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**Integrated Battery Recycling at
BERZELIUS Metall GmbH**

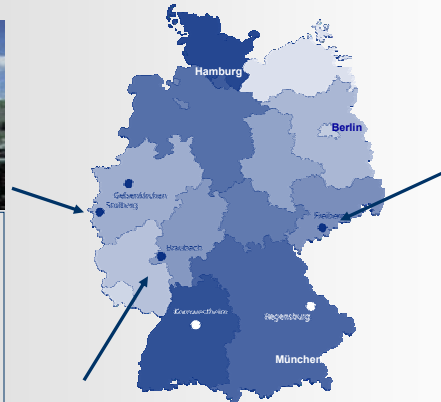
Dr.-Ing. Reinhard Püllenberg
Managing Director BERZELIUS Metall GmbH

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BERZELIUS Metall GmbH - Smelters



PRIMARY SMELTER
Treatment of concentrates
QSL-Technology
Production:
140,000 t lead;
320,000 kg silver;
100,000 t sulphuric acid



SECONDARY SMELTER
Battery-Recycling
Incinerator Plant
Production: 55,000 t lead,
Waste Incinerator: 18,200 t of hazardous waste



SECONDARY SMELTER
Battery- and Polypropylene-Recycling
Production: 41,500 t lead;
33,000 t polypropylene

BERZELIUS Logistik Service GmbH – Battery Collectors



ROLAND Batterieservice GmbH
Gelsenkirchen



POPP Batterieservice GmbH
Kornwestheim



ERV Voggenthaler GmbH
Regensburg und Freiberg

Berzelius Metall

SECONDARY SMELTER PRIMARY SMELTER

Input:

- Battery Scrap
- Scrap Lead
- Production Rejects

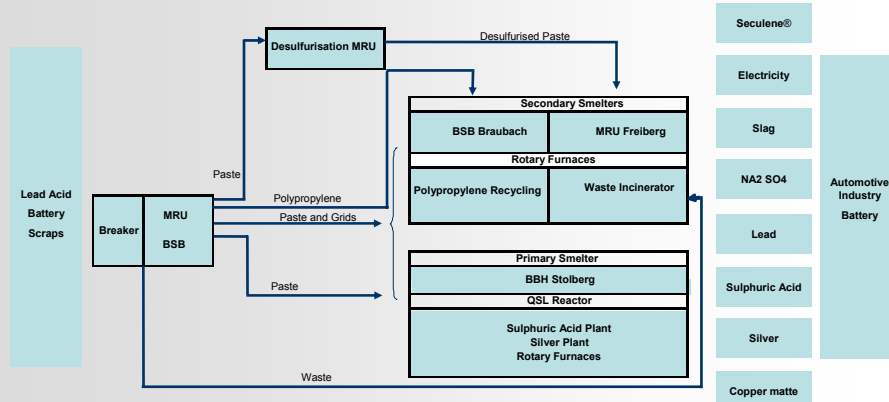
- Lead Concentrates
- Leach Residues from Zinc Industry
- Battery Paste

Output:

- Lead
- Polypropylene
- Battery Paste
- Tin Alloys

- Lead
- Silver
- Sulphuric Acid
- Cu Matte

Integrated Lead Recycling



Overview Secondary Smelters

Here it starts...

Raw materials are scrap lead-acid battery and other lead-containing materials



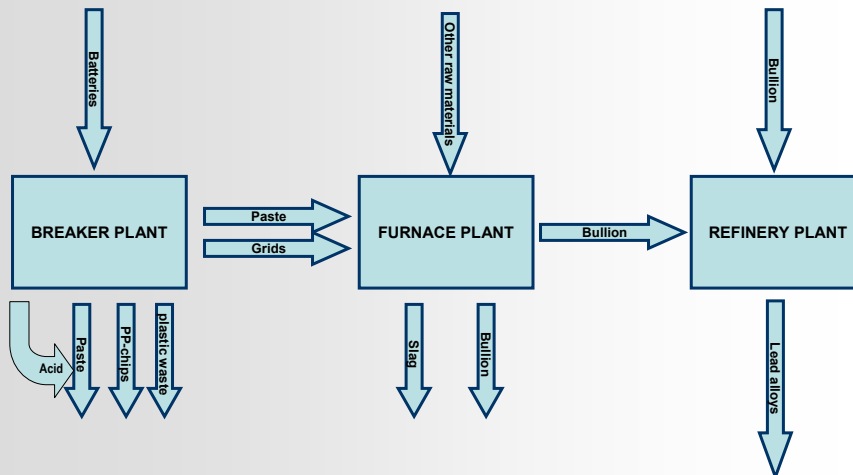
Battery Scrap Deliveries



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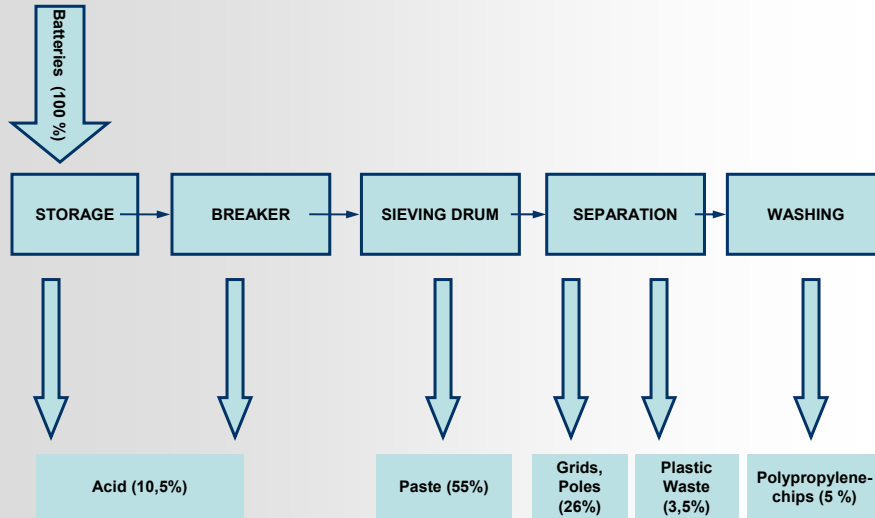
Schematic Production Flow Sheet



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Breaker BSB Plant



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Breaker MRU plant



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Insight into Breaker BSB Plant



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Modern Process Control Systems



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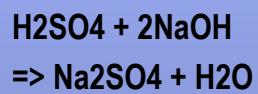
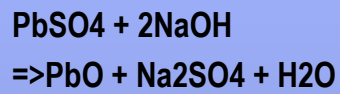
Wet Desulfurisation



