Get ready for the next level in quality control

Christian Eikmeyer, Product Manager, ISRA VISION

INTRODUCTION:

The paper and board industry is diversifying and responding to an increasingly globalised marketplace. Key global megatrends are reshaping the market faster than ever: E-Commerce, lightweight, Big Data packaging, Intelligent or smart sensors, recyclability.
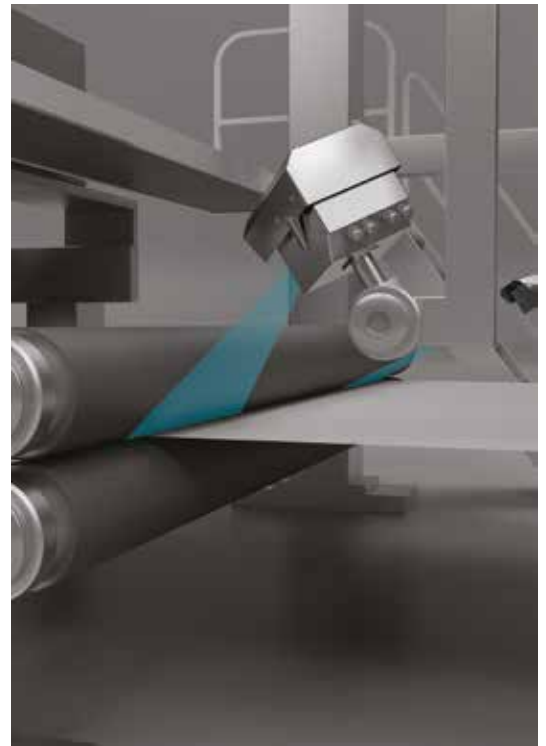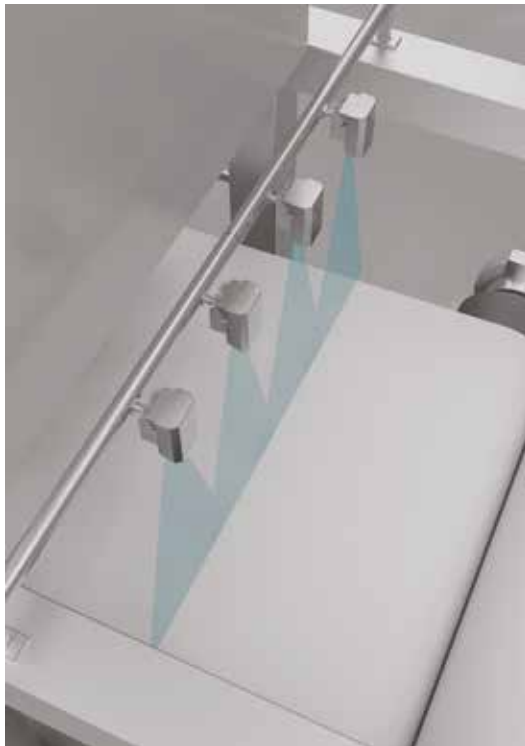

Figure 1 – Surface inspection on the full web width / Web Break Monitoring

Let´s take a closer look what this exactly means for the paper industry.

A key driver for the demand for new packaging solutions is internet shopping. Consumer packaging – such as carton-boards – serves the needs of both, on-the-shelf display and advertising. This trend is creating positive growth rates for corrugated box production and its raw materials. As such, demand is growing for shorter lead times and for a commitment to next-day and increasingly same-day delivery services. This means packaging must be available immediately and in the right quality.

Lightweight packaging boards offer multiple benefits depending on the end user. In luxury carton boards, lighter weight boards can improve brand value to major customers. It can also meet the demands of expanding a customer base, building on successful branding, and supporting business growth while increasing production capacity. Demand for lighter weight packaging board will continue to grow as it helps to reduce pulp costs, offers less weight in logistics (reducing costs and CO2 emissions), sports better pricing, enables more primary packs and ensures less waste at end of the life cycle.

Another driver is the ever-increasing use of Big Data for different applications like marketing, sales, production optimisation and maintenance. Production excellence and quality rely on connected devices, a large-scale deployment of versatile sensors and intelligent systems. Many key process control applications – such as online controls of basis weight, moisture, and other properties together with optical quality control – have long been based on Big Data analytics collected from fast-running paper machines.

Typical measurements in the pulp and papermaking process – flows, temperatures, consistencie, optical quality and other process information – are taken and fed back into the process control cycle. One way of advancing process controls is to develop and fit sensors with smarter built-in intelligence and combine those data with the results of optical Inspection systems. Across the next decade, the paper and board industry will feel the benefit of intelligent, fully connected and industry 4.0 savvy sensors in multiple applications in the mill – for example, when targeting reductions in downtime and breaks at paper and board machines.

Figure 2: Overview of the defect count and defect classes

But big data and industry 4.0 are not limited to the production as another example is the use of Big Data analytics in forestry operations to evaluate the growth and volume of harvestable trees for wood supply. Big Data analytics will become widely popular in all phases of the paper and board value chain during the next ten years.

Recyclability is becoming more of a key requirement for flexible and rigid consumer packaging products. When entering recycling streams many traditional waterproofing and oil/grease-proofing barrier coatings are hard to remove economically and can lead to such packs being sent to landfill. This is also the case when talking about the migration from plastics or undissolved ink particles into the pulp of recycled fibre. This creates a significant potential for new ways to reuse this recycled material for new products, such as recyclable barriers. And of course, one of the biggest drivers disrupting the current market situation as well the future market is the need to significantly reduce energy costs and at the same time a dramatic reduction of your ecological footprint.

