Pb 2025 JUNE 25-27 ASTC

U4Lead: Revolutionising Lead Desulphurisation:

From existing process to high-margin opportunity

In the next 10 minutes we'll explore STC's patented U4Lead process:

we'll reveal how this innovation transforms traditional lead paste desulphurisation, delivering remarkable advantages for your operations.

We will show how an existing process can be transformed into a highly profitable one and how a simple retrofit can revolutionize your existing facilities.

ASTC

Giorgio La Sala

Alberto Bergamaschini

Paste Desulphurization: the advantages

The main benefits of the paste desulphurization process in a battery recycling plant are the following:

Process optimization

- Lower smelting temperature of desulphurized paste;
- Lower Sulphur in the desulphurized paste (typically 0,6-0,7%);
- Easier formation of iron-soda matte;
- Good quality of obtained slag;
- Easier refining operation (time reduction);
- Reduction of dross and ashes from refinery to be recycled.

Environmental impact reduction

- Drastic reduction of generated hazardous waste to be transported and disposed of in special landfill sites;
- Reduction of SO_2 emissions -90%;
- Less fossil fuel consumption (oil or natural gas etc.);
- Less CO_2 generated because of fuel consumption reduction;
- No liquid effluents as the process is Zero liquid discharge : the condensate is reused inside the plant;
- No need for an external electrolyte neutralization as the H2SO4 can be converted into Na2SO4 in the same time;

Savings in production costs

- Reduction of slags generated (-65%) – hazardous waste to be transported and disposed of in special landfill sites at high cost;
- Less fluxants required and particularly iron consumption is reduced by 90%;
- Less fuel required (-15%);
- Less oxygen required (-15%) when using oxy-fuel burners;
- Higher productivity;
- Faster cycle;
- Smaller furnace; (or higher productivities for existing RF's
- Less lead lost with slags;
- Revenue from sodium sulphate covers some of the additional costs (chemicals and energy).

The Traditional Chemistry

The chemistry of the traditional desulphurization is relatively simple and consists in the reaction between an alkali chemical (Na_2CO_3 or NaOH) and the lead sulphate ($PbSO_4$) that is converted into Lead carbonate ($PbCO_3$) or lead hydroxide $Pb(OH)_2$.

The simplified overall reactions involved are the following:

$$PbSO_4 + Na_2CO_3 \rightarrow PbCO_3 + Na_2SO_4$$

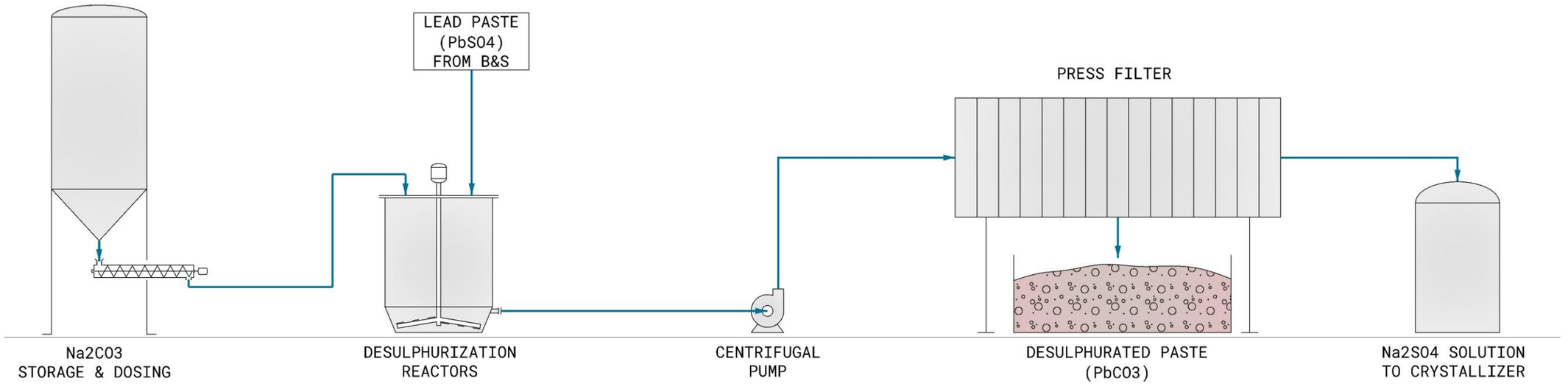
$$PbSO_4 + 2NaOH \rightarrow Pb(OH)_2 + Na_2SO_4$$

