# SORTING FIBROUS MATERIALS FROM WASTE TEXTILES

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## Initial situation

At present, textile recycling is mostly restricted to manufacturing lower-quality products (downcycling). A major precondition for the high-quality recycling of waste textiles is the highly-selective separation of fibrous materials in predetermined sorting fractions. Currently, the quality levels of manual and visual sorting processes in recycling facilities are insufficient and do not meet the requirements of an innovative and fibrous material specific reuse of textile waste. As a result of the research project NEUROCHIPS FOR THE DETECTION OF FIBROUS MATERIALS, a method is now available for a fast-acting online detection of fibrous material components in waste textiles, making use of the spectral analysis in the infrared range (NIR) and of neural networks.

## Research target

The project is aimed at developing, building and testing a trial installation for the highly-selective separation of waste textiles according to pre-determined sorting criteria. The following goals should be reached:

- creating a fast-acting online system for detecting moving textile fabrics,
- evaluation by means of neural networks,
- implementing control systems for activating the actuators used for sorting,
- creating a reliable sorting facility.

## Research results

The sorting installation developed under the project is of the following design (Figure 1, Figure 2): The waste textiles are thinned out and moved on a conveyor belt towards collecting vessels arranged alternatingly on the right side and left side of the conveyor belt. While the measuring device is passing, several NIR measurements are performed. To determine the composition of the textiles, the measured spectra are evaluated by means of high-performance computation equipment via neural networks. This approach allows for detection times in the millisecond range. On the control side, the result of the detection is communicated to the associated collecting vessel. As the textile item reaches the position of the collecting vessel during transport, the control unit of the facility activates the appropriate actuators that move the textile item from the conveyor belt into the corresponding collecting vessel. The assignment of the vessels to preselected sorting fractions may be performed via PC. Textiles consisting of materials other than those selected are collected in a vessel arranged at the end of the conveyor belt. These textiles may be sorted in additional passes after the fractions assigned to the collecting vessels have been newly set. Several versions of actuators for discharging the textiles have been designed and tested. In the trial installation, waste textiles of up to 1 kilogram were sorted. At a conveyor belt speed of 1m/s and an average distance of 1 m between the textile items, a throughput of 3600 waste textile items per hour is possible.
In order to obtain high levels of detection accuracy, a number of influence parameters were examined, including the distance between the textile item and the measuring sensor as well as the lighting intensity during the NIR measurement. Textile-specific factors such as the humidity of the textiles were also examined. Based on these findings, a large number of teaching files for teaching the neural network were created. The files are used to detect fibrous materials according to special algorithms.

## Application and economic advantages

The sorting installation developed under the project improves the quality of fibrous-material-specific sorting processes of waste textiles in recycling plants. The improved purity of the sorting fractions results in more added value of waste textiles to be used as raw materials. This approach allows for implementing innovative recycling strategies aimed at reusing textiles at high quality levels. The fast-operating online detection system used with a fast-acting and automatically operating sorting facility allows users to gain more profitability in operation.

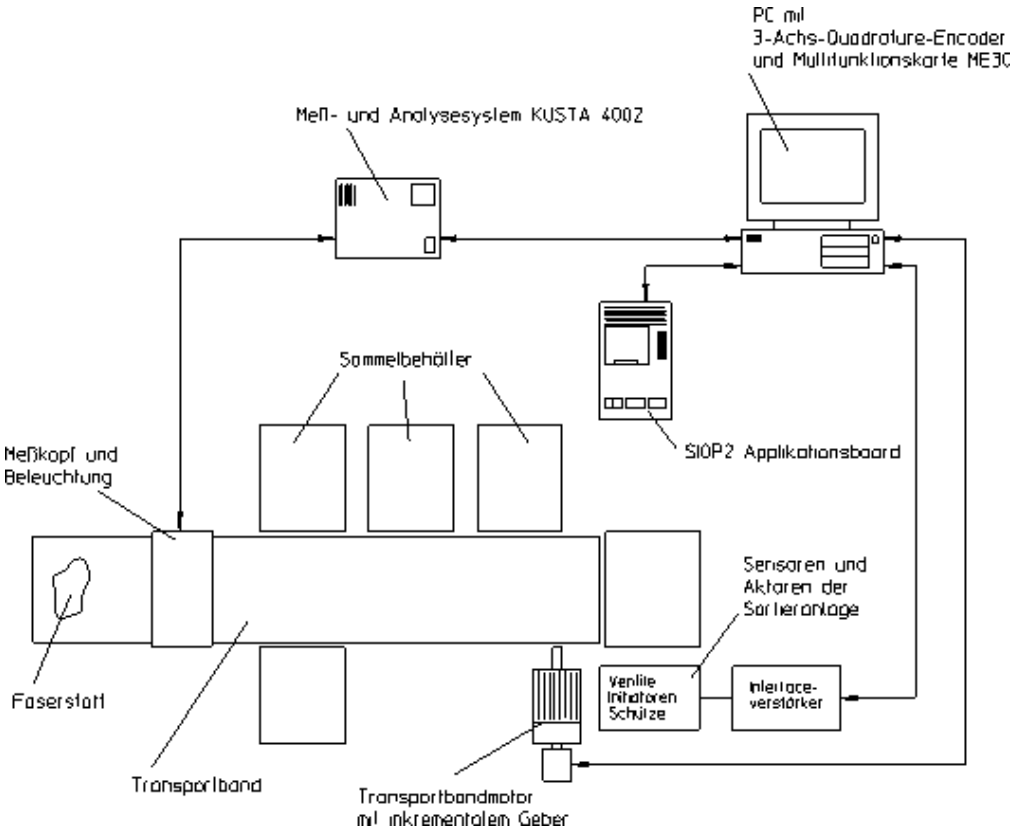


Figure 1: Diagrammatic view of the sorting installation

Bild 2: Sorting installation