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RESOURCE & TECHNOLOGY

INNOVATING FCR A GREENER FUTURE

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Introduction to The Process and Equipment for Lead Containing Solid Waste Comprehensive Recycling And Safe Disposal

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CONTENTS

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1

Lead containing waste introduction

Part 1- 1. Lead containing waste types

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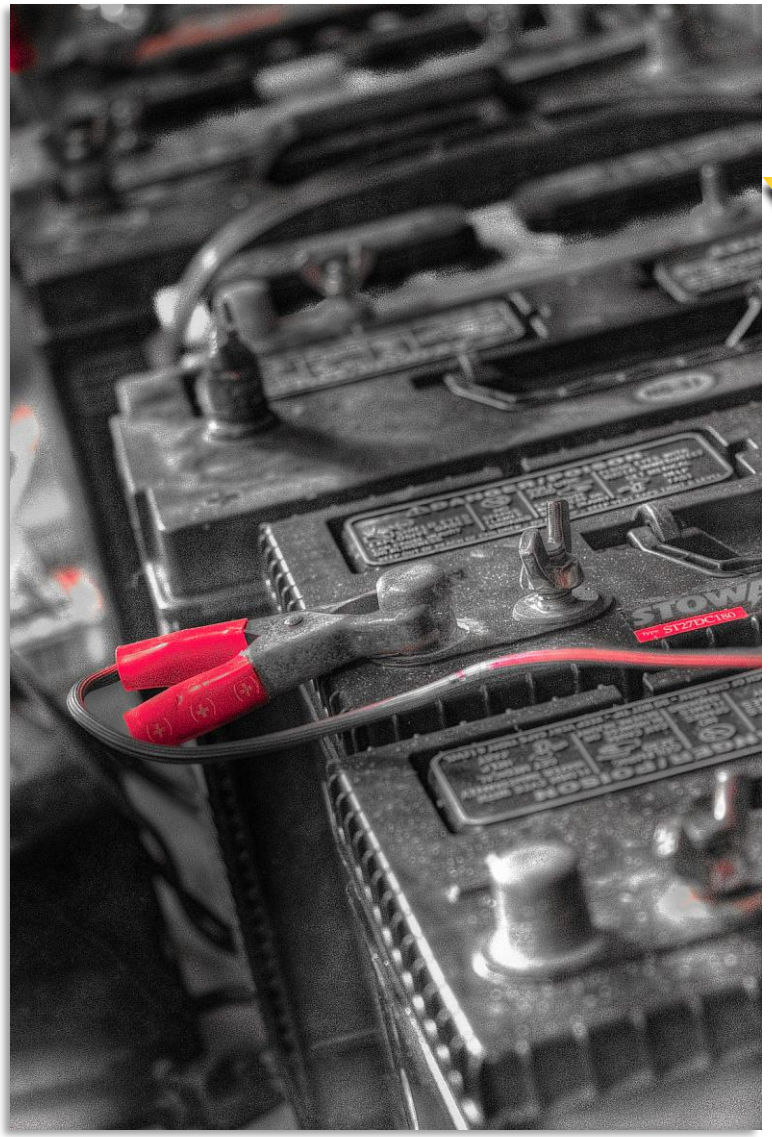

Used Lead-acid Batteries (70%)

Other Lead-containing Waste (30%)