The sodium sulphate solution Na_2SO_4 obtained as by product from the reaction, after a purification step (necessary to remove the contamination from heavy metals), can be crystallized to produce pure sodium sulphate that can be sold to detergent, glass, textile and paper industries.

1 kg of Sodium Carbonate → 1,34 kg of Sodium Sulphate

1 kg of Sodium Hydroxide → 1,77 kg of Sodium Sulphate

The Equipment Involved



The equipment required for the desulphurization process consists of stirred reactors, pumps, Na_2CO_3 dosing system, filter press. Generally, the sodium sulphate solution is afterwards crystallized in a crystallization unit.

The Equipment Involved

Na_2CO_3 dosing system

Stirred reactors

Filter Press

Problems with Traditional Desulphurization

The main issues related to the traditional desulphurization process are:

1. The demand for sodium sulphate, one of the main filler components used in washing powder production, has become weaker with the advent of liquid detergents and the sale price has consequently decreased.

2. The quality of the available sodium carbonate (which normally contains chlorides) imposes the use of special construction materials like AISI 904L or DUPLEX for heat exchanger and crystallizers in order to avoid the corrosion problems caused at high temperature in presence of chlorides.

3. The cost of the chemicals increased a lot during recent years (NaOH is a by-product of the chloro-alkali process and with the reduction of chlorine uses the cost of caustic soda in certain countries increased) thus making the overall process more expensive.
4. The sodium sulphate solution requires a further expensive purification step to remove dissolved Heavy Metals

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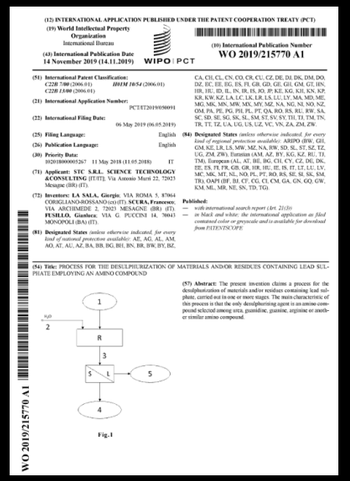
U4Lead Patented Process by STC



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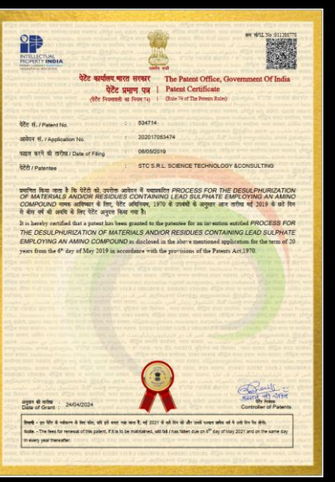
(54) Title: PROCESS FOR THE DESULPHURIZATION OF MATERIALS AND/OR RESIDUES CONTAINING LEAD SULPHATE EMPLOYING AN AMINO COMPOUND

(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 desulphurizing agent is an amino compound selected among urea, guanidine, guanine, arginine or another amino compound.



