IPPC DIRECTIVE – SHREDDER mini-BREF STRUCTURE

DRAFT 5.0 – 16th March 2011

Executive Summary

Main findings of the report summarised in such a way it can be used as a standalone document as required.

Preface

Outline of how the document was written, contributors, etc. This will be important for those companies seen to have contributed to the work.

Significance of the contributions would be also demonstrated.

In 1996 the European Union adopted the Integrated Pollution Prevention and Control (IPPC) Directive for industrial plants.

The aim of the Directive is to unify the permits for industrial plants that are particularly relevant for the environment and thus make a contribution to preventing or reducing environmental pollution of the air, soil and water. In addition to protecting the environment distortion of industrial location and competition should be lessened as a result. The objective of the IPPC Directive is to implement the best practicable solution for the environment taking into account reasonable economic expense. To this end, "Best Available Techniques" (BAT) for the plants concerned are to be used and emission limit values are to be derived from such "BAT plants". "Best Available Techniques" must restrict the effects on the environment in an optimal way, i.e. reduce pollutant influx into the air, water and soil with as little energetic expenditure as possible, and at the same time be economically deployable for the operator. BREF documents – Best Available Techniques Reference documents – serve to implement the requirements of the IPPC Directive.

BREF documents are the result of an exchange of information between representatives from public authorities, industry and environmental associations. The information required for their drafting is collected, discussed and edited over a period of approximately three years. The EU Commission then publishes the BREF in English. The BREF is revised after around five years. The information exchange is stipulated in the IPPC Directive and has been organised by the European Commission according to the corresponding plants since the beginning of 1997. Similar competitive conditions within the EU are to be achieved – including those for environmental protection – by having uniformly demanding BAT. The amendment of the IPPC Directive currently being undertaken (in future: Industrial Emissions Directive – IED) is designed to make the BREF more binding and thus of greater importance.

Proposal

A multi-competence and European Working Group (WG) has been set up by EFR :

Country	First name	Name	Company / Association
AUT	Manfred	Kandelhart	Bundesgremium des Sekundärrohstoff- und Altwarenhandels
BEL	Olivier	François	Gallometal

ESP	Nicolás	Molina García	FER
FRA	Manuel	Burnand	Derichebourg
FRA	Jean Louis	Clergue	ECORE
GER	Christian	Rubach	TSR Group
GER	Christian	Satlow	Theo Steil
ITA	Elisabetta	Perrota	AIRA
ITA	Luca	Carbonoli	ASSOFERMET
SWE	Kristofer	Sundsgård	Stena
UK	Stuart	Cottam	Simsmetal
UK	Tony	Bird	Bird Group
UK	Howard	Bluck	BMRA
[EU]	Eric	Johnson	EFR
[EU]	Ross	Bartley	EFR

Chapter 1 – General information

Outline of the shredding industry within the EU, size, volumes, production capacity, companies etc. This will involve manufacturers and the operators of the equipment. Where we have gaps ie where companies do not reply to the information requests we will have to make inferences.

We would also look to include reviews of similar work already undertaken in other EU countries.

We will also include information from the regulators in respect of what information they would like to see and how they would like to see the project developed.

1.1 - The purpose of shredder plants

Due to the increasing demands of the iron and steelworks and foundries shredder technology – beginning with the USA – asserted itself worldwide in the early 1960s. Shredder technology has been applied in Germany since the end of the 1960s. It is particularly well suited to recovering scrap iron with a low proportion of foreign substances (nonferrous metals, plastics and other contaminants). [Textbook: Stahlrecycling, BDSV 1998]

For example, scrap cars and light mixed scrap are processed in a shredder plant to recover valuable metallic raw materials and recycle them. The shredder plants constructed in the 1980s and 1990s were, in terms of their technical setup, designed primarily to recover ferrous metals for recycling in steelworks. Alongside such plants, metals (predominantly nonferrous metals) are separated from shredder residues in specially equipped reprocessing plants – so-called post-shredder plants – that are not always situated directly downstream. By means of impact crushing the shredder feed is, depending on the load intensity and intergrowth depth, reduced into material components that can be separated from one another in a downstream sorting process. Large items of scrap can thus also be shredded. The end product is quality scrap with a high density, high degree of purity and predominantly homogenous particle size. This shredder steel scrap, which conforms to grade 4 of the German steel scrap grade list (see Appendix I – German steel scrap grade list), can be used directly in the industry to produce steel. Nonferrous metals recovered during the shredder process or in downstream plants (e.g. sink-float tanks) are used industrially for nonferrous metal production. The use of steel scrap leads, for example, to reduced energy requirements and emissions (particularly CO_2) and to increased efficiency of the melting furnaces (c.f. Chapter 1.3) in the production of steel. The same applies to the use of nonferrous metal scrap.

By recycling metals shredder plants make a significant contribution to conserving resources and are thus an important component in improving the environmental performance of steel-producing nations.

> [Exclusion of plants for the mechanical treatment of scrap metals
> In addition to industrial shredder plants there are various plants that separate materials mechanically, but they are not included in this paper. The document on hand deals with shredder plants that come under Section 8.9, column 1 or 2 of the 4th Federal Immission Control Ordinance (4. BImSchV). This means that only shredder plants whose rotor drive power is greater than or equal to 100 kW are taken into account. Shredder plants include shredders, kondirators (shredders with the grid on the left) and zerdirators (shredders with a grid at the top and bottom).
>
> Semi-wet shredders, wet shredders and cyrogenic shredders are special construction types, of which only a few are operated in Germany and thus are not considered representative enough for BAT (see also Chapter 2.3.2).
>
> Electronic scrap shredders, which are also special construction types, but more of them are operated, are exclusively for treating electrical and electronic waste. As a rule, these shredders are smaller than industrial shredder plants and only process electrical and electronic waste. A varied range of metalliferous feed is input into industrial shredder plants however. Electronic scrap shredders are described in a separate draft for the German contribution to updating and extending the existing BREF for waste treatment plants and are thus likewise not included in this document.
>
> Linked to industrial shredder plants is the storage of the various input and output materials, which are described in detail in the VDI guideline 4085 "Planning, construction and managing of scrapyards" and in the BREF "Emissions from storage" and are thus not a part of this document.]

1.2 – The type of shredders

1.2.1 - Car shredders

Generally use hammers.

Plant capacity is generally evaluated through horsepower or ton/hour capacity.

In Europe, shredder capacity is generally between 1000 and 3000 horsepower. A few plants have lower capacity (750 to 1000 horsepower) or higher capacity (4000 to 6000 horsepower).

Shredder plants are generally located on a yard from 20.000 m2 to 100.000 m2.

1.2.2 - Fridge shredders (WEEE)

(process is very different from a car shredder with specifically the PUR foam recovery through inert atmosphere and the extraction of gazes).

Complementary information can be supplied by SEG.

1.2.3 - Small Device Appliances shredders (WEEE)

that generally use knives, have low power and introduce hand sorting in the process
To be developed

Mixed scrap shredder plants:

Background

These plants are the largest and most common type of shredding installation in the EU as detailed in the General Information section of this report. They are often mis-described as car shredders. Generally, however, cars (in the form of depolluted end-of-life vehicles) usually form only a minority percentage of the material being processed by such installations. The remaining material is comprised of any light steel (and, in the case of larger installations, sometimes heavier steel) suitable for shredding in either clean (e.g. cladding from buildings) or complex/composite form (e.g. large white goods).

The purpose of such installations is threefold. To separate the materials in the feedstock from each other, to ensure that the metals produced are sufficiently clean to facilitate their smelting into new metal products, and to densify the metals so that they are of a furnace-size suitable for smelters.

Densification also increases logistical efficiency (and thus decreases the economic impact of transporting these product materials). For similar reasons, feedstock to these installations has often been pre-densified (by other operators in the supply chain) in the form of sheared or baled material.

Process

Incoming materials are inspected for deleterious materials (for example, steel which is too heavy to shred). Such materials are removed and processed appropriately away from the shredder installation.

Feedstock is then generally fed by grab crane to a ground level conveyor which elevates the material to the shredder feed chute. The feed materials then fall by gravity into the shredder box. Within the shredder box is a heavy, fast-spinning rotor equipped with hammers which cut the material on anvils within the shredder box and then drive the cut (shredded) materials through sizing grates to further process the scrap to the desired state of liberation, size and density.

The mixed shredded materials are then transported to a range of separation systems which separate the shredded materials into streams of ferrous and mixed non-ferrous scrap and residual, non-recyclable non-metallic materials, which in turn are treated further before disposal to landfill or recovery in Energy from Waste plants. This is usually known as the downstream shredder installation equipment.

Mixed scrap shredder installations in the EU are generally capable of processing between 25 and 300 tonnes per hour, this throughput being dependent upon the size of the shredder box and the power of the rotor drive motor. In general, all EU mixed scrap shredders will utilise some form of magnetic separation to extract the ferrous content from the mixed stream, and some form of air classification to separate the non-ferrous content from the non-metallic materials. Material is generally transported, between stages and to storage bunkers, on conveyors.

The majority of such shredders in the EU are located in the open air, not enclosed within buildings.

Dust is generated within the shredder box and dust control at this stage of the process is generally carried out in one of two ways. Either there is a dedust unit which maintains a negative air pressure within the shredder box and the captured dust is then transported to bunker via cyclonic precipitation and conveyors. Alternatively, a water mist is injected into the shredder box to encapsulate dust and prevent escape – this results in a damp, non-dusty mixed shredded material exiting the shredder box. In either case, there generally follows an air-classification stage which captures the remaining dust in the mixed shredded materials and transports it to a bunker via cyclonic (and sometimes plenum chamber) precipitation and conveyors.

The ferrous stream is a furnace ready material. Individual operators may choose to improve the quality of the mixed non-ferrous output by further separation stages, for example eddy current separators and metal sensing or colour sorting machinery. This is generally carried out off-line so does not form a part of the shredder installation. Alternatively the mixed non-ferrous materials may be separated by dense media separation, which is always an entirely separate process.

A typical EU mixed scrap shredder installation:

An aerial view of the same installation:

WEEE shredder installations

Background

Waste electronic and electrical equipment shredding is generally carried out in dedicated plants because it is necessary to keep these materials separate from other mixed materials in order to facilitate the most effective metal and other material recovery downstream of the shredder installation. Given the different nature of these materials and the scale of these plants, they are generally located within a building.

Process

It is also necessary to undertake more detailed sortation and depollution of the feedstock before it is shredded, including the removal of:

- All fluids;
- Capacitors containing polychlorinated biphenyls (PCBs);
- Mercury containing components;
- Batteries;
- Asbestos waste;
- Components containing refractory ceramic fibres;
- Gas discharge lamps;
- Cathode Ray Tubes (CRTs);
- Toner cartridges; and
- Unshreddable materials

This exercise is generally carried out prior to the material being shipped and fed to the shredding line.

The shredding line is generally composed of a shredder feeding mechanism (feed conveyor and/or feed chute), the shredder itself, a magnet for ferrous removal, and an eddy current separator for aluminium removal. Material is transported between these pieces of equipment by conveyor. The ferrous material is a furnace ready material directly from the plant; the aluminium may require some further off-line processing and the remaining stream (ECS drops) also require further off-line processing. These off-line processes generally do not form a part of the shredder installation. There is generally no air classification of materials in a WEEE shredding line, air plants only being utilised as part of dust control systems.

Several types of shredders are used for WEEE processing. Hammermills similar to those used for general mixed scrap processing, knife shredders (either 2 or 4 shaft), chain shredders, rippers, granulators etc. They are all designed to have the same effect, however; to liberate materials from each other and densify those materials. Once again the aim of the process is threefold; to separate the materials in the feedstock from each other, to ensure that those materials are sufficiently clean to either facilitate their smelting into new metal products directly or to prepare them for subsequent processes to this end, and to densify the materials. Plant throughputs are lower than mixed scrap shredders and range generally between approximately 5 – 25 tonnes per hour.

A typical WEEE shredder installation:

Refrigerator shredder installations

Background

Refrigerator shredding is exclusively carried out in dedicated plants, due entirely to the necessity to capture CFCs, HCFCs and HCs both from the refrigerant circuit prior to shredding and also from the foam matrix during shredding and downstream of shredding. The shredding and downstream processes are generally carried out in a nitrogen atmosphere which acts both as a carrier for the gases released from the matrix and also as explosion protection against HC refrigerant. Given the scale of these plants, they are also generally located within a building.

Process

- Stage 1 – refrigerant removal, re-sealing of circuit and often compressor removal for reuse or recycling

- Stage 2 – shredding line

Stage 1 is carried out manually, usually with the device presented to an operator on a roller tray or rack. In stage 2, the shredding line is generally composed of a shredder feeding mechanism (feed conveyor and/or feed chute), the shredder itself, a magnet for ferrous removal, an eddy current separator for non-ferrous removal, a screen to separate insulation foam from plastics, a cryogenic or other mechanism for the capture of the gases from the foam matrix. Material is transported between these pieces of equipment by conveyors (often screw conveyors). These conveyors are heated and covered in order to drive off the gases from the foam matrix and capture them in the nitrogen atmosphere maintained inside the covers. The nitrogen carries these gases to a concentration process, generally cryogenic or sometimes filtration, where they are captured and sent to other plants for controlled destruction.

The ferrous is a furnace ready material directly from the plant; the non-ferrous is predominantly aluminium and may be either sold direct to smelters or passed through further off-line processing to improve its quality. These off-line processes generally do not form a part of the shredder installation. Polymers are predominantly ABS and are sold to plastics recyclers, the inert foam is either sold for various uses or disposed of. There is generally no air classification of materials in a refrigerator shredding line, although some plants with a coarser shredding process may air classify the foam from other materials before further size reduction of the foam. Dust control systems are generally unnecessary as the whole plant is usually isolated from local atmosphere in order to capture the necessary gases.

Several types of shredders are used for refrigerator processing, most predominantly chain shredders or knife shredders but also there may be hammermill or ring shredder installations. They are all designed to have the same effect, however; to liberate materials from each other and densify those materials The aim of the process is therefore fourfold: (1) to separate the materials in the feedstock from each other; (2) to ensure that those materials are sufficiently clean to either facilitate their smelting into new metal products directly or to prepare them for subsequent processes to this end; (3) to densify the materials; and (4) to ensure that the foam is well liberated and size reduced to powder in order that gases can be effectively driven off from its matrix and captured for safe destruction.

Refrigerator shredders have the lowest throughput rates of all the shredders described here, often as low as 2 tonnes per hour, so it is likely that many refrigerator shredders will not fall within the scope of the Directive since they will have a capacity of less than 75 tonnes per day.

A typical refrigerator shredder installation:

Stage 1

Stage 2

1.3 – Shredders in Europe

Number, localisation, size, volumes, production capacity, companies etc

In Europe the European Shredder Group says the total number of plants (EU 27) is 307. The capital expenditure for a modern industrial shredder plant, including infrastructure and the environmental protection facilities prescribed in Germany, ranges from 12 to 15 million euros.

(see Appendix 2).

xxx fridges recycling plants …

xxx Small Device Appliances shredders with a capacity over than 75 t/day

shredder industry in Germany

In 2009 the shredder industry in Germany was operating 44 plants with a drive power of approximately 60,000 kW. Of those plants 21 were shredders, 18 were zerdirators and 5 were kondirators. Of the 21 companies total that operate these 44 plants, 15 of them have just one shredder plant. The remaining 29 plants belong to six companies that have between two and seven plants available in their corporate group. (The locations of the above are shown in Appendix 2).

In 2009 around 3.4 million tonnes[1] of shredder feed per annum was input into these 44 plants, with a steel scrap output of around 2.2 million tonnes. Approximately 500,000 tonnes of shredder light fraction accumulated during processing of the feed.

Ecological and economic aspects of metal reprocessing in industrial shredder plants

A separate presentation of the ecological and economic aspects of metal reprocessing in industrial shredder plants does not seem expedient since the two are partially interlinked and the corresponding issues will thus be presented below on the basis of the shredder scrap addition. The advantages of scrap metal being added in the production of steel will first be dealt with in general and then the shredder scrap addition will be treated specifically.
Table 5-1 below shows the significance of scrap as the most important source of iron in the EU for the production of crude steel. In the previous year the proportion of scrap in the crude steel produced in the EU was 58.2 %.