Part 1- 2. Lead containing waste features

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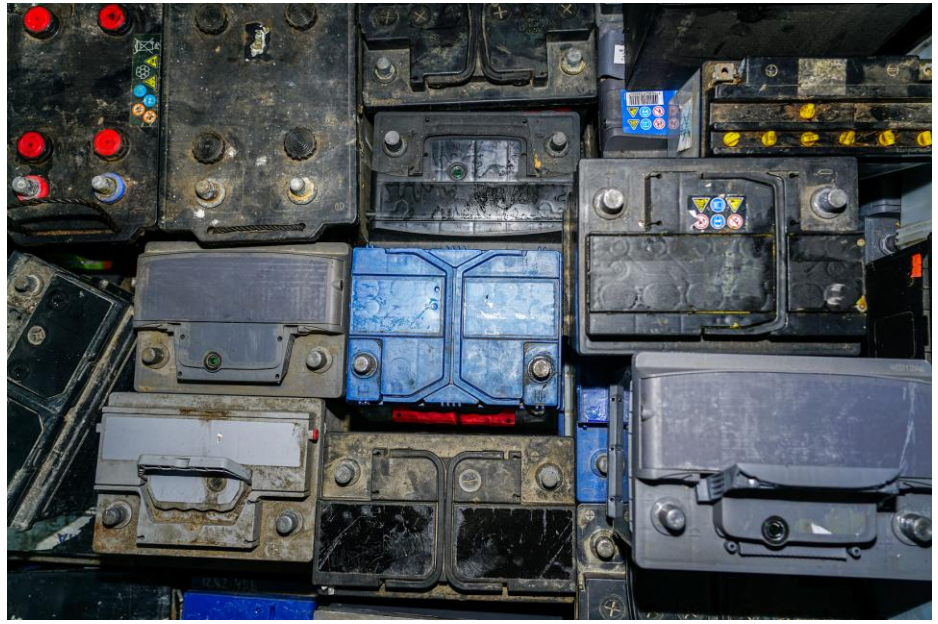
ULAB

ULABs include: Automobile batteries, e-bike/escoot batteries, UPS batteries etc.

80% of lead is used to make differnet types of lead-aicd batteries, so the main source of secondary lead is ULABs.

Features of ULABs

1、High resource value：Lead accounts more than 60% of the total mass of battery, lead can be reused after recycling and has a relatively high economic value.



2、Easy to recycle: Mechanically break, sort through morden system to separate lead paste, grid efficiently. For example, automatic breaking machine line can increase the lead paste purity to 90%+, reduces interference from impuitities during smelting.

Part 1- 2. Lead containing waste features

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Lead containing smelting waste

Source： From copper/lead/zinc/tin/precious metal etc. smelters.

Lead containing in copper / zinc concentrate, during the extraction/smelting lead will become by product in gas or slag status.

Features of lead containing smelting waste

1. The composition of smelting waste is complex, there are various types and the lead grade fluctuates greatly thus its treament becomes difficult. Advanced technologies and methods need to be adopted for safe disposal.

2. Improperly treated smelting hazardous waste can cause long-term pollution to soil, water and air, affecting the balance of the ecosystem and even threaten human health.

Part 1- 3. Challenges of secondary lead industry

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- Increase recovery rate of main metal.
- Reduce energy consumption / CO_2 emission as much as possible
- Reuse energy as much as possible
- Reduce operation cost
- Reduce sanitary landfill as much as possible

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Smelters in China face anticipated shortage of ULABs

1. In 2025 the actual disposal amount of ULABs is far less than designed capacity.

2. Ongoing projects are going to complete and start operation, which indensify the competition.

3.New type of batteries such as Li-on battery occupied some market share of lead acid battery.

4. The purchase price of ULABs increase, while lead market price remain stable, reduce the profit of the plants.

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The Solution in Chinese Secondary Lead Industry

Part 2-1. Strategy target: increase return

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Why?

- Lead recycling technology improvment.
- Cycle rate of lead getting higher.
- Direct profit from lead recycling is reducing.

How?

—— ULABs

- Improve lead recycling rate (lead paste, lead grid)
- Recover S, Sn, Sb, Bi as much as possible
- Reuse other parts such as plastics, copper pole etc.

—— Lead containing smelting waste

- Recover non ferrous metals containing in the waste as much as possible such as Pb, Zn, Au, Ag, Sb, Bi, Cu
- Recover other elements such as S, Hg, Se

—— Method or process?

