solutions for sustainable cycles

March 2024

The PB highlights

Renowned market player	▪ 30 years of specialisation in R&D in the field of separation technology and plastic processing, and as an operator of its own developed technologies on a service and production scale ▪ Excellent market presence through the technological lead and the resulting high-quality separation of technical plastics, combined with the dynamic growth in trading with secondary raw materials
Unique technological know-how	▪ Unique technological position in the recovery (yield) and quality (purity) of separated plastics based on the in-house developed methodology for the technological control of recycling processes (method of density fraction analyses) with innovations in dry-mechanical processing and selective density separation ▪ No need for cut-throat competition, even in the long term, not only resulting from the size of the market, but also from the lack of processes that enable such a high degree of purity as being achieved in the density separation process for complex plastic composites
Sustainable high market potential	▪ Limited availability of virgin materials, high-cost pressure in production, green image and favorable regulation as key drivers for the strong and consistent market growth ▪ Recycling sector as an important supplier of raw materials with changing image from waste recycler to producer of high-quality recyclates ▪ Operative structure (R&D, service, production) enabling a high renewal rate of processes and products in long-term markets
Pooling of competences & synergies	▪ High technical and commercial synergy potentials within the PB Group ▪ Dedicated management team with deep knowledge in the recycling industry, ample experience in the market for recyclates and strong technological capabilities which are reflected in state-of-the-art plant technology ▪ Long-standing, highly qualified production and laboratory team as indispensable factor in coping with research and technology projects

1. Company

PB headquarters in Schömberg-Langenbrand

1. COMPANY

Facts & figures at a glance

Know-how

from the analysis, consultancy and trade with secondary raw materials to the process development and (contract) processing and recycling

Certified waste management company

Management

with deep market knowledge and long-standing experience in the trading of dual system qualities, post-consumer and post-industrial waste, technical regrinds, semi-finished products and much more

4 production sites with

45

employees

10

Innovations

in the process development of dry-mechanical processing and selective density separation

The average annual growth in profit (2019 to 2023) amounting to

>45 %

More than

20 m EUR

annual turnover

> 90,000

tons/year

plastic waste processed and/or traded

1. COMPANY

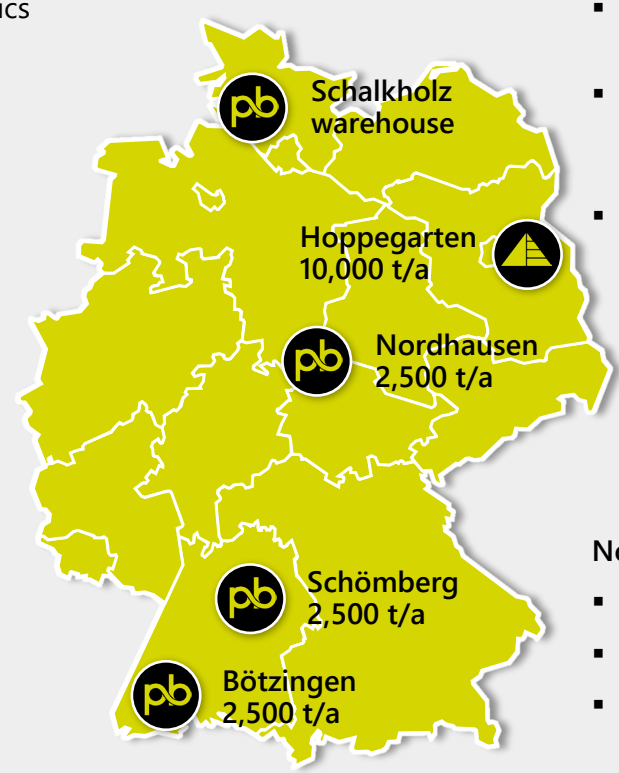
Covering the entire value chain in plastic recycling

Schömberg, Baden-Württemberg

- 2-stage shredding for the processing of thermoplastics incl. metal separation
- Processing of chips, dust and light bulk materials (e.g. films) into transportable pellets
- Processing of mixtures
- 1-stage shredding for processing production waste
- Dry processing of metal-plastic composites

Hoppegarten, Brandenburg

- 2-stage granulation for an optimal composite exposure (multicomponent parts)
- Selective density separation: mixture damages in grinding operations and silos, multicomponent parts and metal/plastic separation
- Analytics, process development, feasibility studies as well as planning of recycling facilities



