The rise of smart packaging solutions

The Hamburg-based machinery experts at KROENERT are discussing first-class production methods for smart labels. An article written by Andrea Glawe (regional sales director) and Markus Waterkamp (managing director)

The global market for smart packaging applications promises continuous growth over the next years. Some experts say the global market for smart packaging is expected to reach $26.7bn by 2024. Solutions for smart packaging are adapting sensor technologies for food as well as pharmaceutical products to measure the storage conditions of packaged products but also the related information flow of the packed material. Thus, products with these smart labels can deliver information such as shelf life, can help improve product safety, monitor freshness or display information about quality but also about the packaging material itself. Considering the aspect of sustainability, information about the used material compounds is very important too.
That is because packaging solutions need to follow governmental recycling regulations as well. And these regulations are becoming more and more restrictive worldwide. The packaging industry therefore needs to adapt its developments to the growing requirements. Recyclability must be ensured while maintaining the optimised performance of the package. Moreover, consumers expect more information about the packaged content in addition to the printed information.

Applications with printed electronics (printed circuits[a] OPV[b], RFID antenna[c])

Functional labels

These needs in the market led to the development of functional labels with RFID or NFC technology, which is produced by printing functional electronic layers. These "smart" labels have partly hybrid features with integrated chips and sensors, and they are the state-of-the-art solution for information transfer about the product itself as well as the used packaging compounds.
The labels can be equipped with all the necessary information about the used raw materials such as polymer films, necessary storage conditions and important handling information, as well as optimal recycling solutions when it comes to the end of its period of use. Part of the production process is carried out by functional roll-to-toll printing, coating and laminating machines.

The value chain within a circular economy is a megatrend for the packaging market *1)

Roll-to-roll printing processes for functional labels

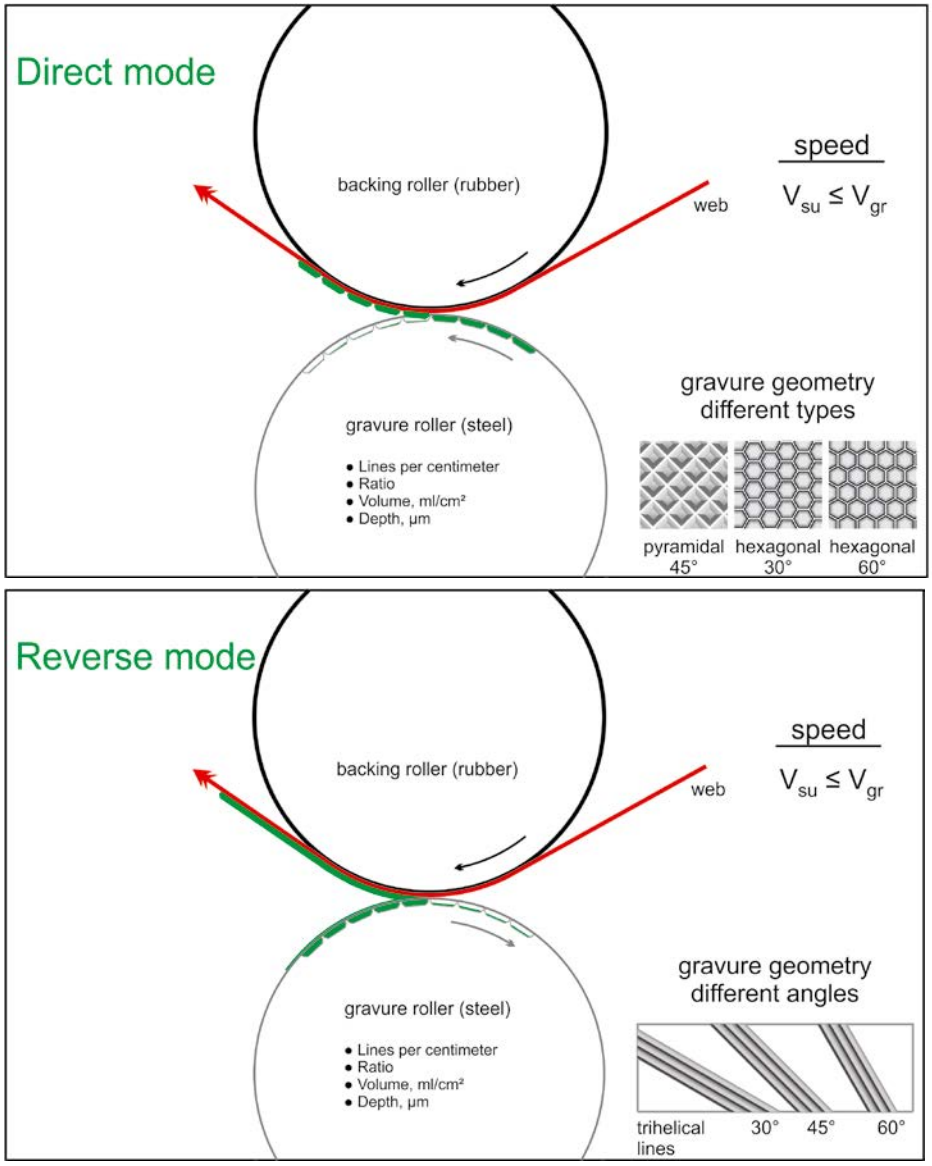
The advantage of roller technology is its flexibility. Depending on the running direction of the application roller and the design of the roller it is possible to achieve the coating as well as the printing operation with the same application equipment.

