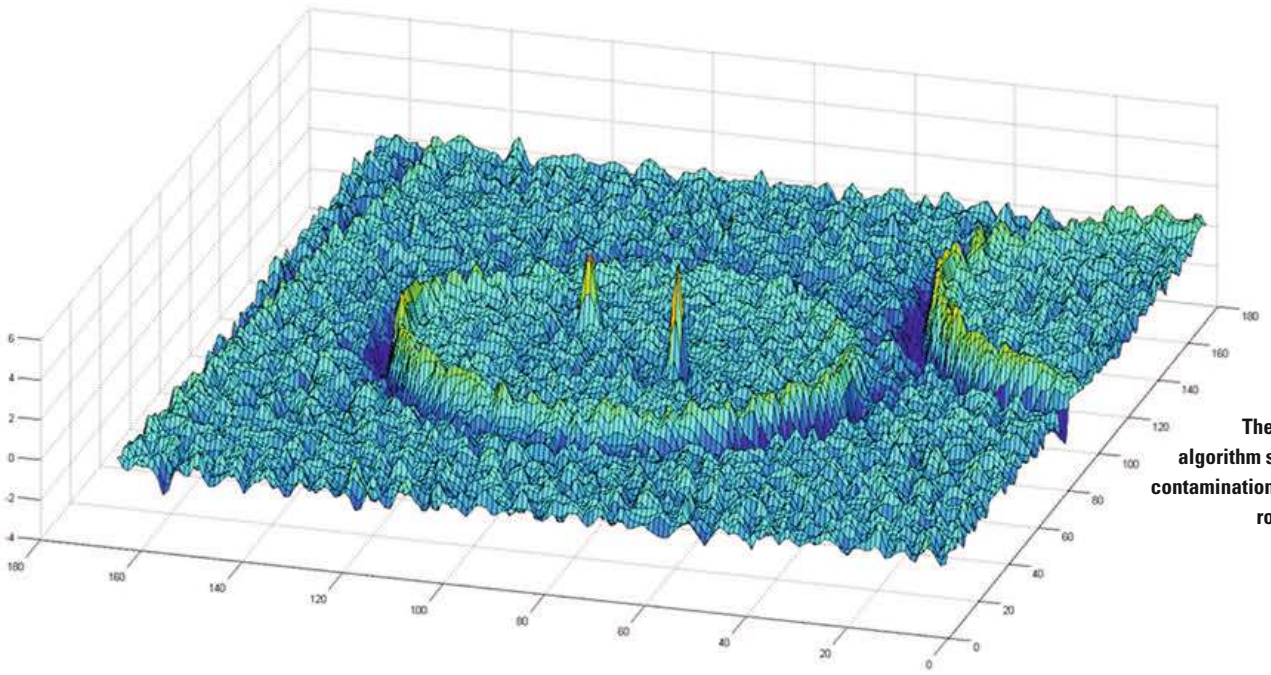

The detection algorithm shows two contaminations within a round pellet

The Good Ones Go into the Pot, the Bad Ones Go into the Crop

Purity Inspection. Impurities in plastic pellets have to be detected and sorted out effectively for industrial processes, even when they are melted down into the pellet. This is achieved by a purity inspection system, which includes a combination of X-ray technology and an optical system.

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For the industrial production, highly pure material is an important quality aspect. Due to the continuously increasing requirements, it is necessary to detect and sort out irregularities and impurities of decreasing size in plastic and intermediate products. Impurities of 50 µm may already cause damage to the end products with high follow-up costs. The repair of a defective submarine cable, for example, which has been damaged by contaminations, can lead to weeks of downtime. Therefore, latest norms and standards, such as the Chinese standard IEC 62067 (for 150–500 kV) for high voltage cables, demand the exclusion of contaminations from 75 µm in the processed material.

In the different processing steps for the production of plastic products, impurities may repeatedly occur. This affects the processes of material producers as well as the compound and masterbatch producers, the processing industry, the recyclers and the whole supply chain.

