



## **INNOVATIVE PROCESSES:**

**U4LEAD** for paste desulphurization  
and

**LEAD<sup>3</sup>** for hydrometallurgical production of  
nanostructured lead oxides

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Part of

**MONBAT**  
GROUP

# YOUR ITALIAN PARTNER FOR **BATTERY** RECYCLING AND **LEAD** PRODUCTION



Starting from our Customer's needs, **STC** designs specific tailor-made solutions for the supply of complete new plants or single units, equipment and services, including revamping and retrofitting of existing plants.



STC is an Italian EPCM (Engineering Procurement & Construction Management) company located in Mesagne – Italy, which designs and supplies turnkey plants, Plug & Play integrative technologies and a complete range of equipment for the recovery of lead, polypropylene, PE and other materials from exhausted lead batteries as well as any needed additional service/upgrading for existing plants.

## **YOUR ITALIAN PARTNER FOR BATTERY RECYCLING AND LEAD PRODUCTION**

# We **LEAD** Technology Innovation (1/2)



SF15 - Sink & Float



Heavy Duty Trommel HDT-40  
Inlet crushed battery capacity: 40 t/h

The company portfolio includes:

- Complete lead recycling plants from 1 to 25 t/h of batteries
- Battery breaking with crusher and pre-crusher
- Battery breaker and component separation
- Paste & Grids desulphurization
- Coarse and fine classification of paste and metal fraction
- Lead oxide regeneration unit - LEAD<sup>3</sup> with production of nano-structured lead oxides
- Polypropylene upgrading up to PP chips or granules
- Polyethylene separators' Treatment System
- Plastic separation (PP, PE and ABS separation)
- Electrolyte treatment



DS15 - Delta Separator

# We **LEAD** Technology Innovation (2/2)



- Evaporation & Crystallization systems with low energy consumption (vacuum, MVR, multi effect, etc.)
- Paste pelletizing for easy charge preparation with fluxes reduction
- Charging machine for rotary furnaces
- Automatic charge preparation unit
- Tilting & fixed axis rotary furnace and burners
- Air pollution control systems (scrubber, baghouse, after-burner)
- Water & waste water treatment plant for sulphate and heavy metals removal and recovery
- Lead pumps & agitators
- Refining kettle, oxy-lancing, dross skimmer
- Ingot Casting Line with robots for stacking and skimming

