Interview on the Use of Artificial Intelligence in Waste Sorting

"AI Has Great Potential for Sorting Food Packaging"

Sorting plays a crucial role in the processing of plastic waste. Systems based on artificial intelligence are one way of improving this. Sorting systems manufacturer Tomra has recently presented corresponding technologies. ***Kunststoffe*** spoke about this with Felix Flemming and Valerio Sama from Tomra. In the interview, they explain what progress can be made with it, how important digitalization is for this and what improvements it means for food packaging.

Artificial intelligence is no longer hype, but is already being used in various places. Sorting specialist Tomra also incorporates it in its systems. It is intended to help improve the sorting performance of the systems and thus increase the amount of recyclable plastics. We spoke to Felix Flemming, Senior Vice President and Head of Digital at Tomra Sorting, and Valerio Sama, Vice President and Head of Product Management Recycling at Tomra Sorting, about the benefits this will bring.

Kunststoffe: *With GAIN and Deep Laiser, Tomra has developed two AI-based systems. How can recyclers reap benefits from it?*
Valerio Sama: Deep Laiser is a further development of our laser object detection technology. This technology is integrated in the latest generation of our Autosort sorting system and fulfills three essential functions. Firstly, we can use it to compensate for the limitations of classic near-infrared sensors (NIR, *editor's note*), such as the detection of black plastics colored with carbon black. To do this, we collect additional information from the waste using a laser. Secondly, this technology also makes it possible to detect overlapping objects and to separate them virtually. We call this Smart Segmentation. For the third function, laser technology is combined with deep learning. This allows systems to be trained on specific objects. These can then be identified and sorted.

> *"Digitalization is a necessary prerequisite for the circular economy."*
>
> Felix Flemming

Kunststoffe: *What about GAIN?*
Sama: GAIN is a pure deep learning technology. We train a neural network with images recorded by a camera. This technology is also used to compensate for the limitations of classic sensor technology. A good example of this are PE silicone cartridges. With conventional sorting systems, only different polymers can be separated from one another, but not PE from PE. The trained camera system now recognizes the shape of the cartridge and can then also separate it.

Kunststoffe: *Is AI being used to improve existing systems and not to replace them?*
Felix Flemming: Exactly. Deep learning technologies can improve the sorting machines performance. The service consists of combining the data from the sensors with those from image recognition. That's where the potential lies.

Kunststoffe: *Neural networks have to be trained so that they can fulfill their function. Do you offer the networks that are already trained or does the user have to do it on site?*
Sama: Of course, the customer receives the finished neural network that is specially tailored to their problem. We have set up our own team to prepare the systems for the respective application. In the plastics sector in particular, however, this is a

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Tomra Sorting GmbH
www.tomra.com/recycling

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continuous process. Packaging, for example, changes very often. That is why the network in the field must be continuously optimized.

Kunststoffe: *Packaging also differs greatly in different countries and regions. Do you take this into account in the trained networks?*
Flemming: We do. In fact, packaging varies greatly between countries. That is why you either have to have a whole set of networks in stock or you have to train the basics. Whereas the bottles of certain brands are largely uniform worldwide, there are country-specific or regional differences the system has to be trained for.

Kunststoffe: *For which regions do you offer appropriate networks?*
Sama: We focus on Europe. The basis can, however, be used worldwide. For special needs, we adapt the neural network accordingly.
Flemming: This is where AI and digitalization interlock. The goal is not to physically maintain the networks on site, but to further develop them remotely. We use digital technologies for this.

Kunststoffe: *Do you use the data collected during active operation to create and improve the networks?*
Flemming: Exactly. Of course, with the restrictions that exist due to data protection. We ensure that no data is transferred from one customer to another and that it cannot be assigned to specific customers. The customer's consent is also required. If a company insists that its data does not leave its own system, then of course we respect that. However, in this case, companies also do not benefit from the advantages that arise from retraining the networks, since we do not receive the necessary data from them as a basis. It's a give and take.

Kunststoffe: *Does AI also open up new applications where sorting was previously not possible?*
Sama: Until now, there were limits on the sorting of food and non-food packaging. Even AI will not be able to make this distinction in one hundred percent of the cases. However, the technology holds great potential to achieving very good results in this area. There are still some legal hurdles for the use of recycled plastics in food packaging, but there is still great interest from customers in the respective sorting technology arising from recycling and sorting plants.