Accordingly, it is necessary to inspect to 100 % the material used before it enters the end product. Sample testing alone is not sufficient to exclude contamination reliably. Technologies for material inspection should detect every contamination and separate contaminated material in order to ensure a "full inspection" and "cleaning" of the entire material to be processed.

Suitable for Transparent and Colored Pellets

With a combination of X-ray technology and optical technology, Sikora AG, Bremen, Germany, developed a system, which meets these requirements. The processed pellets are inspected to 100 % and rejected material is separated. Impu-

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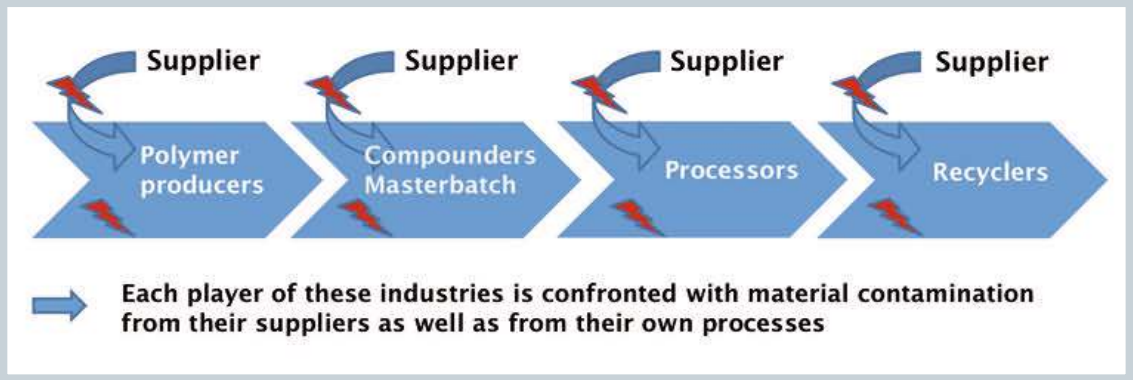

Fig. 1. Industrial process in the plastic processing industry with danger areas for contamination
(figures: Sikora)

rities or irregularities from 50 µm are detected at common flow rates. This allows the detection of metallic and organic contamination, as well as irregularities such as color differences. They are sorted out accordingly. In addition, the dispersion of additives, especially in the compounding process, is detectable. As a result, agglomerates and disturbances in the subsequent processes are avoided.

By the use of X-ray technology, both transparent as well as non-transparent plastics are inspected for contamination. The basic principle is the different attenuation of raw material and impurities, according to the periodic table of elements. The attenuation (µ) of the X-rays is proportional to the atomic number raised to the 3rd power ($\mu \sim Z^3$). For example, the ethylene monomer (PE) consists of two carbon atoms and four hydrogen atoms. That means, it has a very low attenuation. If only one hydrogen atom is replaced by a chlorine atom, the result is vinyl chloride (PVC). This attenuates due to the chlorine atom as strongly as the metal aluminum ($Z_{carbon} = 6$, $Z_{hydrogen} = 1$, $Z_{chloride} = 17$). The measurement of different attenuating material, for example in a plastic pellet, leads to the detection and subsequent sorting out of contamination by means of a special processing and mathematical algorithms.

Fig. 2. The combination of X-ray technology and an optical inspection allows a 100 % inspection of the plastic material to be processed (1: X-ray unit, 2: Optics, 3: Selectioner)

Increasing Quality and Functionality

Regarding the optical inspection, the lighting plays an essential role. By using a novel light construction technique, the smallest contaminant is detected, among other organic impurities. In order to allow an industrial speed, modern camera technologies are used. At this speed, they allow precise images of the pellets to detect contaminations from 50 µm. The contaminations, which are detected by means of X-ray or optical technologies, are identified by a powerful image processing software, characterized as contamination and separated. In order to avoid contamination also being contributed from the outside, a closed, vibrating ramp is used for the scanning and sorting system. This avoids contamination that might occur by conveyor belts. Overpressurizing the ramp assures that contaminants from the ambient air do not enter the processing area.

By integrating different technologies the quality and consequently the functionality of the end product can be increased. This also improves the safety and usability for the end user. ■

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