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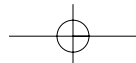
HANSER

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Film Inspection – A Question of Location



special reprint





In-line Production Control. Film inspection systems support the film manufacturer in the objective quality control of his products and in process optimisation. When integrating such a system, the question arises of where to install it: should it be located in the extrusion, laminating or cutting section? Each variation has its advantages.

Film Inspection – A Question of Location

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The customer expects perfect quality. The film manufacturer wants to make optimum use of his production lines. Reason enough to integrate a film inspection system in the film production line. After all, without such a system, it is almost impossible to obtain objective information about the quality of the manufactured film. Once the decision has been taken to install such a film inspection device, the question arises of where to put it: what is the ideal location within the production line? Should the system be positioned in the extrusion, laminating (finishing) or slitting (slitter winder) section?

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Focus on Film

The first question to be asked is what a film inspection system is capable of and what you want it to do. Basically, the system should help to prevent faults, lower the reject rate, optimise the production process, improve the film quality, guarantee consistent quality, and, as a result, avoid complaints and strengthen customer loyalty. A reliable quality control is needed anyway for certification to ISO 9000. Film manufacturers serving the fields of medicine, pharmaceuticals, food, technical film, lamination, coating and printing have pioneered the use of optical control systems.

Currently state of the art are camera systems with data rates of 80 and 120 MHz. Standard high-speed CCD line scan cameras with 2048,

4096, 6144 and 8192 pixels are nowadays available, which means that the equipment can be geared perfectly to the take-off speed and the web width of each individual production line [1].

Surface inspection systems monitor the film web either by transmitted light (for transparent and translucent film) or by reflected light (for opaque film). When both transparent and opaque films are produced or processed on one and the same unit, a combination of both types of illumination is recommended.

Modern systems detect and pick up surface defects such as gels, black specks, fish eyes, cracked coatings, streaks, flow lines and insects

(Fig. 1). With the aid of the pictures, the operator can train the system to the various defects so that it can automatically define the classification criteria for the defect types.

Depending on the configuration, the inspection system warns the operator of critical individual defects. This might be a single insect, or it might be an increasing frequency of defects such as more than ten gels with a diameter of 200 to 300 µm in a square metre. It ▶

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■ EXTRUSION

can also give a warning if rolls or reels are off spec. The system saves the data so that they can be called up at any time, for example in the event of a complaint. Production trends over longer periods – over the last 12 hours, for example – can be depicted online. Offline, entire campaigns can be compared and evaluated, for example to assess raw material batches with regard to gel

external defects (e.g. flies attracted through static charging of the film) remain undetected. On the other hand, by installing the inspection system in one of these sections of the production process, the manufacturer gains a high level of certainty with regard to the final quality control of the roll. Apart from that, he can also directly monitor and optimise the coating or laminat-

er, it may be better to locate it in the slitting department.

Cost Factors

The costs of installing an inline inspection system are made up of direct and indirect costs. The direct costs are the price of the system including delivery, installation, start-up and training. Indirect costs are

different possibilities for integrating inspection systems.

The first example deals with the extrusion of blown film. Here, the inspection system was installed ahead of the wind-up units where it can monitor the full width of the collapsed tubular film. Both transparent and white opaque film are inspected with transmitted light. The most commonly used resolution for the

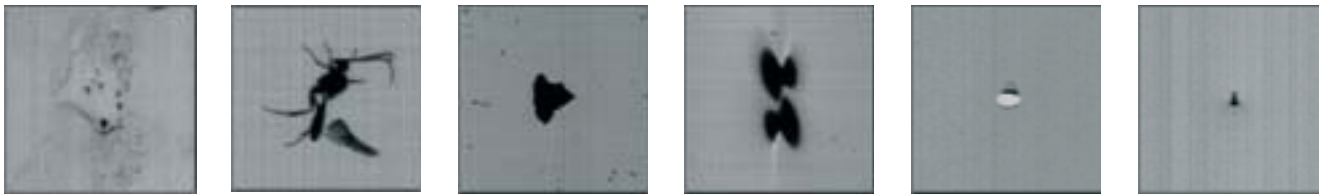


Fig. 1. Typical defects: Gel shower, fly, contamination, glass fibre, hole, gel (from the left to the right)

frequency in conjunction with a specific extruder. Furthermore, the system can print a protocol of the roll quality, geared to the demands of the producer.