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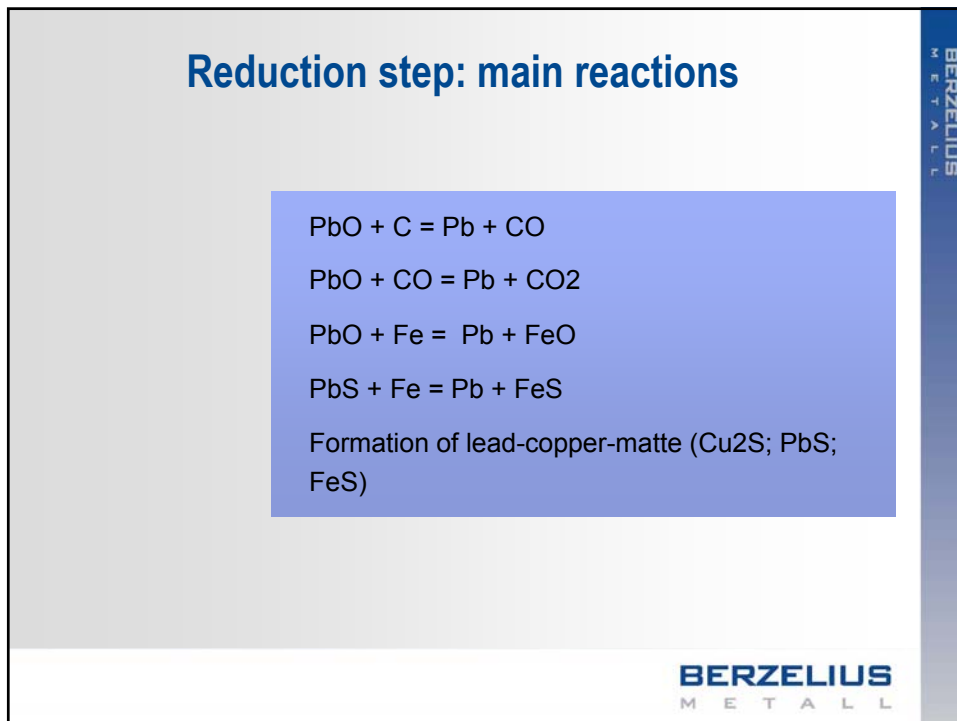
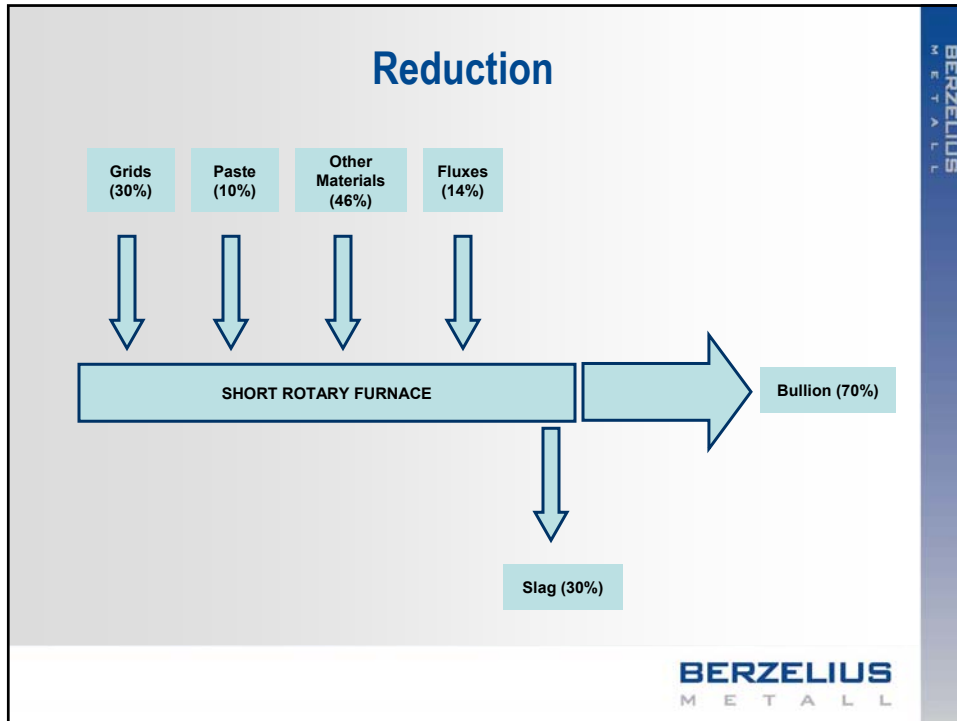
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Wet Desulfurisation



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BSB Furnaces



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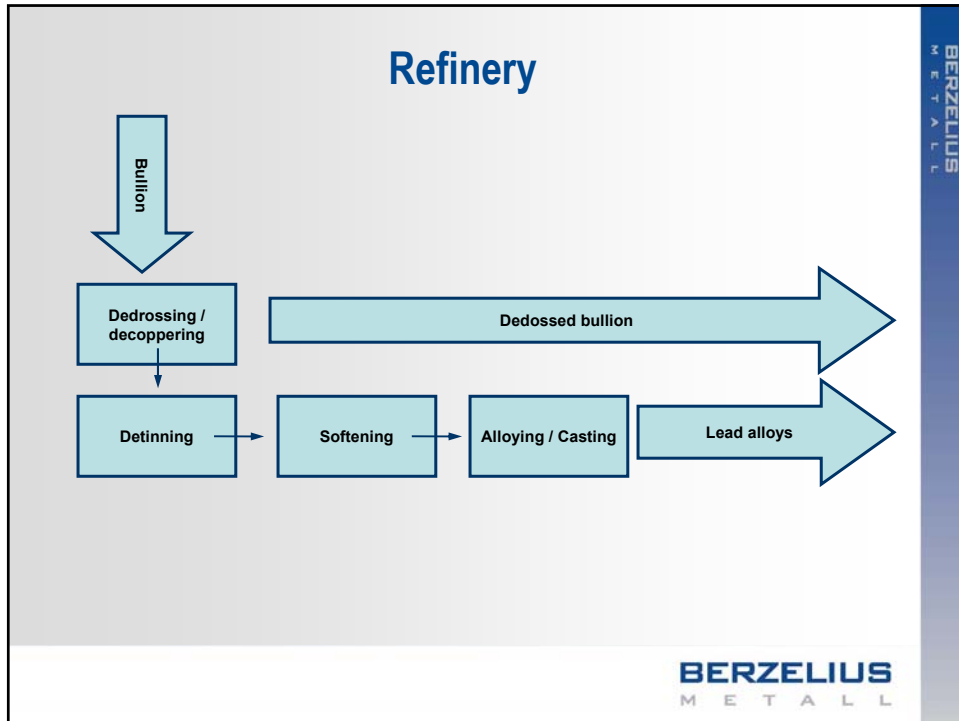
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Raw Lead (Bullion)



