SUMMARY

The primary objective of this thesis is to investigate the characteristics of particles derived from comminuted printed circuit boards (PCBs) during mechanical separation processes. Based on the aim of the thesis, extensive data collection and preparation have been conducted to facilitate further actions. The research endeavors have been instrumental in facilitating a comprehensive comparison of various methods for particle identification and separation, as well as in establishing their underlying theoretical characteristics. By means of laboratory experimentations, crucial particle attributes such as mass, dimensions, coefficient of resistance, and terminal velocity have been determined.

The disintegrator, operating at a high intensity, effectively concentrates stresses, enabling the extraction of elements from the composite material without excessive grinding. Due to the complex structure and composition of PCBs, the source material passed through the disintegrator in several stages. After each stage, elemental particles were obtained ready for subsequent separation in the range of the same size and different grindability properties. The boundary size 2.8 mm (maximum) has been determined for effective separation of the composite material. This size ensures that all particles within the composite exist as separate objects, indicating the breaking of bonds between them and enabling their individual separation.

In one stage of separation a dedicated separation chamber was developed. This chamber facilitated the deposition of the material, along with the accompanying airflow, under the influence of forces such as gravity and inertia. Critical separation parameters, including air flow rates, separator geometry, and particle characteristics (e.g., size, density, and shape), exerted a significant impact on the overall separation outcome. Consequently, a decision was made to conduct computer simulations to track the movement of individual particles, allowing for the identification of optimal design parameters. These simulations not only facilitated practical experimentation but also aided in the selection of ideal parameters for facilitating separation efficiency. It should be noted that, in forthcoming advancements, it holds promising potential to simulate complex separation processes within an air flow by using additional forces such as electrostatics and a magnetic field. The extensive experimentation conducted in this study has yielded significant results, highlighting the feasibility of employing alternative separator types and diverse structural solutions. These include the utilization of distinct channel geometries, cyclones, and other innovative approaches.