Variations in the Set-up

Let us get back to the question of where the system should be installed. The first variation is during extrusion. The particular advantage of this alternative is the possibility for direct process control (close loop). In this way it is possible to estimate at an early stage when rinsing and cleaning of the die are necessary, and thereby save raw material. The direct feedback also supports the operator with the handling of the equipment, for example in optimising the start-up processes. At the same time, the system takes care of the final quality control of the manufactured roll.

If the film is subsequently to be laminated or coated, it is worth considering locating the system somewhere else, because if it is placed in the extrusion section, the producer obviously obtains no information about the coating or laminating process. Coating defects, laminating faults or

ing process. Conversely, of course, quality control of the extrusion process is then only possible within certain limits. The faster the subsequent processing takes place, the better the extrusion process can be monitored.

A third variation is to locate the inspection system in the cutting section, for example in a slitter winder. The main advantage of this is the 100 % final quality control, which prevents complaints and enhances customer loyalty. In this case, however, only a limited process control is possible, for example by analysing all the rolls from a raw material batch in conjunction with the frequency of gels and specs. In this way, a relationship can also be established between a batch of raw material and different extruders.

The question regarding the optimum location for an inspection system is thus not one that can be answered generally. Instead, the film manufacturer will have to weigh up in each case what his main objective is. If, for example, he wants to ensure optimised extrusion, the system should be placed in the extrusion section. On the other hand, if he wants to guarantee 100 % final quality control for the cus-

above all the staff and time needed to look after the system.

A training concept consists of a one or two-day training course for the system administrators, to take place around 14 days before start-up, a training session during start-up and a one-day follow-up training four to ten weeks after start-up. The system administrators have the task of managing the system and, for example, defining the recipes for various products with certain customer specifications. The staff who operate the system, on the other hand, only need to know how to respond to the various alarm warnings.

The extent of the time and personnel costs for looking after the system will depend on the level of integration. If, for example, the development department uses the measurements to evaluate new recipes and new raw materials, the cost will naturally be higher than if the inspection is used merely to monitor the extrusion process.

Practical Examples

Finally, let us look at a few practical examples from various segments to illustrate the

system is 200 to 300 μm . The inspection system controls the extrusion unit (it recognises, for example, when rinsing is necessary or when the die needs to be cleaned). At the same time, it detects critical gel sizes that lie, for example, outside the specification for laminating film.

On the other hand, because of the rotation of the bubble, it is often enough in blown film extrusion to merely carry out a statistical evaluation of part of the film web. For cost reasons, this configuration is certainly worth considering.

In the extrusion of cast film, where there is no rotation, a statistical control of this kind is of no use. A full, 100 % inspection offers the advantage that a defect within a roll can be exactly localised. In the case of a collapsed and slit tube from a blown film unit, this is no longer possible, even with a 100 % inspection, due to the rotation of the bubble.

Flat film for thermoforming, especially barrier film, is often inspected with a combination of reflected light and transmitted light for both transparent and opaque films. Here, apart from monitoring the extrusion process, it is also a matter of detecting criti-

Fig. 2. Open inspection bridge to inspect polycarbonate sheet



cal defects (gels and black specks with a diameter of more than 500 μm), which reduce cycle times during the thermoforming process.

For the extrusion of oriented films, various concepts are conceivable. From an economic point of view, a good solution is to carry out a full, 100 % inspection of the extrusion process and partial inspection of the stretching process (e. g. 1000 mm) with a server system and two camera beams. Where necessary, of

course, the oriented web can be fully inspected, although this can be an expensive matter with a web width of 10 m. If the time delay between the extrusion/stretching process and the cutting on the slitter winder is relatively short, a useful alternative would be to carry out the quality control at the slitter winder to guarantee 100 % final quality control.

In another example involving an extrusion line for manufacturing optical polycarbonate sheets, the inspection

system was located directly after the calendar (Fig. 2). Here, it warns the operator as soon as any problems occur – for example, bubbles, gels or black specks – to enable him to intervene in the extrusion process immediately. Around 30 m away, in a separate room, is the saw, which cuts the sheets covered with protective film into lengths of 3 m. There, with a certain time delay, an alarm light is connected to warn the stack operator if a sheet is off spec. Further-

more, a quality report for the sheet is automatically printed on the label. The system is linked via the company's computer system to the production manager's office and the development department so that the data can be effectively managed and analysed.

The final example comes from the field of extrusion coating and adhesive control. The inspection system for a coating unit has to monitor both the coating process and the liner. Combining the control of the preproduct and the process with 100 % final quality control is usually the best solution. Because both transparent and opaque webs are produced on the coating lines, it is an advantage to work with a combination of reflected and transmitted light. ■

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