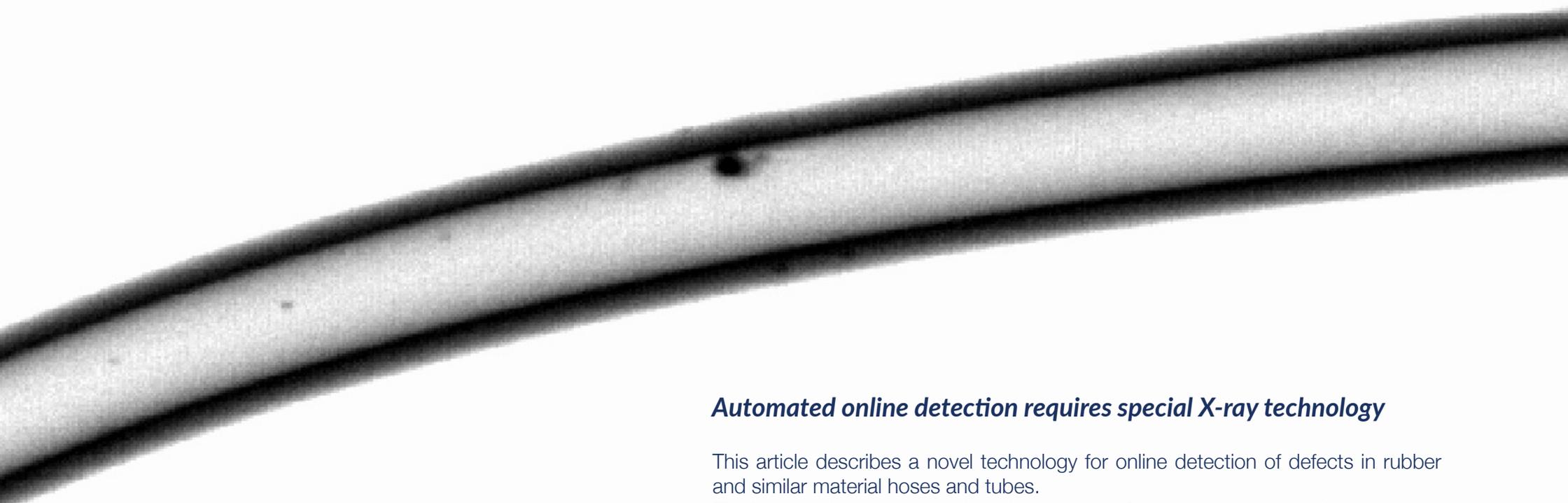


# X-RAY BASED AUTOMATIC DETECTION OF **INTERNAL PARTICLES, INCLUSIONS AND HOLES** IN RUBBER HOSES



## ***Automated online detection requires special X-ray technology***

This article describes a novel technology for online detection of defects in rubber and similar material hoses and tubes.

The X-ray technology was originally developed for packaging automation control. It has proven also to be superior to any other technology for automatic detection of manufacturing imperfections such as inclusions, particles, salt deposits, side holes and other defects. The system can operate with 4 lines, with automatic reject signalling, in real time.

The method is suitable for rubber hoses and other hoses with a wall thickness up to 3 mm, and production speed from 1 to 120 m/min.

## SEEING THE INVISIBLE

During the last years, InnospeXion has developed a unique real-time X-ray imaging technology, based on using a part of the X-ray spectrum not used in other imaging applications.

Along with a very high image resolution of 0.1 mm, this innovation has unveiled a substantial improvement of the on-line detection capability, thus enabling the usage for on-line inspection tasks – especially involving rubber and other low density materials

The technology is used in the rubber hose production for automatic detection of manufacturing irregularities that may have significant implication towards the final application of the product. Internal particles, salt grains and deposits, holes and other defects may cause leakage or blocking the fluid flow in the hose upon installation. The detection and rejecting of hose parts with these defects is therefore a need towards ensuring the end-users acceptance of the product.

When a defect is detected, a signal is sent from a PLC to a reject arrangement, one signal for each line (maximum 4 lines per X-ray system). Different settings can be applied to obtain a sorting

of products into different categories of product. The accurate location of defects can be (or is) transferred to a marking or cutting arrangement.