	Crude steel production (D)	Scrap consumption (D)	Proportion of scrap in % (D)	Crude steel production (EU)	Scrap consumption (EU)	Proportion of scrap in % (EU)
2004	46.4	20.6	44.4	193.4	104.5	54.0
2005	44.5	19.6	43.9	187.4	101.3	54.1
2006	47.2	21.2	44.9	198.4	109.0	54.9
2007	48.6	21.8	44.8	209.7	116.0	55.3
2008	45.8	20.7	45.2	198.6	111.3	56.0
2009	32.7	15.2	46.5	139.1	81.0	58.2

Table 5-1: Crude steel production and scrap consumption in mill. Mg/a (D and EU)[2]

Only a third of the energy that would be required for steel production with an upstream blast furnace route is needed for steel production based on a 100 per cent addition of scrap. In terms of quantity ore, coal, limestone and metal scrap are essentially needed to produce steel. The two most important steel production methods and the input materials required for them are:

1. The integrated method based on a blast furnace and a converter. This requires ore, coal, limestone and metal scrap. With this method an average of 1,725 kg ore, 645 kg coal, 150 kg limestone and 138 kg scrap are needed to produce one tonne of steel. Up to 400 kg of by-products accrue, consisting of slags, dusts, sludges and other materials[3].

2. The electric furnace steel method is based on the use of an electric furnace that primarily requires scrap and/or direct reduced iron and energy to produce crude steel. With this method an average of 1,050 kg scrap, 65 kg coal and 43 kg limestone are used to produce one tonne of steel. Up to 200 kg of by-products accrue (cf. 1.).

In its report from the year 2008 the BIR (Bureau of International Recycling) looked into the environmental benefits that are achieved by recycling and determined the values for saving energy and CO_2 given in the table below when recycled ferrous metals are used:
a) Energy conservation in the production of 100,000 tonnes of steel, depending on the method:

- Energy requirements for primary campaign production in the blast furnace/converter: 1,400 TJ

[1] Extrapolation based on a BDSV member survey in spring 2010

[2] Source: IISI, own estimates, own calculations, Eurofer; Table: bvse (Bonn)
[3] The proportion of process gases occurring are not taken into account in the balance.

- Energy requirements for primary production DRI-EAF 1,920 TJ
- Energy requirements for secondary production EAF 1,170 TJ

b) CO_2 balance in the production of 100,000 tonnes of steel, depending on the method:

- CO_2 balance for primary campaign production in the blast furnace/converter: 167,000 Mg CO_2
- CO_2 balance for primary production DRI-EAF 70,000 Mg CO_2
- CO_2 balance for secondary production EAF 70,000 Mg CO_2

1,784 kWh per tonne is needed to produce one tonne of liquid steel from 100% scrap. Theoretically, 6,481 kWh per tonne is needed to produce one tonne of crude steel from primary raw materials. The amount of energy saved is around 4,697 kWh a tonne, i.e. approximately 72.5 %.[4]

Special advantages of shredder scrap

In comparison to coarser scrap the density of shredder scrap is up to 50% higher. The higher density means that the scrap basket can be filled with a greater quantity. The steel yield per tap is thus increased and overall less scrap has to be charged. In addition, the tap-to-tap cycle is shortened. Another ecological benefit is that the roof of the furnace does not have to be opened as often in relation to the number of melting processes, thus allowing greater energy conservation by 3 to 7%. Moreover, production can be increased by up to 18% a year due to the higher input of scrap that is possible. Due to the material and/or energetic utilisation of the metals, residual fractions and residues, landfill space is no longer used and the emissions typical of such no longer occur. Primary raw materials do not have to be mined and transported over long distances.

1.4 – European regulations and framework linked to shredder BREF

1.4.1 - Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy

The European Union (EC) has established a framework for the protection of:

- inland surface waters *;
- groundwater *;
- transitional waters *; and
- coastal waters *.

This Framework-Directive has a number of objectives, such as preventing and reducing pollution, promoting sustainable water usage, environmental protection, improving aquatic ecosystems and mitigating the effects of floods and droughts.

Its ultimate objective is to achieve “good ecological and chemical status” for all Community waters by 2015.

Administrative arrangements

Member States have to identify all the river basins * lying within their national territory and to assign them to individual river basin districts *. River basins covering the territory of more than one Member State will be assigned to an international river basin district.

[4] Source: President of SRI, Bill Heenan

Member States are to designate a competent authority for the application of the rules provided for in this Framework-Directive within each river basin district.

Identification and analysis of waters

By 2004 at the latest, each Member State shall produce:

- an analysis of the characteristics of each river basin district;
- a review of the impact of human activity on water;
- an economic analysis of water use;
- a register of areas requiring special protection;
- a survey of all bodies of water used for abstracting water for human consumption and producing more than 10 m³ per day or serving more than 50 persons.

This analysis must be revised in 2013 and every six years thereafter.

Management plans and programmes of measures

In 2009, nine years after the Framework-Directive entered into force, management plans were produced for each river basin district, taking account of the results of the analyses and studies carried out. These plans cover the period 2009-2015. They shall be revised in 2015 and then every six years thereafter.

The management plans must be implemented in 2012. They aim to:

- prevent deterioration, enhance and restore bodies of surface water, achieve good chemical and ecological status of such water by 2015 at the latest and to reduce pollution from discharges and emissions of hazardous substances;
- protect, enhance and restore the status of all bodies of groundwater, prevent the pollution and deterioration of groundwater, and ensure a balance between groundwater abstraction and replenishment;
- preserve protected areas.

The management plans for river basin districts can be complemented by more detailed management programs and plans for a sub-basin, a sector or a particular type of water.

Temporary deterioration of bodies of water is not in breach of the requirements of this Framework-Directive if it is the result of circumstances which are exceptional or could not reasonably have been foreseen and which are due to an accident, natural causes or force majeure.

Member States shall encourage participation by all stakeholders in the implementation of this Framework-Directive, specifically with regard to the management plans for river basin districts. Projects from the management plans must be submitted to public consultation for at least 6 months.

From 2010, Member States must ensure that water pricing policies provide adequate incentives for users to use water resources efficiently and that the various economic sectors contribute to the recovery of the costs of water services, including those relating to the environment and resources.

Member States must introduce arrangements to ensure that effective, proportionate and dissuasive penalties are imposed in the event of breaches of the provisions of this Framework Directive.

A list of priority substances selected from among the ones which present a significant risk to the aquatic environment has been drawn up at European level. This list is set out in Annex X to this Framework-Directive.

1.4.2 – Convergence with EU Air Protection Policies : Short guide for ENP Partners and Russia

The European Neighbourhood Policy (ENP) was created in 2003/2004 and is now well established as the principal vehicle for cooperation with the neighbour countries. It is a collective EU response to the aspirations of its Eastern and Southern neighbours to jointly promote prosperity, stability and security in our region.

In order to help partner countries to realize these benefits, the European Commission has decided to provide information on EU environment policy and legislation in key policy areas. To this end, the European Commission has initiated the production of six short guides on the following topics:

- Water quality, with a focus on the Water Framework Directive and related developments, such as the Flood Directive or the Groundwater Directive;
- Waste management, with a focus on the Waste Framework Directive;
- Air quality, with a focus on the Framework and Daughter Directives;
- Environmental Impact Assessment, Strategy Environmental Assessment, Access to Information, Participation in Decision-Making, and Reporting;
- Nature protection, with a focus on the Habitats and Birds Directives (e.g. cross-border co-operation) and the Natura 2000 network (e.g. ways to establish measures or monitoring);
- Industrial pollution, including the Integrated Pollution Prevention and Control Directive.

Where relevant the guides address the seven Thematic Strategies under the 6th Environment Action Program (EAP). The Thematic Strategies constitute the framework for action at EU level in each of the concerned priorities and cover the following fields: soil and the marine environment (in the priority area of biodiversity), air, pesticides and urban environment (in the priority area of environment, health and quality of life) and natural resources and waste recycling (in the priority area of natural resources and waste).

See annex __

1.4.3 – Council Directive 1999/30/EC of 22 April 1999

Relating to limit values for sulphur dioxide, nitrogen and oxides of nitrogen, particulate matter and lead in ambient air.

Abstract to be prepared

See annexe __

1.4.4 – Directive 2001/81/EC of 23 October 2001

On national emission ceilings for certain atmospheric pollutants
Abstract to be prepared

1.4.5 – Stockholm convention about POP and its revisions

Abstract to be prepared

1.4.6 – Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives

Abstract to be prepared

1.4.7 – Regulation (EC) No 166/2006 of the European Parliament and of the Council of 18 January 2006 concerning the establishment of a European Pollutant Release and Transfer Register and amending Council Directives 91/689/EEC and 96/61/EC.

This Regulation sets up a Pollutant Release and Transfer Register (PRTR) at European Union (EU) level in the form of a publicly accessible electronic database. This database will meet the requirements of the United Nations Economic Commission for Europe (UN-ECE) Protocol on Pollutant Release and Transfer Registers, signed by the Community in May 2003.

The public will be able to access this register free of charge on the internet and will be able to find information using various search criteria (type of pollutant, geographical location, affected environment, source facility, etc.)

Scope of the PRTR

The register will contain information on releases of pollutants to air, water and land, as well as transfers of waste and pollutants, where emissions exceed certain threshold values and result from specific activities. The register will also cover releases of pollutants from diffuse sources (such as transport).

Annex II lists the waste and pollutants covered by the register, which include greenhouse gases, acid rain pollutants, ozone-depleting substances, heavy metals and certain carcinogens such as dioxins. The activities concerned are specified in Annex I, and include in particular those covered by Directive 96/61/EC (the "IPPC" Directive). They include those associated with thermal power stations, mining, quarrying and metalworking industries, chemical plants, paper and timber industries and also waste and waste-water treatment plants.

How the PRTR will work

Information gathered at national level by Member States and reported to the Commission will be fed into the database on a regular basis.

First of all, operators carrying out one or more of the activities listed in Annex I will submit information to the competent national authority if their activities involve releases or transfers of pollutants exceeding certain threshold values.

Where applicable, Member States will also be required to gather information on releases from diffuse sources.

Member States must then report the information they have collected to the Commission by the stipulated deadline (within 15 months of the end of 2007 for data relating to 2007, and subsequently within 12 months of the end of each reporting year). Member States are permitted to keep certain information confidential; if they do, they must notify the Commission of the type of the information that is being withheld and the grounds for withholding it.

The Commission, with the cooperation of the European Environment Agency , will provide the public with access to the information contained in the database by ensuring it is available on the internet by the stipulated deadline (within 21 months of the end of 2007 for data relating to 2007, and subsequently within 16 months of the end of each reporting year).

The construction and operation of industrial shredder plants in Germany is subject to a large number of national standards required by Federal German legislation. The most important legal regulations (Chapter 1.1.1) are

- Act on the Prevention of Harmful Effects on the Environment caused by Air Pollution, Noise, Vibration and Similar Phenomena (Federal Immission Control Act, BImSchG),
- Act for Promoting Closed Substance Cycle Waste Management and Ensuring Environmentally Compatible Waste Disposal (Kreislaufwirtschafts- und Abfallgesetz, KrW-/AbfG) and
- the Federal Building Code (BauGB).

Also related are particular specific ordinances and other bodies of rules and regulations. In general, industrial shredder plants also have to consider operating aspects such as occupational safety, accident prevention and fire protection. The legal requirements for these are regulated on a national level in some cases (e.g. Labour Protection Law, accident prevention regulations, preventive occupational medical care) and on a European level in others (e.g. EU Machinery Directive).
If the secondary raw materials produced are to be marketed transnationally, supranational standards also have to be observed (Chapter 1.1.2).

1.1.1. National legal regulations

a) Federal Immission Control Act, BImSchG

The Federal Immission Control Act (BImSchG) represents the most important body of rules and regulations in Germany in terms of environmental legislation. It governs the prevention of harmful effects on the environment caused by air pollution, noise and vibration and, due to its so-called concentration effect as compared to other official rulings pertaining to the plant, is the central element for the construction and operation of a plant in the Federal Republic of Germany.
The Federal Immission Control Act is supplemented by a number of Federal Immission Control Ordinances (BImSchV). They specify how the law is to be implemented. The fourth ordinance on implementing the Federal Immission Control Act (Ordinance on Plants Requiring a Permit – 4. BImSchV) § 2 subsection 1, governs the type of approval procedure for industrial shredder plants. The appendix to 4. BImSchV has a list divided into so-called column-1 and column-2 plants. A formal approval procedure in accordance with § 10 BImSchG with publication of the application documents and a date for discussion is required for column-1 plants. A simplified approval procedure in accordance with § 19 BImSchG can be carried out for column-2 plants. Plants that fall below the minimum threshold values of column-2 plants do not require any permit in accordance with the Federal Immission Control Act, but are to be approved according to other fundamentally pertinent standards

(particularly according to construction law). Industrial shredder plants are specified under Point 8.9 of the list of plants which, on the basis of the drive power of the rotor, prescribes the respective approval procedure:

Point 8.9 of the 4th Federal Immission Control Ordinance **Column 1:**	 **Column 2:**
a) Plants for shredding scrap by means of rotor mills with a nominal rotor drive rating of 500 kilowatts or more	a) Plants for shredding scrap by means of rotor mills with a nominal rotor drive rating of 100 kilowatts up to less than 500 kilowatts
b) Plants for the interim storage of ferrous or nonferrous scrap, including scrap vehicles, with a total storage space of 15,000 square metres or more or a total storage capacity of 1,500 tonnes of ferrous or nonferrous scrap or more, with the exception of interim storage before the waste and plants covered by Number 8.14 are collected on the site of origin	b) Plants for the interim storage of ferrous or nonferrous scrap, including scrap vehicles, with a total storage space of 1,000 square metres up to less than 15,000 square metres or a total storage capacity of 100 tonnes up to less than 1,500 tonnes of ferrous or nonferrous scrap, with the exception of interim storage before the waste and plants covered by Number 8.14 are collected on the site of origin
	c) Plants for treating ELV with a throughput rate of 5 ELV or more a week

Generally, subsection 8.9 b) is also taken into consideration in the approval of shredder plants since the contact area of the aggregate in connection with the shredder feed storage and finished material storage also needs a permit (cf. Chapter 2.1).
The Environmental Impacts Assessment Act (UVPG) must also be observed in the course of the approval procedure for industrial shredders. Due to the assumed harmful impact on the environment when ferrous and nonferrous scrap metals are stored (cf. Appendix 1, 8.7. UVPG) the authorities always demand a pre-assessment of the environmental impacts with the approval procedure. As a rule this results in the environmental impacts assessment being an obligation. The individual procedural steps are set out in §§ 5 ff. UVPG.
General administrative regulations and technical guidelines have also been drawn up to make the procedure within environmental law more concrete and uniform. These are directed at the approval and supervisory authorities and form the basis for approvals and regulations. The two most important German administrative regulations for industrial shredder plants are the Technical Instructions on Air Quality Control (TA Luft) and the Technical Instructions on Protection Against Noise (TA Lärm):

- Technical Instructions on Air Quality Control (TA Luft)

  TA Luft governs the operator obligations and precautionary duties stipulated by the authorities in the approval procedure to protect the environment from harmful impacts caused by air pollutants. The Technical Instructions on Air Quality Control includes details of material-related emission and immission values and corresponding methods of measurement and calculation.
  The aim of TA Luft is – according to the legal task of making standards more specific in accordance with § 48 BImSchG – to provide the competent authorities and thus indirectly, plant operators as well, with appropriate federally uniform standards for assessing air pollutants according to immission protection law, particularly as regards plants requiring permits, taking into account EC/EU Directives, the law on soil protection and other legal provisions currently known.

  The standard for laying down emission limits for the requirements specific to the plants is the best available technology (§ 3 subsection 6 BImSchG); in addition to distinctive plant features, integrative and particularly cross-media aspects are to be considered.

TA Luft does not stipulate any plant-specific immission reference values for industrial shredder plants as it has for numerous other types of industrial plant. Instead, the general emission and immission reference-value requirements laid down in TA Luft are the ones that apply to industrial shredder plants.