Bötzingen, Baden-Württemberg

- 1-/2-stage granulation of thermoplastics
- Dry-mechanical separation of light and heavy goods
- Separation of fabric-reinforced plastics
- Dedusting of paper adherences and much more

Nordhausen, Thuringia

- 1-/2-stage granulation of thermoplastics
- separation of metal-plastic composites
- Homogenising, decanting, transferring, conditioning

Managing director Patrick Blessing with 20 years experience in plastic recycling

Managing owner of PB Solutions GmbH based in Schömberg-Langenbrand, Baden-Württemberg

- Founding (2004), development and management of a company specialising in the processing and separation of technical plastic waste, trade with secondary raw materials and (contract) processing and separation
- Production facilities at the headquarters, in Bötzingen (Baden-Württemberg) and Nordhausen (Thuringia)

Managing owner of IWS Sp. z o.o. based in Krakow, Poland

- Founding (2006), development and sale (2023) of a company specialised in trading with secondary raw materials and processing of PE and PP fractions to granules and regrind for the import to Germany

Managing owner (50%) of S & B Kunststoffrecycling GmbH based in Porta Westfalica, North Rhine-Westphalia

- Founding (2015), development and management of a company specialised in acquiring and processing of thermoplastic materials, plastic waste and semi-finished products

Managing owner of ATP Service & Consulting GmbH based in Hoppegarten, Brandenburg

- Shareholding (2017), acquisition (2021) and management of a company specialised in analytics, process development and (contract) separation of high-value plastics recovered out of complex waste mixtures

Technical Manager Andreas Mattauch with deep expertise in waste technology

Plant manager of wersag / bage plastics Deutschland GmbH (2015 to 2021)

- Management of a company specialising in the processing and sorting of plastics from e-waste into high-quality recyclates

Managing owner of ASG Abakus Sorting GmbH (2012 to 2015)

- Construction of a processing plant for the separation of PET plastic waste and a two-stage shredding line for the grinding of polyamides

Project manager of Veolia Umweltservice West GmbH (2008 to 2012)

- Construction and optimisation of processing plants for the separation of plastic waste from the beverage industry and technical plastic waste

Self-employed retail representative in plastics recycling (2005 to 2008)

- Plant sales, plant optimisation, employee training, safety instructions

Project manager of Schwarzataler Kunststoff GmbH (1999 to 2004)

- Construction and optimisation of several production lines for the processing and sorting of plastic waste mainly from LDPE, PP, PE and PET from the dual system

Assistant to the Management of FARAM GmbH (1994 to 1998)

- Assistance in the management of a company specialising in the processing of plastics from motor vehicles into moulded parts

Sales director Carsten Schipper with outstanding access to the plastic market

Sales director emerging countries of RDB plastics GmbH (2014 to 2019)

- International acquisition and sale of secondary raw materials with Europe, Turkey and the India as main markets

International sales manager of CPE Entsorgung GmbH (2014)

- Acquisition of secondary raw materials for own recycling facilities and sale of plastic granules and regrinds

Managing director of ebb Ersatzbrennstoffe Bremen GmbH (2004 to 2013)

- International trade with secondary raw materials

Managing partner of workstation Bremen GmbH & Co. KG (1997 to 2004)

- Set-up of a wholesale and retail computer company (trademarks workwide, work@home, work@office) with three sites in Bremen

Sales manager of Calli Expreß (1996 to 1997)

- Founding and management of the first home delivery service for computer parts in Bremen

QM representative of C.F. Plump Gewässerschutz GmbH (1989 to 1995)

- Set-up of a QMS according to DIN EN 9001 for a hazardous waste treatment facility

Analytical services

Determination of input specifications

- Initial measurement: spectral densities to determine sample components
- Screening analysis: density fraction analysis and sum parameters to determine percentage of plastics, metal, glass, etc.
- Identification of plastic types and its percentages:
  - Density fraction analysis
  - Spectroscopic methods
- Determination of selected plastic types (according to the specific task):
  - Density fraction analysis
  - Spectroscopic methods
  - Extraction process

Physicochemical tests

- Determination of the residual moisture (surface moisture)
- Determination of lipophilic compounds (oil, fats, waxes, tensides, etc.)
- Determination of the ash residue, bulk density and melt flow index
- Determination of the GF percentage and GF distribution by means of density fraction analyses
- Determination of the percentage of halogen (chlorine, bromine, fluorine), paper and (heavy) metal
- Sieve analyses
- Optical characterisation by means of microscopic imaging, etc.