WO 2019/215770 A1

Fig. 1

पेटेंट कार्यालय भारत सरकार
पेटेंट प्रमाण पत्र

The Patent Office, Government Of India
Patent Certificate

(See 71 of the Patents Rules)

पेटेंट सं. / Patent No. : 534714

आवेदन सं. / Application No : 202017083474

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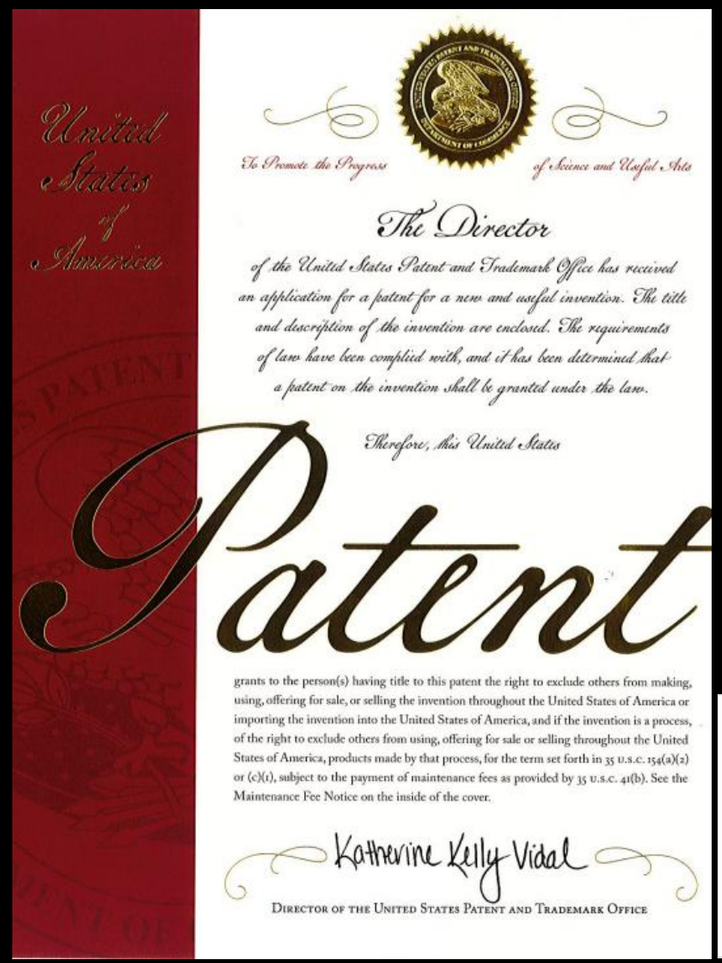
पेटेंटी / Patentee : STC S.R.L. SCIENCE TECHNOLOGY &CONSULTING

एतद्वारा दिया जाता है कि पेटेंट की उपरोक्त आवेदन में यथासंशोधित PROCESS FOR THE DESULPHURIZATION OF MATERIALS AND/OR RESIDUES CONTAINING LEAD SULPHATE EMPLOYING AN AMINO COMPOUND नाम्नी आविष्कार के लिए, पेटेंट अधिनियम, 1970 के उपबंधों के अनुसार आज तारीख 06/ 2019 से 20 वर्ष की अवधि के लिए पेटेंट अनुदान किया गया है।

It is hereby certified that a patent has been granted to the patentee for an invention entitled PROCESS FOR THE DESULPHURIZATION OF MATERIALS AND/OR RESIDUES CONTAINING LEAD SULPHATE EMPLOYING AN AMINO COMPOUND as disclosed in the above mentioned application, for the term of 20 years from the 6th day of May 2019 in accordance with the provisions of the Patents Act,1970.

अनुदान की तारीख / Date of Grant : 24/04/2024

Controller of Patents



United States of America

To Promote the Progress of Science and Useful Arts

The Director

of the United States Patent and Trademark Office has received an application for a patent for a new and useful invention. The title and description of the invention are enclosed. The requirements of law have been complied with, and it has been determined that a patent on the invention shall be granted under the law.