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Refining steps

First step / First dedrossing:
 Segregation with falling temperature (550°C down to 360°C) of NiS, CuS, PbS, PbO

Second step / Decopperizing (360°C):

$Cu + S = CuS$

$Pb + S = PbS$

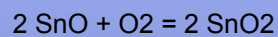
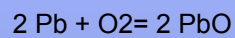
$PbS + 2 Cu = Pb + Cu_2S$

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Refining steps

Third step / Detinning (550°C):

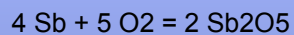
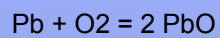


Final detinning with NH_4Cl



Refining steps

Fourth step / Removal of antimony (600 - 650°C):



Fifth step: Final de-oxidation with pet coke and alloying

Sixth step: Casting

Refinery



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Casting



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Casting Machine



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Lead Alloys



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BSB Recycling GmbH



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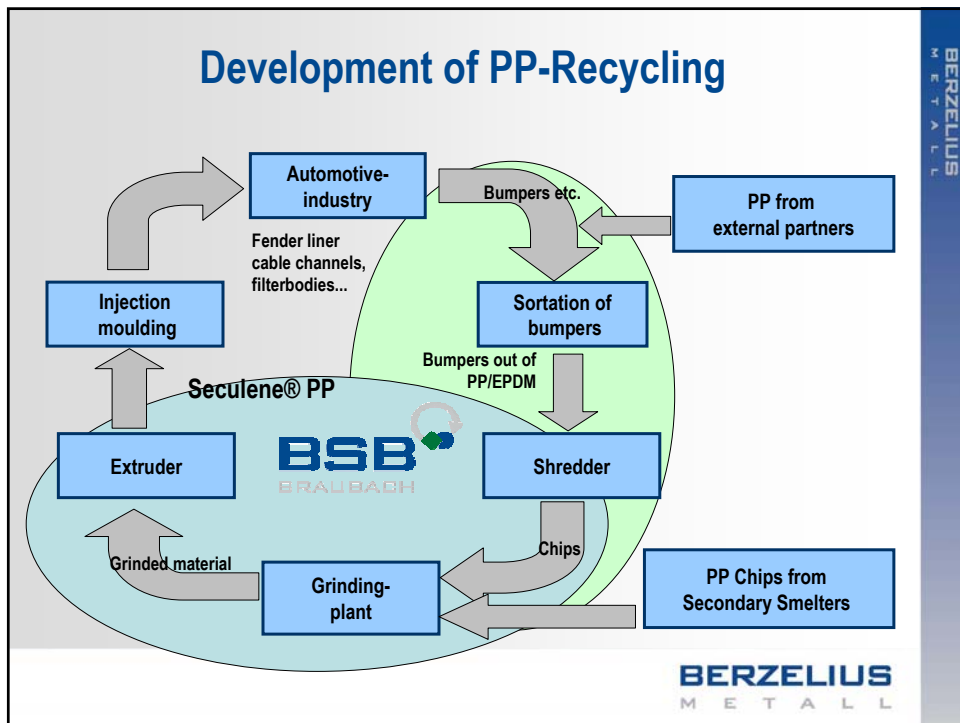
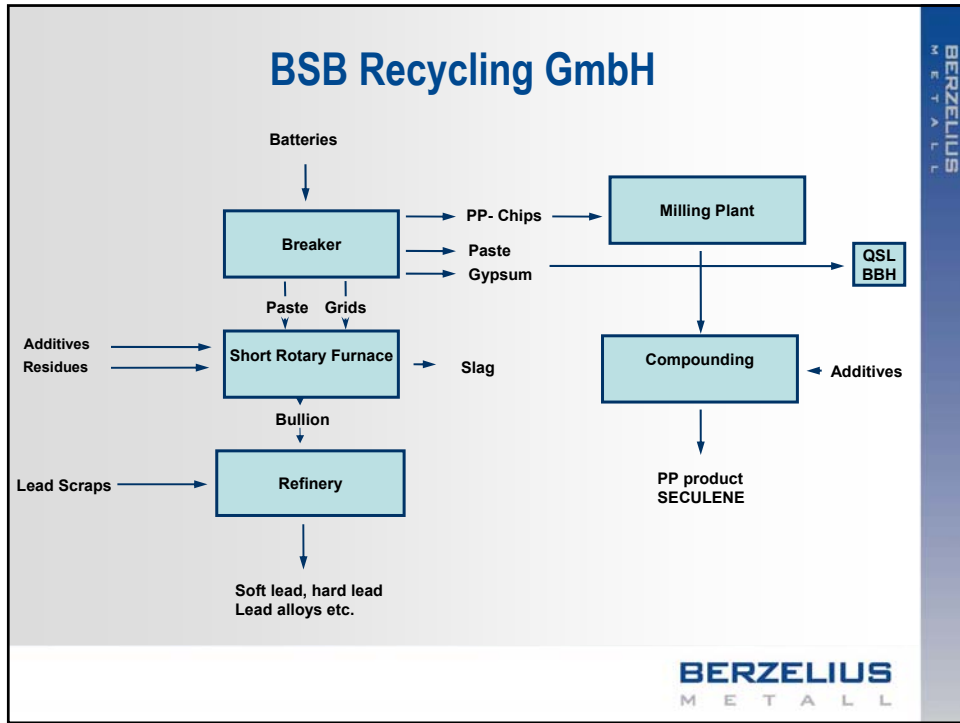
Secondary Lead Smelter with PP-Recycling