- Physical & Chemical
- Pyrometallurgy & Hydrometallurgy

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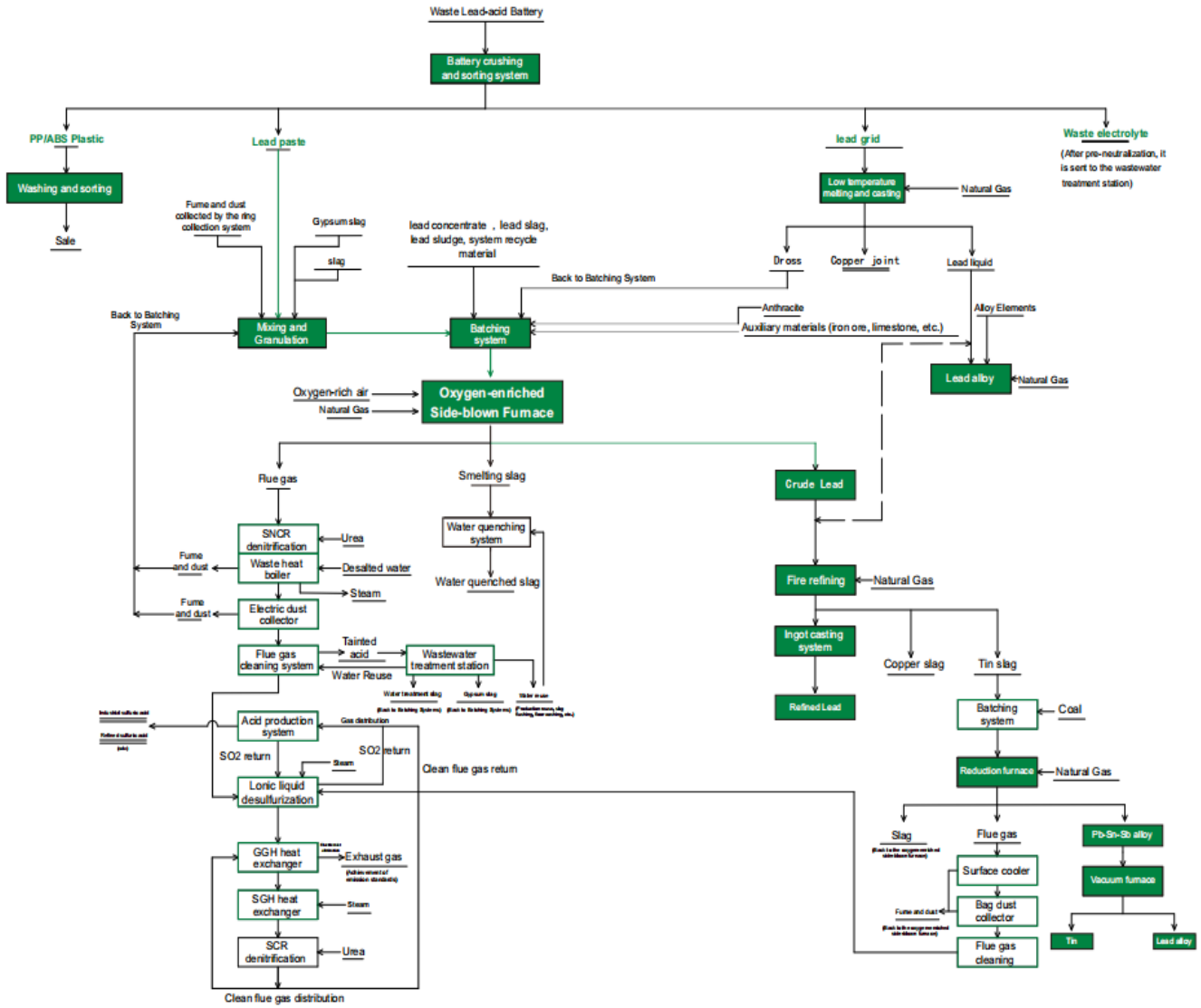
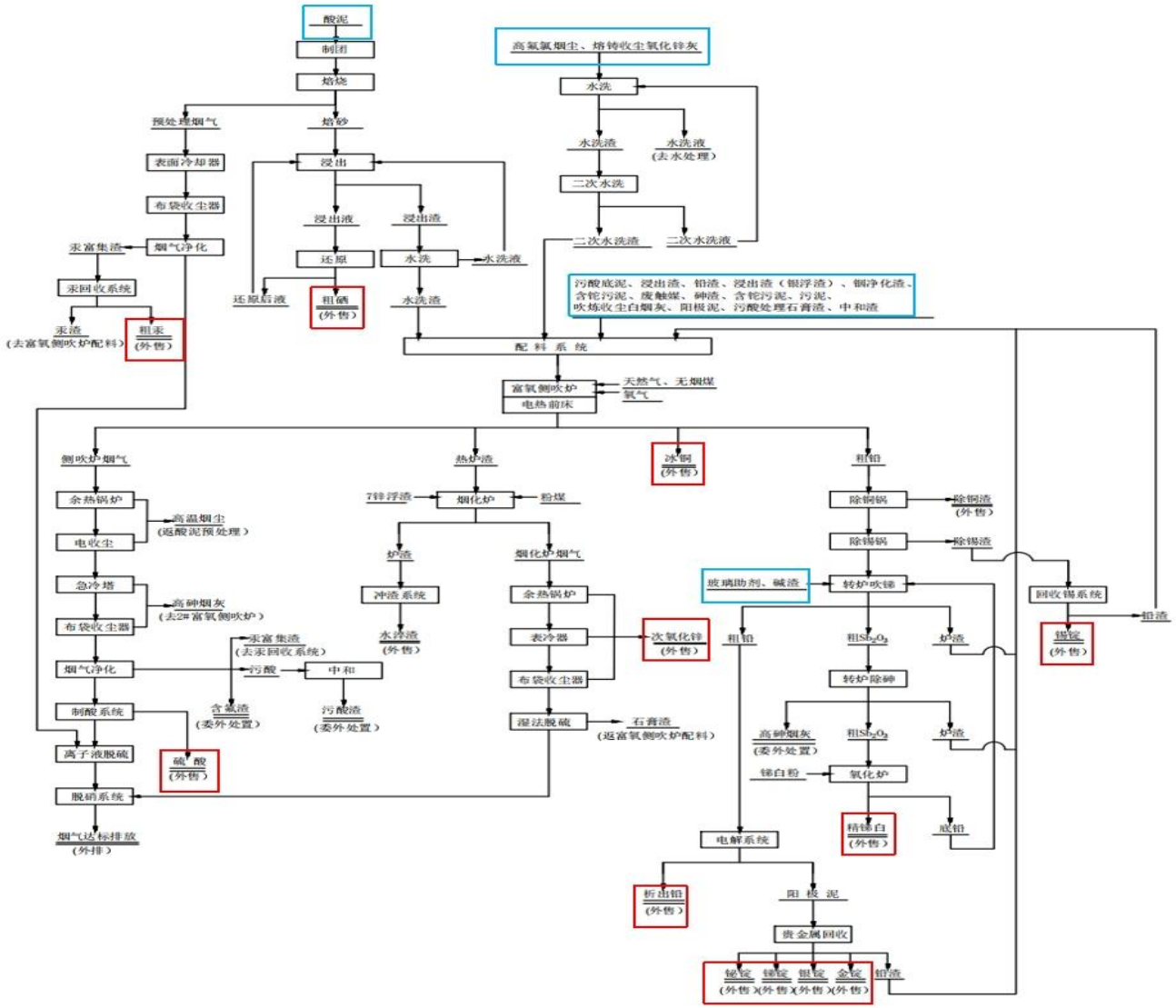
1. ULABs comprehensive recycling