Therefore, this United States

Patent

grants to the person(s) having title to this patent the right to exclude others from making, using, offering for sale, or selling the invention throughout the United States of America or importing the invention into the United States of America, and if the invention is a process, of the right to exclude others from using, offering for sale or selling throughout the United States of America, products made by that process, for the term set forth in 35 U.S.C. 154(a)(2) or (c)(1), subject to the payment of maintenance fees as provided by 35 U.S.C. 41(b). See the Maintenance Fee Notice on the inside of the cover.

Katherine Kelly Vidal

DIRECTOR OF THE UNITED STATES PATENT AND TRADEMARK OFFICE

РОССИЙСКАЯ ФЕДЕРАЦИЯ

ПАТЕНТ

НА ИЗОБРЕТЕНИЕ

№ 2792648

СПОСОБ ДЕСУЛЬФУРИЗАЦИИ МАТЕРИАЛОВ И/ИЛИ ОСТАТКОВ, СОДЕРЖАЩИХ СУЛЬФАТ СВИНЦА, С ИСПОЛЬЗОВАНИЕМ АМИННОГО СОЕДИНЕНИЯ

Патентообладатель: *СТК С.Р.Л. САЙЕНС ТЕКНОЛОДЖИ ЭНД КОНСАЛТИНГ (IT)*

Авторы: *ЛА ЗАЛА, Джорджио (IT), СКУРА, Франческо (IT), ФУЗИЛЛО, Джанлука (IT)*

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Срок действия исключительного права на изобретение истекает 06 мая 2039 г.

Руководитель Федеральной службы по интеллектуальной собственности

Ю.С. Зубов

Economia | IMPI

TÍTULO DE PATENTE No. 420020

SOLICITUD

PRIORIDAD

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EMELIA HERNÁNDEZ PRADO

LETTERS PATENT

INVENTION

PATENT NO. 1/2020/501602

THE DESULPHURIZATION OF MATERIALS AND/OR RESIDUES CONTAINING LEAD SULPHATE EMPLOYING AN AMINO COMPOUND

INTELLECTUAL PROPERTY OFFICE OF THE PHILIPPINES
Bureau of Patents

REPÚBLICA FEDERATIVA DO BRASIL
MINISTÉRIO DO DESENVOLVIMENTO, INDÚSTRIA, COMÉRCIO E SERVIÇOS
INSTITUTO NACIONAL DA PROPRIEDADE INDUSTRIAL

CARTA PATENTE Nº BR 112020022308-5

O INSTITUTO NACIONAL DA PROPRIEDADE INDUSTRIAL concede a presente PATENTE DE INVENÇÃO, que outorga ao seu titular a propriedade da invenção caracterizada neste título, em todo o território nacional, garantindo os direitos dela decorrentes, previstos na legislação em vigor.

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(54) Título: PROCESSO PARA A DESSULFURIZAÇÃO DE MATERIAIS E/OU RESÍDUOS QUE CONTÊM SULFATO DE CHUMBO AO EMPREGAR UM AMINO COMPOSTO

(73) Titular: STC S.R.L. SCIENCE TECHNOLOGY &CONSULTING. Pessoa Jurídica. Endereço: VIA ANTONIO MURRI 22 72023 MESAGNE (BR), ITÁLIA(IT), Italiana

(72) Inventor: GIORGIO LA SALA; FRANCESCO SCURA; GIANLUCA FUSILLO.

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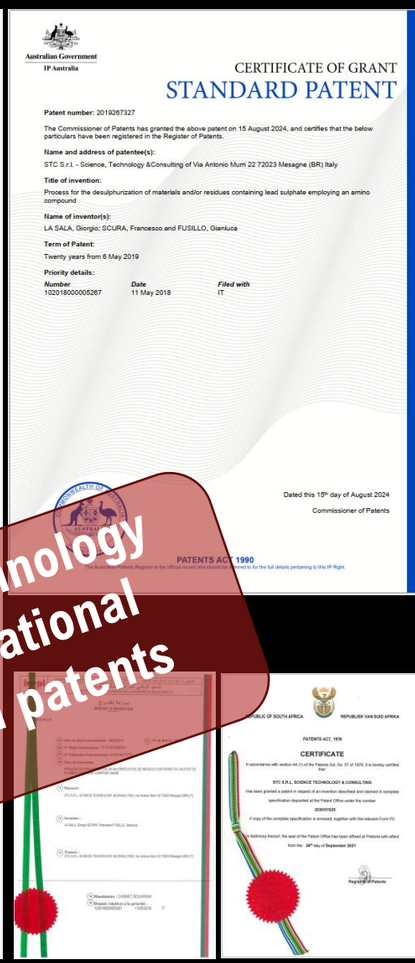