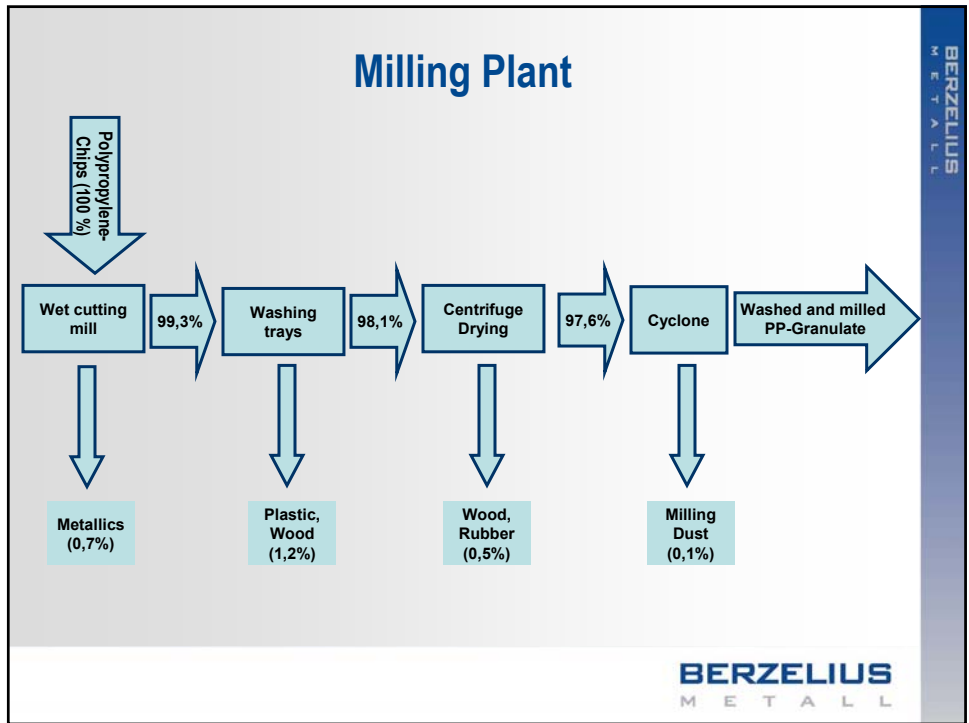
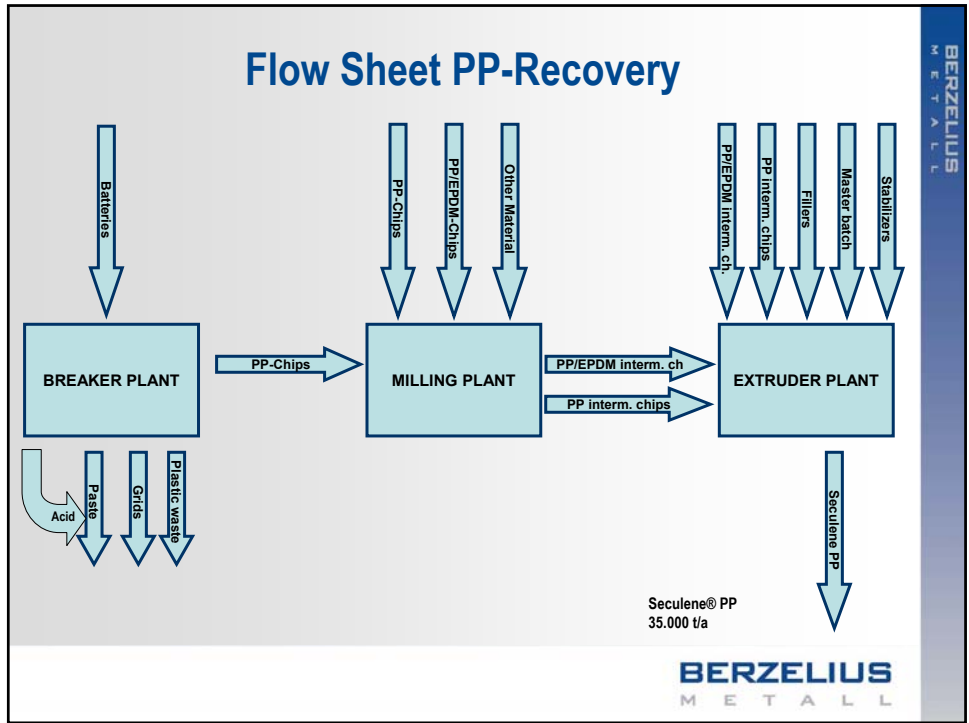
ANNUAL PRODUCTION (approx.):

20,500 tonnes lead (bars, slabs for rolling)
17,000 tonnes lead bullion
44,000 tonnes of paste
1,000 tonnes tin alloys
40,000 tonnes Seculene® PP

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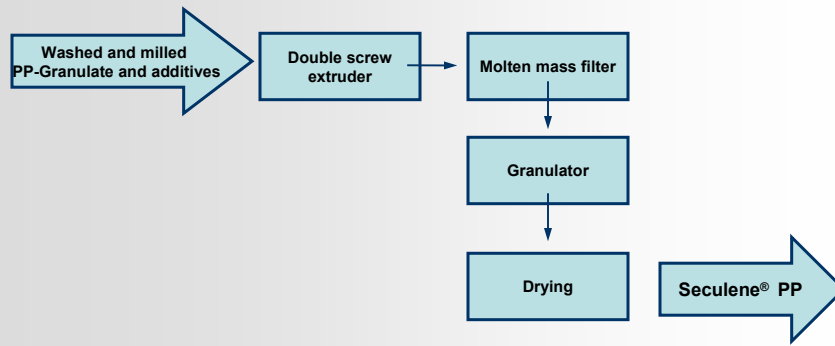
Input material for production of compounds



Seculene-Production



Compounding Process



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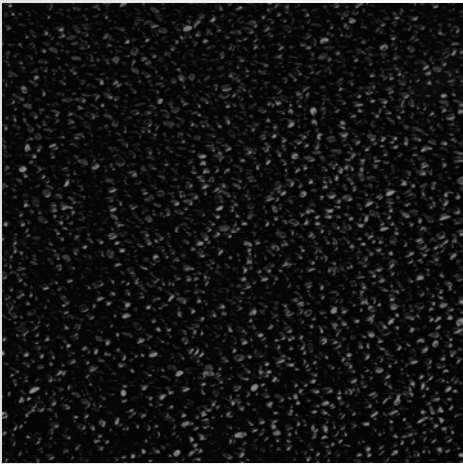
Seculene Production



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Raw material for the Compounding PP granules



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Seculene® PP-Applications

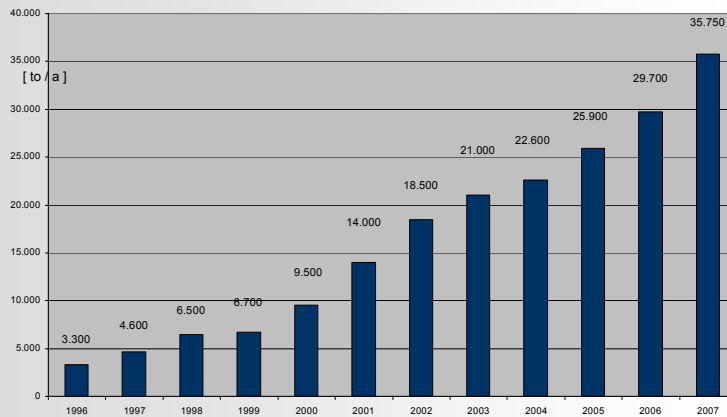


93 % Car Producers (7 % others)
In the automotive industry, more than 80 % of the material is used for wheel-house casing.