# Focus on some of our **Plug&Play** solutions



Heavy Plastic Treatment System



PE briquettes



ABS



Delta Separator



Fine Lead Paste



Coarse Lead Paste



Metallic fraction separation unit



Coarse metallic fraction

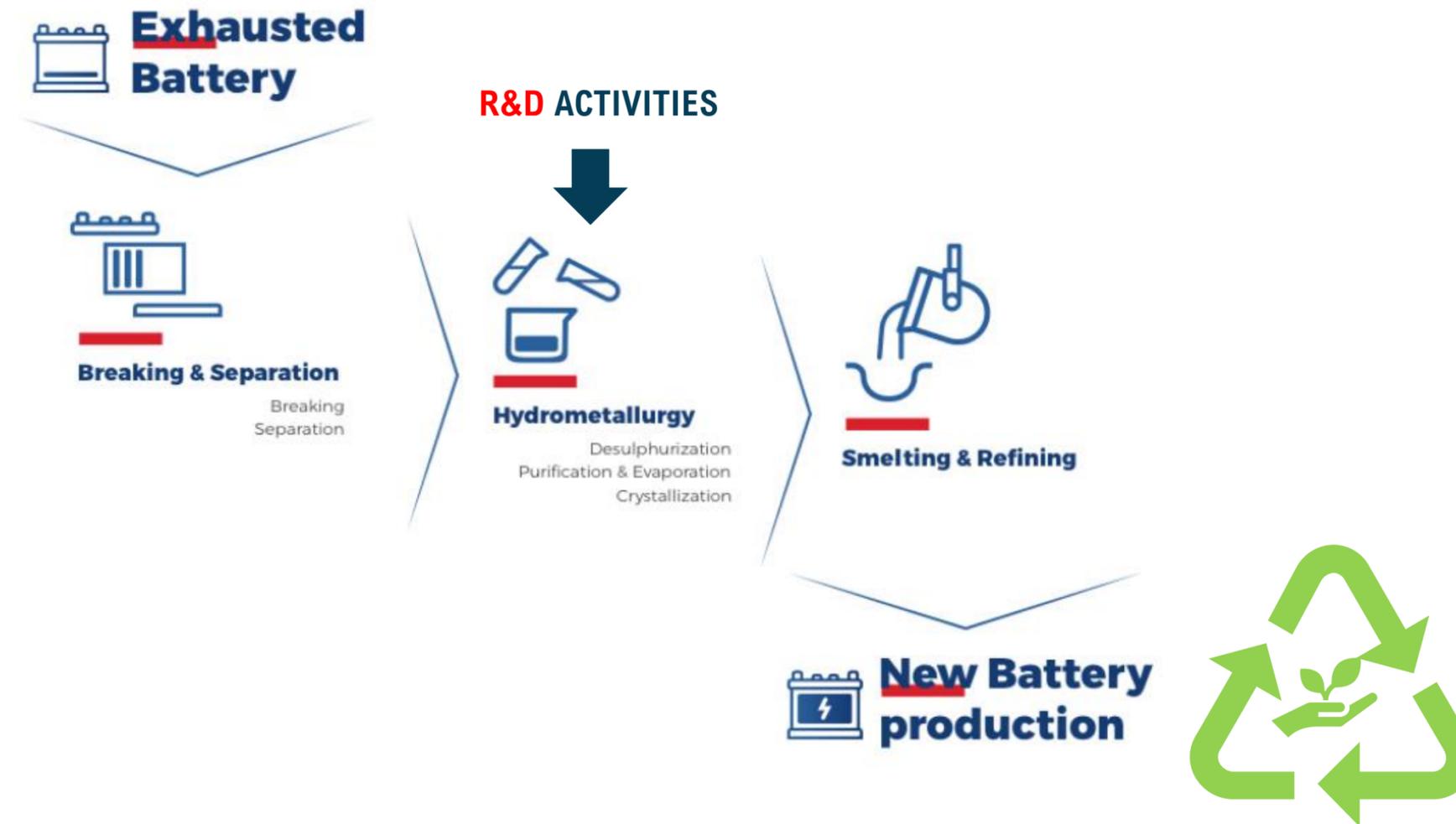


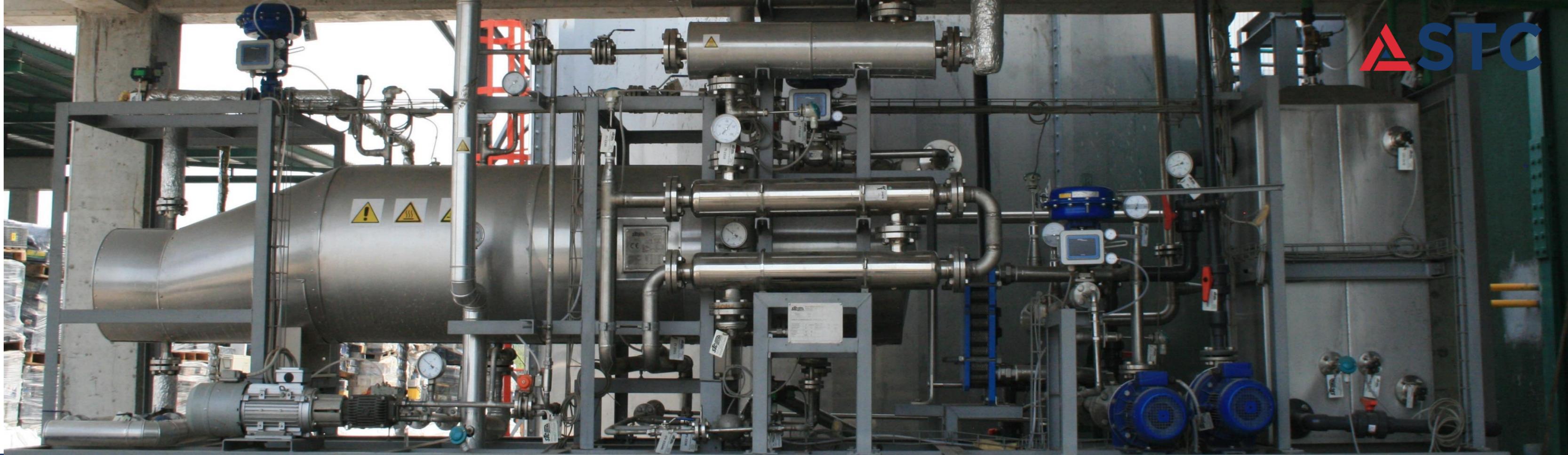
Fine metallic fraction

Some of our **Plug&Play** solutions, easy to install and to integrate into **existing** ULAB recycling plants as well as into **green-field** projects.

# OUR **INNOVATIONS** in the **Lead** Division

STC's aim is to introduce innovative technologies in all the fields of operation in order to ensure a greener and cleaner TOMORROW





# U4Lead

# IMPROVEMENTS OF DESULPHURIZATION STEP THROUGH U4Lead PROCESS

The U4Lead process by STC uses an amino compound, namely Urea, as chemical for the desulphurization of paste and electrolyte neutralization process.

The simplified reaction can be summarized as follows:



# U4lead: protected by patent

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International Bureau



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**Published:**

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- in black and white; the international application as filed contained color or greyscale and is available for download from PATENTSCOPE

(54) Title: PROCESS FOR THE DESULPHURIZATION OF MATERIALS AND/OR RESIDUES CONTAINING LEAD SULPHATE EMPLOYING AN AMINO COMPOUND