Keeping these driving forces in mind, ISRA VISION has developed a complete set of camera-based web monitoring and inspection systems covering the entire process chain from pulp to reel. In addition, our systems and connected software solutions help to optimize the entire production chain – from headbox to the ultimate delivery of the manufactured product to the customers – being the go-to production analytics hub with the paper mill.

Inspection system

Optical systems can help companies on their way to a production increase in a sustainable way. Inspection systems are specialized not only to find all kind of surface defects but also to classify each defect using the latest AI-based classification methods like deep learning and neural networks. Having this information available for the next production or finishing steps, gets the mill operation closer to a full circular quality inspection system – helping to avoid surprises as all defects can be tracked down to their origin and in what process step they were created. In addition, operators will learn more about how inspection and extracting defined sections of produced products in any processing or treatment step will not only reduce waste and lower the carbon footprint, but will also increase the profit at any step within the value-added chain.

Connecting optical quality data in all the different production stages is done in three steps:

- Inspect the material to collect quality data
- Distinguish what is of relevance for quality grading
- Correlate this information with other data and of course hand it over with the product further down the process chain.

Surface quality data and classification

Optical Inspection Systems are a known tool to not only find process disturbances and gather information about the quality of the raw or input material but also to get immediate feedback of the produced quality. Inspection Systems are nowadays located in all production steps so that relevant production specific defects are recognized. After the recognition or detection of a defect the next step is the correct classification of this defect. Today artificial intelligence methods automatically assign the detected defects to individual classes. The usual time-consuming, and error-prone training of the classifier by the operator is eliminated. This is a milestone in defect classification and already surpassed what humans can achieve regarding speed, consistency and quality. The system operator can now concentrate on their main task: the Production of Paper.

Process Control

A key driver for using optical inspection and monitoring systems is process control. Connecting Information (quality and process) from different lines in the mill-wide system allows gathering of status of components as well as the most important quality data. This can be displayed together with the production data and gives an operator or plant manager easy access to the respective system status data of the individual components like the ISRA VISION web inspection and web break monitoring system. Users can thus see possible causes for emerging problems and prevent faults through targeted intervention or predictive maintenance.

Tracking of quality Data

Optical inspection systems, available for all kinds of materials from board to tissue, make a significant contribution to increasing profits and customer satisfaction. All this not only for one single paper machine in one selected mill, but with modern cloud solutions in a network for the entire, worldwide production. A reject

Figure 3: Connecting Information (quality and process) from different lines in the mill-wide system

control system for example, helps to synchronize the roll quality data with the sheet cutter. This improves throughput as only bad material is rejected, reducing waste and avoiding customer claims. Slitting optimization on the other hand helps to enhance the arrangement of the rolls on the current reel with full visualization of the slitting plan, and gives complete documentation of the actual slitting process. In addition, a reliable detection of process-critical defects at the paper machine using AI-based classification helps to precisely detect a defect position and perform a short-term speed reduction during the winding of this to avoid breaks and other disturbances.

Looking at tissue, layer merging with defect position synchronization, including unwind diameter and speed at the converting line, is a key contribution to create multilayer reels that meet customer and quality expectations. This enables full quality grading that takes third party sensors for formation, moisture, thickness and more into account and creates an automated quality assessment of each roll.

Quality decisions

Connecting data throughout the entire process from pulp to recycling helps to answer the main question whether a roll can be shipped or if not whether it can be repaired or re-assigned for a different purpose or customer. Roll release, repair and re-assignment tools are already used in multiple other industries i.e. metal. With these tools, plants can generate blocking and release proposals for each reel according to your quality rules based on surface defects or third-party quality data. Roll repair helps to analyse the surface defects and create easy-to-follow repair instruction. And finally, a roll allocation can help to find a new order and get the best price even for non-perfect rolls.

The complete quality circle

To make the complete quality circle a reality, ISRA VISION doesn't only offer web inspection and web break monitoring but a complete portfolio of solutions to connect the quality results all the way from raw material over base products and finishing treatments all the way to the end customer product, and back to recycling into one quality cycle.

There will be no need to immediately recycle tons of paper due to specific defects (coating streaks, stickie's, ink or colour particles) within a reel when the exact position, type and amount of them within the reel is precisely documented. ISRA VISION´s

inspection systems are specialized not only to find all kind of surface defects, like the tiniest blade streaks or contaminations, but also to classify each defect (if it is a plastic or ink particle, a water drop or oil spot) using latest AI based classification methods like deep learning algorithms and multilayer neural networks also combined with colour inspection cameras.

Having this information already available, the next step would be to hand this over to the next production or process stage. Especially when it comes to rolled material it´s really detrimental if one does not know exactly in which section of the roll a defect from a former process is included. Sheets or parts can be ejected precisely based on all the information available from the very first production step of the base materials.

For instance, companies specialised in finishing and coating could now link this information to their vision solutions. This would define the exact position of defects coming from the treatment process, and defects coming from the base product would be known even if they transform their appearance after the finishing treatment. This information could be used by the treatment companies to optimize their production process based on defects which occur during their specialized production, and again precisely locate a defect on the finished reel/sheet defining which surface defect was coming from which production step.

This way even finished products such as barrier coated paper could be handed further down the process chain even with pinholes present, minimizing the waste thanks to the exact knowledge about each defects position.

At the end only a 100% perfect quality product will leave the last processing plant to the end customer. Whether it is non printed material or printed material finally inspected by our print inspecting systems.

With a full circular quality inspection system, ISRA VISION enables not only a sustainable resource handling but also ensures the competitiveness of a paper or tissue mill in demanding times and with even tighter regulations on the horizon.

More info: https://go.isravision.com/pti