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Historical Development of Seculene® PP



1987 – 1990: Technology development F & E Frankfurt / Braubach
1990: Initial startup of the production plant
2000: Start of the second Extruder
2006: Placing into operation the third Extruder

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Muldenhütten Recycling und Umwelttechnik GmbH (MRU)



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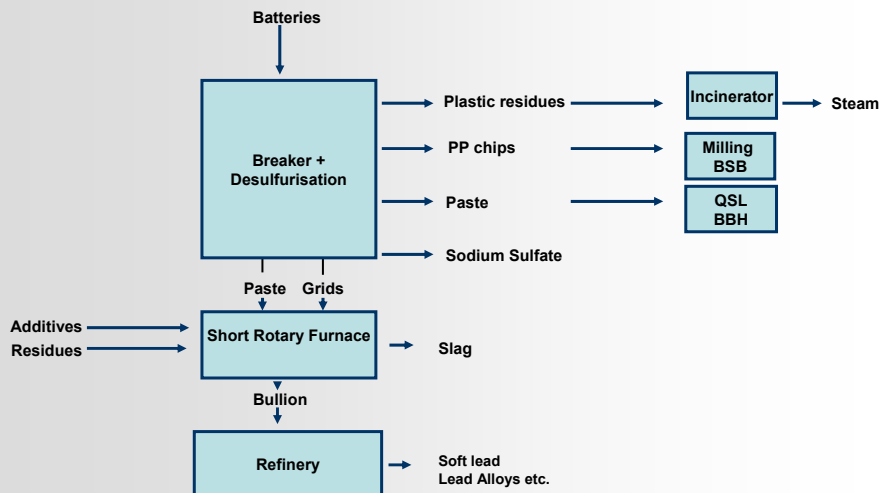
Muldenhütten Recycling und Umwelttechnik

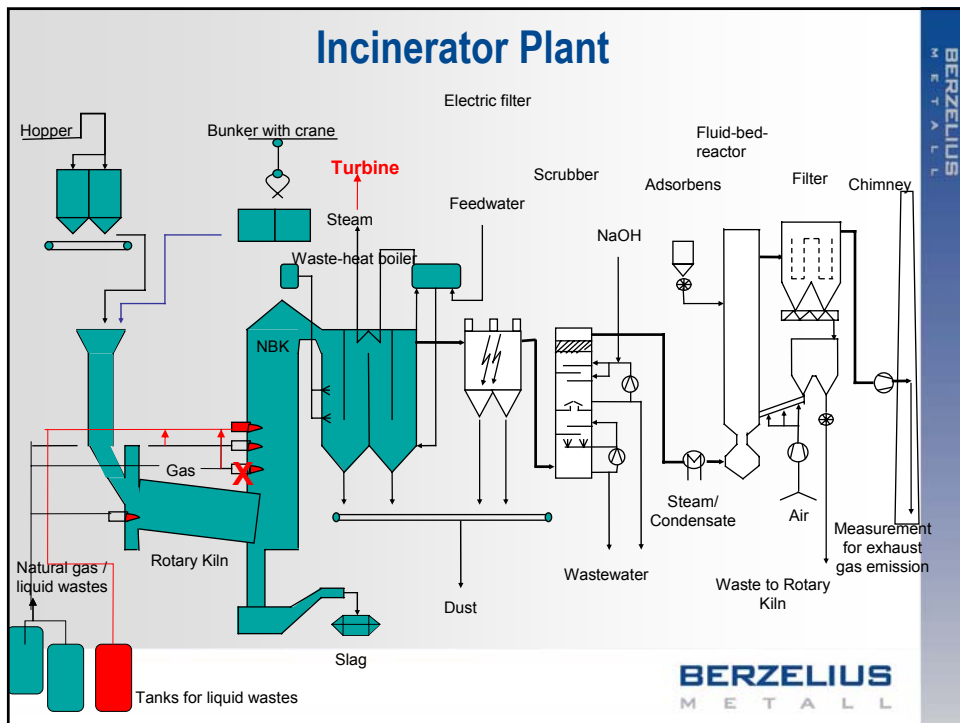
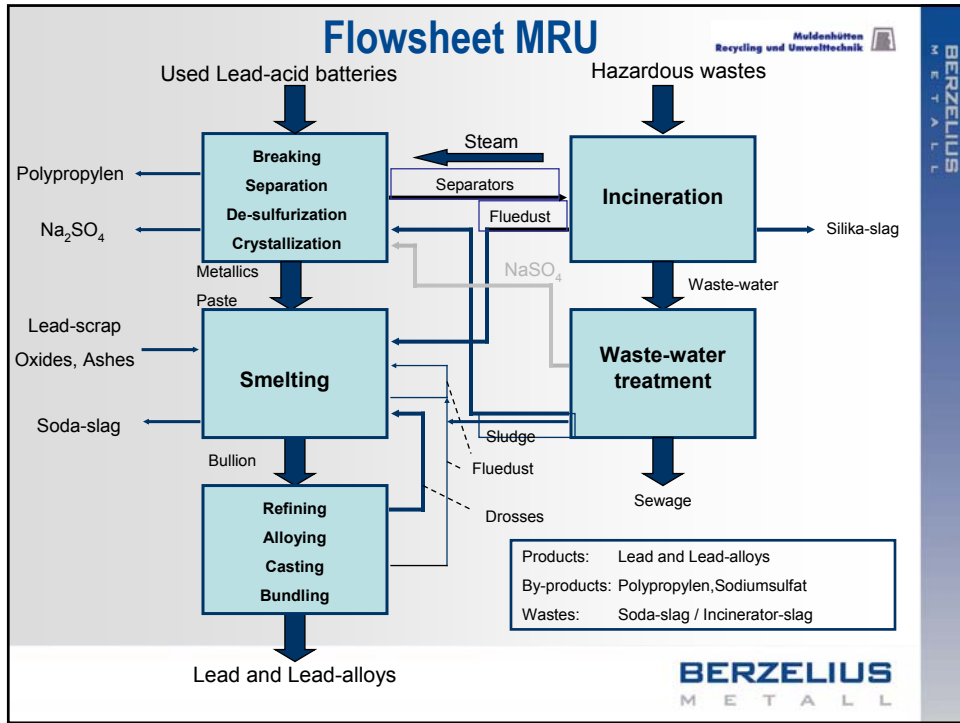
Secondary lead smelter with integrated incinerator for hazardous wastes

ANNUAL PRODUCTION (approx.):
55,000 tonnes lead/lead alloys
5,000 tonnes sodium sulphate
3,000 tonnes PP-chips
plus paste

Exploitation of 20,000 tonnes hazardous wastes in the incinerator plant

Muldenhütten Recycling und Umwelttechnik





Primary Smelter

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BERZELIUS STOLBERG Smelter Area



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BERZELIUS STOLBERG GmbH Primary Lead Smelter with QSL-Technology

ANNUAL PRODUCTION (approx.):