- Widely applied in Chinese lead recycling market.
- ULABs are automatically broken and separate into lead paste, lead grid, plastics and waste electrolyte.
- The plastics: color sorted, extruded for reusing
- The lead paste: directly goes smelting.
- Fire refined lead: sent to battery plant for reuse.
- The refining floating dross: reduced and vaccum distilled to recover Sn, Pb, Sb etc.
- The flue gas: desulfurization, acid making, de-NOx and then discharged meeting standard.
- Metallic lead (lead grid): low temperature smelting to get lead alloy.



2. Lead containing smelting waste compehensive recycling

- All valuable metals are recovered from differnent kinds of lead containing smelting waste through a set of process technology including pyrometallurgy, hydrometallurgy, vacuum distillation etc.
- These metals including: crude mecury, copper matte, crude tin, precipitate lead, zinc hypoxide, gold ingot, silver ingot, bismuth ingot, antimony ingot (or antimony trioxide), H_2SO_4 etc.
- If metals such as platinum, palladium, rhodium and selenium are present in the raw materials, they can also be extracted through process design.



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The adopted equipment

In China,

No matter whether it is the recycling of used lead-acid batteries or the comprehensive recycling of hazardous waste from lead-containing smelting or mixed material, the major smelting process is submerged combustion bath smelting technology whic is supported mostly by oxygen-enriched side-blown furnace.

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Features of the furnace

1. Copper jackets are used on OSBF；
2. Pirmary layer tuyeres are water-cooled protected.
3. It is a typical bath smelting furnace. Fast reaction, low energy consumption and high energy efficiency.
4. Long service life. .
5. The oxygen enriced air concentration reach more than 60%.
6. The volume of flue gas is much less.
7. Fuel and reducing agent can be flexibly adjusted
8. The wide adaptability of fed in raw material.
9. Suits wide range of treatment capacity.

Part 2-1-2. Equipment solution in secondary lead industry

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	Merits	Demerits
OSBF	1) High lead recovery rate(＞ 98.5%), low Pb in smelting slag (＜1-1.5%） 2) High hearth efficiency that can reach ＞70 t/m^2 ·d; 3) Low operation cost: smelting cost around USD65/t pb 4) High adaptability to raw material and suits wide range of treatment capacity 5) Simple structure of furnace with copper water jacket proctection, long service life, simple structure of tuyere, convenient to operate 6)The optional choice of fuel and reducing agent according to local supply condition 7) Friendly working environment 8) High degree of mechanization and automation 9) Water quenched slag can be used as raw material of cement	1) Granular anthracite needs to be added from the furnace top into the molten pool to maintain the heat balance 2) Soot rate is a bit high, reaching 12% ～ 18% 。 3) Frequent shutdown of the furnace will lead to a substantial increase in operation cost

Ancillary equipment - converter

1. Applicable to metal reduction such as Sb, Sn, Au, Ag, Bi etc.
2. Processing capacity suitable for small amount of raw material
3. The operation is simple

Ancillary equipment - vacuum distillation unit

1. Short process and simple physical method to separate metals.
2. It is applicable to the treatment of precious lead alloys obtained from the reduction and smelting of lead anode slime and alloys containing precious metals， such as lead-tin, silver-zinc, silver-bismuth, and tin-zinc separation, etc
3. Small cover area, simple operation

Ancillary equipment - fuming furnace

A type of side blown furnace

1. Smelting zinc containing material, product: Zinc hypoxide
2. Smelting tin containing material (Sn < 8%) efficiently. The Sn content in slag can be controlled < 0.2%
3. Other material

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Superiority in fuel use - less consumption - less CO2 emission

Coal + Natural gas

- Coal / Coke acts as a reducing agent and fuel in the lead smelting process.
- Natural gas - a type of clean energy is used as fuel to provide heat for the lead smelting reaction.
- As the main component of natural gas is methane, it has high calorific value per unit, low exhaust pollution, reliable supply and relatively low price.Reduce SO_2 and PM emission nearly 100%, CO_2 60%, NO_x 50%.
- The proportion of coal and natural gas can be flexibly adjusted according to the different components of raw materials to minimize fuel costs and increase heat efficiency.