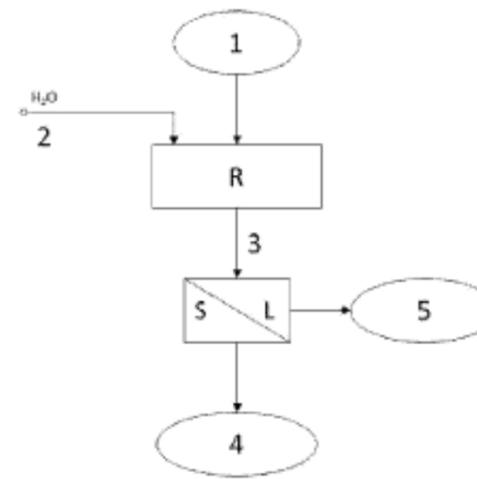
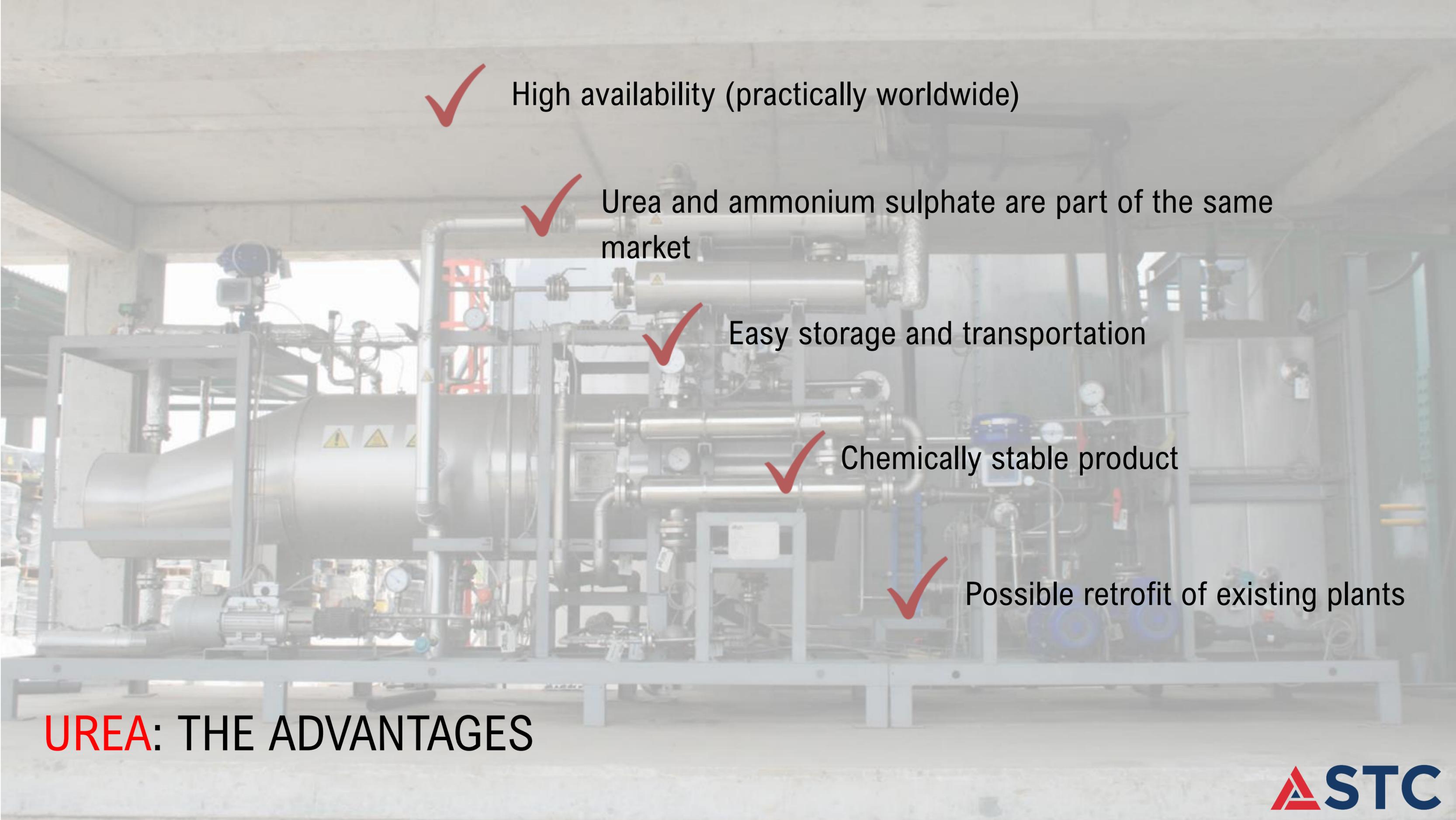


Fig.1

(57) Abstract: The present invention claims a process for the desulphurization of materials and/or residues containing lead sulphate, carried out in one or more stages. The main characteristic of this process is that the only desulphurising agent is an amino compound selected among urea, guanidine, guanine, arginine or another similar amino compound.

This innovative technology is protected by National and International patent PCT n. WO2019/215770

WO 2019/215770 A1

The background image shows a complex industrial facility with various pipes, tanks, and machinery. Five red checkmarks are placed over the image, each pointing to a text overlay that lists an advantage of urea. The text is as follows:

✓ High availability (practically worldwide)

✓ Urea and ammonium sulphate are part of the same market

✓ Easy storage and transportation

✓ Chemically stable product

✓ Possible retrofit of existing plants

## UREA: THE ADVANTAGES

# DESULPHURIZATION VIA AMINO-COMPOUNDS

## MAIN ADVANTAGES

- $\text{PbSO}_4$  conversion **>97%** → low residual Sulphur (< 0.3%)
- No side reactions → no Sodium/Lead double salts formation
- Further reduction of iron addition → less slag production, natural gas/oxygen consumption, etc.
- Ammonium sulphate valuable as **fertilizer**
- No  $\text{Na}_2\text{S}$  for solution purification

# AMMONIUM SULPHATE: A **PRECIOUS** BY-PRODUCT

- Already produced and sold by other lead production companies
- Very low affinity with Lead, Nickel, Arsenic and other heavy metals
- May be crystallized and sold as solid fertilizer
- Can also be sold in liquid form for fertigation applications → Possibility to avoid crystallization

Species	Ammonium sulphate in solution, mg/L	Ammonium sulphate in crystal form mg/kg	Maximum contaminants in an organic fertilizer, mg/kg (see Regulation EU2019/1009, for inorganic fertilizers)
$(\text{NH}_4)_2\text{SO}_4$	120-180 g/L (can be increased through evaporation)	Purity >99,5%	
Pb <sup>++</sup>	< 5 mg/L	<5 mg/kg	120
Ni <sup>++</sup>	<3.0 mg/L	<5 mg/kg	50
As <sup>+++</sup>	<2.0 mg/L	<2 mg/kg	40
Cu <sup>++</sup>	< DL	< DL	600
Zn <sup>++</sup>	< DL	< DL	500

# THE INDUSTRIAL CASE



UREA CONVERSION SYSTEM

# U4LEAD as part of a bigger project



**Project info:** Design, construction and supply of a spent lead acid battery recycling plant, including desulphurization of lead paste and a smelting & refining area