Australian Government
IP Australia

CERTIFICATE OF GRANT
STANDARD PATENT

Patent number: 2019267327

The Commissioner of Patents has granted the above patent on 15 August 2024, and certifies that the below particulars have been registered in the Register of Patents.

Name and address of patentee(s):
STC S.r.l. - Science, Technology &Consulting of Via Antonio Murri 22 72023 Mesagne (BR) Italy

Title of invention:
Process for the desulphurization of materials and/or residues containing lead sulphate employing an amino compound

Name of inventor(s):
LA SALA, Giorgio; SCURA, Francesco and FUSILLO, Gianluca

Term of Patent:
Twenty years from 6 May 2019

Priority details:

Number	Date	Filed with
102018000005267	11 May 2018	IT

Dated this 15th day of August 2024

Commissioner of Patents

PATENTS ACT 1990

REPUBLIC OF SOUTH AFRICA

PATENTS ACT, 1978

CERTIFICATE

In accordance with section 44 (1) of the Patents Act, No. 57 of 1978, it is hereby certified that:

STC S.R.L. SCIENCE TECHNOLOGY & CONSULTING

Has been granted a patent in respect of an invention described and claimed in complete specification deposited at this Patent Office under the number

2020/07025

A copy of the complete specification is annexed, together with the relevant Form P2.

In testimony thereof, the seal of the Patent Office has been affixed at Pretoria with effect from the 28th day of September 2021

Registrar of Patents

This innovative technology is protected by National and International patents

...and it is about to be granted in many more Nations around the World!

U4Lead Innovative Process

STC has developed and patented an innovative desulphurization process in order to overcome the problems of the chemicals cost/quality and the relatively poor market for sodium sulphate, ensuring at the same time all the advantages of the desulphurization 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:

$$CO(NH_2)_2 + PbSO_4 + 2H_2O \rightarrow PbCO_3 + (NH_4)_2SO_4$$

As by product, pure Ammonium Sulphate is obtained: this chemical has a very good market and can be sold in liquid form or in crystals as fertilizer for agriculture.

1 kg of Urea → **2,2 kg of Ammonium Sulphate**

Key Advantages of U4Lead Process

All the advantages of the traditional desulphurization are maintained and furtherly improved and in particular:

- The process is faster than using Na_2CO_3 thus allowing a reduction of reactors volume or higher efficiency
- The desulphurization level obtained is higher than the traditional process (0,3-0,5% of remaining Sulphur)
- Further reduction of slag generation (only 5-6% on Pb produced!) and associated lead losses are achieved
- Further reduction of Iron usage in the charge for Rotary Furnaces
- UREA is normally cheaper than other reagents and is worldwide largely available
- The by-product obtained is ammonium sulphate that could be used and sold as fertilizer in liquid or crystals form: the selling price is much higher than sodium sulphate
- UREA does not involve any environmental, pollution and safety problems for workers during transport, storage and handling
- Ammonium Sulphate is already produced and sold by other lead production companies (e.g. Teck, East Penn)
- Ammonium Sulphate has a very low affinity with Lead, Nichel, Arsenic and other heavy metals so there is no need for purification step
- Ammonium Sulphate may be crystallized and sold as solid fertilizer but it can also be sold in liquid form for fertigation applications, thus avoiding the cost associated with crystallization unit

Ammonium Sulphate Usage

Fertilizer - The primary use of ammonium sulfate is as a fertilizer for alkaline soils. In the soil the ammonium ion is released and forms a small amount of acid, lowering the pH balance of the soil, while contributing essential nitrogen for plant growth.