- Technical Instructions on Protection Against Noise (TA Lärm)

  TA Lärm governs the operator obligations and precautionary duties to protect the environment from harmful impacts caused by noise. It stipulates emission reference values, the adherence to which in the course of the approval procedure is to be proved either by forecasting the noise to be expected or by taking measurements after the plant has been put into operation.
  To be noted is that the noise caused by the plant is to be added to a possible noise level already existent at the location in question. However, in the case of so-called rare incidents TA Lärm allows the emission reference values to be exceeded, even if the noise level was already high.
  The Federal German industrial shredder plants firmly adhere to the standards laid down in TA Lärm. In some cases the erection of sound barriers in the main direction of the wind or in the direction of the neighbouring areas with sensitive uses may be necessary, depending on the calculation and measurement results.

b) Act for Promoting Closed Substance Cycle Waste Management and Ensuring Environmentally Compatible Waste Disposal (KrW-/AbfG)

The Act for Promoting Closed Substance Cycle Waste Management and Ensuring Environmentally Compatible Waste Disposal (KrW-/AbfG) is the guiding law as regards recycling management and waste disposal. It categorically governs how waste is handled.
KrW-/AbfG is supplemented by numerous legal regulations and special laws that make the KrW-/AbfG provisions more specific for lists of wastes and waste surveillance, for waste disposal and recycling requirements and the demands of operational regulations and product and product-related regulations.
Important ordinances for industrial shredder plants are the Waste Catalogue Ordinance (AVV), the End-of-Life Vehicles Ordinance (AltfahrzeugV), the Electrical and Electronic Equipment Act (ElektroG) and the Ordinance on Specialised Waste Management Companies (EfbV):

- Waste Catalogue Ordinance (AVV)

  The Waste Catalogue Ordinance governs the correct designation and classification of waste according to origin and dangerousness. When the flow of material passes through the plant waste treatment system the AVV code number changes as at all waste treatment plants. If the shredder feed was still classified according to its respective origin and dangerousness[5], the shredder and post-shredder output fractions are classified under the AVV code numbers 19 10 XX or 19 12 XX.
  In contrast to before, when there was a separate catalogue of dangerous wastes in addition to the waste catalogue with the complete list of waste types, there is now just a uniform complete catalogue, in which the types of waste that are classified as dangerous are marked separately with an asterisk. Administrative practice classifies the types on the basis of the European Chemicals Directive. The analysis methods selected by the authorities however often give rise to conflicts with the shredder operators. Many questions in this respect are still awaiting conclusive legal clarification.

- End-of-Life Vehicles Ordinance (AltfahrzeugV)

  The End-of-Life Vehicles Ordinance governs the handover, return and environmentally sound disposal of end-of-life vehicles. Its aim is to have certain motorised vehicles either handed over to a recognised place of acceptance or a recognised recycling facility. The Joint Site for End-of-Life Vehicles (GESA) in Germany is responsible for implementing the ordinance. It collects the data on recognised dismantling plants, shredder plants and other plants etc. and makes them available to the

[5] AVV code numbers to be found regularly in the input of industrial shredder plants are, for example, 17 04 05 (iron and steel), 16 01 06 (scrap vehicles), 16 01 18 (NF metals) or 16 02 14 (used appliances).

general public. The "requirements made of shredder plants and other plants as regards further treatment" are specified in greater detail in Point 4 of the AltfahrzeugV.
The Federal German industrial shredder plants firmly adhere to the standards laid down in the AltfahrzeugV.

- Electrical and Electronic Equipment Act (ElektroG)

  The ElektroG is designed to prevent waste from electrical and electronic equipment, to promote the recycling and material utilisation of such waste and protect the environment and our health from toxic substances. The law governs the municipalities' recording and collection of such appliances separately from the general disposal system and the manufacturers' obligation to take goods back and recycle them.
  Items for treatment in industrial shredder plants are, in particular, large domestic appliances (e.g. washing machines, dryers, dishwashers, ovens, radiators). Basic obligations to be observed when treating scrap appliances are laid down in §§ 11 and 12 ElektroG.

- Ordinance on Specialised Waste Management Companies (EfbV)

  A specialised waste management company is a business that is entitled to bear the quality mark of a recognised waste management association or has concluded a supervision contract with a technical monitoring organisation that includes an audit at least once a year. The status of specialised waste management company is thus awarded by the waste disposal industry itself and not by a government body. In order for a company to become certified as a specialised waste management company it has to provide proof of certain specialised knowledge, be equipped with appropriate appliances and machinery and be owned by reliable people. Details on this are laid down in the EfbV.
  Customers of certified specialised waste management companies have a higher degree of certainty that the disposal jobs are carried out properly and the treated waste leaving the waste disposal company indeed meets the quality requirements made of it. Practice shows that industrial shredder companies are generally certified as specialised waste management companies.

c) Federal Building Code

The requirements laid down by the law on planning building projects are to taken into account when choosing the site for an industrial shredder plant. The most important German legislation in this case is the Federal Building Code (BauGB). Its provisions ensure that local urban land-use planning is followed and in this way have great influence on the design, structure and development of the populated area. In this respect it defines the most important town planning instruments that the municipalities have at their disposal.
Industrial shredder plants that are applied for according to BImSchG are, due to the concentration effect of the BImSchG process, always approved, also as regards the provisions of the law on planning building projects. An independent planning permission process has to be carried out for small plants that come under the quantity limit in column 2 of the 4th BImSchV.

1.1.2. Supranational legal regulations

Directive 2008/98/EC of the European Parliament and of the Council of 19.11.2008 on waste and repealing certain Directives establishes the framework for the national waste laws in the EU-27 and thus also for the German law on waste. The KrW-/AbfG still effective in Germany has to be adapted to the new European Waste Framework Directive in many places. The Federal Ministry for the Environment, which is responsible for the draft, has decided to make clear in the very title that – in coordination with the updated European legal priorities – it is time to turn the page and start a new chapter in waste legislation in Germany: the new Federal law is simply to be called the Closed Substance Cycle Waste Management Act (KrWG).

Germany was basically obligated to put the national act to implement the Waste Framework Directive into effect by December 12th, 2010. At the moment – as per January 2011 – this process has not yet been concluded, however.
Directly applicable supranational law exists, particularly for the subject of transnational waste transportation. The regulations for both the input and output streams from industrial shredder plants must be observed if they are to be shipped beyond the German borders. All regulations are revised and adapted regularly. The most important bodies of regulations are:

- Waste Framework Directive (Directive 2008/98/EC) of 19.11.2008, which sets out the legal framework for the waste legislation of the Member States,
- Basel Convention of 22.3.89 on the control of transboundary movements of hazardous wastes and their disposal,
- Regulation (EC) No. 1013/2006 of the European Parliament and of the Council on shipments of waste in the consolidated version of 16.05.2010,
- Commission Regulation (EC) No. 1418/2007 of 29 November 2007 concerning the export for recovery of certain waste listed in Annex III or IIIA to Regulation (EC) No. 1013/2006 of the European Parliament and of the Council, to certain countries to which the OECD Decision on the control of transboundary movements of wastes does not apply, last amended with Regulation of 23.09.2010.

In Germany, the Waste Shipment Act of July 19th, 2007 also has to be observed for transboundary shipments. It includes the supplementary process provisions for the notification process that are necessary for applying the EU Regulation on shipments of waste, specifies the obligations concerning information, taking back goods and labelling and provides authorisation to conduct official checks and give orders in individual cases.

a.) **Directive 2008/98/EC (Waste Framework Directive)**

Directive 2008/98/EC has replaced Directive 2006/12/EC on waste of 5 April 2006. Resource conservation and environmental protection are reinforced in the new Directive, European waste legislation is tightened by the integration of the Waste Oil Directive and Directive on hazardous waste and legal certainty in the use of core legal terms, particularly when differentiating between waste and non-waste, and the differentiation between recovery and disposal has been increased. Of great practical significance, especially for shredder operators, are the provisions on the end of waste status.
The EU Commission has meanwhile submitted a draft Regulation regarding the criteria for determining when certain types of scrap are no longer to be viewed as waste. The end-of-waste criteria for iron, steel and aluminium scrap in this draft are extremely demanding. If no major changes are made before the Regulation is passed we can assume that the majority of scrap will not be able to leave the waste regime despite treatment.
The adoption of the End-of-Waste Regulation can be expected in the second half of 2011. The EU Regulation will apply immediately; it does not require any additional implementation by German law. Until its adoption all scrap that has been shredded (output) is legally to be classified as waste and thus subject to the provisions of waste legislation.
Insofar as shredded scrap meets the criteria of the legally effective End-of-Waste Regulation in the future (and waste law is thus no longer applicable) attention must be paid to meeting the obligations of the European Regulation on chemicals – REACH. However, REACH eases the way for materials recovered through recycling, particularly as regards the registration obligation.

b.) Basel Convention

The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal dating from the year 1989 contains the first essential features of an international "waste management convention". This includes the principle of wastes being disposed of as far as possible in the State where they were generated, giving priority to waste reduction over waste disposal and the task of drawing up general principles for environmentally sound waste disposal with worldwide application. The core of the Convention however is made up of concrete regulations for controlling transboundary shipments of hazardous wastes:

- Import, export and transit of hazardous wastes are only permissible if all States concerned have been informed beforehand and agreed to the shipment,
- Shipments to "non-party States" are not permitted unless bilateral or multilateral arrangements exist, which meet the requirements of the Basel Convention,
- The exporter of wastes or alternatively the State from which the hazardous wastes originate is responsible for observing the Convention and obligated to take back the wastes in the case of illegal shipment.

c.) Regulation on Shipments of Waste

Regulation No. 1013/2006 on shipments of waste implements the requirements of the Basel Convention and the OECD Decision on waste shipment. In addition to defining terms it includes general shipment prohibitions and essential procedural rules to be observed in transboundary traffic. Notification, consent and approval are required for any type of export, import or transit of waste between the Member States, but also with third country participation. The obligations of the Regulation are restricted for "green" listed waste if they are recycled exclusively in plants with a permit to do so properly.

d.) Special rules for the shipment of green listed waste to third countries for recycling

Shipping information is to be carried during transport for shipments of green listed waste (as a rule, non-hazardous waste for recycling) from the EU to a country not covered by the OECD Decision. A notification procedure is normally not necessary. However, approval (e.g. for transit) is to be obtained in such countries if applicable and special rules are to be observed. Furthermore, transitional arrangements are to be observed for new EU Member States in accordance with Art. 63 of the Regulation.

1.5 - Institutional and economic aspects of the shredder sector

1.5.1 - Permits

Based on European or national regulations, permits are generally delivered by local authorities considering the specificities of the yard implantation and the nature of its industrial activities.
Various requirements are generally specified concerning:

- Type and size of the activities on the shredder yards,
- Energy supply,
- Definition of controls from the administration
- Integration in the landscape
- Action taken to prevent water pollution, definition of used water collection constraints,
- Action taken to prevent fire risks
- Definition of chemical requirements on water sent back to the environment,
- Action taken to prevent air pollution,
- Definition of chemical and physical requirements on air emissions
- Waste management
- Noise and vibration limits

Permits are generally given without date of end but can be withdrawed if requirements are not fulfilled.

Permits are required for plants exceeding 500 horsepower.

1.5.2 - xxx

1.6 - General environmental issues related to shredders

1.6.1 – Water output

Water used for dust separation is used in closed circuit.

1.6.2 - Air emissions

1.6.3 - Noise

1.7 – Shredders industry emissions compared to other industries covered by IPPC

Proposal of Jean Louis CLERGUE

Chapter 2 – Applied processes and techniques

Description of the methods currently employed in the shredding sector, raw materials, chemicals, materials preparation, materials handling storage etc. In order to understand the processes and therefore the emissions and consumption we will write a section on the shredding methods techniques and differences between manufactures and their equipment.

2.1 – Common techniques applied in the sector

2.1.1 - Reception, acceptance, traceability and quality assurance

Measurement techniques

2.1.2 - Management techniques

2.1.3 - Safety, Health and Environment management

This paragraph will explain what do we measure and how, how do we comply with the permit.

2.1.4 - Energy Systems

2.1.5 - Storage and handling

2.1.6 - Material feeding

2.1.7 - Crushing and compression

2.1.8 - Cleaning of the scrap metal

2.1.9 – Ferrous metal separation

2.1.10 - Other common techniques

2.1.10 - …

2.2 – Specificities of Fridge shredder

2.3 – Specificities of SDA shredder

2.6 – Users of outputs
Users are generally steelworks and non-ferrous metal works ….
In certain cases, shredders are used by electric arc furnace plants.

Energy recovery from automotive shredder residue

2.7 – Techniques for water protection

2.8 – Techniques for air protection

2.9 – Techniques for noise prevention and vibration reduction

(2) Applied processes and techniques

First, an outline of the balance scope of a shredder plant is given to describe the applied processes and techniques. There are a total of five plant areas to differentiate between, but the ones not relevant for this document, e.g. administration facilities, have been omitted:

1. Delivery and acceptance (see Chapter 2.1),
2. Pre-treatment (see Chapter 2.2),
3. Shredder technology (see Chapter 0),
4. Post-shredder process (see Chapter 0) and
5. Emission-reducing technologies (see Chapter 0).

The following diagram clearly shows the balance scope of the actual shredder as drawn in this document, highlighted in yellow. Also delimited in the diagram is the balance scope of disposal facilities highlighted in green and the balance scope of post-shredder technology for SLF and SHF highlighted in blue.

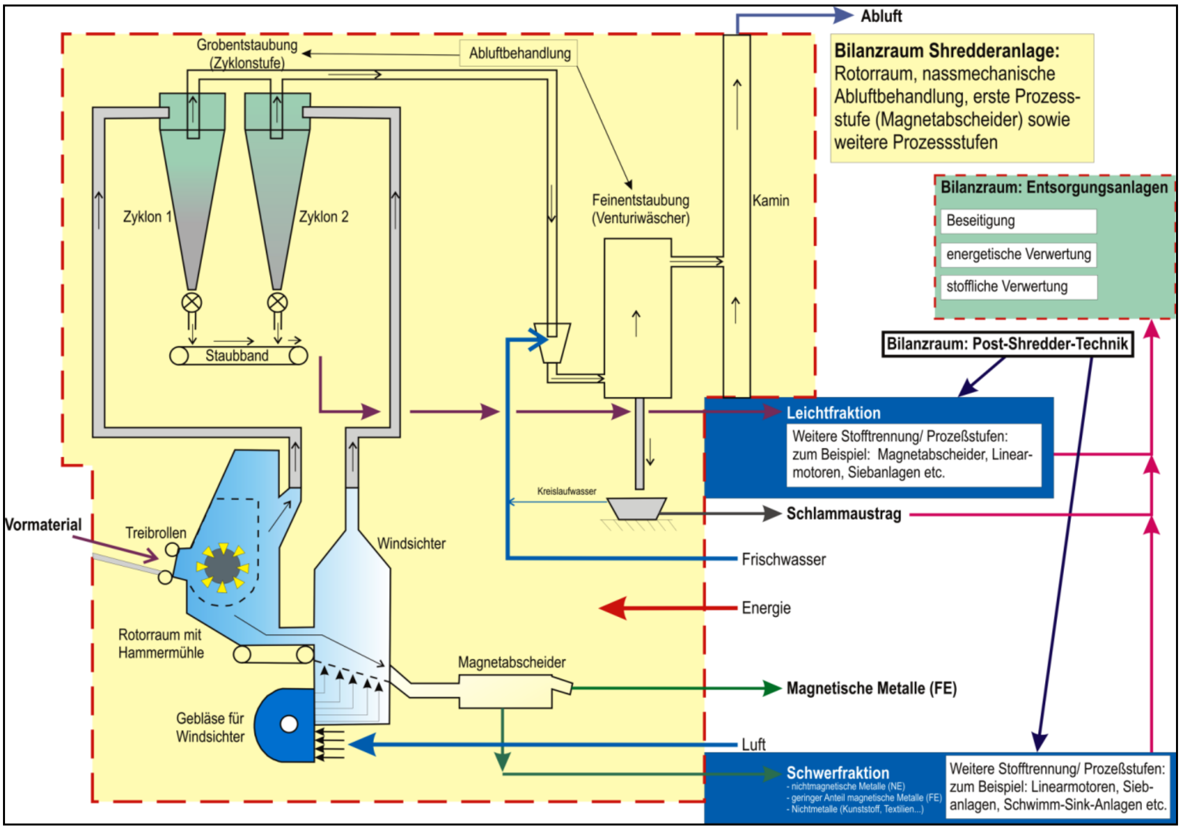


Fig 5-1: Balance scope of an industrial shredder plant in this document

(2.1) Delivery and acceptance

The delivery area of an industrial shredder plant consists of a sufficiently sized acceptance area, which as a rule is a paved surface with a weighing station and corresponding weigh office. The weight of all material input and output streams are recorded at the weighing station. The delivery area offers the possibility to carry out an intake control both as concerns the supplier and in legal terms as concerns the waste, and to make a pre-selection according to visually recognisable criteria. The visual inspection can be made directly at the weighing station or during dumping in the delivery area. It serves to pre-select waste into main groups and detect elements containing harmful substances or impurities (e.g. lead batteries). This place can also be used for pricing.

