

Environment:  
Sustainable Technology  
for Environmental  
Protection

# Waste

# 2.4

2E a division of



This product area is one of GUNT's current areas of development. If you have any ideas for future teaching and research equipment in this field, please get in touch. We would love to work with you.

## Introduction



**Subject Areas**  
Waste

316



**Basic Knowledge**  
Waste

318

## Comminution



**CE 245**  
Ball Mill

320

## Separation Processes



**CE 280**  
Magnetic Separation

322



**CE 275**  
Gas Flow Classification

324



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# Subject Areas Waste



Subject Areas

Products

## Comminution

The comminution of waste materials plays a key role in waste management and is a prerequisite for many recycling processes. Comminution prepares waste materials for subsequent process steps. Ball mills are a traditional method for the comminution of solids. Our CE 245 experimental unit clearly demonstrates this process.

## Separation processes

Separation processes are used to divide mixed waste into separate fractions. The separation can be carried out according to material characteristics (materials) or geometrical characteristics (particle size).

One classic example is separation of metals for subsequent feeding into a recycling process. The separation of metals is usually carried out with magnetic separators. Our CE 280 trainer allows you to clearly demonstrate this separation process in the laboratory.

In gas flow classification, however, the individual fractions of a waste mixture are separated in terms of their geometric characteristics. We have developed our CE 275 zigzag sifter in order to clearly teach the fundamentals of this process.

Comminution

**CE 245**  
Ball Mill

Separation processes

**CE 280**  
Magnetic Separation  
**CE 275**  
Gas Flow Classification


Many processes used in waste management have their origins in conventional process engineering. Separation processes, especially from mechanical process engineering, are put to use. Other devices of interest from this field of process engineering can be found in our catalogue 5.





# Basic Knowledge Waste

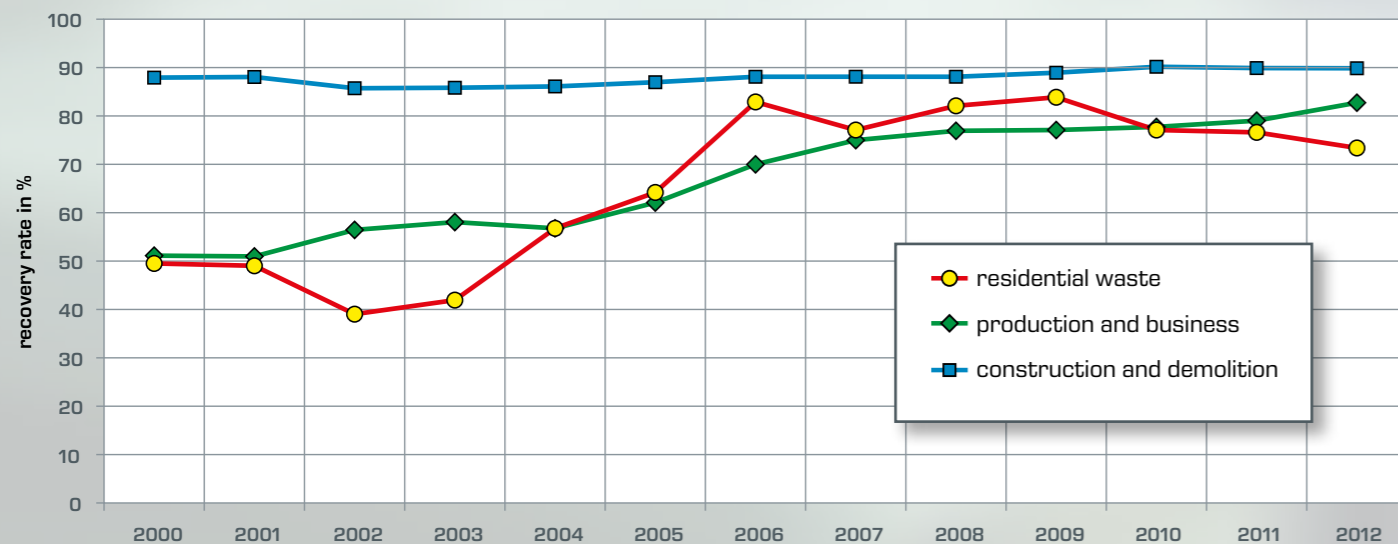
## Waste in the economic cycle

Every resident in Germany produces approximately 500-600 kg of domestic waste each year. This waste consists of a wide variety of materials and represents an important resource for the procurement of raw materials for the economy. Waste legislation in Germany is regulated by the Waste Management Act. The main objective of the law is to promote conservation of natural resources by reusing and recycling waste, and to ensure protection of human health and the environment in the production and management of waste.