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)
$(NH_4)_2SO_4$	120-180 g/L (can be increased trough evaporation)	Purity >99,5%	
Pb++	< 5 mg/L	<5 mg/kg	120
Ni++	<3.0 mg/L	<5 mg/kg	50
As+++	<2.0 mg/L	<2 mg/kg	40
Cu++	< DL	< DL	600
Zn++	< DL	< DL	500

Financial Model & Feasibility Assessment

A dedicated calculation model is available to assess the feasibility of the proposed process, including OPEX and CAPEX estimation, as well as ROI evaluation. An example referred to a plant processing 40.000 ton/year of batteries with an existing traditional desulphurization process:

Costs Analysis for a Desulphurization plant with Crystallization	Unit	U4LEAD	SODA ASH
MASS BALANCES			
Total ULAB treated batteries	ton/year	48.000	48.000
Working days per year with desulphurization	day/year	300	300
Treated lead paste per year	ton/year	22.080	22.080
Total electrolyte in the ULAB to be neutralized	ton/year	8.640	8.640
Main reagent used for desulphurization/neutralization	-	UREA	SODA ASH
Formula	-	CH_4N_2O	Na_2CO_3
Total quantity of main reagent to be used in the year	ton/year	3.356	5.922
Total production of Ammonium or Sodium Sulphate to be sold	**ton/year**	**7.185**	**7.340**
EXPECTED SAVINGS AND ADDITIONAL REVENUE FROM THE PASTE DESULPHURIZATION IMPLEMENTATION			
Saving of Slag Disposal Costs in case of Desulphurization via Urea			
Slag produced in the smelting furnaces feeded with desulphurized paste	(ton slag /ton paste)	0,060	0,070
Slag produced per year in the smelting furnaces feeded with desulphurized paste	ton/year	1.324,80	1.545,60
Reduction of produced slag with desulphurization process	ton/year	3.091	2.870
Unit price of slag disposal	**€/ton**	**€ 300,00**	**€ 300,00**
Savings for slag disposal	**€**	**€ 927.360,00**	**€ 861.120,00**
Expected revenue from anhydrous salt sulphate sale			
Byproduct (Salt) produced using Desulphurizing/Neutralization plant	formula	$(NH4)_2SO_4$	Na_2SO_4
Byproduct produced using Desulphurizing/Neutralization plant	ton/year	7185	7340
Value of anhydrous Salt sulphate crystals	€/ton	280	80
Sale of anhydrous salt sulphate		**€ 2.011.693,23**	**€ 587.227,39**
Recovery of raw lead from slag			
Value of recovered lead	**€/year**	**€ 306.028,80**	**€ 284.169,60**
TOTAL SAVINGS AND REVENUE DUE TO PASTE DESULPHURIZATION		**€ 2.522.330,03**	**€ 1.061.390,13**

