digitalization Is Not an End in Itself

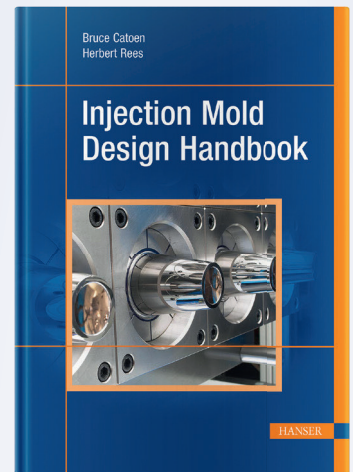
From the start of the collaboration, Duo Plast pursued three goals:

- Improve productivity understanding:

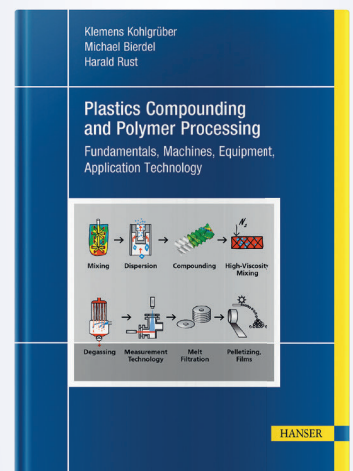
where is the greatest lever for optimization?

- How can new products be quickly transferred into series production and how can we conserve expert knowledge to maintain reproducibility?
- How can we understand manufacturing anomalies and prevent them as effectively as possible? »

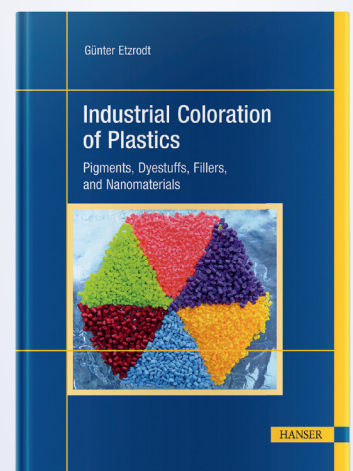
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Enlyze used these goals when setting up the solution.

Benchmarks Calculated for Individual Articles, Not for the Extrusion Line

To increase productivity, reliable KPIs must be generated to make the optimization potentials visible. For this, the OEE (overall equipment effectiveness) forms a suitable metric. Enlyze and Duo Plast have advanced the OEE methodology and modified it for the requirements of extrusion. The innovation consists in benchmarking the OEE components of performance, quality and availability individually for each article, instead of global benchmarks per extrusion line. The example illustrates the effect with respect to the performance.

Figure 3 shows two manufacturing orders (FA101, article 4711, and FA102, article 0221). The extrusion line has a theoretical performance of 350 kg/h. Normally the performance-OEE would be calculated as a ratio of the average performance to these 350 kg/h. Due to the resulting skewed productivity assessment, FA101 scores better than FA102, since FA101 is much closer to the theoretical machine performance maximum than FA102. However, FA102 is much closer to its achievable performance maximum for the manufactured article 0221 (maximum demonstrated speed). FA101, on the other hand, is further away from its specific MDS.

Hence, in reality, FA101 offers more improvement potential than FA102. With

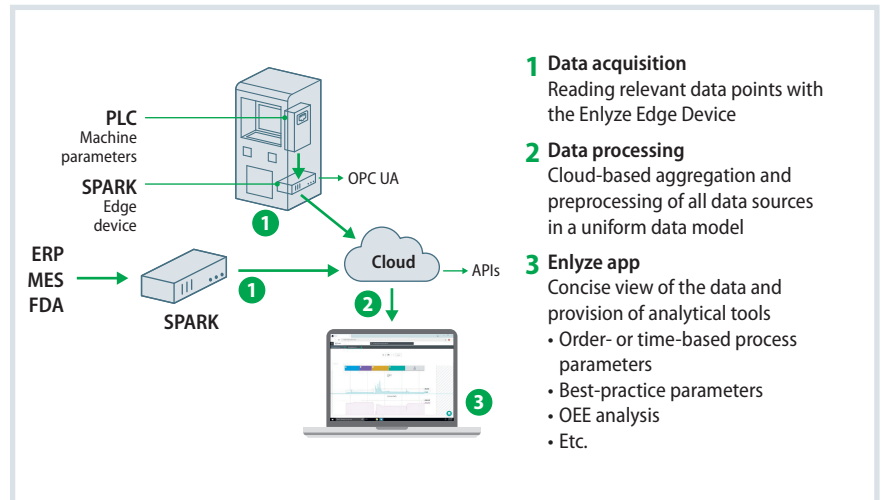


Fig. 2. The Enlyze system includes hardware and software components. Source: Enlyze; graphic: © Hanser

a conventional OEE analysis, the focus would be incorrectly concentrated on FA102. For extrusion, all three OEE components have to be assessed on a production order basis, with article-related benchmarks being automatically derived from the production history and continually updated. The machine-OEE is thus an aggregation of the individual orders and the machine idle times.