1	Waste prevention
2	Preparation for reuse of waste
3	Recycling waste
4	Other recovery of waste (e.g. energy)
5	Disposal of waste

## The 5-stage waste hierarchy

A key aspect of the Waste Management Act is the 5-stage waste hierarchy. According to this hierarchy, prevention of waste has top priority (1). If production of waste is unavoidable, then reusing the waste through cleaning or repair should be strived for (2). If direct reuse of used products is not possible, these have to be recycled, sorted in accordance with material properties (3). If this is not possible or uneconomical, the waste is exploited in other ways (4), such as for energy. The bottom of this hierarchy is the disposal of waste (5), which usually takes place in landfills.



Recovery rates of the most important types of waste in Germany

Source: Federal Statistical Office, Wiesbaden, waste balance, various years; Federal Environment Agency, own calculations

## Comminution: prerequisite for effective recycling

The comminution of waste plays a key role in waste management. Comminution reduces the particle size of the waste materials. Simultaneously, comminution leads to an increase of the specific surface area of the particles. Comminution is normally a pre-treatment which is followed by subsequent process steps. For example, the melting of plastics is made easier by a small particle size. Various technologies are used for comminution of waste, such as ball mills.



## Magnetic separation

Magnetic separation is a separation process in which the magnetisation of components (e.g. iron) of a waste mixture is exploited. The waste mixture is conveyed to a rotating, non-magnetic drum. In one area of the drum there is a permanent magnet that sticks the magnetisable parts to the drum and carries them along. The non-magnetisable parts fall into a collection tank due to gravity. The magnetisable parts are detached from the drum once they leave the permanent magnet's sphere of influence and drop into another collection tank.

## Gas flow classification

This separation process uses the different settling velocities of particles in an airflow. The settling velocity depends on the size, density and shape of individual particles and on the resulting flow resistance and weight forces. Gas flow classification primarily uses what are known as zigzag sifters. In a zigzag sifter, the waste mixture to be separated is fed in from the side of the zigzag channel in which an airflow moves upward. Depending on geometry and density, the particles are taken along by the airflow or fall downwards due to gravity. Often, a zigzag sifter is located downstream of a cyclone. This separates the fraction carried along by the airflow so that the air can be fed back into the cycle.

### Gas flow classification

- 1 mixed waste
- 2 zigzag sifter
- 3 gas cyclone
- 4 fan
- 5 tank for fine material
- 6 tank for coarse material

# CE 245 Ball Mill



Learning objectives
<ul style="list-style-type: none"> <li>■ cascade motion</li> <li>■ cataract motion</li> <li>■ determining the critical speed</li> <li>■ comparison of theoretical and actual power demand</li> <li>■ influence of the following parameters on the degree of comminution:                             <ul style="list-style-type: none"> <li>▶ mill time</li> <li>▶ speed</li> <li>▶ ball diameter</li> <li>▶ ball filling</li> <li>▶ material to be milled</li> </ul> </li> </ul>

Many processes used in the recycling of waste are favoured by a small particle size. Waste usually has to be comminuted first for this reason. Various techniques such as ball mills are used to do this.



Large-scale ball mill in waste management

Our CE 245 experimental unit allows you to teach the fundamentals of this comminution process in practice. There are three different drums available. All drums have transparent faces. This means you can observe the comminution process and the motion states inside the drum which are characteristic of ball mills.

The speed of the ball mill is continuously adjustable. Speed and power consumption of the drive motor are displayed digitally. This allows you to compare the theoretical demand with the actual power demand. You can adjust the desired mill time using a timer.

The instructional material sets out the fundamentals of this process in detail. Example experiments are clearly described and evaluated.

## Recommended accessories



We recommend our CE 264 Screening Machine for analysis of the experiments.



# CE 280 Magnetic Separation



## Magnetic separation: recovery of important raw materials

The recovery of reusable materials is a central aspect of waste management. A very effective and therefore widely-used method for separating magnetisable reusable materials such as iron from a mixture of waste is by using magnetic separators.

## Magnetic separator CE 280

With our CE 280 trainer, you can clearly demonstrate how a magnetic separator works. The main component is a professional drum-type magnetic separator, as is often used in industry to sort solid mixtures.