**Client Name:** GREEN RECYCLING INDUSTRIES Ltd.

**Location:** Agbara, Ogun State – Nigeria

**Capacity:** 5 ton/h battery input or 36.000 t/year



And two more EU plants under development

# Comparison/summary

Data referred to 1 ton of SLI batteries treated full of electrolyte (15% of H <sub>2</sub> SO <sub>4</sub> ) with a total average Pb recovery of 56%.	No desulphurization*	Desulphurization with Na <sub>2</sub> CO <sub>3</sub>	Desulphurization with NaOH	Desulphurization with U4Lead Process by STC
<b>Paste characteristics</b>				
Insoluble Sulphur %	6,2%	0,5%	0,5%	0,3%
Na content	--	2,5%	2,5%	--
<b>Chemicals consumption</b>				
Na <sub>2</sub> CO <sub>3</sub> kg/t	--	130	--	--
NaOH kg/t (100%)	--	--	100	--
(NH <sub>2</sub> ) <sub>2</sub> CO, kg/t	--	--	--	75
<b>By Products production</b>				
Na <sub>2</sub> SO <sub>4</sub> kg/t	--	150	150	--
(NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub> kg/t	--	--	--	145
<b>Smelting parameters and Chemicals for paste smelting (soda slag)</b>				
Iron kg/t	50	10	10	5
Coal kg/t	20	20	20	20
Soda ash kg/t	20	15	15	10
Batch time h	6	5,5	5,5	5
Fuel consumption (CH <sub>4</sub> ) Nm <sup>3</sup> /t	45	37	37	34
Oxygen consumption Nm <sup>3</sup> /t	90	74	74	68
<b>Environment impact</b>				
Typical SO <sub>2</sub> concentration at stack mg/Nm <sup>3</sup>	600-800	100	100	80

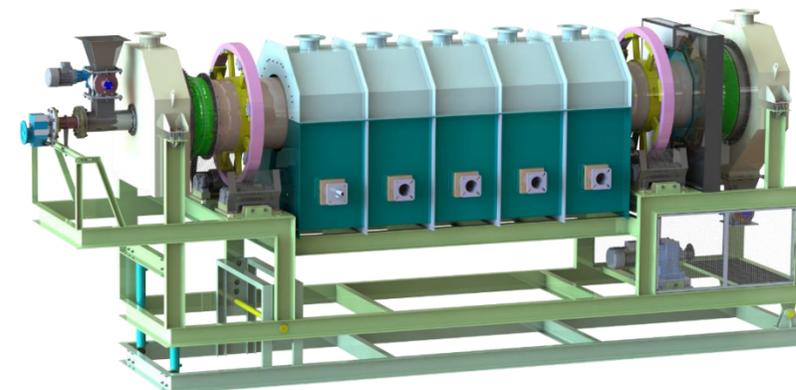
BEST ADVANTAGE → SELLING PRICE OF AMMONIUM SULPHATE



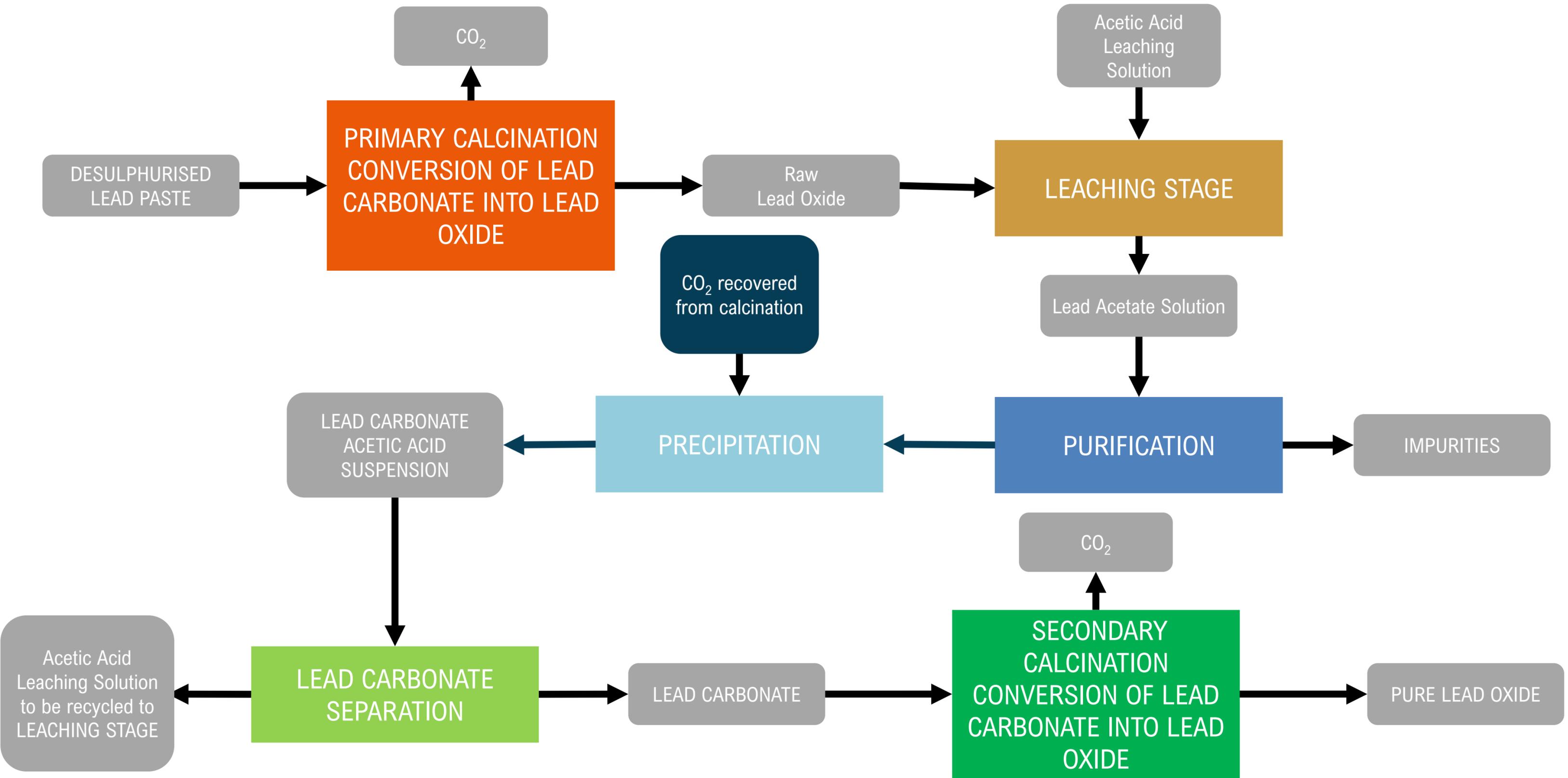
Lead Oxide Regeneration Unit – Pilot Plant