The input material delivered to shredder plants is called feed. As a rule, shredder feed comprises :

- scrap cars from recycling facilities,
- scrap from municipal and commercial collections,
- industrial scrap from production or demolitions,
- pre-treated large domestic appliances (usually excluding refrigerators),
- tin scrap,
- scrap from waste incineration plants (bicycle frames, mattress supports, steel frames etc.),
- metal mixes (ferrous and nonferrous) from processing and sorting plants and

- other metal compounds.

The proportion of each type of scrap in the total volume is difficult to calculate since the composition of the shredder feed varies from one plant to another and depends on the season and region.

Shredder feed is delivered in containers, walking floor vehicles and normal lorries that are registered for the transport of waste. Sites with water or rail connections also use ships or trains for their input/output logistics.

A means of checking the delivered materials for an increased level of radioactivity is also at the delivery area. This control station is mostly a stationary automatic reading taken immediately before the weighing station. The delivery vehicles (road or rail) have to pass through this station at a very slow speed (use of ground beams for lorries) to ensure an accurate reading.

Another possibility for measuring radioactivity is by means of mobile units. In this case the detector can be attached to the grab, magnetic plate or arm of the unloading equipment. This technique can be found when unloading ships or rail cars, for example.

If impurities are found in the shredder feed during the acceptance process, e.g. hollow objects and explosives (safety regulation BGV D23), pressure vessels, vessels that are only partially empty, materials with dangerous adhesions, spray cans, refrigerators, batteries etc., these are either separated out or – if legally admissible – the delivery is rejected. Containers for the fractions removed in the process of separating out impurities or recyclable fractions can be placed in the acceptance area. Sometimes storage boxes or storage areas can also be found for various materials.

After the acceptance check the shredder feed goes into interim storage in the delivery area.

(2.2) Pre-treatment

The shredder feed undergoes pre-treatment before being sent to the shredder. In practice there can be various types of pre-treatment, depending on the operational requirements. The aim of the pre-treatment processes is to optimise plant availability / minimise shredder downtime and achieve an optimised composition of the input material from an economic point of view as regards the quantity and quality of the output streams.

With the exception of heavy scrap such as cast iron parts and bulky parts (rail tracks, sectional steels and girders), which usually undergo separate shredding, all types of scrap can be shredded in shredder plants. Even scrap cars which make up an appreciable proportion of shredder feed can be handled by the shredder without any prior size reduction.

Below is a summary of the technologies generally used in scrap and metal processing, with a brief description of their differences and relevance.

a.) Pre-sorting

Pre-sorting is a part of integral stock management. The goal is to sort out impurities and homogenise or keep separate selected input materials in order to be able to produce the qualities the customer demands. Pre-sorting can be done manually or mechanically (e.g. with a grab / magnet).

Pre-sorting is an important way of increasing plant availability, homogenising the material input and reducing the ancillary costs of the plant operation. It also guards against deflagration or explosion.

b.) Screening

Another possible pre-treatment step for the input material is the upstream installation of a sturdy screen (usually a bar screen) to separate a fine (mineral) fraction. The aim is to increase the service life of high-wear aggregates in the following process stages. The upstream installation of a screen can be found as a pre-treatment step, depending on the input material.

c.) Prior size reduction

Another considerably more elaborate and costly pre-treatment measure can be reducing the size of the feed prior to shredding. The aggregates used are shears or pre-shredders. A pre-shredder is a slow running, sturdy shredding aggregate installed upstream from the shredder. The pre-shredder rips up the material fed into it. The upstream installation of a size reduction step can be found, depending on the input material.

(2.3) Shredder technology

Shredders are scrap-reducing machines that work on the principle of rotor mills and were invented in the USA as early as 1920. The increased demands made of quality by the steelworks as the main scrap consumers led to industrial shredder plants asserting themselves in the USA as of around 1960, since shredder scrap normally contains only small fractions of impurities for steelworks, i.e. nonferrous metal, rubber or plastic. In the Federal Republic of Germany companies in the scrap industry began the construction of shredder plants at the end of the 1960s.

(2.3.1) Conventional shredder technology

How a conventional shredder plant works is described below, taking a traditional shredder as the basis. The various methods and plant designs are explained in Chapter 2.3.2.

The shredders used to reduce scrap are rotor mills, which differ in the construction of the rotors and in the arrangement of the anvils and grids for the material output. The scrap mix to be shredded is picked up by a grab crane and deposited on a feed chute or (static) apron conveyor. From there it is passed to two drive pulleys, pressed and pushed into the shredder rotor mill at a controlled speed.

The rotor mill consists of a rotor in which several hammers weighing between 70 and 260 kg are suspended. The rotor is driven by a motor with a rating of up to 7,000 kW and rotates at 450-600 rpm. The hammers move forward as a result of the centrifugal forces caused by the rotation. The material pushed forward into the beating area of the hammers is severed over the edge of an anvil. Sufficiently shredded pieces of material are spun through the upper grid. The material parts expelled from the grids are subsequently shredded at the angle of impingement.

The material is compacted by the collision with the grids and the deflector and the reciprocal collision in the shredding area below the upper grid. This shredding and compaction process continues until the shreddable material has passed through the grid. Unshreddable material parts are discharged through the hydraulically actuated bulk ejection door.

A de-dusting system hooked up to the suction nozzle prevents dust escaping from the shredder and frees the shredded scrap leaving the shredder from low density non-metallic impurities.

The shredded and pre-cleaned material is forwarded over a vibrating conveyor located beneath the shredder and a downstream belt conveyor for separation.

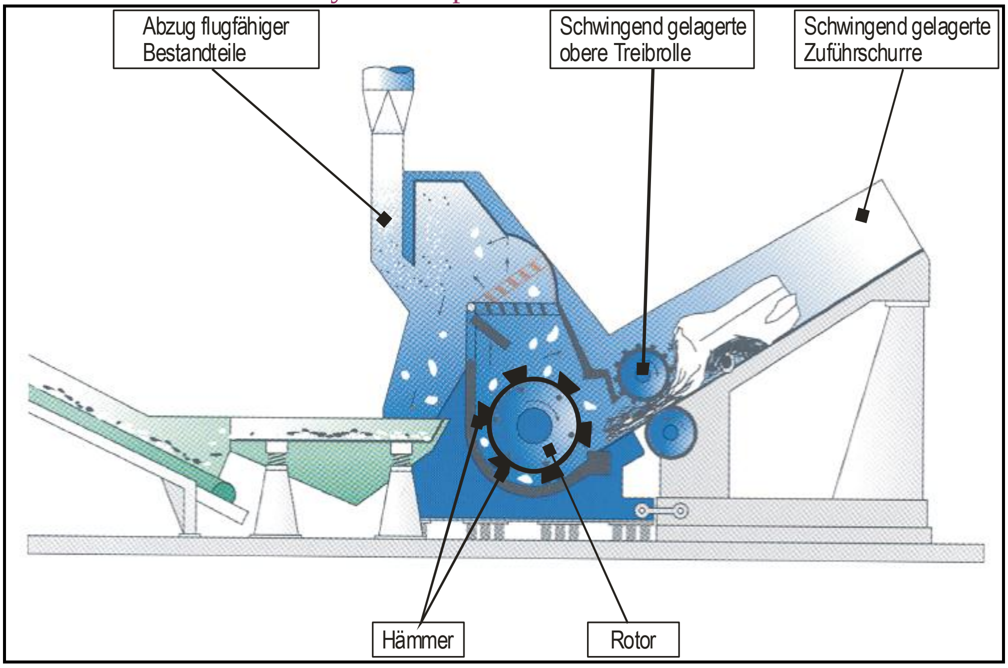


Fig. 5-2: Schematic diagram of a shredder

The lightweight low-density fraction is fed into a cyclone separator. Since the low-density material is drawn out of both the rotor chamber and the air separator, this material mix also contains low-density metals (small parts or particles, e.g. screws, nuts, pieces of aluminium, aluminium foil, metal dusts).

The lightweight low-density fraction is separated again in the cyclone separator into shredder light fraction and the finest particles (e.g. dust) that cannot be separated in the cyclone separator. The latter are discharged from the air in an exhaust air treatment system located downstream from the cyclone separator.

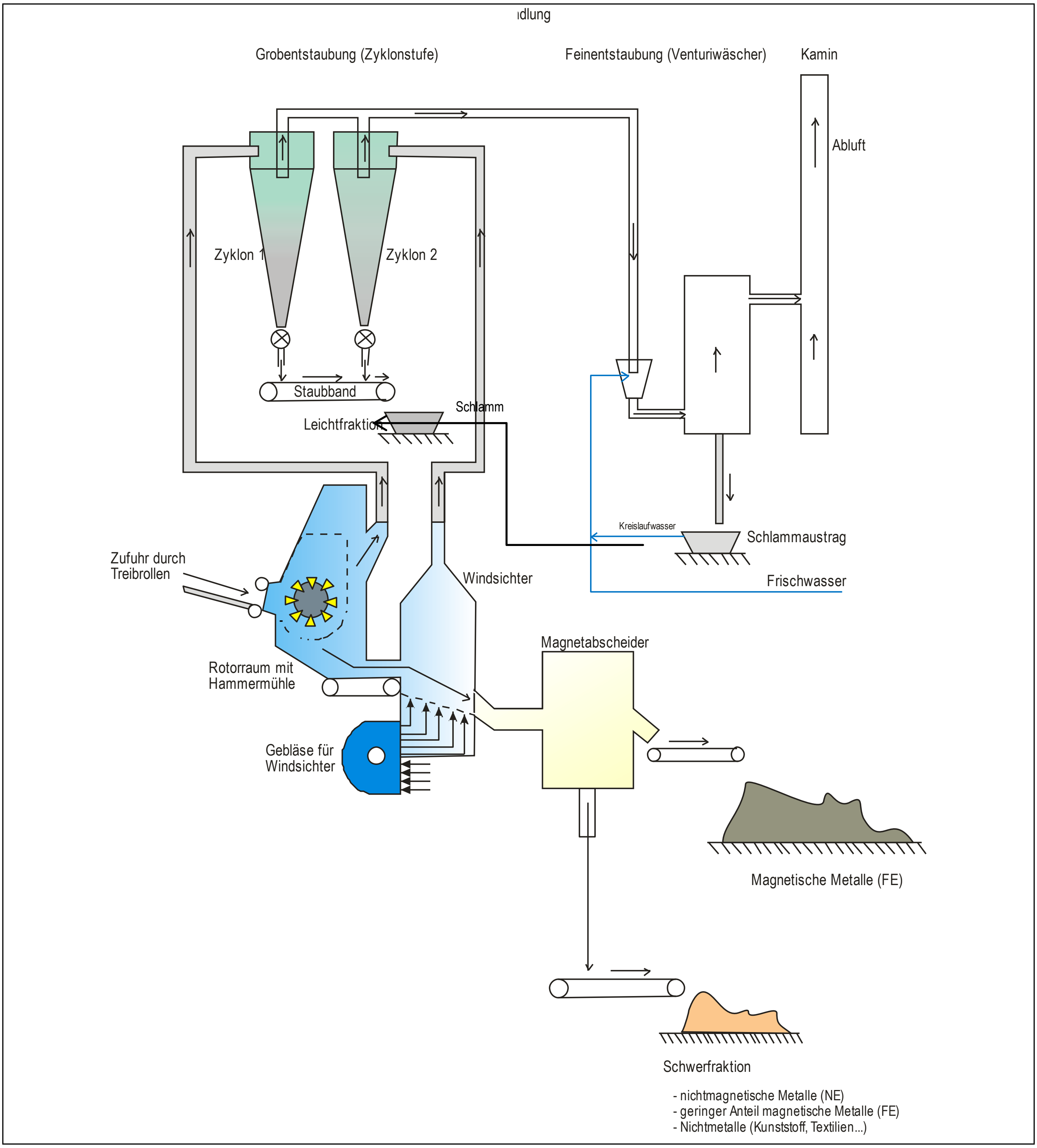


Fig. 5-3: Exhaust air treatment in a shredder

The heavy fraction remaining after passing through the air separator is separated by a magnet separator into a magnetic ferrous fraction and a predominantly nonmagnetic fraction (nonferrous metals such as copper, aluminium, zinc and similar and non-metals such as wood and plastics as well as minimal iron particles that are not caught by the magnet separator).

(2.3.2) Other shredder technologies

In addition to the conventional plant concepts described above the following types of shredder plant are the subject of this document's examination:

- Zerdirators

  Zerdirators have been in operation in Germany since 1983 and have a drive power of between 500 and 4,000 kW. Zerdirators are rotor mills for processing lightweight scrap. Material discharge from the rotor chamber is different from that of conventional shredders because the zerdirator has a grid at the top and the bottom.

- Kondirators

  Plants of this nature were developed to reprocess medium-heavy mixed scrap that is too heavy for the shredder. Structural changes as compared with conventional shredders were made particularly in the rotational direction of the rotors and the material discharge from the rotor chamber. The drive power is between 750 and 3,000 kW. In the kondirator bulky or long items of scrap can be separated from the remaining shredded material during the shredding process through a separate discharge outlet. There are no differences in the subsequent separation of materials as compared with the methods described above.

In addition, there are special forms of the plant types described above, which differ from the above in their modes of operation:

- Semi-wet shredders

  The semi-wet shredder is to be regarded as a special design shredder. An electronically controlled injection of water binds the dust during the shredding process. The water is taken from a supply tank and injected into the rotor chamber at several places via a pump station. The large surface area of the drops enables the rotor and the pieces of scrap to be cooled quickly. The steam that is produced escapes through the openings in the shredder, i.e. around the feed chute and the vibrating extraction conveyor. Most of this steam is captured by the soundproof housing of the shredder. The electronic control regulates the quantity of water in an optimum way, depending on the motor current. There are only a few shredders like this in Germany and they are in the form of zerdirators.

- Wet shredders

  Wet shredders operate with pre-wetted shredder material. For this reason material separation is different from that of other shredders. The fact that the shredder feed is wet reduces the proportion of low density materials as compared with dry processes and that later accumulate as shredder residue. However, a considerable quantity of sludge accumulates when the contaminated wastewater is cleaned and this has to be disposed of. Scrap vehicles and light to medium-heavy scrap metal and industrial scrap are shredded in wet shredders. The scrap quality is that of customary shredder scrap. There is only one shredder of this type in Germany.

There are also other special types of shredder plants that are not taken into consideration in this document and are only mentioned here for the sake of completeness:

- Scrap mills

  These differ from other shredders as a result of the vertical axis of the rotor (so-called vertical shredders). As a rule, the scrap mill is used simply as a shredder, without any downstream post-shredder processing. There are only a few of these shredders in Germany.

- Cryogenic shredders

  Plants of this type use the brittleness of materials at low temperatures. The shredder feed is cooled down in a cooling tunnel to -196 °C with liquid nitrogen. Due to the cold embrittlement only 25 % of the energy otherwise consumed is required for the subsequent shredding process. The resulting scrap is in smaller pieces than usual and displays a very high bulk density. One disadvantage in particular is the high costs of the liquid nitrogen, meaning that the method has only been used so far in special cases, e.g. the shredding of electric motors. There are no shredders of this type in Germany.

(2.3.3) Output fractions

Irrespective of the type of shredder being used the following output fractions are the result of the average input from the shredder process (see Chapter 2.1.):

- Iron/steel fraction (also called Fe fraction or shredder scrap)

The size of the iron/steel fraction scrap is fairly homogenous, ranging from 50 to 150 mm, and is over 92% iron. The recovery of this fraction is the main reason for operating a shredder plant. It is sold to steelworks at home and abroad. The iron/steel fraction corresponds to approx. 65 to 70% by weight of the shredder feed.

