

PROCESSING & SORTING OF BULKY WASTE

APPLICATION OBJECTIVE

- Processing the collected mixed bulky waste from households and commercial sources to generate unpolluted marketable fractions of wood, metals and optionally other materials for recycling or further utilization

OUTLINE ON APPLICATION FRAMEWORK

PARTICULARLY APPLICABLE FOR WASTE TYPES

Glass		Light-weight packaging		Biowaste	
Paper / paperboard		Mixed household waste		Bulky waste	X
Lamps		Textiles		Electrical and electronic waste	
Scrap metal	X	Waste wood	X	C&D waste	
Waste oil		Old paint & lacquer		Waste tyres	X
Hazardous waste					
Branch specific waste	X	forwarded to collection as a mix without components of hazardous nature			
Other waste material	X	commercial waste with a large proportion of recyclables but without components of hazardous nature (e.g. accumulators)			

SPECIAL CHARACTERISTICS AND REQUIREMENTS OF THE APPLICATION

Pre-treatment of the input material:

Beside the separate collection of the bulky waste at source or separate delivery to points of reception no further pre-treatment is necessary.

Options for the utilisation of the generated output:

The different fractions of recyclable material obtained from sorting can either directly (e.g. metals) or after further processing steps be used for recycling. Also possible is the use of certain fractions for energy production.

Options for the disposal of process output and/or residues:

Sorting residues with a high calorific value can be incinerated whereas for the inert materials a disposal at landfills is possible

Aftercare requirements:

Aftercare must be applied to sorting residues in that either an additional treatment is applied before final disposal or the common aftercare procedures are followed for landfills at which such waste is deposited.

Protective needs:

Of particular importance is noise protection, the protection from fire, and operational safety resp. accident prevention at all stages of the operations.

Employment potentials:

The sorting and processing of bulky waste in many cases can be manually performed. This opens up good employment opportunities whereby it is also possible to employ persons with lower levels of education and technical qualifications.

A special scheme for the processing of bulky waste is to commission part of the work to socially deprived people (e.g. disabled persons), persons in social support programmes or such with a limited capacity to find employment elsewhere. Their work will be to separate from the amount of bulky waste those items which may have a potential to be resold or used for other purposes (e.g. old furniture, antiques, certain technical devices), and to repair, refurbish or dismantle them until they are fit for sale or a reuse as spare parts, in charity programmes or public institutions becomes possible.

RESTRICTIONS OR INFLUENCE OF EXTERNALITIES ON THE APPLICATION

Infrastructural conditions:

A good accessibility and sufficient space for temporary storage should be ensured for collection and as far as the facilities for sorting and reprocessing are concerned. Long distance transports of bulky waste are inefficient and uneconomical.

<p><u>Climatic conditions:</u> The waste and facilities used for further processing should be protected from weather effects which means that especially operating areas and storage yards shall be sheltered from strong rainfalls and wind.</p> <p><u>Suitable financing mechanism:</u> The process can be economically viable where output quality is high, re-usable items are recovered and good markets exist for recyclables as well as for second-hand products. Re-financing in general must be secured by instruments such as a tipping fee or a general charging mechanism, however. Expenses for processing are ideally incorporated in the general charges for waste services or subject of a special levy whereby latter can be charged for each unit forwarded (e.g. per m³) or only for those units forwarded in excess to a fixed annual amount of such waste. Proceeds from the sale of refurbished and repaired components/items or from the sale of recovered spare parts should be considered in the calculation of the charge. In that way it might be possible to offer part of the bulky waste collection for free or to collect especially those items free of charge which have a potential for further utilisation or sale after their refurbishment.</p>	
TECHNICAL DETAILS	
GENERAL OVERVIEW	
ABSTRACT	The sorting of bulky waste can be done at the place of its generation or after commingled collection at a central sorting facility. The process generally comprises various mechanical steps with a varying degree of automation with the objective to obtain material fractions of a certain purity for recycling or further utilisation. The process generally aims at the separation of wood, recyclables such as metals, paper and plastics and mixed residual fractions of high respectively low calorific value.
BASIC REQUIREMENTS	- no hazardous components and only low shares of mineral or organic substances shall be contained in the collected waste
EXPECTED RESULTS	- various material fractions (wood, metals, high calorific waste, sometimes paper) in the required purity respectively marketable quality for recycling or further utilisation - recovery of products or items with a potential for reuse or sale
SPECIFIC ADVANTAGES	- easy to implement and very reliable due to the simplicity and low capital demand of the processes - little failure prone and therefore a high general availability of the installed capacities - can be flexibly adjusted to deal with changing input or to create specific output stream
SPECIFIC DISADVANTAGES	- can be very labour demanding
APPLICATION DETAILS	
TECHNICAL SCHEME	<p>The sorting of bulky waste can be done with <u>rather simple methods/techniques at the place of its generation</u> or at the central collection points/recycling yards or by means of more advanced processes with a higher degree of automation <u>in specialized sorting facilities</u>. Principal process steps in both cases are:</p> <ul style="list-style-type: none"> - pre-sorting which aims at the separation of household and electric/electronic appliances (if collected together with the bulky waste) and disturbing materials of large size from the rest of the materials, - the real (main) sorting. <p><u>Sorting at the place of bulky waste generation/collection point</u></p> <p>Components of the collected bulky waste worth to be kept intact or maintained in their structure, which have reuse potential or require special processing (e.g. mattresses, carpets, furniture) should be isolated at source and picked up/transported to further processing in a separate manner. This method of separation is technical characterized as (and known under the term)</p>