**BUILDING A BETTER TOMORROW**

From U4LEAD to LEAD<sup>3</sup>



# STC INNOVATIVE LEAD<sup>3</sup> PROCESS





Conversion of Lead Paste into pure lead



Production of Lead ingots or lead cylinders



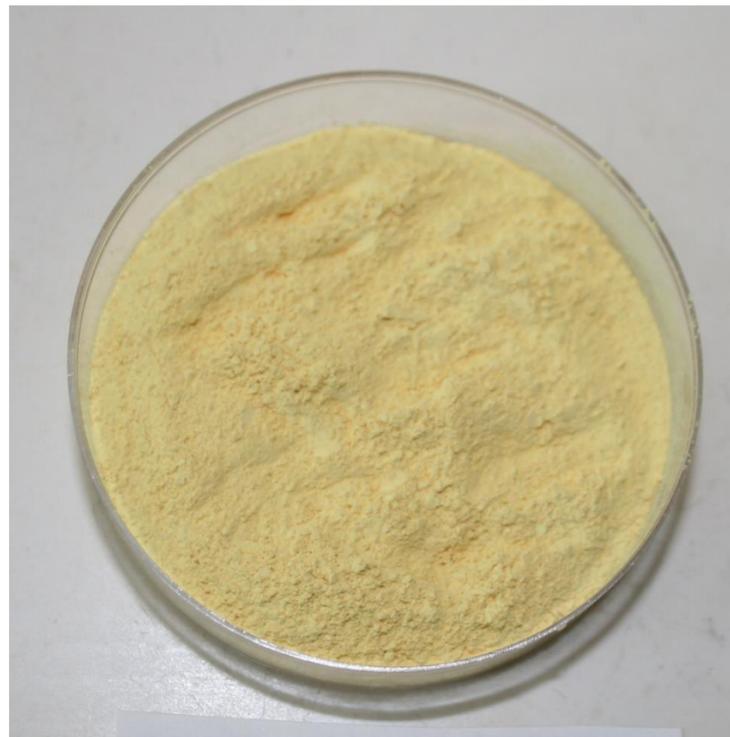
Conversion of lead into lead oxide using Ball Mills or Barton Process