The mixture to be separated is fed evenly to the magnetic separator by a vibrating trough. The height-adjustable hopper allows you to adjust the distance between the hopper outlet and the vibrating trough. The amplitude and frequency of the vibrating trough can be individually adjusted. These three settings allow you to control the mass flow rate of the feed material.

You can adjust the speed of the drum-type magnetic separator continuously for studying the influence of speed on the effectiveness of the separation.

🎓	Learning objectives
■	fundamental principle and operating behaviour of a drum-type magnetic separator
■	influence of the following factors on the effectiveness of separation: <ul style="list-style-type: none"> <li>▶ mass flow rate of the feed material</li> <li>▶ mixing ratio of the feed material</li> <li>▶ type of feed material</li> <li>▶ drum speed</li> </ul>

Product No.  
083.28000  
More details and technical data:  
[gunt.de/static/s4790\\_1.php](http://gunt.de/static/s4790_1.php)

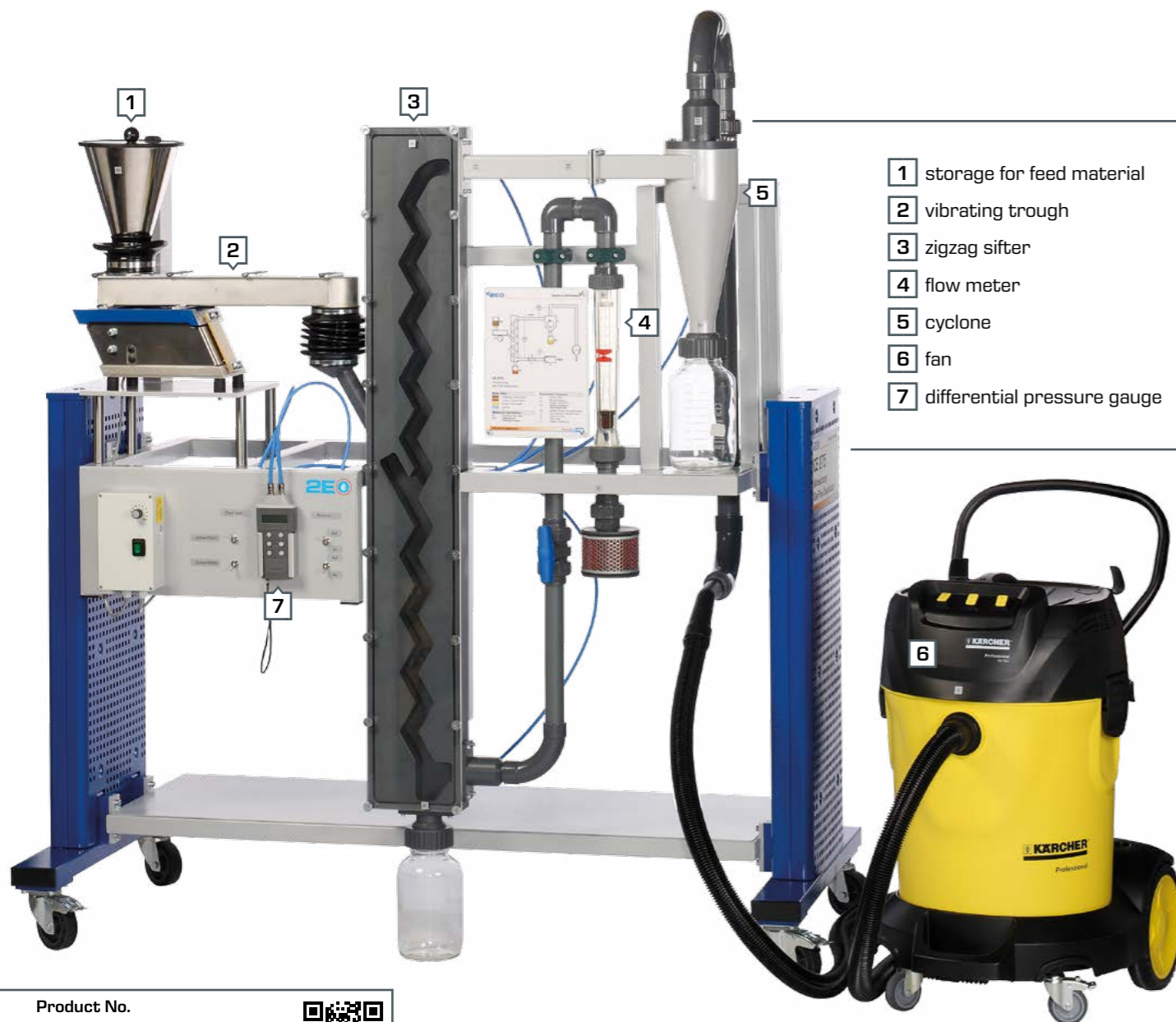


# CE 275 Gas Flow Classification

## Gas flow classification with zigzag sifter: a mechanical separation process

Gas flow classification is a mechanical separation process from the field of conventional process engineering. In waste management, this process is used for the separation of various wastes, for example, to separate dust, sand or non-reusable materials from reusable materials. This is mainly achieved by the use of zigzag sifters.

This teaching unit is perfectly suited to teaching the theoretical fundamentals of this process, clearly and practically. The main element of CE 275 is a 20-stage zigzag sifter, which is equipped with a transparent cover. This allows you to observe the separation process in the zigzag channel over the entire height.



- 1 storage for feed material
- 2 vibrating trough
- 3 zigzag sifter
- 4 flow meter
- 5 cyclone
- 6 fan
- 7 differential pressure gauge

## Principle of operation

The waste mixture to be separated (feed material) is conveyed evenly into the zigzag sifter by a vibrating trough. The fan generates the upwardly-directed airflow necessary for separation through the zigzag channel. You can adjust the mass flow rate of the feed material and the volumetric flow rate of the air. The fraction of the feed material transported along with the air is then separated in a cyclone. This allows a closed circuit for the air flow. The zigzag sifter and cyclone are each equipped with differential pressure measurement.



CE 275 during a trial run:  