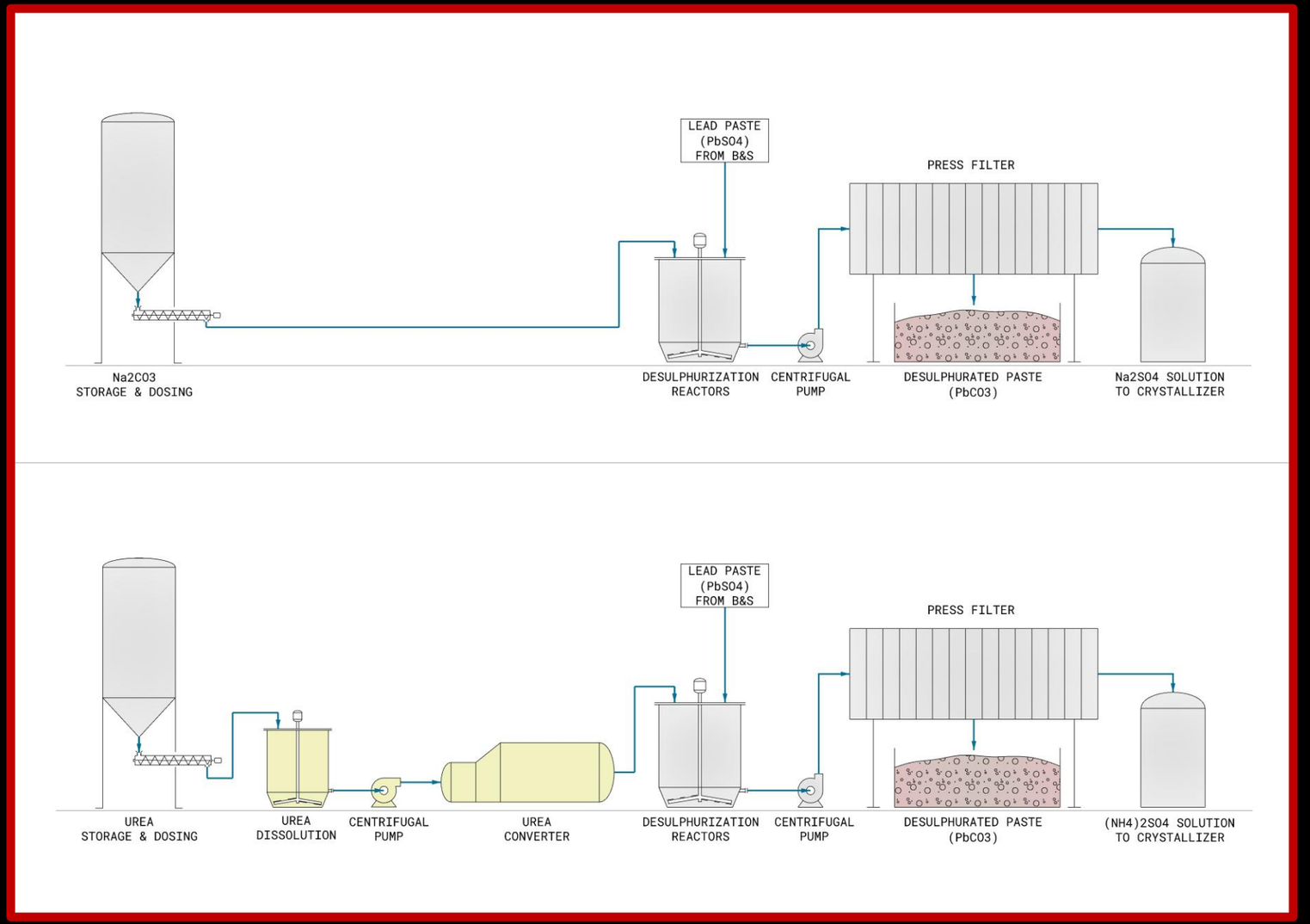
Financial Model & Feasibility Assessment