Process analyses of recycling technology

- Determination of input specifications
- Qualitative and quantitative analysis of the separated fractions
- Evaluation of the process selectivity
- Evaluation of the disintegration degree of the recycling processes
- Determination of the purity degree of the plastic fractions
- Determination of the production and processing of the plastic fractions
- Process control
- Evaluation of the process stability
- Quality control of the recovered products

Services in consultancy, technology development & (contract) processing

Consulting & evaluation

- Determination of the composition of plastic compounds as well as its practical meaning and implementation
- Consultancy in purity degree and separability of plastic compounds, process analyses and the use of recyclates for extruding and injection moulding
- Consultancy in process and purity control as well as in optimising recycling processes
- Evaluation of the separation process:
  - Density separation process such as hydrocyclone, float-sink and centrifugal
  - Electrostatic processes
  - Other automatic and manual sorting processes such as colour and IR sorting

Technology & process development

- Technologies for density and dry mechanical recycling processes and its combinations
- Development of separation media and analysis methods for plastic compounds
- Processes for selective separation, environmental and economic design of separation media cycles, plastic-metal separation and selective metal separation
- Customised process development:
  - Sample analysis
  - Determining the separability
  - Determining the separation conditions of the technical process
  - Testing the properties of recyclate
  - Selecting applicable processes

(Contract) processing & separation

- Homogenising, decanting, transferring, conditioning
- Dedusting of paper adherences, removal of fixed foamed parts
- 1-/2-stage granulation of thermoplastics, fiber material or thermoplastic elastomers
- Dry-mechanical separation of light / heavy goods
- Separation of fabric-reinforced plastics
- Selective density separation:
  mixture damages in grinding operations and silos, multicomponent parts and metal-plastic separation
- Selection of plastic compounds recovered:
  PP/PVC, PA/PET, PP/PPO, PC/PBT, ABS/PA, PA/POM, PS/SAN, PP/PA, PCABS/TPU, ABS/PVC, ABS/elastomers

2. Market & customers

PB production site in Nordhausen

Acquisition of all common plastic wastes in larger quantities

Customer and market structure in the trading segment

- System quantities
  - Suppliers: European dual systems directly or the sorting plants with free quantities
  - Customers: established recycling companies with business relations for partly more than 15 years
- Commercial quantities
  - Suppliers: classic disposal companies with standard qualities
  - Costumers: worldwide but with clear focus on Europe
- Acquisition of post-industrial waste
  - PVC waste soft and rigid from industries such as automotive, window production, print houses, etc.
  - Films on rolls sorted/mixed, start-up lumps sorted
  - Seals (EPDM), panel waste (HDPE, PP, POM, PC, PMMA), automotive parts carrier (ABS, PP, PS), bumper (PP/EPDM), etc.
  - All thermoplastic waste from production
- Acquisition of post-consumer waste
  - PE/PP rigid plastics from collection points (e.g. recycling depot)
  - Plastic types from LWP sorting plants such as DSD 310, 324, 329
  - Industry foils (coloured to natural)
  - Oil tanks, IBCs, barrels, canisters and pipes
  - PVC mixtures (bars, profiles, shutters), flower pots (PS/PP)
  - Backlight sheets from dismantling flat screens, CD/DVD from sorting

Customer and market structure in the production segment

- Potential suppliers of plastic waste and the potential customers for recyclates of high purity in many economic sectors
- Potential customers for process engineering
  - Manufacturing industry to return production waste to the recycling process
  - Private and municipal recycling centres that intend to realise a higher added value by processing the mixed plastic fraction
- Limited availability of virgin materials, high-cost pressure in production, green image and favorable regulation as key drivers for the strong and consistent market growth
- Industrial companies
  - Sale or contract processing of production waste
  - Purchase of recyclates for direct reuse
- Compounders
  - Contract processing of plastic waste
  - Purchase of recyclates for further processing or direct sale
- Plastic traders
  - Sale of plastic waste
  - Purchase of recyclates