- *Consecutive collection ('Tandemabfuhr')*

Separating the wanted materials/items is mostly done manually. Meanwhile this collection scheme is also used when wood (as oftentimes the largest single material fraction in bulky waste) shall be separated from the remaining bulky waste at source. The separated materials/items are loaded onto different vehicles and transported to the installations where their further processing/utilization can be executed in the most appropriate way. Vehicles equipped with compacting technology shall not be used for items worth preserving or containing reusable components.

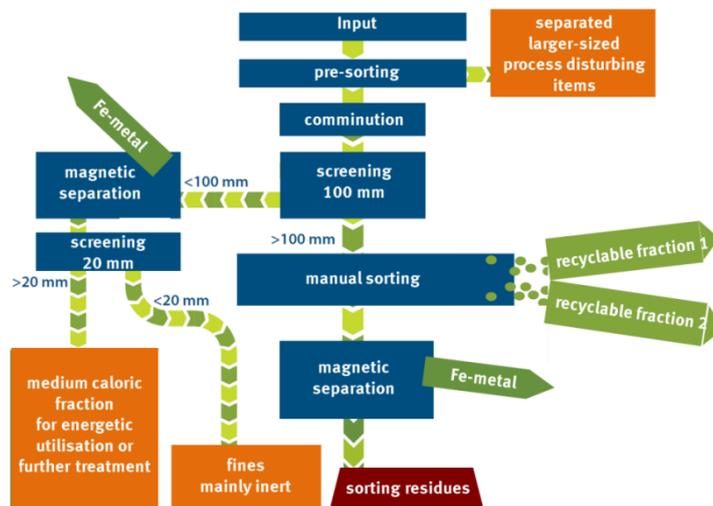
Separation at the discharge area or on a collection yard

In this sorting arrangement, bulky waste is collected, picked up and transported in a mix. Unloaded at a collection yard or processing facility, wooden materials and metals are separated manually or with the help of heavy manipulators or mobile cranes with gripper. Wood and large metal parts are taken out from the hump of bulky materials which leads to a positive sorting. From the average share of approximately 30–50 % wooden material in the bulky waste, about half of the wood can be separated by this technology.

Specialized sorting facilities

Sorting facilities able to handle bulky waste (so called mechanical processing plants) often deal with more than one material stream, aside from the bulky waste recyclable material from commercial sources is also sorted here (which to obtain economies of scale is also recommendable). The technical equipment and process arrangement in such facilities varies, mainly in dependence from the available resources (labour force) and the targeted output stream. In such schemes the pre-sorting step (to remove oversized and non-processable items) is normally followed by a screening and separation of Fe-metals. Further screening stages might be added in order to separate the fine inert from the high calorific coarse materials. The process is often split in several lines, also near-infrared (NIR) technology to separate plastics can be employed in one such line. The example of a common process scheme is shown in the following figure.

Figure 1: Example of a sorting process to generate different recyclable fractions from mixed bulky waste



QUANTITY ASPECTS

The output quality depends basically on the composition of the input. The following figures exemplify the average situation in Germany:

- Input: 100 % mixed bulky waste
- Output: 25–50% wooden material
10–20% metals
10–20% high calorific materials,
the rest being inert fine material