Kunststoffe: *You mentioned digitalization. How can this improve the establishment of a circular economy?*
Flemming: Digitalization is not the only but one of the necessary prerequisites for a successful circular economy. A stable circular economy requires transparency about which materials are available in which places. Companies need to know where they can get material, what quality it is and to whom to sell it. Digitalization will help enormously in this.

Kunststoffe: *What could this look like in practice?*
Flemming: Sorting systems record, for example, which polymers are currently available and in what quality, and then pass this data on to platforms. This enables companies to find out very quickly which recycling materials they can currently purchase. This is very much dependent on interfaces that enable communication and secure data exchange between the various machines, systems, IT systems and participants. »

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About the Interviewee

Dr. Felix Flemming is Senior Vice President and Head of Digital at Tomra Sorting. There he is responsible for Tomra Insight and other digital offerings. Before moving to the sorting systems manufacturer in 2018, he held various management positions at the Voith Group in Germany and the USA, including in the areas of innovation, global service strategy, change management, software tool development, system technology and hydraulic development. Most recently, he was responsible for the development of Internet of Things solutions and new business models at the company. Flemming holds a doctorate in mechanical engineering from the Technical University of Darmstadt, Germany, and a Master of Engineering from Cornell University in Ithaca, USA.

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About the Interviewee

Valerio Sama has been Vice President and Head of Product Management Recycling at Tomra Sorting since 2018. He has now been with the company for twelve years; initially as an application engineer, and later as a product manager for sensor systems. Sama studied waste management at RWTH Aachen University, Germany, and science, technology and innovation management at Wilhelm-Büchner University, Germany.

Kunststoffe: *With Tomra Insight you offer a digital tool for sorting systems. To what extent can this improve sorting performance?*
Flemming: Tomra Insight creates added value in four areas. It reduces system downtimes through predictive maintenance, the classic of the Internet of Things world. This is accompanied by an increase in throughput. However, the operators can also increase the sorting performance by optimizing the machine's settings. It also saves costs by making data directly available online, as well as manuals and spare parts information. There is also a particular focus on the quality of the material. Our systems continuously collect data on the quality of the plastic waste collected. Of course, the recorded data cannot be compared with laboratory measurements. However, operators still have a continuous overview of which plastics are passing through their systems and, for example, how many contaminants are contained. Tomra Insight also helps in particular to optimize the systems. Recycling systems are very complex systems with many different individual components. The tool makes the various processes and machine performances transparent and thus enables holistic optimization.

Kunststoffe: *Are there any plans to use AI for this as well?*
Flemming: There are. We already use this to some extent, but not yet for automated processes. Examples of this are, for example, the detection of anomalies in material flows or analyzes of throughputs over a certain period of time. In selected cases, customers are also shown possible causes of problems. That's where we are now. Tomra Insight, as it is on the market today, is the start of this journey. We continuously add improvements or new functions about every three weeks.

Kunststoffe: *Various initiatives, such as HolyGrail, want to sort plastic waste using digital watermarks. Will the sensor systems you manufacture become obsolete?*
Sama: Sensors are still necessary for these technologies, but only those that recognize the watermarks. Sorting units are also still required. It will also be decades before all products are watermarked. And don't forget the products that are already in circulation. These also end up in the waste streams and have to be sorted. We therefore do not see the sorting using digital watermarks as competition.
Flemming: A lot is happening in this area at the moment. However, we do not expect a quick introduction. After all, it is not just a question of equipping products with these watermarks, the recycling systems must also have the appropriate sensor technology.

Kunststoffe: *Keyword design for recycling: how should plastic products be implemented so that they can be sorted particularly well?*
Sama: Multilayer structures make sorting considerably more difficult. Full sleeves are also problematic, for example bottles that are completely labeled for marketing reasons. These are very problematic when it comes to sorting by color. In addition, companies should avoid plastics colored with carbon black.
Flemming: In general, simplification is important, i.e. less complex packaging, no combination of different materials. For example, bottles and caps should be made of the same plastic. ■

"AI is used to compensate for the limitations of classic sensor technology."

Valerio Sama

Interview: Florian Streifinger, editor