Recovery of high-purity recyclates from complex plastic mixtures

	Post-industrial waste		Post-consumer waste
MedTech	▪ PC light-coloured ex dialysers ▪ PS injection-moulded coloured ex disposable syringes	**Gardening**	▪ PS coloured ex plant bowls
Toys	▪ PC and ABS coloured ex modular systems	**Filter**	▪ PPGF grey ex water filter
Automotive	▪ ABS, PC/ABS and PVC black ex dashboards ▪ PP/EPDM black ex bumpers	**Packaging**	▪ PET clear/grey ex beer kegs
Other	▪ PVC and TPE coloured ex shower hoses ▪ PC/ABS coloured ex Bayblend T 65 ▪ ABS extrusion black ex chads ▪ w-PVC black ex slush and foam films ▪ w-PVC light-coloured ex film lamps	**Other**	▪ HDPE injection-moulded coloured ex beverage crates ▪ HDPE and ABS extrusion black ex KLTs ▪ PP injection-moulded coloured ex KLTs

Importance of process development for the recyclability of plastics

The ecological aspect of reintegrating production and consumption waste into the economic cycle as a source of raw materials is undisputed, but it also requires the constant development of methodological know-how for recycling plastics into high-quality, reproducible recyclates as well as ecological and economic processing technologies.

The state of the art in separation technology is characterised by the quality of the recyclate. Whereas in the early years of plastics recycling the view was held that the quality of the recyclate should be measured against the virgin material, many years of practical experience have since led to the view that recyclates should be understood as a new type of plastic, i.e. that adapted new physical-mechanical test methods should be developed and used to classify plastics processing technologies. The quality of the recyclate is thus characterised by its technical application properties.

The recycling sector has established itself as an important supplier of raw materials, which has also been accompanied by a change in image from waste recycler to producer of high-quality secondary raw materials. Within the framework of the EU directives, producers from various sectors are obliged, but are also increasingly committing themselves voluntarily, to make greater use of recycled materials in the production process together with the materials and supply industry in order to expand the markets for recycled materials. The opportunities for using secondary plastics have also increased significantly due to the limited availability of virgin materials as well as the high-cost pressure in production. There are thus favourable opportunities for the market introduction of high-grade, quality-tested secondary raw materials that are more cost-effective than virgin materials.

With the further development of plastics recycling, the expectations of developed sorting, separation, processing and application processes will be limited to the concrete product, to the concrete waste, to the concrete plastic, and the hope for all-encompassing technologies and solved problems in plastics recycling will fade.

The pressure to take up developments in new process stages is coming from the growing volume of waste, which is becoming more complicated in terms of materials. However, the design of a concrete separation process is ultimately dominated by the input and the marketing conditions of the secondary plastics.

Our developments are aimed primarily at the market segment of high-purity, quality-tested, reproducible secondary plastics for their reuse in injection moulding and extrusion processes. The new secondary plastic must be economically viable for the additional process stage. Process development must be based on these boundary conditions.

Some manufacturers already take back, reuse, recycle and recover their products. The high-quality separation of two- and multi-material mixtures is still one of the most important tasks. The separation of these materials by type is mainly solved for material flows without complication with plastic compounds.

There is no need for cut-throat competition in the long term. However, this is not only due to the size of the market, but also to the lack of processes that enable such a high degree of sort purity during separation as can be achieved in our density separation process.

3. Know-how

ATP headquarters in Hoppegarten near Berlin

Sustainable unique selling proposition in technology development

Our density fraction analysis is still the only method on the market for qualitative and quantitative analysis of the composition of plastic mixtures. Density fraction analysis, which is fuzzy enough to cope with the problems of large piles such as homogeneous, inhomogeneous distributions of constituents and extreme impurities, and accurate enough to determine material structures and their separability in the waste, provides us with a method for analysing and evaluating waste streams that meets the most modern demands for reproducibility, diversity and effectiveness.

We use density fraction analysis for in-process analysis to technologically control the processing and recycling of plastic mixtures, to determine the qualitative and quantitative composition of material streams of the same provenance, and to evaluate the separability of plastic mixtures and the performance of separation processes.

Plastic mixtures as mixtures of different types or species are generally not recyclable. The questions to be solved in the development of recycling processes are: Is the plastic mixture separable? What are the properties that allow profitable identification and thus differentiation in the separation process? In what purity are the plastics separable? What yield of plastic (value product) is obtained? What is the quality of the separated plastics for reuse in production?