*The InnospeXion rubber hose defect detection system is based on the newest and most effective X-ray technology. The technology has been proven in numerous applications during the last 6 years, and has been further developed to satisfy the requirements in the rubber industry, notably concerning robustness, cleaning, and detection performance.*

## DETECTION PERFORMANCE

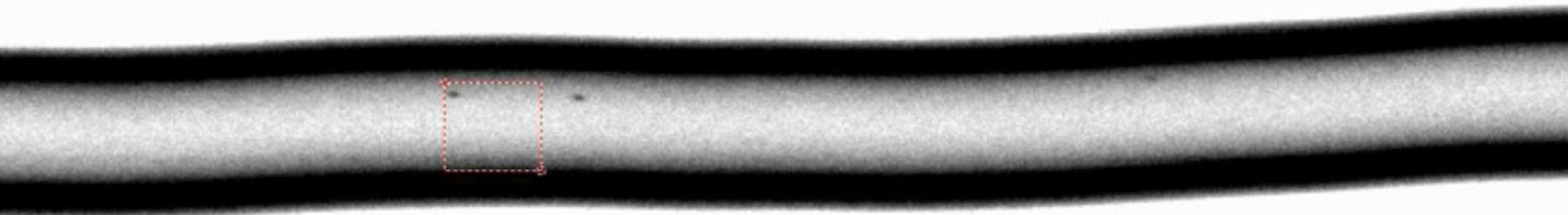
The low X-ray energy gives a very high contrast for even small manufacturing irregularities. At the same time, the high imaging resolution implies that a defect is represented by many pixels. This highly improves the software recognition of a defect.

Special imaging technologies are implemented in order to accommodate high manufacturing speed – up to 200 m/min.

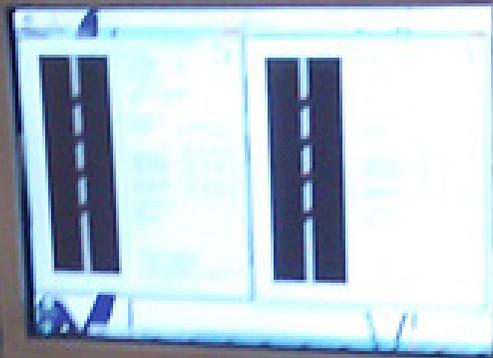
The examples show typical defect images acquired during production. For rubber hoses, the typical performance is the detection of particles down to 0.5 mm in diameter in hoses with wall thickness of up to 1.5 mm, at line speed of 30 m/min. At the same conditions, holes are detected with diameters from 0.6 mm.

Typical false reject rate is less than 1 per cent, or less than 1 meter false reject for 100 meter hose. Larger wall thickness and faster speed has an impact of the probability of detection, which is gradually lowered.

The detection requires that the hose is free of water and other external (or internal) contamination. It is also important that the hose is guided through the X-ray system without severe vibration or other high frequency movement. For multiple lane systems, maximum hose diameter is around 20 mm.



LASER HAZARD



**InnospeXion**  
the invisible made visible

YOUR MUST BE PLACED  
WITHIN 100MM OF THE



**Warning 1**  
Do not touch the probe tip



CE

*Tailoring towards the customer's need is of an essential key point of the integration of the technology in the different production lines.*

*InnospeXion supplies auxiliary equipment for in-feed, out-feed, sorting, reject arrangements, timing control and overall system integration.*



## CONCLUSIONS ON THE TECHNOLOGY

Low energy X-rays are ideal for detection of rubber hose manufacturing irregularities, on-line. The method may be used from slow to very high speed manufacturing. The X-ray system is controlled by a PLC, which keep track of the timing and ensures signal giving for the 4 lanes that may be covered by one X-ray system.

The system is simple, robust, compact and easy to service. It features a tailored design, has a long lifetime and is fully automatic.

We take pride in integrating the hose defect detection system into existing production lines, along with required automation and auxiliary equipment.

*Jørgen Rheinländer  
Managing Director  
InnospeXion ApS*