150,000 tonnes lead/lead alloys

100,000 tonnes sulphuric acid

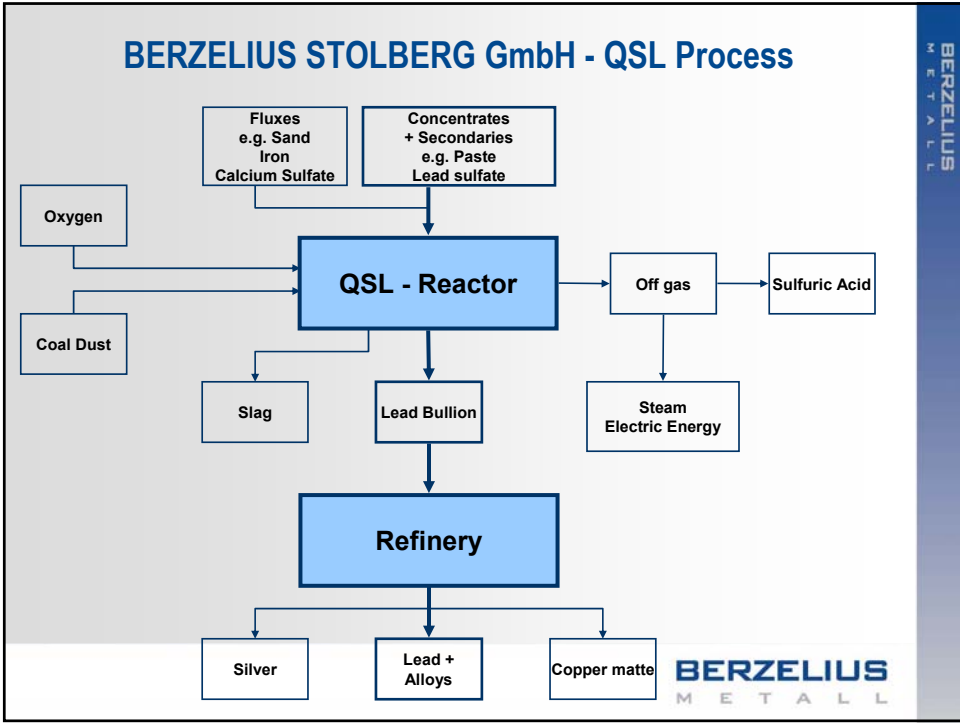
60,000 tonnes BERZELIT

6,000 tonnes copper/lead matte

300 tonnes silver

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Raw Material Storage - inside



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Raw Material Storage Hall - inside



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QSL Building

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QSL Building



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Charging System to the QSL Reactor



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QSL Reactor with Cooling Elements



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QSL Reactor with Cooling Elements



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Sulfuric Acid plant

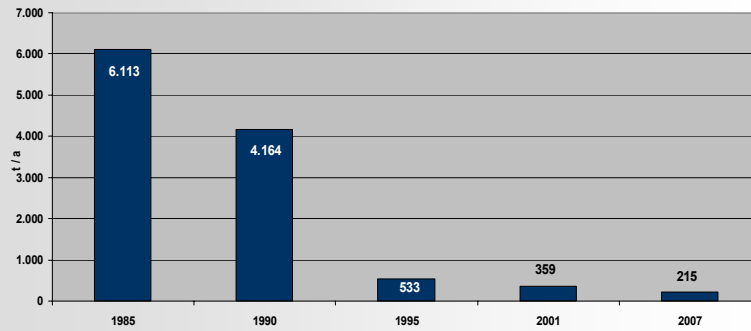


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Air Pollution Control

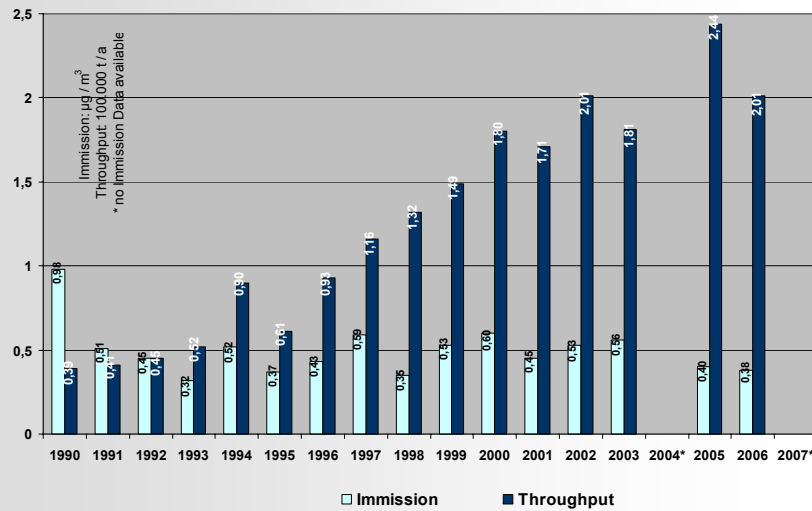
SO₂ – Emission QSL Plant (Development 1985 – 2007)



Source: Berzelius Metall GmbH

Air Pollution Control

Lead - Immission and Production (1990 – 2006)



Source: Berzelius Metall GmbH

BERZELIUS LOGISTIC SERVICE GmbH (BLS)

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ERV
Logo

Abrechnung für die Lieferung von...

Abrechnung für die Lieferung von...

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BERZELIUS Logistik Service GmbH

Nationwide collection- and treatment system for automotive, industrial- and portable batteries; founded in 2007

ERV- Regensburg +
Freiberg/ Collector

RBS- Gelsenkirchen/
Collector/ Treatment

PBS- Kornwestheim/
Collector

Economic Operator - Collection and Treatment § 8 (RL2006/66/EG, Battery Directive)

- 45 employees
- 25 trucks
- Waste management facilities
- Quality management system EN DIN ISO 9001ff, etc.
- Environmental System EMAS and EN DIN ISO 14001ff