The selection of the plant technology and the development of the process technology for any separation process is determined by the input, mass flow and the required final qualities of the plastics to be separated. The methodology of density fraction analysis offers the opportunity to examine the costs, benefits, emerging product properties and associated new markets and areas of application in advance of technology developments in the recycling sector, in order to find the most effective variant in relation to the company.

The development of the technology for the return of a new secondary plastic into the production cycle, i.e. a new product, is the overriding objective of a development project in the field of plastics recycling. It comprises the entirety of the processes, process controls, procedures and production techniques necessary for the recovery of the secondary plastic. The first prerequisite for the development of branded products is the reproducibility of the recyclate in the technical application requirements. This requires the measurable reproducibility of the material composition in order to be able to control the individual treatment processes of collecting, sorting, separating, regranulating and reprocessing.

The objective and novelty value of development projects consists in the process development for the isolation of selected plastic compounds (plastic mixtures from complex waste streams) or for composite separation, including the separation and washing circuits, as well as in the development of a process analysis for the identification, quantitative and qualitative analysis of plastic compounds, for composite digestion and for the determination of the purity of the plastics, as well as the methodical extension of the density fraction analysis. Based on this method, new plastics separation technologies and product developments of secondary plastics have been developed through systematic process developments in the last decades.

Selected technology & process developments (1/2)

Production waste toys 2017 until today	▪ Process development for recovering ABS (>70%) and PC (>10%) of high quality by means of a 4-staged recycling process ▪ Know-how: – Exact adherence of the separating cut – Process control and management of the production – Cleaning work between the separation processes
Production waste dialysers 2017 until today	▪ Dry mechanical processing and the selective density separation of PC (>50%) with a purity of >99.99% from a compound of 5 components including 15% PSU fibres ▪ Know-how: – Cleaning regime of technical units to recover transparent PC of high purity
Production waste automotive 2011 to 2019	▪ Dry mechanical processing of triple-layer compounds and the selective density separation of PPGF20 and PVC as well as PPGF20 foamed from PVC (lightweight material) to recover PPGF20 with a purity of >99.98% for the direct reuse in the production of dashboards ▪ Know-how: – Complete decomposition for the 1-staged separation process of PPGF20 and PVC – Process control and traceability of the 4-staged recycling process

Selected technology & process developments (2/2)

Production waste mobile phones 2003 to 2011	▪ Recovering PC/ABS with a purity of >99.96% by means of developing the separation media and process technology for technical plastics with a density of >1.20 g/cm³ as well as its separation media cycles ▪ Know-how: – Process development, project planning and set-up of a density separation plant with colour sorting and electrostatic separation as input preparation
Post-consumer carpet waste 2000 to 2002	▪ Process analysis for recovering PA 6.6 fibres from carpet waste ▪ Know-how: – Density fraction analysis of fibres in the centrifugal field – Method development for determining the disintegration degree of the PA 6.6 fibres – Sample preparation – Determination of the reproducibility of the analysis methods
Production waste cooling units 1997 to 2010	▪ Process development for recovering PS by means of a 2-staged density separation process (centrifuge float-sink separation) and the development of coupled separation media cycles ▪ Know-how: – Procedural and economic optimisation of the separation technology by developing and setting up a post-digestion process for the centrifugal separation of plastics and the integrated metal splitting

High innovation potential for the technology & process development

Post-industrial & Post-consumer – fibres

- Technology development for separating fibres such as from
  - Old clothing (cellulose and PA/PET fibres)
  - Technical products (aramid and PSU-PES fibres)
- High innovation potential such as for the textile industry with a deep scope of supply and services
- Know-how development:
  - Density fraction analysis of fibres in the centrifugal field
  - Determining the disintegration degree of the fibres
  - Process control

Post-industrial – electrical engineering

- Technology development for a clear separation of flame retardants from the plastic fractions ABS/PS
- Know-how development:
  - Density fraction analysis
  - Determination of the disintegration degree
  - Process control

Post-consumer – packaging

- Technology development for separating PS from the dual systems with a high purity to be reused in extrusion
- Technology development for processing and separating PO fractions from PP/PE
- Know-how development:
  - Density fraction analysis
  - Determination of the disintegration degree
  - Process control

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