The vibrating trough evenly conveys the mixture of spelt husks and cherry stones to be separated from to the zigzag sifter.



In the zigzag channel, the separation of the mixture can clearly be observed.

Learning objectives
<ul style="list-style-type: none"> <li>■ familiarisation with the basic principle of gas flow classification</li> <li>■ influence of the mass flow rate and the airflow rate on                             <ul style="list-style-type: none"> <li>▶ fine material fraction</li> <li>▶ quality of separation</li> <li>▶ sifter pressure loss</li> <li>▶ cyclone pressure loss</li> </ul> </li> <li>▶ fraction balance</li> <li>▶ separation function</li> <li>▶ separation size</li> <li>▶ sharpness of separation</li> </ul>

} with CE 264



We recommend our CE 264 Screening Machine for analysis of the experiments.

Product No.  
083.27500  
More details and technical data:  
[gunt.de/static/s4791\\_1.php](http://gunt.de/static/s4791_1.php)



This device has been developed by our experienced engineers in collaboration with the Institute of Mechanical Process Engineering at the Anhalt University of Applied Sciences (Germany).

**Hochschule Anhalt**  
Anhalt University of Applied Sciences

Environment

 **Soil:**  
hydrogeology

**HM 165**  
Studies in hydrology

Investigation of precipitation-discharge relationships, storage capacity of soils, seepage flows and ground-water flows



Order No.:  
070.16500

**HM 141**  
Hydrographs after precipitation

Correlations between precipitation and percolation; storage capacity and drainage methods



Order No.:  
070.14100

**HM 167**  
Groundwater flow

Three-dimensional investigations and demonstration of flood and drainage



Order No.:  
070.16700

**HM 169**  
Visualisation of seepage flows

Graphical determination of flow fields and investigation of water pressure on structures



Order No.:  
070.16900

Environment

 **Soil:**  
soil treatment

**CE 225**  
Hydrocyclone

Separation of solids from liquids by using a centrifugal force



Order No.:  
083.22500

**CE 630**  
Solid-liquid extraction

Continuous or discontinuous extraction of the soluble components of a solid mixture using a revolving extractor



Order No.:  
083.62000



Environment

 **Waste:**  
comminution

**CE 245**  
Ball mill

Observation of the grinding process with regards to the comminution of solids

Order No.:  
083.24500



Environment

 **Waste:**  
separation processes

**CE 275**  
Gas flow classification

Zigzag sifter to separate solid compounds

Order No.:  
083.27500



**CE 280**  
Magnetic separation

Sorting with a drum-type magnetic separator

Order No.:  
083.28000