SCALE OF APPLICATION	- The average throughput rate in a sorting plant for bulky waste is in the range of 5–20 Mg per hour and processing line
INTEROPERABILITY	- Where sorting operations are simple and focus on a certain material fraction only (e.g. wood) there is the possibility to integrate the processing as a preceding step to the recycling operations within the production facility. Where diverse material fractions are recovered and more complex processing is required, separately erected and specialized sorting plants often give the better solution.
OPERATIONAL BENCHMARKS: RESOURCE CONSUMPTION	
ENERGY BALANCE	- Energy consumption rate is relatively low when set in relation to the processed throughput, the energy demand rises the more complex and automated process steps are involved
CO ₂ -BALANCE	- Secondary raw materials obtained from sorting and processing bulky waste reduce the need to consume primary resources for production whereas recycling saves energy and emissions the use of these primary resources would otherwise require. Metal recycling provides one example for this. The use of 1 Mg ferrous scrap in production avoids an equivalent of over 900 kg CO ₂ emissions when compared with metal production from crude ore, in case of 1 Mg precious metal scrap the saved emission equivalent rises to 9,000 kg CO ₂ ¹ .
AIDS/ADDITIVES NEEDED	- No auxiliary material is needed in sorting
HUMAN RESOURCES	- The staff demand depends on the size of the facility, the applied process and degree of automation. The usual plant size requires up to 8 labourers, of which one is the foreman, six members of staff do the manual sorting and one operates flexibly as engine driver and machinist. - Sorting at source (incl. consecutive collection) requires a minimum workforce of 2–3 persons.
SPATIAL NEEDS	- Surface area of about 3,000 m ² to 5,000 m ² for an average sized sorting facility
AFTERCARE DEMANDS	Apply to impurities and residues which require further treatment (combustibles) and final disposal (inert fraction)
OPERATIONAL BENCHMARKS: COST DIMENSIONS	
INVESTMENT COSTS	- Investment needs range in the amount of 70–200 EUR per Mg and year depending on the size (throughput), applied process and technical equipment of the sorting facility - Sorting at source and at collection yards require capital investments to be made in machinery (manipulator) in particular, including the development of the yard (min. 250 m ² sorting space) the investment amount is approximately EUR 150,000–200,000 in total (Price level of 2008)
OPERATING COSTS	In the range of 20–50 EUR per Mg (Price level of 2008, proceeds and disposal costs not included). The costs of sorting at source are in the range of 10–20 EUR per Mg. - The costs for the consecutive collection are about 10–30% higher as compared to the conventional pickup of mixed bulky waste (mainly due to the additional personnel and vehicles). This concept makes economically sense in areas with a high dwelling density only.

¹ German Environment Agency: Umweltbundesamt Texte 46/2015: The Climate Change Mitigation Potential of the Waste Sector

POSSIBLE PROCEEDS	- depending on the market situation from the sale of the sorted material fractions such as metals, wood and paper and from recovered items which are being sold as spare parts or for reuse after refurbishment
MASS SPECIFIC OVERALL COSTS	On average must be calculated with overall costs in the range of 50–100 EUR per Mg (depending on the amount and costs for the residues disposal, here German price level of 2008)
MISCELLANEOUS	
MARKET INFORMATION	
REFERENCE FACILITIES <i>(Note: the list of sites and/or firms does not constitute a complete compilation)</i>	<p>Applications of the different concepts (sorting at source vs. sorting in specialized plants) are very common and can be found in different scale everywhere in Europe and the world.</p> <p>Most waste management providers in Germany undertake the processing of the collected bulky waste in one or the other way and have designed and erected their own procedures, processing schemes and facilities for that.</p> <p>A list of sorting facilities can be found in a database of the Federal State of Brandenburg</p>
RECOGNIZED PRODUCER AND PROVIDER FIRMS <i>(Note: the list of firms does not constitute a complete compilation of companies)</i>	<p>The aggregates and equipment used for the processing and sorting of bulky waste belong to the pool of technical equipment which is generally available and in use for mechanical operations in the waste management sector. In particular these are:</p> <p><u>Feed hopper, conveyor:</u></p> <ul style="list-style-type: none"> - Rudnick + Enners Maschinen- u. Anlagenbau GmbH, Alpenrod www.rudnick-enners.de - Ludden & Mennekes, Meppen www.ludden.de - Spezialmaschinen & Recyclingtechnik, Chemnitz www.sr-recyclingtechnik.com <p><u>Shredder/comminutor:</u></p> <ul style="list-style-type: none"> - HAMMEL Recyclingtechnik GmbH, Bad Salzungen www.hammel.de <p><u>Separators/classifier:</u></p> <ul style="list-style-type: none"> - EuRec Technology GmbH, Merkers www.eurec-technology.com - Mogensen GmbH & Co. KG, Wedel www.mogensen.de - Spaleck – Förder- und Separiertechnik www.spaleck.de <p><u>Metal separators (Fe, non-Fe):</u></p> <ul style="list-style-type: none"> - Steinert Elektromagnetbau GmbH, Köln www.steinertglobal.com - IMRO Maschinenbau GmbH, Uffenheim www.imro-maschinenbau.de - Wagner Magnete GmbH & Co. KG Spann- und Umwelttechnik, Heimertingen www.wagner-magnete.de <p><u>Sensors/NIR-technology:</u></p> <ul style="list-style-type: none"> - Tomra Systems GmbH, Langenfeld www.tomra.de - Sesotec GmbH www.sesotec.com