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Core Competence of BLS

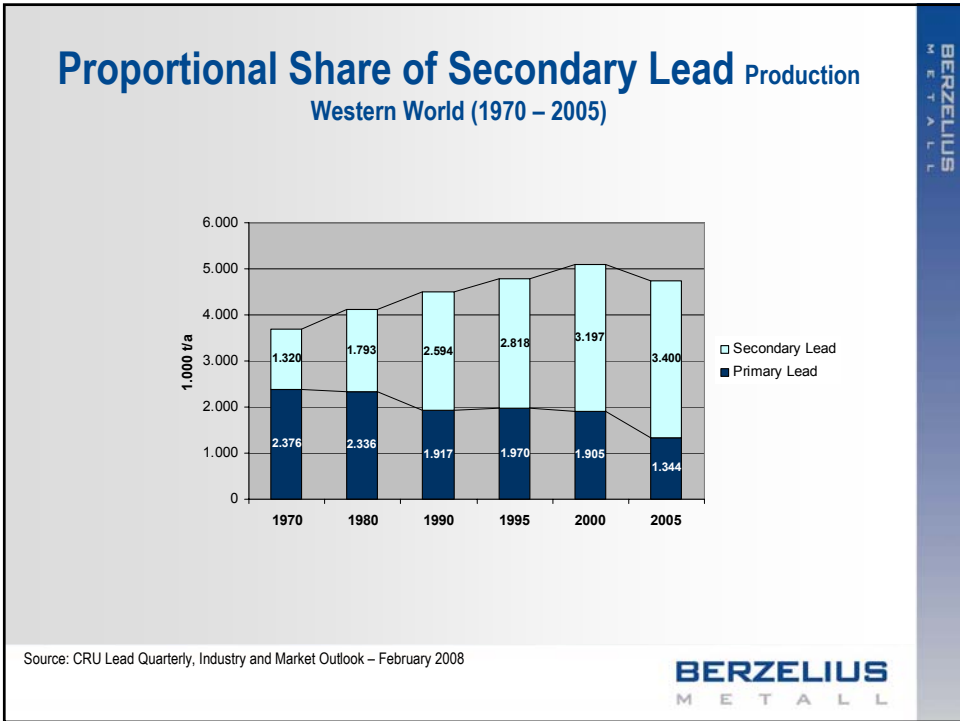
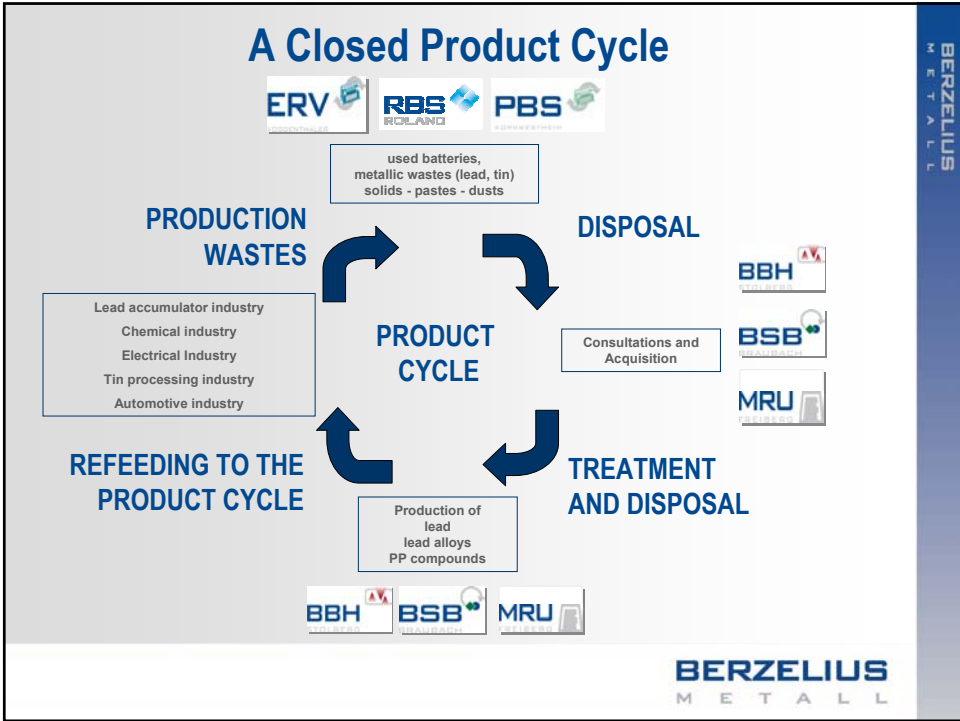
Collection, transport, storage, treatment of car- and industrial batteries:

Lead batteries, Ni-Cd batteries, Alkali-
batteries and electrolytes collected separated

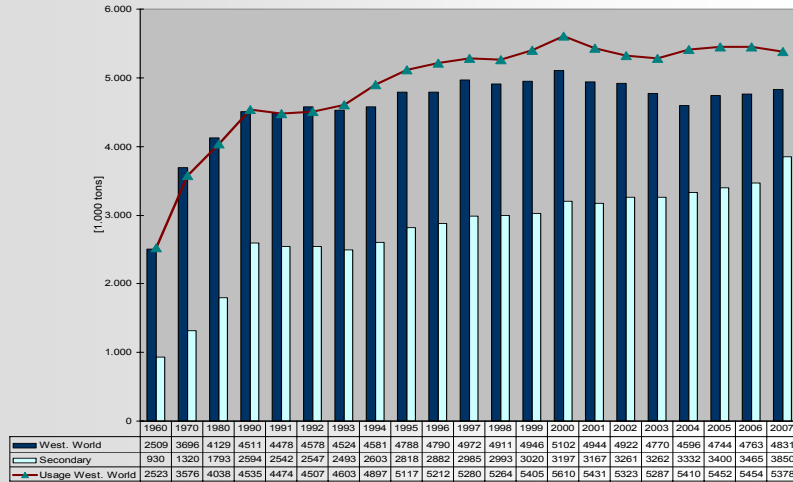
- Container Management
- Dismantling of industrial batteries
- Consulting work in all logistic related questions

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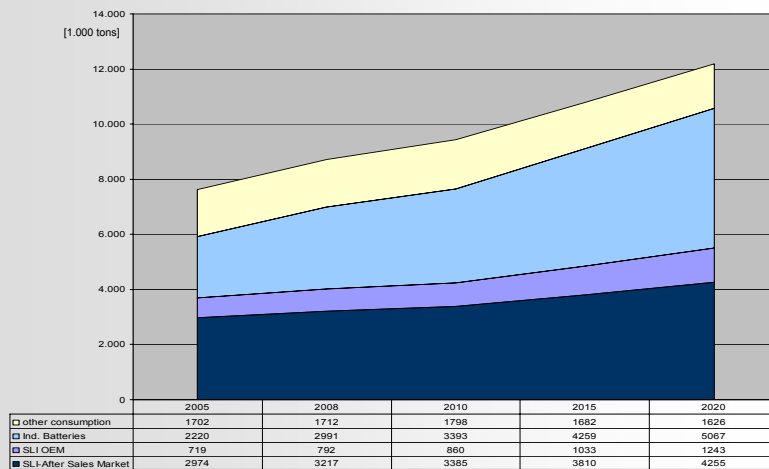


Lead Consumption/Production Western World and Secondary Production (1960 – 2007)