These evaluations (**Fig. 4**) allow Duo Plast to analyze the manufacturing productivity in detail and understand where optimization potentials are available:

- Are there products that are responsible for a large share of the losses?
- Are downtimes, quality or performance the causes of losses?
- What is the OEE trend, is productivity rising or falling?

Realizing Potentials in Manufacturing

In extrusion, replicability is one of the main challenges. Enlyze helps achieving replicability by providing optimal production parameters, taking into account secondary conditions and the optimization goal (**Fig. 5**).

After Duo Plast successfully reduced their scrap rate in recent years, its focus is now turning to increasing throughput. With the aid of Enlyze, Duo Plast can determine with which articles the greatest improvements are achievable. The parameterizations are evaluated and compared for each stable production run, so that reference orders (Golden Runs) are defined and their machine parameterizations become visible. In line with the continuous improvement

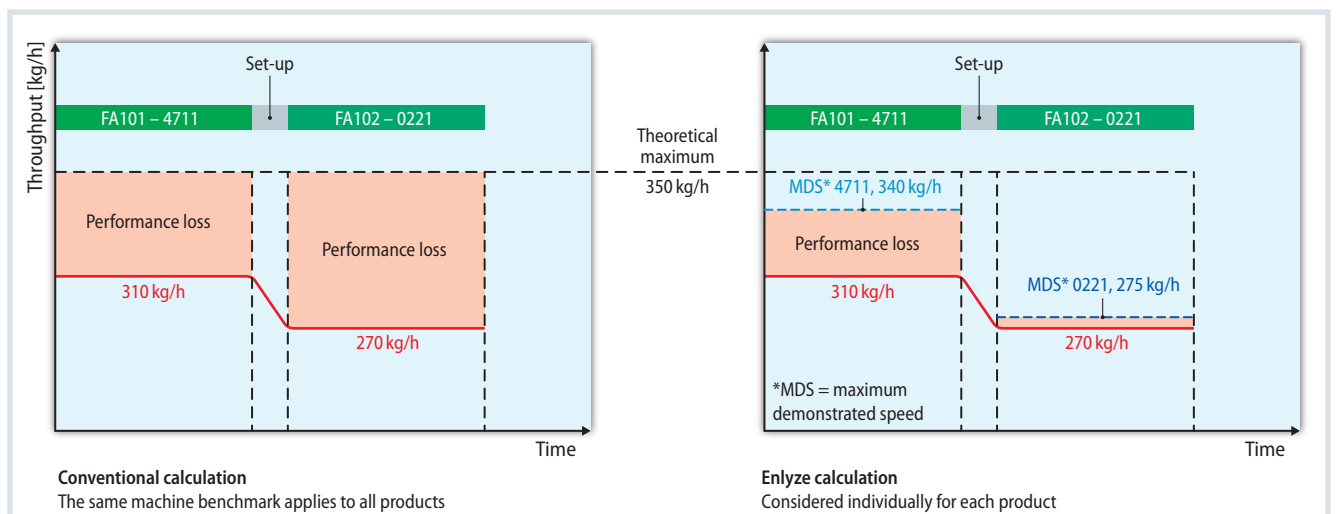


Fig. 3. In the conventional calculation (left side), the same machine benchmark applies to all products. The Enlyze computation considers each product individually. Source: Enlyze; graphic: © Hanser