- Nonferrous metal fraction (also called shredder heavy fraction / SHF)

On average the NF metal fraction makes up approx. 5 to 10% by weight of the shredder feed and mainly consists of aluminium, copper and zinc mixed with non-metals (e.g. rubber, plastics, glass or stones). These non-metals represent an impurity in terms of using the valuable (because expensive) NF metals.

Before further metallurgical reprocessing (e.g. in foundries) the non-metal content of the NF fractions has to be removed. They are reprocessed in internal or external treatment stages until the non-metal content is removed and the NF metals are separated.

- Shredder light fraction (SLF)

In the process of shredding the input material composites are separated and broken apart into small pieces. Heavy materials are discharged from the shredder, whereas the remaining light components of the input material are discharged by the forced air supply of the cyclone and air separator systems. The SLF mix thus also contains components of the input material in a shredded form. These are essentially:

- textiles (e.g. seat covers)
- foamed plastics (e.g. from seat cushioning)
- plastics and plastic sheeting (e.g. from trims)
- mineral components (e.g. adhesions in the wheelhouses and on the undercarriage)
- metal foils (e.g. from insulating layers), but also
- screws, nuts, NF pieces of metal and aluminium pieces and foils and
- paint residues / rust

- wood and
- elastomers.

Approximately 10 to 20% by weight of the shredder feed, depending on its composition, is shredder light fraction. Its material composition varies greatly and is largely influenced by the type of feed. The individual proportion of any type of scrap in the total volume is difficult to determine since the composition of the feed varies greatly from plant to plant and also according to season and region. The fluctuations in the composition of the shredder feed are passed to the composition of the shredder light fraction. Shredding scrap vehicles thus leads to a disproportionately high proportion of plastics in the shredder light fraction, just as the shredding of mixed scrap and industrial scrap (e.g. pipelines and light sectional sheet with concrete adhesions) causes a considerably lower proportion of plastics in the shredder light fraction. Moreover, the type of air separation has a substantial impact on the composition of the SLF. With a weak air current the SHF contains more plastics and with a strong air current the SLF contains more plastics.

(2.4) Post-shredder processes

Post-shredder technology (PST) is the further reprocessing of shredder residues (SLF and/or SHF) and goes beyond the technologies described in Chapter 0. This can be done internally – i.e. at one and the same place – or externally and also inline or offline. Inline is the continuous feeding of the material stream from the place it (SLF or SHF) is generated into a reprocessing facility, generally via a belt conveyor system. Offline is a discontinuous plant operation, e.g. in batches via a wheel loader.

Most but not all industrial shredder plants in Germany have PST. Its main goal is to recover materials from the SLF and SHF. Regional conditions can also make the PST necessary to ensure the safe disposal of partial fractions. Whatever, the basic legal requirements such as recycling quotas and immediate landfill ban etc. are to be observed. As a consequence the reprocessing extent of the respective PST is always in accordance with the respective shredder process configuration and the disposal possibilities available under the basic economic and local conditions.

The summary below is not comprehensive and does not purport to be complete. The named processes / process stages can be combined in different ways and can to a large extent generally be presented in any order as regards the process. Basically, all these processes / process stages are sufficiently well known from the reprocessing of secondary raw materials and also described in other BREF documents, which is why they are a part of this document.

a.) Dry mechanical reprocessing aggregates

- Manual picking: manual sorting is widely used for the coarse fractions from shredder residues, particularly from SHF, to separate the larger residual metal parts.
- Screening/sifting: possible post-treatment to separate certain particle sizes.
- Air separation/density separation: as a rule, after upstream shredding and screening steps for fractions that are separated according to their specific density with accurately adjustable separation aggregates.
- Size reduction: for better fractioning, shredder residues are often reduced in size, i.e. the particle size is reduced to a homogenous size suited to the subsequent reprocessing step.
- Induction sorting systems: metal separation by exploiting electromagnetic properties.

- Eddy current separation: NF metals, with the exception of lead and stainless steel, can be separated via electromagnetic conductivity. There is usually also a screening process, so that these aggregates can be charged with defined classes of particle size.
- Magnet separator: magnetisable Fe metals are separated selectively.
- Visual sorting systems: visual sorting systems can separate metals according to colour. This is used to separate cooper/brass from other heavy metals.
- X-ray systems: metal composites are sorted according to various material densities, halogen components or organic components with the aid of x-rays. Sorting can be according to light and heavy metals, but also according to PVC made of plastics.

These process stages can be applied to the reprocessing of SLF and SHF. Reprocessing can take place internally and/or externally.

b.) Wet mechanical reprocessing aggregates

- Sink-float tanks: method of sorting to separate two solids by exploiting the different material densities.

c.) Mechanical-biological treatment

- Digestion: method of biologically treating partial streams from industrial shredder plants to produce storable materials.

d.) Thermal treatment

- Pyrolysis: low-temperature thermal process that converts high-calorific-value waste into low-calorific gas and ash/soot.
- Depolymerisation: special form of pyrolysis to convert plastics into a synthetic crude oil.
- Gasification: thermal treatment process for high-calorific-value materials, by which a synthesis gas and ash are produced, whereby the synthesis gas may be of varying quality depending on the form of the process.
- Waste-to-energy plant: thermal treatment plant that treats the atmospherically combustible parts of the waste for the purpose of reducing the waste volume by using inherent energies and at the same time compacting the remaining quantities for landfilling.
- Power station: a power station is an industrial plant for producing electricity and partially for providing thermal energy. The electric power is fed into the electricity network.
- Cement plant: the cement produced there is a hydraulic binding agent for mortar and concrete. Cement is also the binder between synthetic additions to make a firm building material.

e.) (Raw) material recycling

- Blast furnace: reducing metallurgical aggregate to convert iron ore into pig iron with the addition of coke and coal/fuel oil.

As a rule, there are already some of the aforementioned post-shredder process steps available internally at the respective shredder sites. The depth of reprocessing at the site is determined by the types of feed, the mass flows and basic regional conditions. However, the technologies used and whether they are applied on site or purchased from third parties is, in the end, the decision of the plant operator and is dependent to a certain extent on the operator’s industrial knowhow.

There are service providers on the market that have specialized with their particular plants in reprocessing partial fractions from shredder plants by using the aforesaid process steps. The extent of reprocessing ranges from a single process step to a complex process technology, depending on the operator and site.

There are also overall processes (e.g. Scholz Recycling in Espenhain or the SiCon process) with complex process technology that produce materials from the shredder residues (SLF and SHF) with defined properties for further utilization. These processes recover almost all residual metals with a high degree of purity and organic fractions for further utilization steps.

(2.5) Emission reduction technologies at industrial shredder plants

The application of the existing legal standards for reducing emissions is handled differently by the authorities, meaning that the technologies and processes used vary from site to site. Below are descriptions of individual measures that have been implemented at various locations in Germany. The principle of proportionality must be observed when selecting the emission reduction technologies.

(2.5.1) Organisational measures

A visual check of the input material, including monitoring for increased radioactivity as described in Chapter 2.1. is an important element in reducing the emissions at industrial shredder plants and in Germany is best available technology. The input of pollutants into the plant is minimized as a result. Regular operational and technical measures are also to be implemented to minimize dust emissions from diffuse sources:

- work instructions, e.g. closing doors and gates,
- enclosing belt transfer points,
- localised extraction and / or misting / sprinkler systems on aggregates with heavy dust formation /e.g. screen drums) or in dumping zones,
- Regular sweeping of roadways, depending on the weather.

All of these points are likewise best available technology in Germany.

(2.5.2) Technical measures

The technical measures to reduce emissions at industrial shredder plants are described in more detail below.

a) Atmospheric emissions

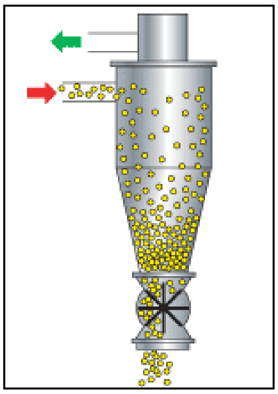
There are several process technologies available for reducing atmospheric emissions during the shredding of scrap in shredder plants. However, not all of them can be used at industrial shredder plants. Below, therefore, the various aggregates have been examined and evaluated in terms of their status for use at industrial shredder plants. All of these technologies require the exhaust air from the rotor chamber to be collected and discharged through a channel.

- Cyclone

  As a rule, the exhaust air from a shredder plant is first passed through a cyclone stage in order to minimize the dust fraction. A cyclone separator operates according to the principle of inertia. It comprises a vortex insert and collection chamber. The vortex insert is designed in such a way that it sets the compressed air in spiral motion. Solid and liquid parts of the air are spun against the container walls by virtue of their own inertia. As a result, heavy particles of dirt and drops of water fall to the bottom and are separated. The separated foreign particles flow past a baffle plate into the collection chamber. The baffle plate also prevents the airflow from carrying back the separated materials. The separated materials can be discharged automatically from the collection chamber via a so-called cellular wheel sluice and then disposed of.

Fig. 5-4: Schematic diagram of a cyclone

  The separative capacity of a cyclone separator depends on the speed of the airflow – the higher the



  airflow speed, the higher the degree of separation. However, pressure loss also increases in the separator as the airflow speed accelerates.

  Status: cyclone separators are established and time-tested technologies at industrial shredder plants.

- Venturi washer

  The finer parts remaining in the exhaust air after the cyclone treatment are often passed via a pipeline system to a so-called Venturi washer with downstream sludge dredger. These washers stand out as a result of their particularly intensive extraction of the carried particles in a Venturi tube. Due to the high-speed gas flow in the Venturi throat the injected wash liquid is dispersed to an extremely fine degree. Water dispersion and dust particles come into contact with one another so intensively in the Venturi diffuser that the particles are sufficiently dampened and bound to the liquid.

Downstream from the Venturi tube is a countercurrent scrubber, in which the water drops carried along by the gas flow are extracted with the dampened fine dust particles.

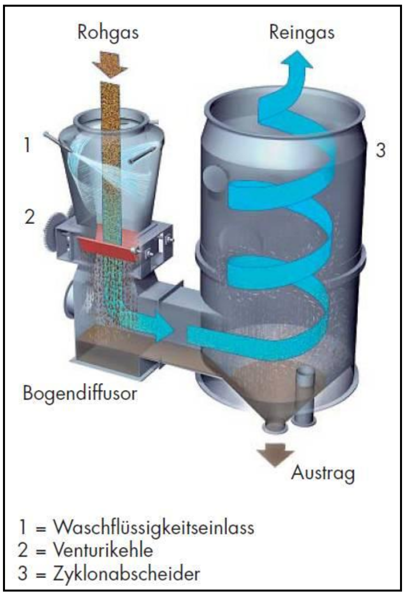


Fig. 5-5: Schematic diagram of a Venturi washer

The wash water used can be reused as circulation water after being reprocessed in a drum screen or sludge dredger. In addition to the intensive dampening and the cleaning capacity connected with this, the use of a wet scrubber offers the considerable advantage of withstanding pressure surges of up to 3 bar overpressure. Such deflagrations can never be excluded completely in shredder plants. Status: Venturi washers are established and time-tested technologies at industrial shredder plants.

- Other scrubber systems

  In addition to the Venturi washer there are other aggregates / technologies for wet dedusting in industrial shredder plants (e.g. ring washers) that differ in their respective configuration, yet in the end have the same goal of ensuring the required dedusting capacity by dampening the dust particles. What these aggregates also have in common is that they are sturdily designed and (comparatively) insensitive to pressure surges.

  Status: washers / wet systems are usually employed at industrial shredder plants at the separation stage. These wet dedusting technologies are generally time-tested and deployable.

- Bag filters / fabric filters

  In bag filters / fabric filters the dusty exhaust air is passed through a porous filter layer that allows the gas through and leaves the dust particles on the surface. The filter fabrics are arranged as bags in a housing that is divided into several chambers. The filters work without moisture so that periodic shaking or blasts of compressed air can dedust the filter material.

  In practice, industrial shredder plants with dry-operating separation stages can only be run as an exception. Their use in the main exhaust air flow presupposes that the danger of deflagration resulting from the rotor chamber is virtually zero. Sustained operation of such a separation stage is otherwise impossible. With every deflagration the bags would be destroyed by the pressure surge or – if fire develops – by the temperatures.

They can be used, for example, with a separate air separator dedusting system or with shredders that only shred aluminium.

Status: bag filters can be used at industrial shredder plants with separated air systems and separate exhaust air lines (e.g. air separator dedusting).

- Electric filters

  The mark of electrical dust separation in electric filters is the shifting of dust articles to the separation surfaces by means of electric energies in a high voltage field. This first entails the dust particles borne in the exhaust gas being electrically charged by discharge electrodes arranged in channels and as a result accelerated to the collecting electrodes (the separator surfaces). Extraction is done by a knocking device.

  Status: electric filters are not used at industrial shredder plants for the same reason as for fabric filters.

- Activated carbon filters

  Activated carbon filters belong to adsorption filtration technology, by means of which gases and vapours are adsorbed independently on the surface of solid materials due to physical or chemical reactions. The quantity of adsorbed material depends on the surface and surface structure. Activated carbon has a very large internal surface and is able – also partly on the basis of different coatings – to bind all harmful gases except for carbon monoxide and carbon dioxide.

  If the basic conditions are right activated carbon tends to auto-ignite. Furthermore, dust fractions in the exhaust gas flow can clog the filter bed prematurely, i.e. before its intake capacity has been exhausted, making its replacement necessary.

  Status: activated carbon filters can be used only in selected areas of industrial shredder plants due to the pressure surges and accompanying fire hazard from deflagrations inherent in the plant. Their use at industrial shredder plants is unknown.

- Biofilters

  Biofilters are often used to reduce odours with exhaust air cleaning. Their mode of operation is based on the organic substances to be broken down from the exhaust air being dissolvable in a liquid phase (usually water), so that a biologically oxidative breakdown via microorganisms can occur. Certain requirements, which ensure a constant microorganism growth, have to be met for the necessary breakdown to occur.

  Status: biological systems for exhaust air cleaning are rejected due to the plant specifics of industrial shredder plants.

- Thermal oxidation

  The aim of thermal oxidation is to destroy pollutants in the air that can oxidize. Ideally the process burns organic harmful gases to produce CO_2 and water. Carried out in a regenerative thermal oxidizer (RTO) the process is a fixed part of mechanical-biological residual waste treatment plants in the Federal Republic of Germany as a means of adhering to organic limits in exhaust air volume flows. Mostly performed in three-chamber systems the organic pollutants burn in an RTO at between 800 and 850°C and a dwell time of >1 seconds in the combustion zone. The temperatures can be reduced to a minimum of 250 to 400 °C in other areas of application by using catalysts. This is called a recuperative catalytic oxidizer (RCO).

Status: the use of RTOs or RCOs at industrial shredder plants to destroy pollutants that can oxidize is unknown. In addition, the energy intensive application is unacceptable in economic terms.

b) Noise emissions

The operation of industrial shredder plants results in noise emissions. In order to minimize the impacts on the natural resources protected by environmental legislation local construction planning is the first thing to consider when selecting the location. In addition, sound barriers can be erected in certain cases to minimize the noise emissions reaching neighbouring areas with correspondingly sensitive use insofar as applicable noise prognoses or readings advise such.

c) Water emissions

Drainage of the shredder feed storage area is generally connected to the separation facilities since contamination of the solids and mineral hydrocarbons with the precipitation water accruing on the surface cannot be excluded. The separation facilities are to be constructed in accordance with DIN EN 858 in combination with DIN 1999-100 and comprise, as a rule, a sludge trap / gravity separator, coalescence precipitator and sampling shaft.

If the exhaust air from the shredder plant is cleaned by means of a wet scrubbing phase (Venturi washer), a small amount of operating water accrues and that is circulated. For cleaning and maintenance purposes the residual water from the collection basin must also be passed through the separation facility described above or – depending on the onsite conditions – removed separately if necessary.