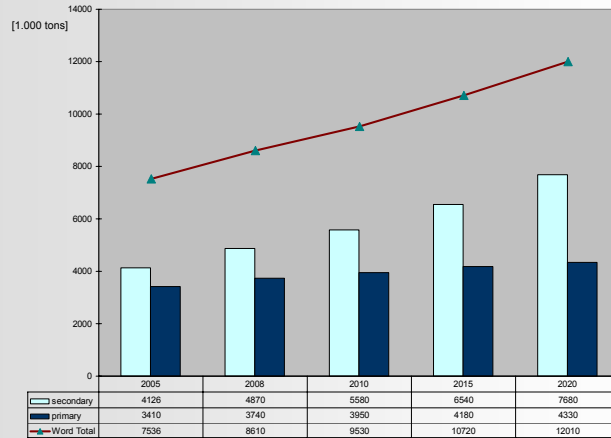


Source: CRU Lead Quarterly, Industry and Market Outlook – February 2008

CRU Forecast for Increase of Lead Consumption (2005 – 2020)

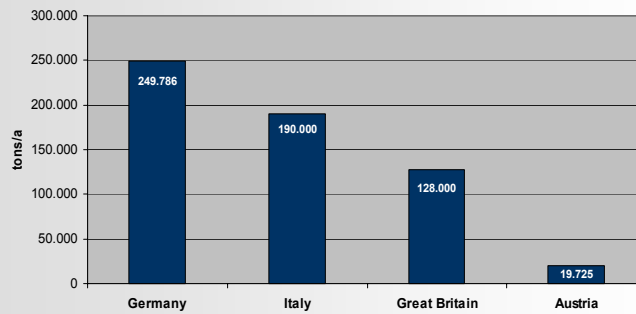


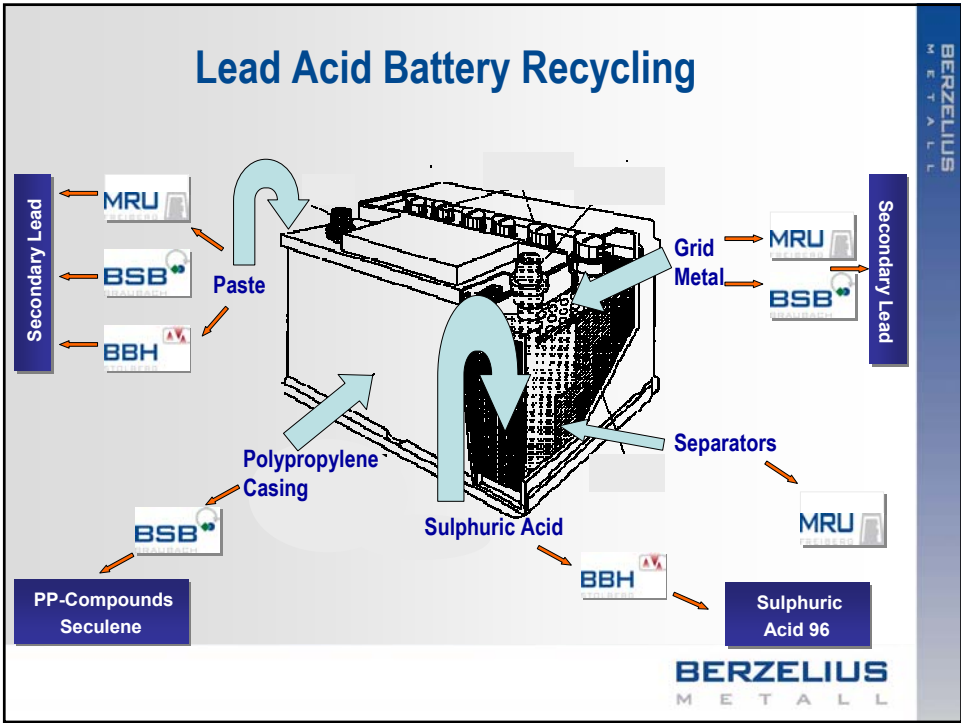
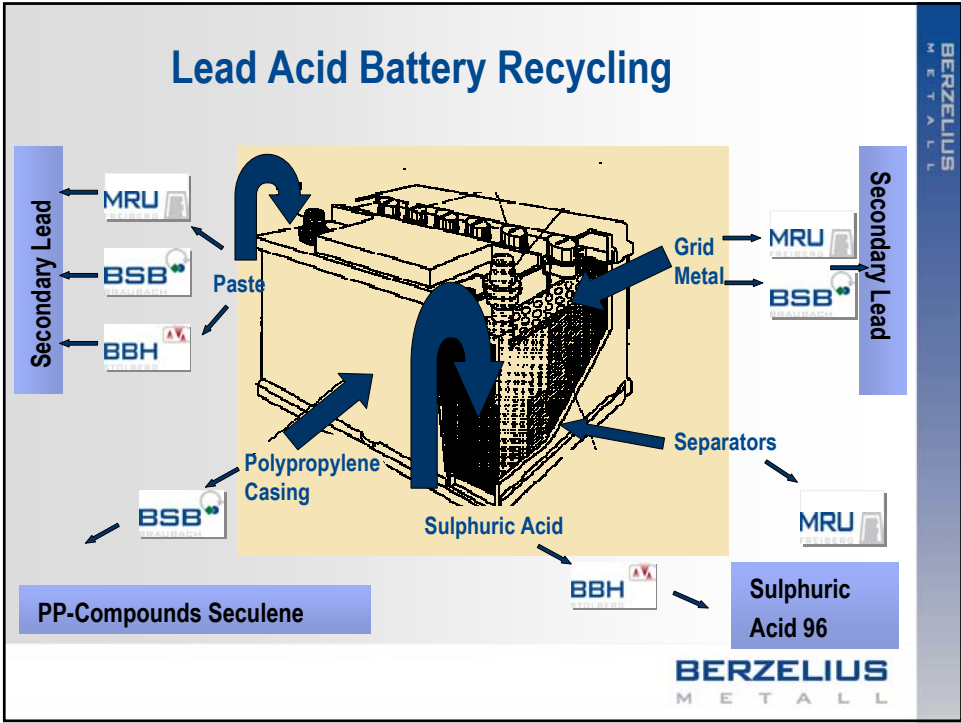
Possible Development of Lead Production (2005 – 2020)



Source: CRU

Battery Quantities delivered for Recycling in 2007





BERZELIUS Metall GmbH-Group

Recycling network of 1 primary- and 2 secondary-lead smelters, 1 incinerator plant and 3 collecting companies

- Nationwide biggest collector of car - and Industrial batteries
- Leader in treatment and recycling of lead acid Batteries
- State-of-the-art technologies
- 420 employees in Germany
- 5 of 6 companies are waste management facilities
- Quality management according to EN DIN ISO 9001ff, etc.
- Environmental management EMAS and EN DIN ISO 14001ff.
- Works safety certification OHSAS 18001.

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