For printing applications, a gravure design with high resolution is required. Engraving structures with hexagonal cells are used for printing processes. With laser gravure processes it is possible to define very thin structures of 3µm-thin lines with a distance of less than 10µm. Chemistry and substrates need to be well adapted for such high requirements.
As an alternative to the gravure process, the indirect or flexo printing technology is used for printing applications. An application roller (anilox roller) supplies the printing media from a chamber system or pan to the flexo roller in a relief printing process.
In addition, rotary screen technology is used for printing processes. This technology is used mainly for functional applications with higher thicknesses. Inkjet technology is also ideal for the described applications. The advantage of inkjet printing technology is the high flexibility, as well as the very fast change of the feature and the lowest image

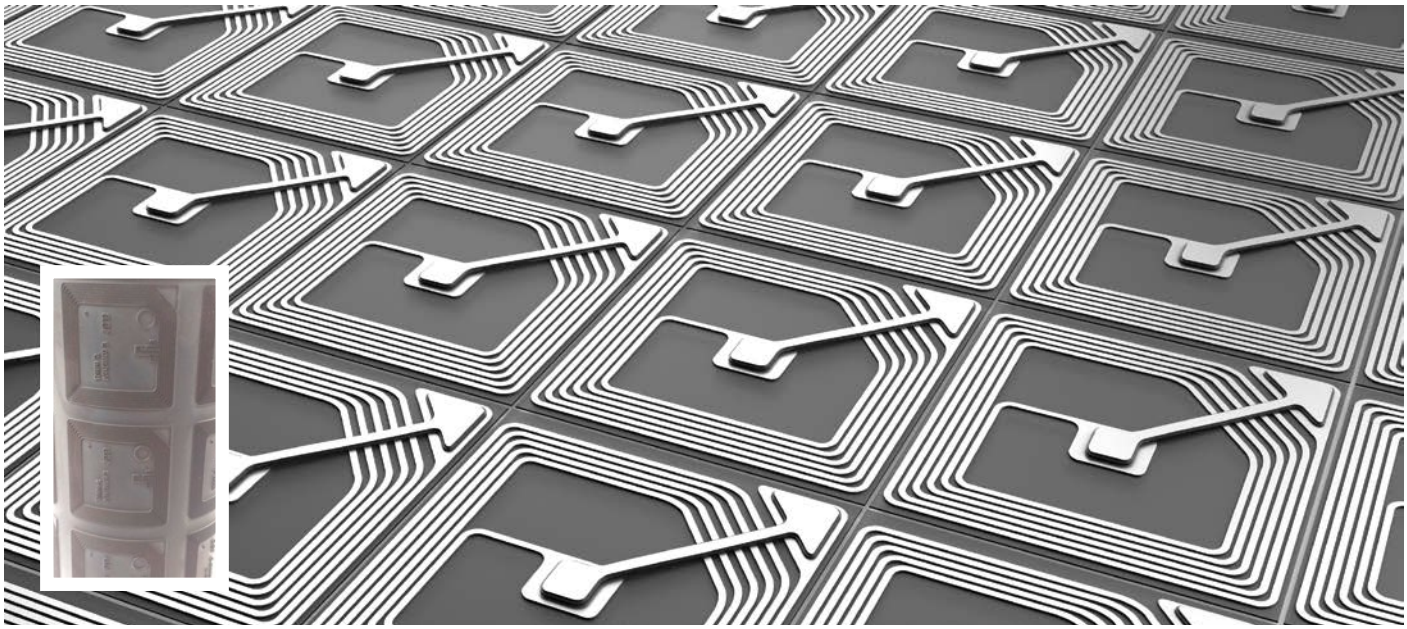
costs. The printing inks must be adapted to inkjet printing processes, of course.
With printing and coating technologies like gravure, slot-die and flexo-printing it is possible to guarantee at least the following parameters today:
Printing Applications: Gravure, slot-die, flexo-printing, screen printing, inkjet printing
Film thickness (wet): <0.5µm up to 500µm
Coating Tolerances: +/- 1% (MD and TD)
Machine Speed: 0.1 up to 100m/min
Register (longitudinal): +/-20µm
Register (lateral): +/-20µm

KROENERT has integrated all above-mentioned technologies with selected partners. Each technology has its application. And, as often, the product defines the necessary technology in the end.
Smart packaging solutions are able to help preventing the waste of food, to inform consumers about the product, they improve tracking of packages during transport and finally they support recycling solutions for the used packaging material. These value-added benefits promise an increasing demand of functional smart packaging solutions.

Image sources: KROENERT
1) https://future.vdma.org/viewer/-/v2article/render/35536576*



Printing compared to coating with roller application technologies



Printing processes with flexo-printing cylinders