(2.6) Measuring technology / methods for controlling emissions

TA Luft lays down the emission values for total dust, organic and inorganic dust-producing materials and organic and inorganic gaseous substances in order to prevent harmful environmental impacts. Shredder plant operators are required to prove every three years[6] by means of a § 26 BImSchG recognised measuring station that the required emission limits – as a rule, total dust and gaseous organic substances (total carbon) – are being observed if nothing else has been determined in the plant permit process. Techniques for determining emissions are described below:

(2.6.1) Basic exhaust air conditions

In order to be able to compare the results of the emissions measurement for comparable plants representatively with one another they are given under standard conditions, i.e. at a temperature of 273.15 K and a pressure of 1013.25 hPa. The following basic exhaust air conditions have to be determined to do this:

- static pressure in the vent stack,
- air pressure at the point of the measuring station,

[6] § 28 BImSchG

- exhaust air temperature and
- exhaust air humidity.

Emissions are given as mass flow and mass flow concentration of concentrations in relation to the exhaust air flow rate of the plant. Calculation of the exhaust air flow rate is made via the exhaust air velocity, which is measured in accordance with VDI 2066 Part 1 with a standardised Pitot tube type L (Prandtl tube).

(2.6.2) Dusty materials

Total dust

The following measuring process is specified:

- Measuring process: gravimetric analysis of the separated dust mass on filters
- Guideline: DIN EN 13284-1 / VDI 2066 Part 1

Organic and inorganic substances

Since the emission values are usually very low or below the detection limit a recurring measurement is not necessary. This can be evidenced by a measurement taken during commissioning of the plant.

- Measuring process: gravimetric analysis of the separated dust mass on filters
- Guideline: DIN EN 13284-1 / VDI 2066 Part 1

(2.6.3) Gaseous substances

Total carbon

- Measuring process: the total organically bound carbon is burned in a hydrogen flame by means of a flame ionisation detector (FID) and registered as a sum signal.
- Guideline: VDI 3481 Part 1 and DIN EN 12619 / 13526

(2.7) Balance scope of finished material

The finished material generated by the actual shredder process is magnetic ferrous metals (shredder scrap). The chemical and physical quality requirements made of the finished material are laid down in the grade lists.

The non-alloy steel scrap types are distinguished between:

- German steel scrap grade list
- European steel scrap specification

- ISRI Scrap Specification Circular (as a rule, for the export of used steel scrap grade list from the USA)

In the European trading area the European steel scrap specification (see Appendix II) is the most customary form.

In the metal recycling industry comprehensively defined "customary conditions" are also used. They supplement the general terms of business of individual companies. Usual are the following fixed agreements:

- customary conditions for the supply of non-alloy steel scrap
- customary conditions for the supply of alloyed iron and steel scrap
- customary conditions for the supply of cast-iron scrap and foundry steel scrap
- trade practice of the metal trade

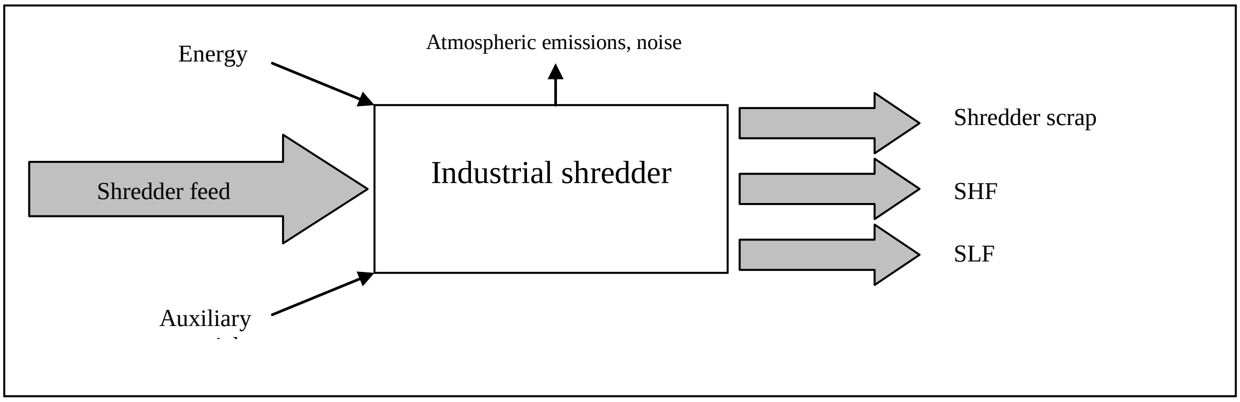
Quality assurance systems have been introduced into companies in the metal recycling industry to make sure that the quality requirements are adhered to. The series of standards DI EN ISO 9000ff. has been drawn up for quality assurance by international experts as a standard for setting up such a quality management system.

As a rule, shredder scrap undergoes manual picking before being dumped on the finished material stockyard to sort out any impurities, e.g. non-metallic parts, wrongly discharged composites such as copper armatures and visible nonferrous metals etc.

Chapter 3 – Current consumption and emission levels

This will report on the inputs and outputs to the shredding process. Includes energy use, water, raw materials and an indication of issues such as noise, emissions to air etc. We will be dependant upon the operators to provide this information. We will be asking for information which they may feel is commercially sensitive, but without the consumption rates the process and the emissions can not be related to operational practise. We would also present the data we collect during intensive monitoring of shredder operations.

The consumption and emission of a shredder plant depend to a great extent on the shredder technology used (see Chapter 2.3) and the respective downstream emission reduction technology (see Chapter 0). Figure 3-1 shows the essential input materials and emissions of an industrial shredder plant.



The following details on consumption and emissions relate – unless otherwise stated – to the balance limit of an industrial shredder given in Figure 2-1. The details on consumption and emissions originate from a member survey taken by the BDSV in spring 2010.

Shredder feed

A prerequisite for the operation of an industrial shredder plant is that only solid, predominantly metalliferous and non-hazardous waste is treated. Hazardous waste is not used in the shredder plant. All other details on shredder feed are given in Chapter 2.1.

3.1 – Energy consumption

This paragraph will present ranges of consumption in relation with shredder capacities

Energy input and auxiliary materials

The energy input in the form of electrical power depends directly on the rotor power and the type of processes and technologies used. It is thus very specific to an individual case and only comparable to a limited extent. The specific energy demand given by the operators for a shredder plant is shown in Table 3-1. The installed power of the industrial shredder plants participating in the questionnaire was between 499 and 4,420 kW.

Energy demand and auxiliary material input of a shredder plant	
Energy demand of shredding aggregate	22.14 – 46.3 kWh/t input
Energy demand of dedusting system	213 – 500 kW
Process water consumption	100 – 1,150m³/a
Water consumption of wet scrubber	580 – 600 m³/a

Table 5-2: Energy demand and auxiliary material input of a shredder plant

Another important auxiliary material is water for the wet separation process in industrial shredder plants that do not have only dry-operating dust separation. Mains water, well water, collected surface water, river water and even sea water are used for this. Although the water is generally circulated in the plants, water losses (evaporation, sludge discharge) have to be replaced regularly. Other water consumers are the sprinkler / spray systems available at certain plants for binding dust, e.g. with the storage of the feed, and cleaning water.

The other auxiliary materials used are mainly fuels and lubricants for grabs, dredgers, wheel loaders, industrial trucks and in-plant transport. The forms of use and specific consumption in this field are so varied that general details are impossible.

3.2 – Water output

Permits can define different requirements regarding the type of water rejected by the plant.

Generally, the water that is concerned is coming from rain or fire prevention.

Two kinds of situations have to be considered, rain water collected on the yard:

1- Discharged into surface waters

2- is treated in a dedicated water treatment plant (sewage plant).

3- <u>3.2.1 - Emission level when water is discharged into surface waters</u>

Sites	Country	PH Mini	PH Max	Tempe-rature	Oxygen Chemical Demand (OCD)	Oxygen Biogical Demand (OBD)	Hydro-carbons total	Total material in Suspension (TMIS)	Metals total	Lead	Copper	Mer-cury	Phenols index	Nitro-gen
					mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
1	FRA	5,5	8,5	< 30 °c	120		20	30						
2	FRA	5,5	8,5	< 30 °c	125	30	10	30	10	0,5	0,5	0,05	0,3	30
3	FRA	5,5	8,5	< 30 °c	120		10	30						
4	FRA	5,5	8,5	< 30 °c	120	40	20	30						
5	FRA	5,5	8,5	< 30 °c	120		5	30						
6	FRA	5,5	8,5	< 30 °c	125	30	10			0,5	0,5	0,05	0,2	10
7	FRA	5,5	8,5	< 30 °c	125		10	35		0,5	0,5	0,05		
8	FRA	5,5	8,5	< 30 °c	300	100	10	100	10					
9	FRA	5,5	8,5	< 30 °c	300	100	5	100		0,5	0,5			
10	FRA	5,5	8,5	< 30 °c	300	100	10	100						

<u>3.2.2 - Emission level when water is rejected in water treatment station</u>

Sites	Country	PH Mini	PH Max	Tempe-rature	Oxygen Chemical Demand (OCD)	Oxygen Biogical Demand (OBD)	Hydro-carbons total	Total material in Suspension (TMIS)	Metals total	Lead	Copper	Mer-cury	Phenols index	Nitro-gen
					mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
11	FRA	5,5	8,5	< 30 °c	2000	800	10	600	10					

3.3 – Air Emission

Parameters regarding air quality protection vary from a country to another.

More the permit is recent, more precise parameters and limits are defined.

Sites	Country	Total dust	Asbestos	Cadmium	Lead	Mercury	Organic subs-tances	Inorganic Mercury +Thallium	Inorganic Sulphur + nitrogen oxydes	Arsenic + selenium + tellure	Inorganic Mercury +Thallium + cadmium	Sb + Cr + Co + Sn + Mn + NI + V + Zn
		mg/m3	fiber/Ncm3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	g/m3	mg/m3	mg/m3	mg/m3
1	FRA	20								1	1	5
2	FRA	40										
3	NOR	20	1	0,01	0,1	0,01						
4	GER						50	0,05	0,35			
5	GER						150					

3.4 – Noise

<u>3.5 – List of parameters that appear relevant for shredder industry</u>

<u>This parameter will also recommend measuring methods</u>

Noise and atmospheric emissions

The emissions occurring in industrial shredder plants are, on the one hand, noise caused by the machinery and materials handling technology as well as the delivery of the shredder feed and the transport of the products. On the other they are atmospheric emissions, particularly dust.
The atmospheric emissions and noise are limited by national regulations. In Germany these are BImSchG and the accompanying ordinances, particularly 4. BImSchV in connection with TA Luft and TA Lärm (see Chapter **Errore. L'origine riferimento non è stata trovata.**), the implementation of which is binding for the operator and effected by the respective notice of approval.

Compliance with the permissible emissions is monitored by the competent authorities. The best available technology in Germany is a discontinuous emission monitoring of the exhaust air every three years in the consolidated exhaust air flow by a competent measuring body.

The following values were determined during the member survey within the scope of required air measurements:

- Total dust: 1.3 – 18.7 mg/Nm³
- Total carbon: 32 – 170.5 mg/Nm³

Output fractions

Details of these are given in Chapter 0. The three output fractions are, in terms of waste legislation, regular non-hazardous waste (see Chapter **Errore. L'origine riferimento non è stata trovata.**).

3.6 – Evaluation on health impact

To be developed (JL CLERGUE)

Chapter 4 – Techniques to consider in the determination of BAT

Report on the methods used to reduce emissions or other environmentally beneficial operations. This will also include costs, availability, application etc. Information on the measures used to control emissions would be derived from the manufactures (ie what would be fitted as standard), and the operators, based upon what modifications they have made to the plant to improves aspects of operation.

The modes of operation, processes and process stages of industrial shredder plants in Germany described in Chapter 2 are proven and tested and can be drawn on to determine the best available techniques.

The modes of operation, processes and process stages are discussed further below as regards BAT.

(4.1) Plant organisation

Various plant officers (for waste, water protection, immission control, hazardous substances etc.) or the person responsible according to the specialised waste management company ordinance are appointed pursuant to the laws and ordinances in force at the time.

The plant also has to ensure that conditions in the permit (e.g. drawing up and maintaining conditions of acceptance, plant logbook and operating manual) are implemented. The requirements for implementing hygiene and occupational safety measures will be found here, for example.

Certification as a specialised waste management company has been legally regulated in Germany for many years and has proved itself in practice. The introduction of an environmental management system in accordance with DIN ISO 14.000 ff is not comparable because that is geared towards conventional production plants and does not take the specifics of a specialised waste management company into account sufficiently.

The introduction of a quality management system is not necessary for a specialised waste management company since many important points of a QM system are also an integral part of the certification as a specialised waste management company. However, customers of industrial shredder plants often demand an additional QM system.

(4.2) Pre-treatment process

The vehicles are weighed before and after being emptied as a matter of principle. This weighing is also done for the output fractions and residual materials and is binding in accordance with the national legal regulations.

A combined visual inspection of the deliveries, in part via cameras, and a measurement of radioactivity is part of the quality assurance system and an integral part of the acceptance procedure. The goal of the incoming goods inspection is to exclude problem materials and substances such as hollow objects and explosives (BGV D23), pressure vessels, vessels that are only partially empty, materials with dangerous adhesions, spray cans, refrigerators, batteries etc. from the subsequent process cycle.

Monitoring of the delivered shredder feed for radioactive emitters before the shredding process is likewise done with the best available technology. The caesium-137 source in a delivery of mixed scrap shown in Figure 4-1 is capable of contaminating several 100 Mg of scrap despite its small size. It would not be discovered if there was no radioactivity measurement during the incoming goods inspection.

Fig. 5-7: Source of radiation in mixed scrap

It is sensible to have additional areas in the incoming goods area for the direct exclusion of impurities or large parts with product character.

The storage, pre-sorting and feed area is usually a paved open area with storage organisation (incoming goods storage with areas separated according to input material). The feed area and the technical equipment there for charging the shredder are designed in such a way that the shredder can be charged as required and no overload of the feed area or the installation engineering is to be expected.

The separate areas of the incoming goods storage area are sufficiently large to compensate fluctuations in the incoming quantities and allow the shredder feed to be pre-sorted and impurities to be sorted out. It is also sensible for the separate storage areas to have sufficient space available for the separate storage of almost mono-fraction secondary raw materials with product character.

In individual cases misting systems may be used at places where the process steps cause a lot of dust, e.g. dumping zones, if this process step is concentrated on a very large operation. These misting systems spray a fine water mist, which causes the dust to settle. It also binds the dust and there is no wastewater as a result. Despite all the organisational and technical measures there is no "dust-free" atmosphere at an industrial shredder. For that reason regular cleaning of dust deposits with a mobile industrial vacuum cleaner is obligatory and also best available technology.

As a rule, grabs, wheel loaders or dredgers are used for pre-sorting and charging.

Depending on the feed and the space available, pre-treatment steps may be expedient immediately before the actual shredder process for operational reasons (to increase plant availability, reduce energy costs etc.):

- compiling the menu from separately stored feeds,
- vibrating conveyor / bar sizer for fine grain isolation,
- pre-shredding to improve energy efficiency,
- decompacting to homogenise the feed.

Use of a pre-shredding aggregate or shears cannot replace efficient pre-sorting of the shredder feed. Pre-shredding may be expedient for operational reasons, in order to increase the performance of the main shredder for selected partial streams or to ensure detection of heavy parts.
Screening and pre-shredding are rare and are dependent on the input material.

(4.3) Main process

(4.3.1) Shredder technology

Due to the various operating modes of the plants connected with the respective market-related orientation of the shredder plants (e.g. heavy scrap, mixed scrap, pure aluminium sheeting etc.) a comparison of the plants in operation in German is not possible.

Moreover, site-specific or seasonally fluctuating factors, which the plant operators are not always able to influence, have an effect on the installation engineering. The available shredder technologies (as in Chapter 0) are used, depending on the type, quality and inhomogeneity of the shredder feed. A kondirator is thus more suited to processing predominantly heavy feed. The conventional shredder is more suited to reducing lighter materials. Varying the material feed speed, altering the shape and material of the hammers, the angle of the hammers on the rotor and alternating frequency of the hammers, changing the hole size and shape of the discharge grids on the shredder rotor chamber and subsequent settings of the downstream separation aggregates produces optimum results in the reduction of the shredder feed, the separation of metals and non-metals and the particle shape and size of the finished scrap geared to the requirements of various customers.

