Making Hoses Smart

Industrial hoses are processed by various means such as continuous extruding, spiralizing, cutting or crimping. In each step, huge sets of data are generated which are relevant for the quality, sustainability, and other properties of the semi-finished product.

During further processing steps, single pieces are usually cut from these semi-finished coiled hoses. In this process step the data link between the single piece and the parent product is broken. The single piece does not usually carry any information about its exact material composition, the position within the parent product, about its mechanical properties, or quality relevant production parameters, and thus any sustainability information is lost.

By Werner Aumayr, Managing Director, coilDNA

Primary Challenges

The main challenge to maintaining sustainability information for a hose is making it possible to trace the manufacturing conditions and sustainability information for each part of a parent production lot of the hose. Hoses supplied to the food or pharmaceutical industry are an excellent example.

Tolerances are in place for every single process parameter in each step of the production; from raw material, melting, and extruding to surface treatment. This means that during the production of a single production lot, parameters vary with time given within the allowed tolerance, which results in a variation of material properties with length. There are also transitional phases during the extruding phase, especially at the start and end of the process. This is valid for any deviation from stable production conditions. For example, small speed or temperature variations during extrusion can lead to different liquid rubber or silicon flow patterns in the mould and cooling condition after extrusion. All this has effects on the quality of the hose, and ultimately, on the material properties and quality parameters.

Gathering Data

To gain an understanding of how the data is collected it is best to use an example, such as a coiled hose that yields 4,000 automotive break hoses with a length of 15 inches. Each of these hoses would be manufactured under slightly different conditions and therefore has slightly different properties within the product specification. These minor deviations might have an impact on further processing and consequently on final part properties.

In addition, processors use hose strips from different manufacturers for one single component (e.g. a dairy processing equipment). Hoses are tracked by an immense amount of related data. Length based data are rare or not available. Once cut into a single piece, all the information about the origin, product, and quality data, as well as sustainability indicators are lost and no longer assigned to this piece. If quality issues arise during processing or application, it is almost

Figure 1.

A CLOSER LOOK AT THE TECHNOLOGY

- *Provides efficient processing of hoses by considering the local properties of the semi-finished product used.*
- *Seamless tracking of products and their sustainability properties throughout the whole supply chain from producer to processor to end user.*
- *Data driven communication with the producers using a simple picture of a product, taken for example by a cell phone. A smart phone application allows to identify the product and to give direct feedback to the producer.*
- *Check of sustainability information by simply using a smart phone, Figure 2 and 3.*
- *Check of validity of product related paper documents.*
- *This technology combines physical products and documents, like quality or sustainability reports, in a forgery-proof manner, for example using block chain technologies.*

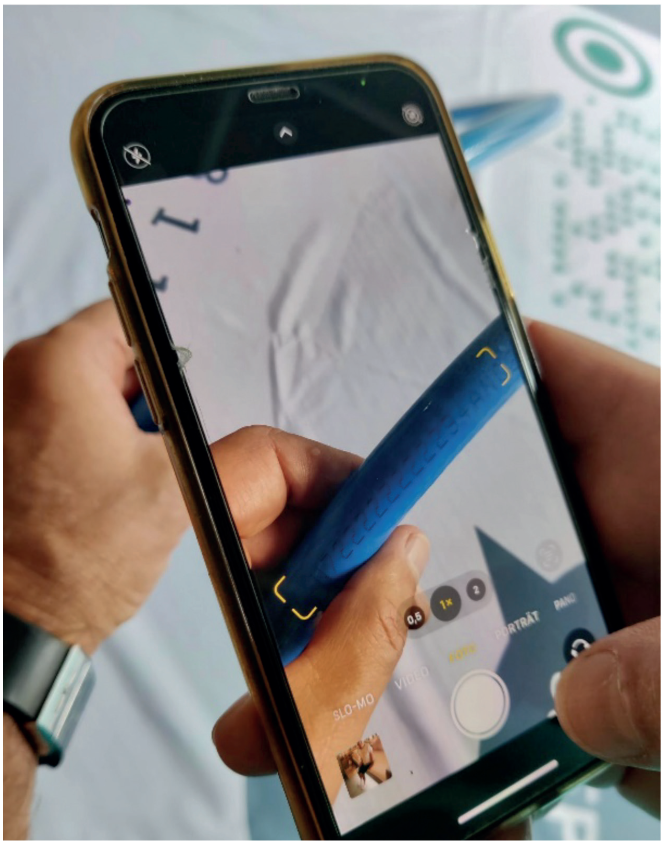

Figure 2.