**ELIMINATION OF 3 STEPS FROM  
TRADITIONAL PROCESS**

# Lead Oxide Types



Minium - Red Lead



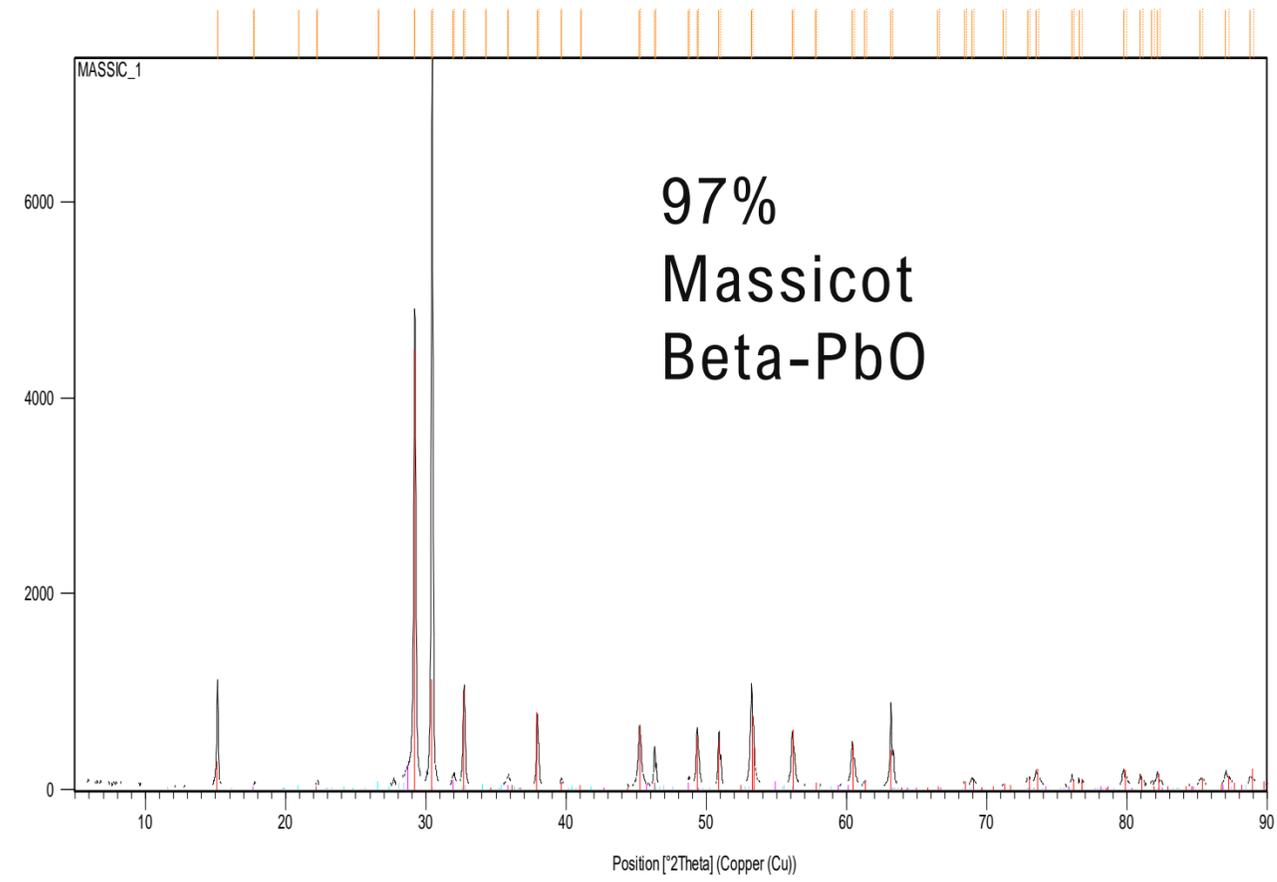
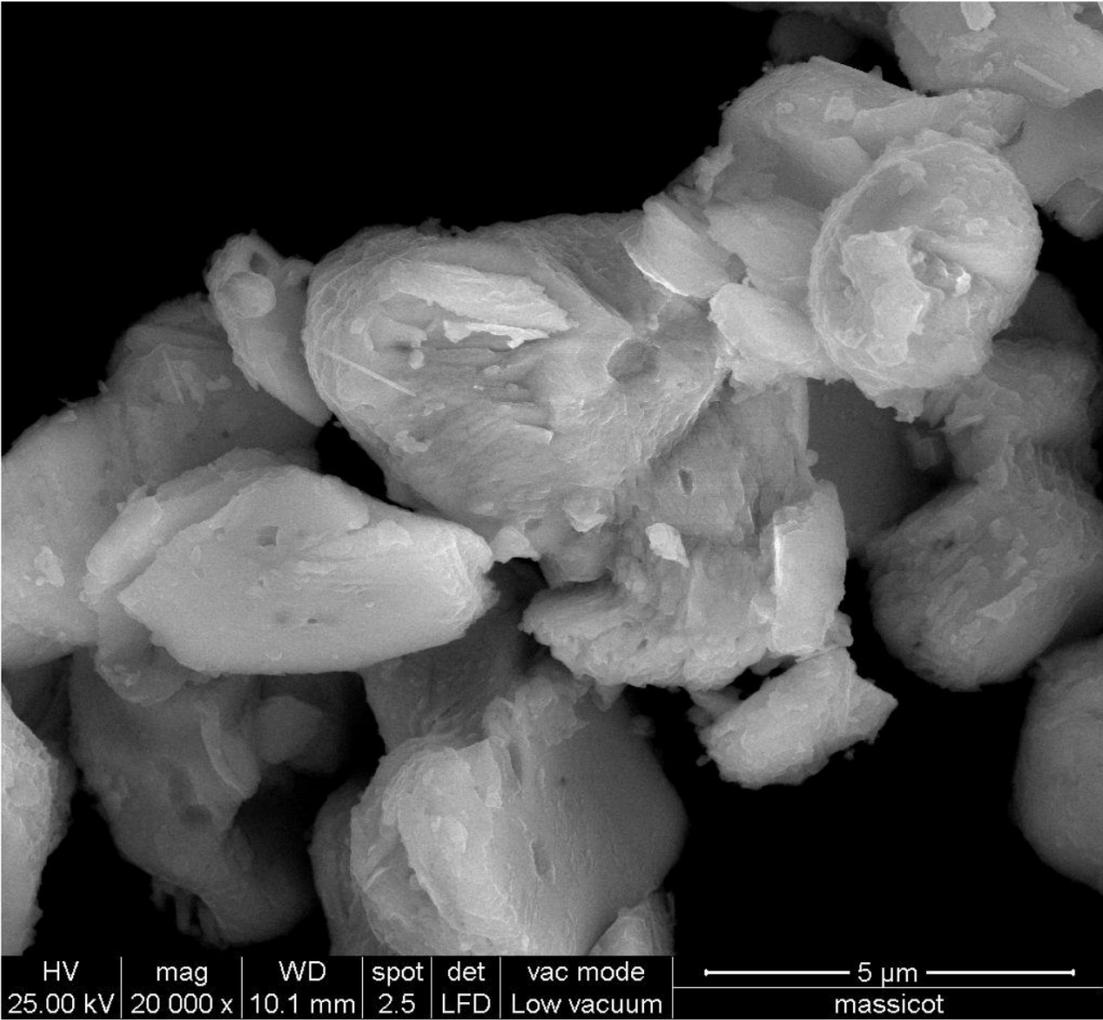
Massicot - Beta