Due to the reasons mentioned above there are no environmentally relevant advantages for the actual shredder technology and thus no specific BAT. There is thus no corresponding subchapter to "Shredder technology" in Chapter 5 below.

4.1 – Technologies to reduce energy consumption

4.1.1 – Pre-shedders

4.1.2 – Energy efficient motors

4.1.3 – Energy management systems

Best available technology is measures to minimise peak consumption and power losses as well as avoiding unwanted shutdowns. Compressed air systems are to be checked for leaks and the supply lines serviced and repaired regularly to minimise such.

4.2 – Technologies to prevent water pollution

4.2.1 – interceptors

4.2.2 – settling tanks

4.2.3 – filters

4.2.4 – recycling water

Since industrial shredder plants do not, as a rule, produce any continuous process water – except for small quantities from the wet separation process and cleaning operations – they do not need separate water treatment facilities at the plant. Extensive circulation of industrial process water is expedient.

Wastewater coming from the sanitary facilities is fed into the municipal sewer network. It is generally the case that both national and European requirements as regards the use of water and wastewater are to be observed.

4.3 – Technologies to reduce air emission

4.3.1 - Cyclones

4.3.2 – Dust reduction by water projection

4.3.3 - Filters

4.3.4 – Bag house filters for small appliance shredders (WEEE)

4.3.5 – Venturi scrubber

(4.3.2) Exhaust air

The variants in emission reduction possibilities are just as diverse as the constructions and fields of application of industrial shredders. These were likewise presented in Chapter 2.

The many different combinations on the market of an industrial shredder with a specific "appropriate" exhaust air system result, on the one hand, from the many years of experience of the shredder operators and the adherence to the legal principles presented in Chapter **Errore. L'origine riferimento non è stata trovata.**, which define the basic conditions for the best available techniques. Other standards and restrictions can also be set out in the respective plant permits.

Due to the large number of different basic conditions it is, as a whole, not possible to identify and define a scientifically well-founded and uniformly standardised process for exhaust air treatment in industrial shredder plants. Each individual case is to be judged according to the basic conditions specific to the location and taking into account the individually prevailing situation.

The decisive factors in this respect are the available shredder technology and technical equipment of the operator. These two elements determine the following basic conditions that lead to the composition established in the exhaust air flow of a shredder. The basic conditions include:

- type of operational demands and extent of reduction, depending on the shredder technology and feed to be processed,
- dwell time of the material in the rotor chamber,
- exhaust duct and exhaust air quantity,
- material throughput,
- quality requirements of the product (cf. Chapter 0).

Frequently found in practice to reduce dust at industrial shredder plants are cyclones and Venturi washers and – when technically expedient in terms of the process – bag filter systems (see Chapter 0).

Gaseous organic contents in the exhaust air can only be reduced to a certain extent with the regular combination of cyclones and wet scrubbers. Conventional oxidation and separation processes that serve to limit gaseous organic emissions and at the same time withstand the process conditions of a shredder plant cannot be used. Large volume flows, heavy wear, sudden changes in pressure due to possible deflagrations and greatly fluctuating concentrations of hydrocarbon with a low basal level in relation to the applicability of the available process exclude, as a rule, the use of end-of-pipe emission reduction technologies.

Plant work instructions (e.g. work instructions for the reduction of dust when transhipping goods, dampening the roadways) to minimise dust emissions from diffuse sources or technical measures (enclosing belt transfer points, localised extraction, sprinkler systems etc.) are best available technology.

4.4 – Technologies to reduce noise and vibration

Due to their process characteristics industrial shredder plants involve noise emissions. Best available technology is checking the site selected by the operator for its admissibility in terms of legal planning and, if applicable, erecting sound barriers or other appropriate technical installations in the direction of the neighbouring areas with sensitive uses or enclosing the shredder plant itself insofar as noise forecasts or corresponding measurements make such advisable.

(4.3.3) Waste

The goal of reprocessing at an industrial shredder plant is to maximise the parts for recycling from the shredder feed and return metals into the material cycle. On economic grounds the volume of not directly marketable material streams that are to be passed to further reprocessing or disposal are this minimised. The two material streams for further treatment from an industrial shredder plant are SHF and SLF (see Chapter 4.4.), which can be further reprocessed internally or externally using post-shredder technologies

The production of waste caused by the use of operating materials is also minimised in accordance with legal standards and for reasons of economic efficiency.

Any unavoidable residual waste that cannot be reprocessed is disposed of according to the legal requirements in a proper and harmless way.

4.5 – Specificities of fridges recycling plants

4.6 – Specificities of SDA recycling plants

(4.4) Post-treatment process

(4.4.1) Post-shredder reprocessing

The operators of industrial shredder plants put into practice optional, location-related process technology tailored individually to the respective market conditions to increase added value by re-concentrating marketable material streams in the post-treatment process. The fractions produced as a result are (with saleable degrees of purity) in part marketed directly to steelworks, smelting works, foundries or other secondary raw material recyclers. Partial fractions go to specialised reprocessing plants, which in turn further increase added value by separating the materials. Some plant operators also have a fuel substitute reprocessing facility at their site.

No process can be laid down as BAT for post-shredder reprocessing. What is involved here is process technology that is optional and can be implemented for economic considerations at the site or externally to increase added value.

(4.4.2) Storage, loading and transport

The output fractions at industrial shredder plants are mostly stored on paved open areas. Usually the outgoing goods storage facility consists of spatially separated storage areas, in which the varying qualities are put in interim storage, depending on their accumulation and the development of the market. Very high quality sorts of metal are also stored temporarily in halls that can be locked to protect them against theft; this is at the discretion of the operator. The separated areas of the outgoing goods storage space are sufficiently big to allow for production and market fluctuations of the various output fractions.

The material from the storage facilities is loaded on to lorries (walking floor vehicles or containers), trains (if a railway siding is available) or ships (if the site has a water connection) with wheel loaders, excavators, cranes or conveyor belts.

The secondary raw material is then transported to the ultimate consumer (steelworks, smelting works, foundries or other secondary raw material recyclers), to specialised reprocessing plants for further separation of the usable fractions if this cannot be done at the site or – for the fractions with no usable materials – to material recovery facilities (underground stowage or landfill utilisation) or energy recovery plants (fuel substitute power stations, cement works, CO-combustion in CHP plants, appropriate conditioning plants etc.) or, if applicable, disposal facilities.

SELECTION OF BEST AVAILABLE TECHNIQUES (BAT)

- *Storing hazardous products in such a way that they can't have any negative effect on the environment.*
- *Pursuing a strict (conclusive) acceptance policy and carrying out correct pre-inspections.*
- *Storing waste in such a way that it can't have any negative effect on the environment.*
- *Having hazardous waste collected by a registered collector.*
- *Placing a rain water tank and using unpolluted rain water.*
- *When purchasing new material, considering energy consumption as one of the decision-making criteria.*
- *Using variable speed drives.*
- *Using a condenser battery (to compensate cosine phi).*
- *Installing a liquid-proof floor, draining towards an industrial sewer system (a.o. equipped with sufficient drains/drainage gutters) on the parts of the industrial site where substances or liquids hazardous for the environment can penetrate the ground.*
- *Storing metal/scrap polluted with liquids hazardous for the environment (a.o. turnings and borings) in such a way that these liquids can't penetrate the ground.*
- *Keeping industrial waste water (incl. polluted rain water) separate, as much as possible, from unpolluted rain water when designing, realizing or adjusting the industrial sewer system.*
- *Applying a pre-treatment (sludge collector/ settling basin and oil-water separator) for the disposal of settling substances, oil and fat from industrial waste water.*

The discharge of waste water respects the local discharge norms, which respect the local fulfilment of the Framework Directive 2000/60/EC. It can be based, a.o., on:
- *The application of a physicochemical purification (sand filter and activated carbon filter).*
- *The application of a biological purification (activated sludge tank)*
- *The application of a physicochemical post-purification (sand filter and activated carbon filter) (after biological purification).*

- *Concreting industrial sites*
- *Keeping paved roads clean (sweep) with a mechanical sweeper and moistening unpaved roads with a mobile watering cart (dry and windy weather).*
- *Using an appropriate exhaust system and dedusting installation in the installations (or parts of installation) where significant dust emissions can appear.*
- *Equipping the entry of the shredder installation with sprinklers or rubber flaps.*
- *Using closed conveyor belts or protecting conveyor belts from the wind influence by means of coverings.*
- *Enveloping the conveyor belts transfer points for the "fluff".*
- *Maintaining correctly and regularly the internal means of transport and other material.*
- *Equalizing road paths.*
- *When purchasing new material, considering sound level as one of the decision-making criteria.*
- *Placing vibration-generating machines on an appropriate foundation.*
- *Enclosing main sound sources (totally/partially).*
- *Forbidding smoke and use of open fire in places near fiery, inflammable products.*
- *Not treating (closed) metal objects polluted by fiery, inflammable products (containers, tanks ...) with an oxyacetylene burner.*
- *Taking conclusive measures to prevent fires and explosions as well as their consequences.*
- *Guided dust emissions for shredder installations max 20 mg/Nm³*
- *Dioxin emissions max 0,1 ng I-TEQ/Nm³*

Chapter 5 – BAT

Concludes on what is considered to be BAT. This must link costs and environmental performance in relation to the shredding sector. It is not a section on setting emission limits. The most complicated issue we would need to link processing operations with the expected emissions to determine where we feel BAT lies.

A Comment from French Ministry of Environment gives the information that BAT will influence the determination of the emission limits.

5. Best available techniques for industrial shredder plants

The industrial shredder plants described in this document are treatment plants that accept and reprocess secondary raw materials and waste that unavoidably accrue. The goal of such industrial shredder plants is to reprocess the accrued waste in such a way that as many secondary raw materials as possible can be returned to the economic cycle. As a whole the operation of industrial shredder plants is defined by a large number of basic conditions specific to the location. These include:

- the non-homogenous, seasonally fluctuating material properties – the composition of which varies according to the region – of the waste treated at the plant,
- the recycling and disposal possibilities available in the region,
- the regionally valid municipal regulations (waste regulations, drainage regulations etc.),
- the regional social acceptance,
- the regionally valid waste management plans and eco-political targets of the Federal states and
- the approval conditions specific to the plant.

It is thus not possible to identify a uniform, standardised process for waste treatment in industrial shredder plants.

To be understood by the term "best available techniques" used in BREF terminology for waste treatment plants – in contrast to production plants – is, therefore, those measures that overall enable as little contamination as possible when treating waste within the scope of the plant operation.

The best available techniques in the operation of an industrial shredder plant are presented below. The technical aspects are based on the balance scopes shown in Figure 2-1 and the basic material streams diagram in Figure 5-1 below.

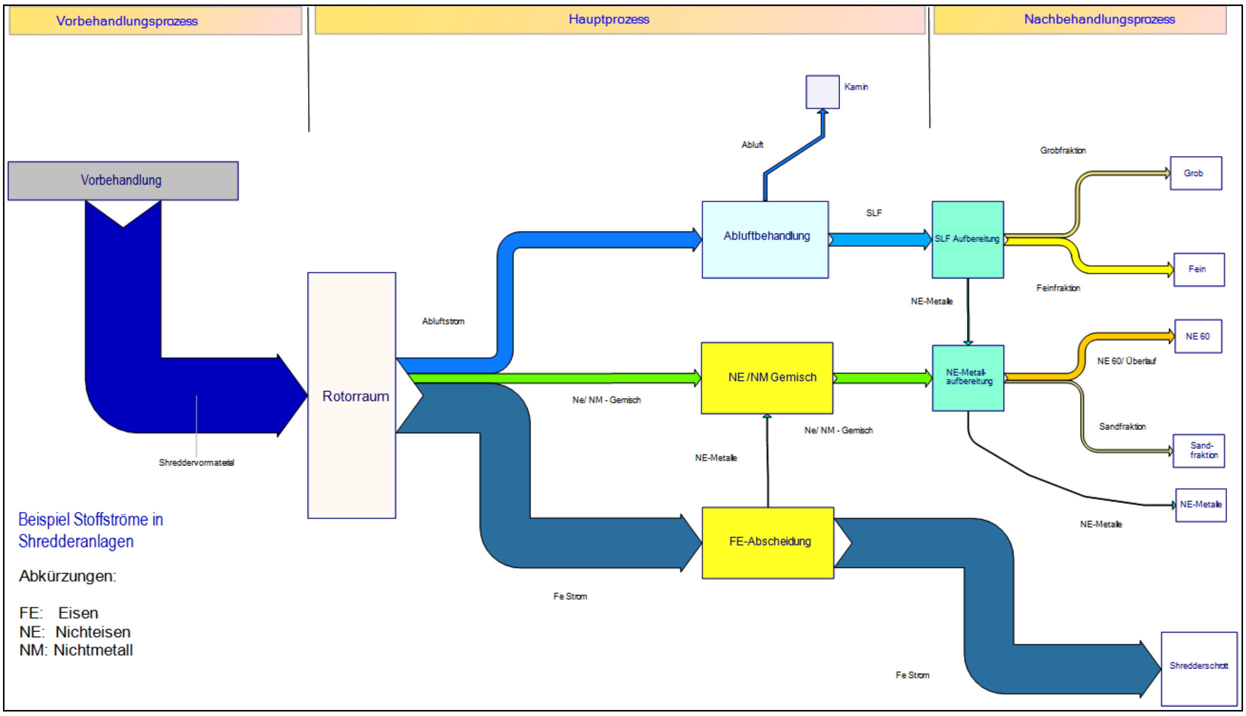


Fig. 5-1: Basic material streams diagram of industrial shredder plants

In addition to the technical aspects, the organisational sequences in the plant are of great importance when considering the best available techniques. These are also discussed below.

5.1. BAT plant organisation

1) The plant is certified as a specialised waste management company or has established a comparable recognised environmental management system (e.g. DIN ISO 14.000 ff), which in particular also includes an appropriate internal system of officers.

2) The operator has established a quality management and control system, which sets out clear structures and responsibilities and includes regular training of the personnel. For example, this can be according to QM ISO 9001:2008 or take place within the course of the specialised waste management company certification.

5.2. BAT pre-treatment process

1) Input and output weighing is to be carried out without exception. The input and output mass flows can be retraced in a comprehensible way by means of a register.

2) The plant conducts an acceptance inspection comprising a visual material inspection and a mobile (grab measurement) or stationary radioactivity measurement (weighing area, wagon delivery area). Operational measures will ensure that the acceptance inspection is guaranteed and that all suppliers go through the inspection without exception.

3) Impurities are to be sorted out as thoroughly as possible by means of appropriate inspection measures before the material is fed into the plant, and passed on for special disposal / treatment or (if legally permissible) rejected. Impurities are, in particular, any parts in the

shredder feed that can lead to deflagrations in the shredder (e.g. hollow objects) or radioactive materials. In addition, the operator is to set out acceptance conditions, in which impurities that can cause operational disturbances or breakdowns are listed.

4) Delivery of the shredder feed to the storage area before it is fed into the plant is to be done in such a way that multiple handling of the materials is reduced to a minimum or avoided.

5) The surface is to be paved in the entire feed storage area and have a drainage system. The area is to be cleaned regularly, depending on the degree of contamination and the weather.

5.3. BAT main process

5.3.1. Exhaust air

1) The shredder plant is to be equipped with appropriate emission reduction technology such that a minimisation of dust is ensured, especially from the rotor chamber and air separation.

2) The operator is to ensure that the requirements of the pertinent standards for minimising components in the exhaust air are adhered to by a combination of adequate emission reduction technologies and measures.

3) The operator is to provide proof that the requirements for minimising components in the exhaust air are being adhered to on the basis of repeated discontinuous measurements taken after commissioning and subsequently every three years. The measurements must be taken by an independent and authorised measuring body.

4) Operational or technical measures are to be implemented to minimise dust emission from diffuse sources.

5.3.2. Waste

1) The process technology at the plant is on principle to be operated in such a way that as high a yield as possible of recyclable and marketable material streams is produced.

2) Any unavoidable residual waste that cannot be reprocessed is to be disposed of in a proper way.

5.3.3. Wastewater

1) A drainage infrastructure comprising a use-related storm drain and sewer system is to be provided for the entire paved area.