COSTS DUE TO PASTE DESULPHURIZATION			
LABOUR			
Yearly operation costs		€ 270.000,00	€ 270.000,00
RAW MATERIALS			
Primary Reagent	Name	UREA	SODA ASH
Unitary cost of the primary reagent	€/ton	410	380
Total yearly cost for reagents	(€/year)	€ 1.438.302,54	€ 2.276.625,28
THERMAL ENERGY (GAS LPG)			
Combustible (Natural Gas) necessary in the Urea Converter	Nmc/year	402.703	
Combustible (Natural Gas) Crystallization Area	Nmc/year	211.777	216.630
Total Combustible (Natural Gas) related to Desulphurisation/neutralization Plant	Nmc/year	614.480	216.630
Unit price of combustible (NG)	€/Nmc	€ 0,50	€ 0,50
Total cost of combustible (NG)		€ 307.239,90	€ 108.315,00
ELECTRIC ENERGY			
Power for urea converter	Kw	28	
Power for Crystallization	kw	215	220
Power for desulphurization lead paste	kw	25	25
Electric energy consumption	MW*h/year	1.872	1.705
Electric energy unit price	€/MW*h	€ 160,00	€ 160,00
Total electric energy cost		€ 299.571,16	€ 272.854,04
MAINTENANCE			
Maintenance costs per working day		€ 300,00	€ 200,00
Working days per year		300	300
Increased maintenance, extraordinary repairs, lubricants, detergents for membrans, filters, etc.	€	€ 90.000,00	€ 60.000,00
U4LEAD PATENT LICENSE			
Total cost for royalties per ton of ULAB treated		€ 12,00	€ 0,00
Total cost for royalties to be paid to STC	€	€ 576.000,00	€ 0,00
TOTAL OPERATING COSTS PER YEAR		-€ 2.981.113,60	-€ 2.987.794,33

Financial Model & Feasibility Assessment

CAPEX			
Estimated investment costs for a desulphurization plant of sulphate paste			
Total investment costs for conversion from Sodium Carbonate plant to Urea plant		€ 3.250.000,00	€ 0,00
Local work (site civil works)		€ 200.000,00	€ 0,00
Costs Associated with IPPC Significant changes and REACH Registration of new material		€ 100.000,00	€ 0,00
Total Investment Cost		€ 3.550.000,00	€ 0,00
Depreciation period of the plant		10	10
Amount of depreciation of the STC desulphurization plant		€ 355.000,00	€ 0,00
DELTA SAVINGS (Slag Disposal,Combustible Consumption, Oxygen and Ferrous Scraps)	€ 66.240,00		
DELTA REVENUE (Anhydrous Salt Sulphate Selling, Lead recovered, reduction of furnace use)	€ 1.446.325,04		
DELTA COSTS U4LEAD DESULPHURIZATION VS SODA ASH	€ 6.680,72		
DELTA NET CONTRIBUTION IMPROVEMENT WITH U4LEAD DESULPHURIZATION VS SODA ASH	€ 1.519.245,76		
INVESTMENT PAY BACK FOR SODA ASH PLANT CONVERSION INTO U4LEAD (YEARS)	2,34		

Retrofit with the U4Lead Process



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The New Equipment:

Retrofit Implementation Guide

Preliminary Analysis

Assessment of existing plant compatibility. Identification of modification requirements.

Infrastructure Modifications

Integration of U4Lead system. Adaptation of current equipment.

Staff Training

Safety protocols education. Process management training.

System Launch

Staged implementation. Performance monitoring.

Few words about STC

STC is an Italian EPCM (Engineering Procurement & Construction Management) company which designs and supplies turnkey plants 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.









Smart Engineering for Smarter Clients

STC recently launched a new Global Strategy to support our clients worldwide:

Engineering and process design by STC
Local fabrication and procurement by Clients.

This strategy preserves the excellence of our proprietary process know-how while allowing our partners to:

- Reduce overall investment costs, avoiding high international transport expenses
- Stimulate local economy by involving national contractors and suppliers
- Speed up implementation thanks to quicker availability of manpower and materials
- Ensure faster access to spare parts and local technical support, minimizing downtime (while STC remains ready to provide immediate assistance and remote support)
- Increase engagement and ownership of the project on the client's side

We remain fully available to supply turnkey solutions when required, but we have seen that this modular and collaborative approach is often the most effective way forward – especially for revamping, modernization and cost-sensitive projects. We're excited to bring this model to life in new regions and with new partners.

STC: Your Ideal Implementation Partner

Success Guarantee

Measurable results and guaranteed performance

Expert Team Availability

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Comprehensive Services

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