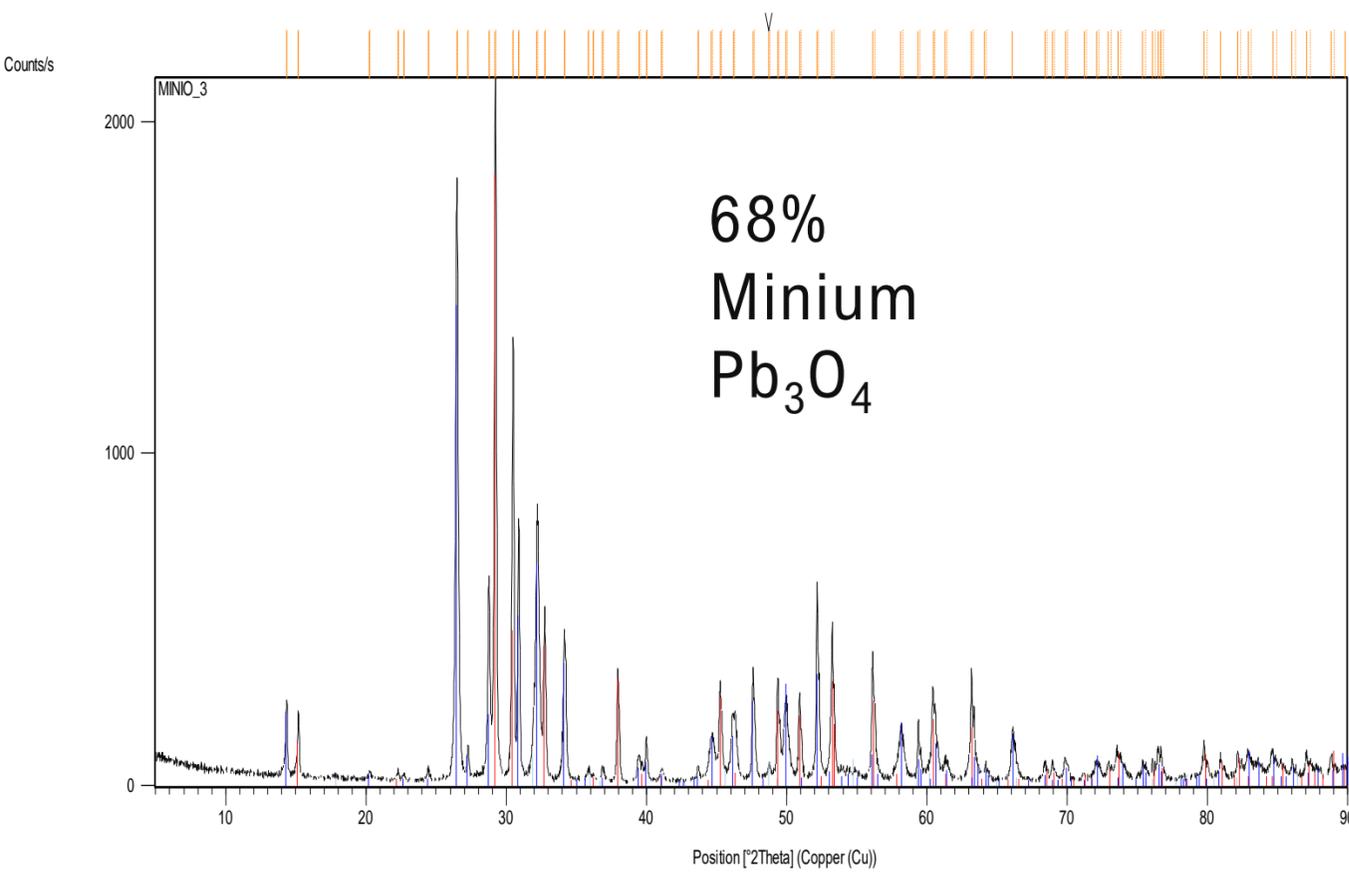
Litharge - Alpha

# STC Lead Oxide: **MASSICOT** BETA-PbO

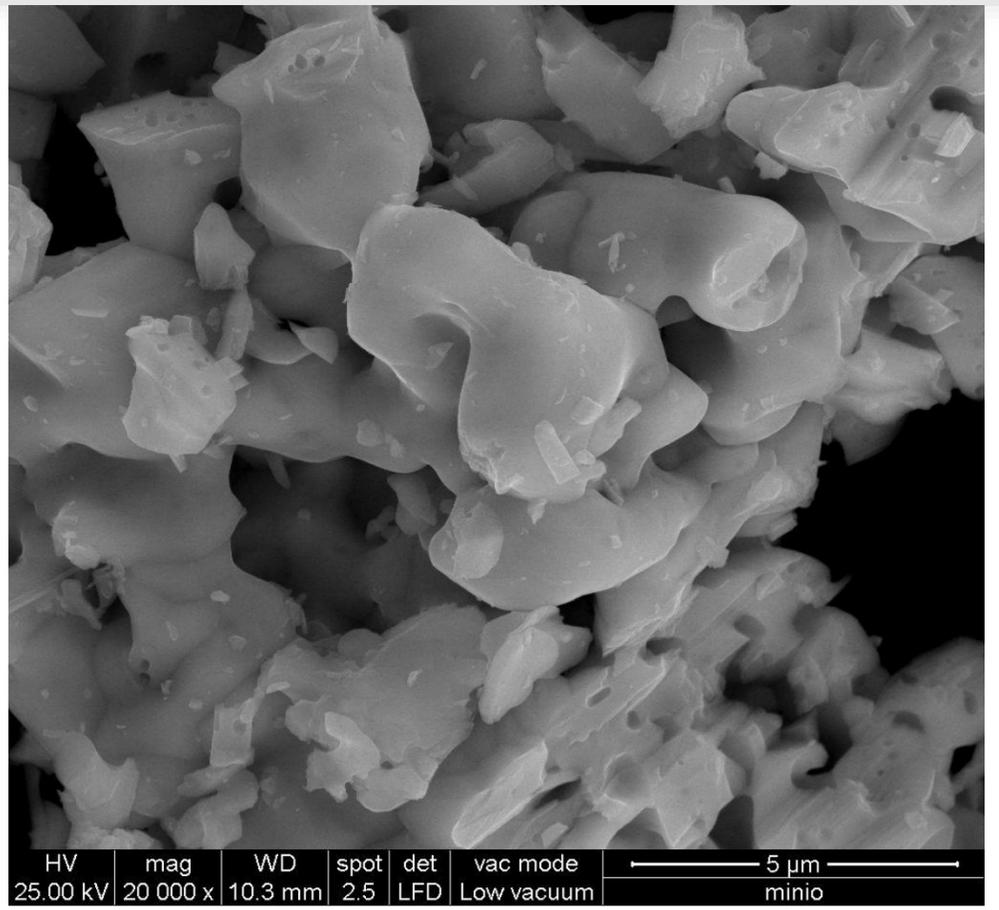
Elements	%
S	0,008
Si	0,003
Sb	----
Fe	0,012
Mg	----
Sn	----
Ag	----
Al	----
As	----
Ba	0,003
Bi	----
Cd	----
Co	----
Cr	----
Cu	----
Hg	----
Mn	0,0005
Ni	0,006
Zn	----