2) It is to be ensured that the drainage infrastructure on the plant premises is sufficiently dimensioned and capable of collecting and discharging all runoffs in the case of heavy rains according to the standards in force.

3) Precipitation water from contaminated areas is to be pre-cleaned via traps according to its presumed degree of contamination. The traps are to be equipped with inspection shafts for measurements and serviced regularly in a verifiable way.

4) The process water used in the wet dedusting stage is to be circulated.

5.3.4. Noise

1) In terms of legal planning the plant location is to be in special areas, industrial parks or trading estates with as great a distance as possible from residential areas or areas with sensitive use.

2) Within the scope of the approval procedure (e.g. environmental impacts pre-assessment) new plants are either to submit an independent noise forecast or conduct a noise control measurement in the first three months after commissioning of the plant. If the results show that the noise limits have been exceeded the operator must take organisational measures to effectively minimise the noise source or install noise insulation or noise abatement cladding.

5.3.5. Energy consumption

1) It is to be ensured that power peaks during plant operation are minimised (e.g. with a star-delta connection for the rotor).

2) The installation engineering is to be equipped with an efficient power factor correction.

5.4. BAT post-treatment process

1) SHF and SLF are to be recycled (internally or externally) independent of the location.

2) Storage is to be on paved areas and separated according to product group.

5.5. Plant examples for BAT

Industrial shredder plants differ greatly in terms of their plant management, the process technology used and their shredder feed. For this reason a general comparison of energy consumption values per Mg input, for example, is not without its problems. The plants also vary as regards their capacities and throughput, so that the significance of economic reference values is very limited.
In Table 5-1 three industrial shredder plants are nevertheless presented as plant examples for BAT. The industrial shredder plants are all approved in accordance with BImSchG and operated with the best available technology in Germany in accordance with the law.

	Data		Plant A	Plant B	Plant C
General information	Operator		Operator A	Operator B	Operator C
	Total storage area	m²		6,838	8,000
	Type of plant		Reprocessing for scrap	Reprocessing for scrap	Reprocessing for scrap
	Size reduction aggregate		Kondirator	Shredder	Zerdirator
	Year of approval	a	2002	1972	2007
	Commissioning	a	2003	1972	2007
	Installed rating of size reduction aggregate	kw	2,200	935	2,200
	Soft start main motor / star-delta connection		yes	yes	yes
	Energy efficient mode of operation (unscheduled switching off of main motor)		yes	no	yes
	Power factor correction		yes	yes	yes
ga ni	Officers for				

	Waste	yes	yes	yes
	Water protection	yes	no	no
	Immission control	yes	yes	yes
	Hazardous substances	yes	yes	yes
	Safety (safety expert)	yes	yes	yes
	Specialised waste management company	yes	yes	yes
	Certified according to			
	QM DIN ISO 9.000ff	yes	yes	yes
	UM DIN ISO 14.000ff	no	no	no
	Specialised waste management company	yes	yes	yes
Acceptance	Input/output weighing	yes	yes	yes
	Radioactivity inspection	stationary and mobile	stationary and mobile	stationary and mobile
	Efficient handling of feed	yes	yes	yes
	Selection of impurities			
	Explosives	yes	yes	yes
	Hollow objects and pressure vessels (gas bottles, spray cans, gas cartridges etc.)	yes	yes	yes
	Not fully emptied containers (tanks, barrels, buckets)	yes	yes	yes
	Not pre-dismantled electronic and electrical scrap	yes	yes	yes
	Not pre-dismantled car bodies and vehicles	yes	yes	yes
	Heavy parts	yes	yes	yes
	Materials with dangerous adhesions	yes	yes	yes
	Hazardous waste (if not approved)	yes	yes	yes
	Accompanying documentation (routing slip, photo etc.)	yes	no	yes

Table 5-1: Specifications of BAT industrial shredder plants, Part 1

Data		Plant A	Plant B	Plant C
Pre-treatment	Menu composition	yes	yes	yes
	Fine particle separation	yes	yes	no
	Pre-shredding	no	no	no
	Decompacting	yes	no	yes
Exhaust air / emissions	Dedusting system			
	Mill dedusting	2-stage, cyclone	2-stage, cyclone	2-stage, cyclone
	Air separator dedusting	2-stage, cyclone	1-stage, cyclone	no
	wet / dry	both	both	wetVenturi washer
	Circulating air dedusting	yes, Sichter	yes, Sichter	yes, Sichter
	Use of systems to bind dust (sprinklers, misting systems etc.)	yes	yes	yes
	Enclosure of belt transfer points	yes	yes	yes
	Use of power sweepers	yes	yes	yes
	Dampening of roadways	yes	yes	yes
	Localised extraction in plant	yes	yes	yes
	Last emission measurement complied with approval/TA Luft	yes	yes	n.s.
	Year taken a	2009	2009	n.s.
Waste	High yield of recyclable material streams	yes	yes	yes
	Proper disposal of residual waste	yes	yes	yes
te w	Paved storage area	yes	yes	yes

	Sewer system as part of the paved surface	yes	yes	yes
	Dimensioning of sewer system	yes	yes	yes
	Sludge trap	yes	nein	yes
	Light liquid separator	yes	yes	yes
	Separate wastewater system (precipitation water/sanitary water)	yes	nein	yes
	Circulation of process water	yes	yes	yes
Noise	Legal planning location of plant	Special area port	restricted GI	GI
	Noise forecast within the approval procedure	yes	yes	yes
	Noise measurement after commissioning	yes	yes	yes
PST	Further recycling of material streams	yes	yes	yes
	Internal / external	internal and external	internal and external	internal and external

Table 5-2: Specifications of BAT industrial shredder plants, Part 2

Chapter 6 – Emerging techniques

Up and coming innovations for the shredding sector.

Chapter 7 – Concluding remarks

Summary of the process to this point with a frank discussion on information sources and any gaps in the data or understanding. The more open the operators are and the better the quality of the information they and manufactures can provide the fewer gaps and the more robust the final document will be.

Appendices

Will hold summary information on the contributors to the project. They need not be associated with the information they have provided. All of the information/ raw data upon which the report and conclusions are founded would be included in the appendices. This will allow an open review of the conclusions.

Appendix 1

Definition of terms

- **Waste**

  Any material or object of which the owner disposes or of which the owner wants to or must dispose.
- **Wastewater**

  Wastewater is water, the properties of which have changed as a result of domestic, industrial, agricultural or other use, and the water draining off together with it during dry weather (sewage) and water from precipitation running off built-on/cultivated or paved surfaces and then collected (precipitation water). Sewage is also deemed to be any fluids escaping from waste treatment, storage and landfill plants and then collected.
- **Aggregate**

  An aggregate is part of a plant and serviceable for that purpose. The term aggregate is used as a synonym for the terms machines, apparatus and plant components.
- **Plant**

  The Federal Immission Control Act (BImSchG) defines plants as industrial premises and other fixed facilities, as well as machines, equipment and other movable technical facilities, and vehicles insofar as they are not subject to the provisions of § 38 (note: § 38 governs the requirements for motorised vehicles and their trailers as well as rail vehicles, aircraft and watercraft) and pieces of land on which materials are stored or landfilled or on which work is conducted, said materials or work being able to cause emissions, with the exception of public traffic routes.
  The term plant, however, will also be used below in the sense of process engineering, according to which plants are linked pieces of apparatus (e.g. vessels, columns) pipelines, machines (e.g. pumps, compressors, centrifuges) or process-control equipment (e.g. measuring instruments, control valves, regulators) for implementing a process. The real plant in this sense is the material casing of a process.
- **Treatment**

  Physical, thermal, chemical or biological processes or combinations thereof that change the quantity or harmfulness of the waste constitute waste treatment. Its aim is to reduce the volume of waste or change the properties of the waste in such a way as to facilitate its handling or to enable or assist its recycling or disposal.
  One form of treatment is processing. This is done in a targeted manner on adherence to the quality requirements of the customers. In the process certain
  - physical properties (e.g. dimensions),
  - chemical properties (e.g. metal content and purity of types),

- safety properties (e.g. free from hollow parts and explosive materials) and
- other properties (e.g. disturbing adhesions)

are to be achieved. The processing goal has been achieved when the materials can be used directly by the customer without further treatment being necessary.

- **Charging**

  Charging is feeding the charging basket with scrap.

- **Circulation water**

  Process water that circulates, used for wet scrubbing.

- **Metalliferous waste**

  Metalliferous waste is all types of composites (simple and complex) that come from households, industrial establishments or municipalities and that – without or after treatment – are declared to be waste and recycled in appropriate plants. These include large domestic appliances (so-called "white goods"), end of life vehicles (ELV) and metalliferous waste from industrial processes just as much as components from domestic waste (e.g. cutlery, cable, austenitic steel sinks, prams, pushchairs, bicycles) and pre-treated electrical appliances and scrap from demolition jobs (e.g. reinforcing steel, pipes, steel girders, cable).

- **Scrap metals**

  Ferrous and nonferrous scrap (scrap metals) are all metalliferous waste that comes from industry, businesses, municipalities and households. These scrap metals are collected and handled, stored and treated in scrapyards.

- **Metal shredder**

  See "shredder plant".

- **Process**

  The directed course of physical, chemical, biological and IT operations to ensure a desired function.

- **Process stage**

  Process stages are organised in a process as an ordered sequence (serial, parallel or both). Process stages can operate independently of other process stages and lead to a planned progression of chemical or physical changes in a material (treatment). Process stages are particularly characterised by reciprical independence, the allocation of a formula and as a bundle of operations. Process stages can be created and edited as independent modules or as dependent elements in the formula or the process. It is possible to create stages from a pool of modules. Each process stage consists of an ordered sequence of one or more process operations.

- **Recycling**

  The term is not yet regulated by law in Germany. However, the coming law on closed substance cycle waste management (KrWG) will contain a legal definition in accordance with Art. 3 No. 17 of the Directive 2008/98/EC: "any recovery operation by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes. It includes the reprocessing of organic material but does not include energy recovery and the reprocessing into materials that are to be used as fuels or for backfilling operations".

- **Residual waste**

  From an economic and eco-balance point of view this is SLF and SHF residues, including operational waste, none of which can be reprocessed further.

- **Shredder plant**

Shredder plants within the meaning of this document are plants for shredding metallic materials by means of rotor mills: metal shredders. Not dealt with in this document are waste shredders, wood shredders, building construction waste shredders or other shredders that treat non-metalliferous waste.

- **Shredder feed**

  The input material delivered to shredder plants, which is suitable for treatment in the shredder plant, is called (shredder) feed.

- **Shredder residue(s) (SR)**

  The total of all materials that accumulate during and after shredding in the metal shredder with the exception of the ferrous fraction

- **Shredder light fraction (SLF)**

  Non-magnetic part of shredder residues that has a low density. The balance limit for SLF is the respective cellular wheel sluices and discharge from the wet scrubber.

- **Shredder heavy fraction (SHF)**

  Non-magnetic part of shredder residues that has a high density. The balance limit for SHF is the non-magnetic part discharge belt on the magnet separator.

- **Shredder scrap**

  Magnetic part of the heavy materials discharge from the air separator. The balance limit is the magnetic part discharge belt on the magnet separator.

- **Best available technology**

  Best available technology in this document is based on the IPPC Directive on BAT [source: revision of the BREF waste treatment plants, first meeting of the German group of experts, talk by Judith Kaliske, FME, Berlin, March 11th, 2010]

  - **Best:** most effective for achieving a high level of protection for the environment as a whole.
  - **Available:** developed on a scale which allows implementation in the relevant industrial sector under economically and technically viable conditions, taking into consideration the costs and advantages.
  - **Techniques:** the technology used and the way in which the installation is designed, built, maintained, operated and decommissioned.

- **Composite material – metallic, containing plastics and similar**

  A composite is a material made of two or more combined materials, which has different and mostly better material properties than its components.

Appendix 2

The locations of the shredders in Germany are shown in the following map.

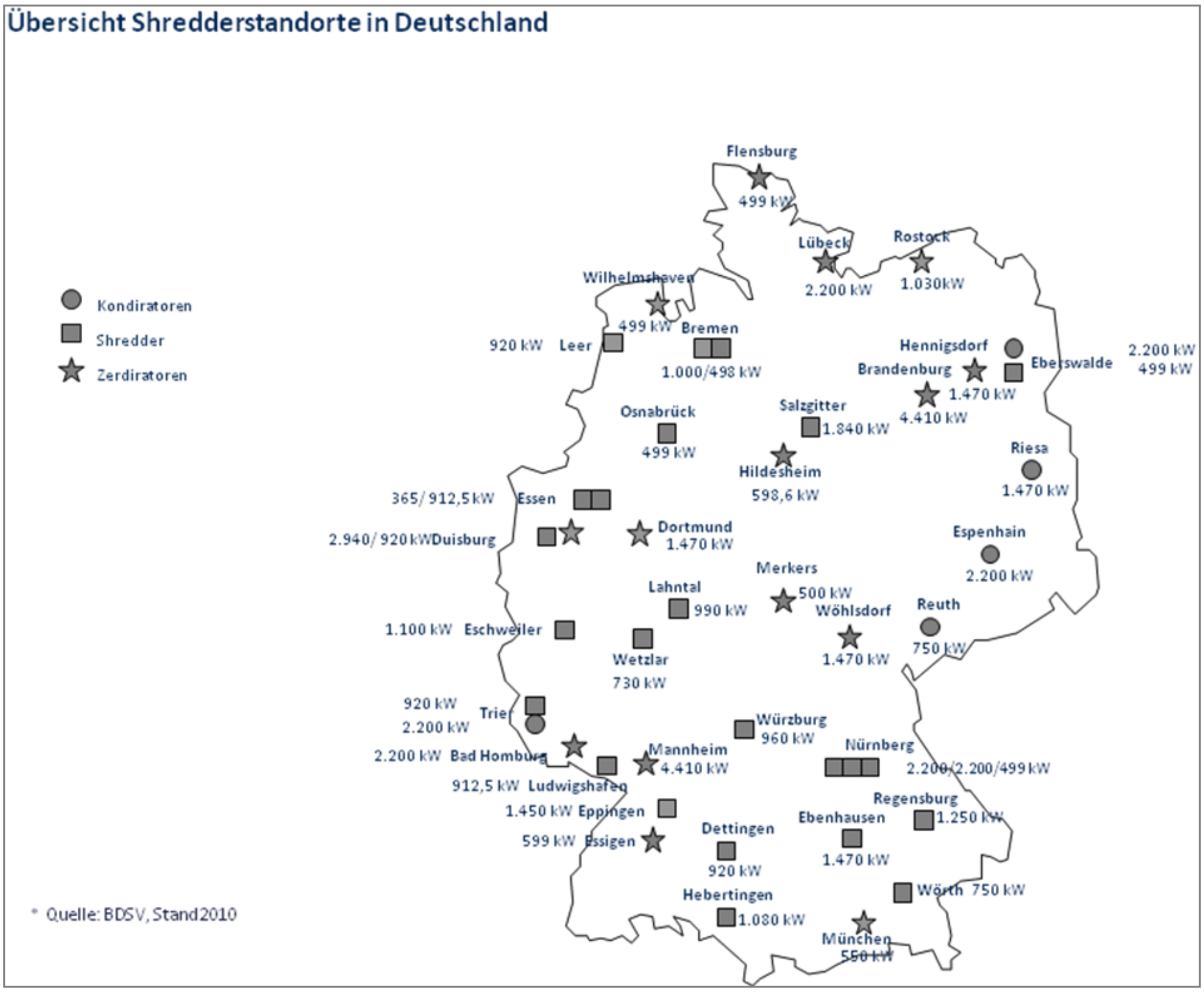


Fig. 5-2: Industrial shredder plants in Germany

Appendix 3

- Environmental legislation and emission limit values applied to the waste treatment sector

Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy

Council Directive 1999/30/EC of 22 April 1999

Directive 2001/81/EC of 23 October 2001

Stockholm Convention POPs

Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives

Regulation (EC) No 166/2006 of the European Parliament and of the Council of 18 January 2006 concerning the establishment of a European Pollutant Release and Transfer Register and amending Council Directives 91/689/EEC and 96/61/EC.

ELV Directive

WEEE Directive

Revision of waste directive

EU-27 Steel Scrap Specifications