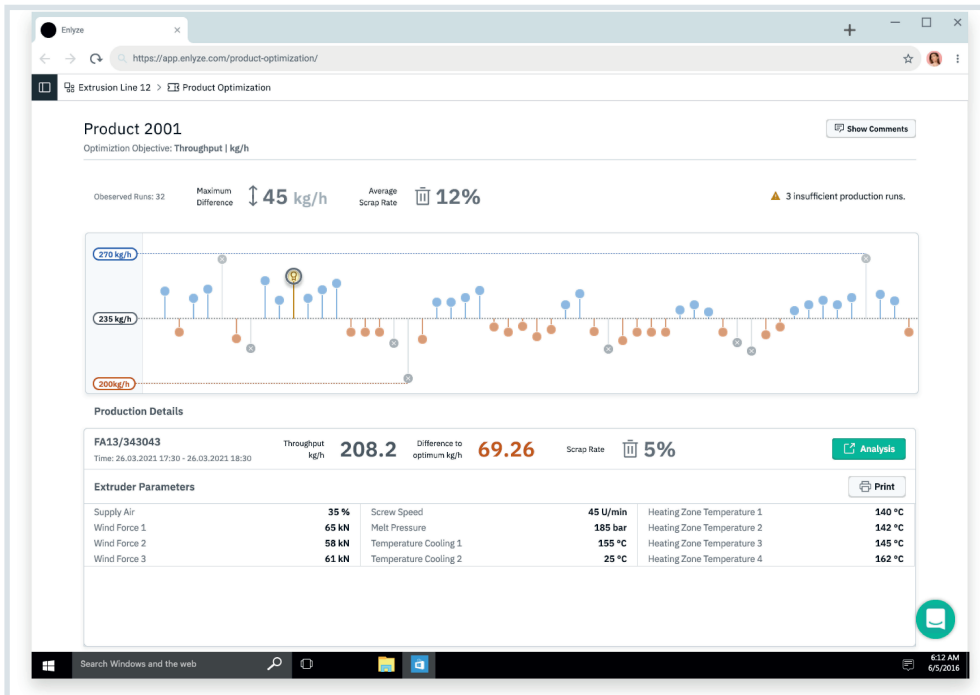


Fig. 4. The app provides optimum system parameters taking into account secondary conditions and goals Source: Enlyze; graphic: © Hanser

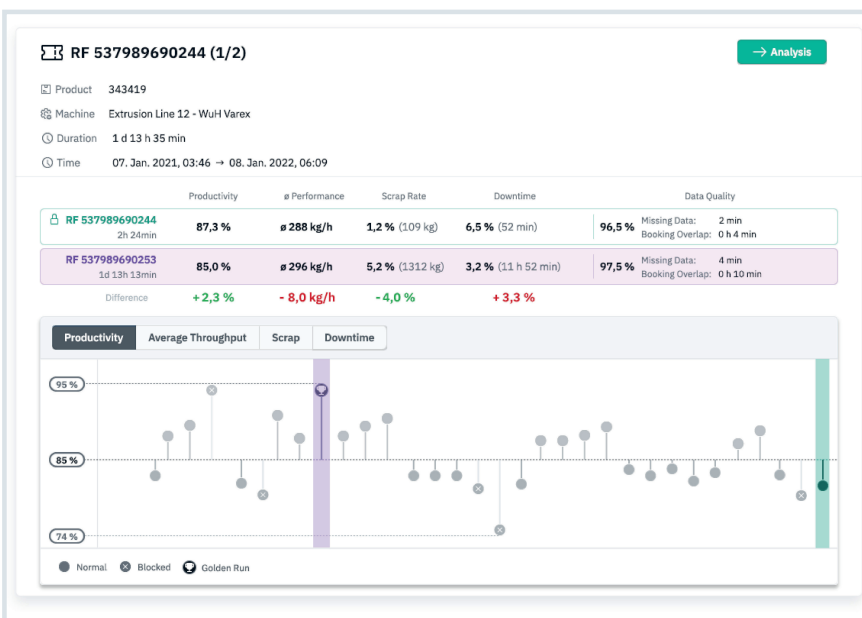


Fig. 5. The evaluations allow productivity to be analyzed and the identification of optimization potentials. Source: Enlyze; graphic: © Hanser

methodology, each article's production is gradually optimized.

As a side effect, the experience values of the operators are also preserved and shared. In addition, the formulation management is digitally modeled and continually updated. The development department of Duo Plast thereby gains valuable insights into the manufacturability of the articles in the portfolio and can further optimize formulations.

The various abstraction levels – from KPIs, via machine parameters, to

deep down process data analytics – help Duo Plast to better understand production anomalies and identify their causes.

The users can enter article or FA numbers via a search function and jump directly into the various analysis functions. Duo Plast thus finds the relevant information faster and can spend more time on the analysis. ■

Info

Text

Henning Wilms is CEO of Enlyze GmbH; h.wilms@enlyze.com

Clemens Hensen is Head of Customer Success Management and authorized signatory at Enlyze GmbH; c.hensen@enlyze.com

Alexander Kaunath is factory manager at Duo Plast AG at the Lauterbach site; alexander.kaunath@duoplast.ag

Company Profile

The digitalization company Enlyze was founded in 2017 at the RWTH Aachen, Germany. The 20-strong team digitalizes the production of 15 manufacturing companies and helps them to achieve greater manufacturing productivity. The software solution is provided in a flexible subscription model without high initial investment. enlyze.com

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