# STC Lead Oxide: **MINIUM** $Pb_3O_4$



Elements	%
S	0,004
Si	0,004
Sb	----
Fe	0,006
Mg	----
Sn	----
Ag	----
Al	----
As	----
Ba	0,005
Bi	0,006
Cd	----
Co	----
Cr	----
Cu	----
Hg	----
Mn	0,0004
Ni	0,0005
Zn	----



1000 STC BATTERIES PRODUCED: LEAD<sup>3</sup>



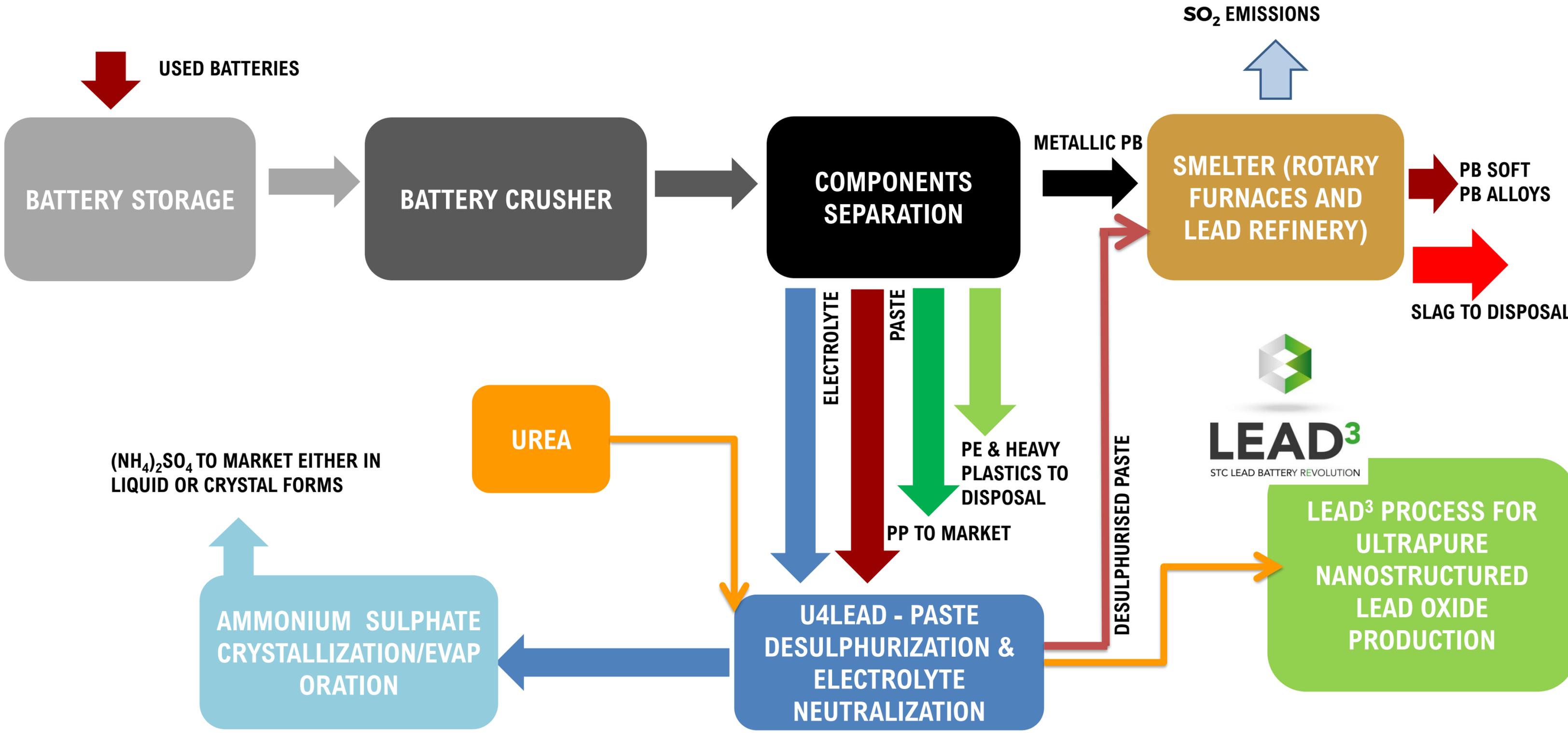
A new semi-industrial Lead3 plant is under development



# THE IMPORTANCE OF **CIRCULAR** **ECONOMY**

From exhausted batteries directly to  
NEW BATTERY PRODUCTION

# TWO OPTIONS AFTER BATTERY BREAKING:



BATTERY RECYCLING WITH INNOVATIVE "U4Lead" and "Lead<sup>3</sup>" PROCESS



# Thanks to a strategic cooperation agreement, a **THIRD OPTION** is now available



ACE makes available its Zero Emission Technology and STC will act as main contractor and system integrator.

STC will provide the manufacturing of recycling equipment as well as the overall engineering and project management activities and will integrate it with ACE's technologies for lead and lithium-ion batteries.



STC and ACE will also explore opportunities for licensing and co-marketing their battery recycling technologies



**MONBAT**  
RECYCLING

**MECA** S.R.L.  
NEW  
**CCA**  
NEW MECA S.R.L.

**GREEN**  
RECYCLING

**ENTERRA**

**PIOMBIFERA ITALIANA**



**RCX**  
Recylex Group

**ASTC**

**KOVOHUTĚ**  
Příbram

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“Technological solutions inspired by Innovation”

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**Arab Lead Company L.L.C**  
Smart Recycling Made Easy

**Batteries**  
**NOUR**  
part of MONBAT GROUP

**I** Industriepark und  
**V** Verwertungszentrum  
**H** Harz GmbH

**KCM 2000** GROUP

**MOURA**

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