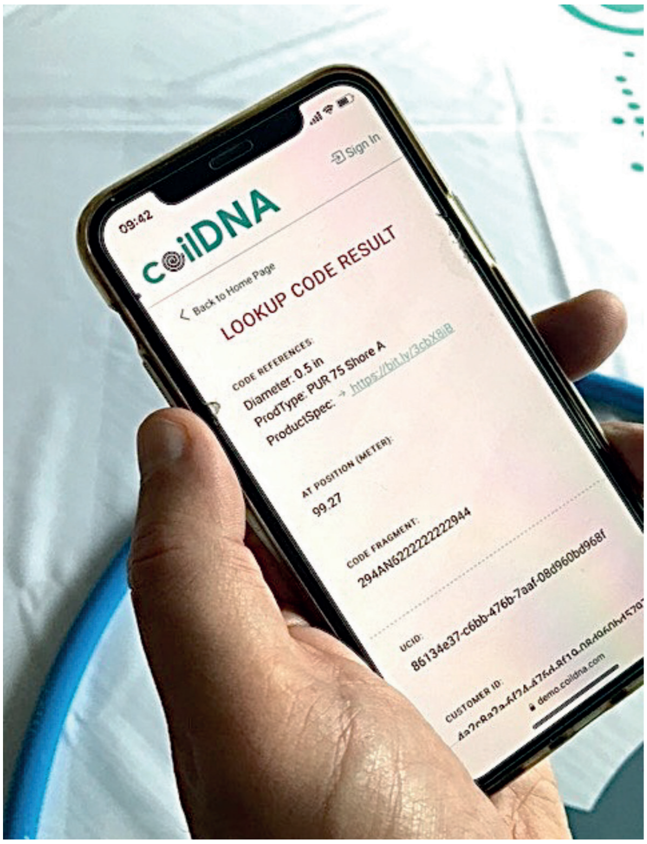

Figure 3.

impossible to identify the single piece to follow up the issues with the material supplier.

There are numerous other examples of continuously manufactured semi-finished hose products that lose their identity in a further dimension-changing processing step. Hoses used for construction in medical equipment are a typical show case. Once cut to length and assembled into the final equipment, all the identity of the single hose element usually gets lost. Life cycle tracking becomes a particular challenge.

Life Cycle Tracking

To address this challenge, technologies have been developed that gives individual pieces of hoses a unique identity. By making these hoses smart, they may be connected to the Internet as well. So IoT - Internet of Things - the concept of connecting smart devices to the internet now applies to smart hoses and thus IoM - Internet of Materials - is taking shape.

To make this revolutionary development tangible, one can look back in retail history. In 1974, a pack of Wrigley's chewing gum heralded a revolution in retail. It was the first product in the world to be issued with a barcode for scanning at a supermarket checkout. Today, everyone uses barcodes and associated apps to look up consumer product information such as nutritional data, allergens, vitamin content, etc.. For retailers, this not only makes data maintenance much simpler, but it is also an invaluable tool for warehousing, re-ordering, and sales forecasting. Like that pack of chewing gum, semi-finished hoses marked with a code, open opportunities for users that are as revolutionary as those offered by the barcode 49 years ago.

How it Works

The human DNA is an excellent role model for this technology. Every single cell of a human body can be used to identify the individual. DNA sequencing allows re-construction of the entire DNA information obtained from only parts of a single DNA molecule. Technologies, such as coilDNA, use comparable mathematical algorithms. A unique information code gets continuously printed on the surface of a parent hose, Figure 1, by inkjet marking systems. This code uniquely identifies the position within the parent product and subsequently allows the assignment of the production data recorded at this position. Regardless of how this parent product is cut in subsequent production steps, the item-related and even the position-related information is always available. All the information about the respective piece of hose can be retrieved. This information track is direction detecting – this is important because the direction of a hose may be reversed in further production steps - and can even detect errors.

Conventional identification methods based on bar- or QR-Code fail as soon as the material is divided, and the barcode is cut. In addition, after these markings have been attached at certain intervals, it cannot be guaranteed that each individual part shows a marking and can thus be assigned to the original mother product, to a position within this mother product, or even to the manufacturer.

For example, a hose producer who is proud of its 'green' product, wants to make sure that every part of the further processing chain can unambiguously identify this green material with an ordinary smart phone, even if there are only a couple of inches left. The hose producer just applies a code for, where already known markers are placed, and adds sustainability information, product name and more data.

It is of no relevance how the hose is divided in further steps, if there are fourteen remaining characters identification and data retrieval is possible.

New ways for the optimization of production processes, supply chains and communication via useful apps are opened.

In Summary

Smart-hoses technology is the key to the Internet of Materials, where pieces of hoses have an identity in the form of a unique and eligible, division-independent code. This enables users to communicate with the manufacturers and processors simply by entering 14 consecutive characters of the visible code manually or by taking a picture.

Any kind of data generated during production and processing are clearly assigned to each segment of hoses. As a result, each single step of the value chain could be linked to the other to improve the properties of the final product, seamlessly monitoring quality and take producer-processor integration to new levels.

ABOUT THE AUTHOR

Werner Aumayr received a Ph.D. in mathematics from the Technical University in Vienna. He has spent most of his professional life in process industries in various consultancy, marketing and I.T. positions. He entered the Aluminium world 2007 by joining the largest Austrian Aluminium producer AMAG where he has been CIO and responsible for all digital activities. Responding mainly to automotive and aircraft customer requirements he invented a new technology to accomplish the vision of the Internet of Materials – a unique way to make products intelligent along their process and logistics routes. In 2019 he became the managing director of the newly founded start-up coilDNA to commercialize this vision.