“Waste treatment with waste”

Some hazardous wastes mainly consist of carbon. Such wastes can be used as reducing agents to replace coal, achieving the effect of "waste treatment with waste", and at the same time reducing operation costs.

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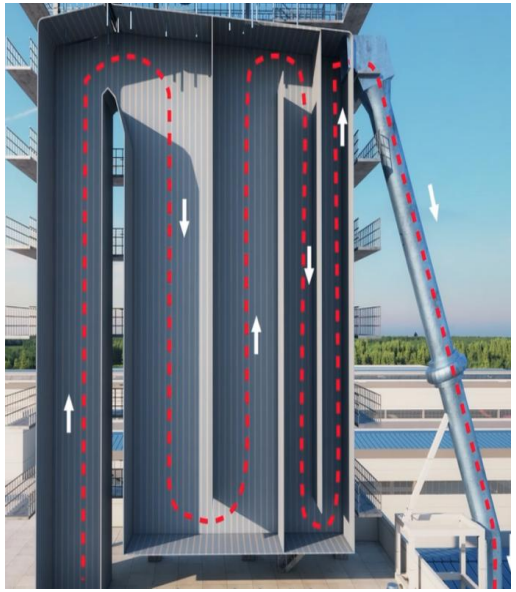
Superiority in energy management - energy reuse

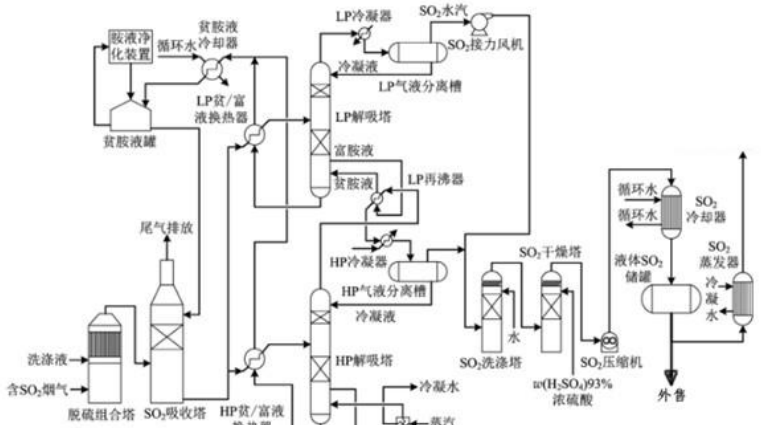
where the waste heat generated

waste heat boiler

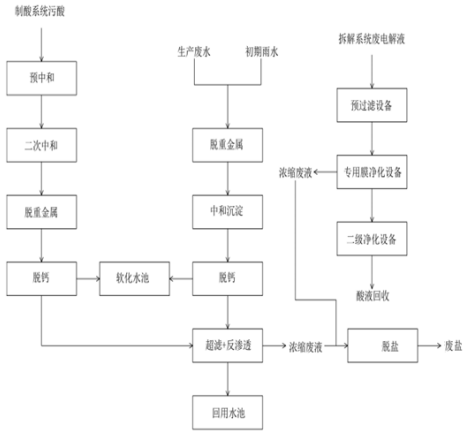


The heat usage within the main process system

where the waste heat can be used



1) desulfurization and sulfuric acid making



2) waste water treatment needs

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Superiority in energy management

where the waste heat can be used

Heat usage outside the main process system

(1) Cogeneration

2. Drive the motor

3. Evaporation of waste salt

4. Sale to external use

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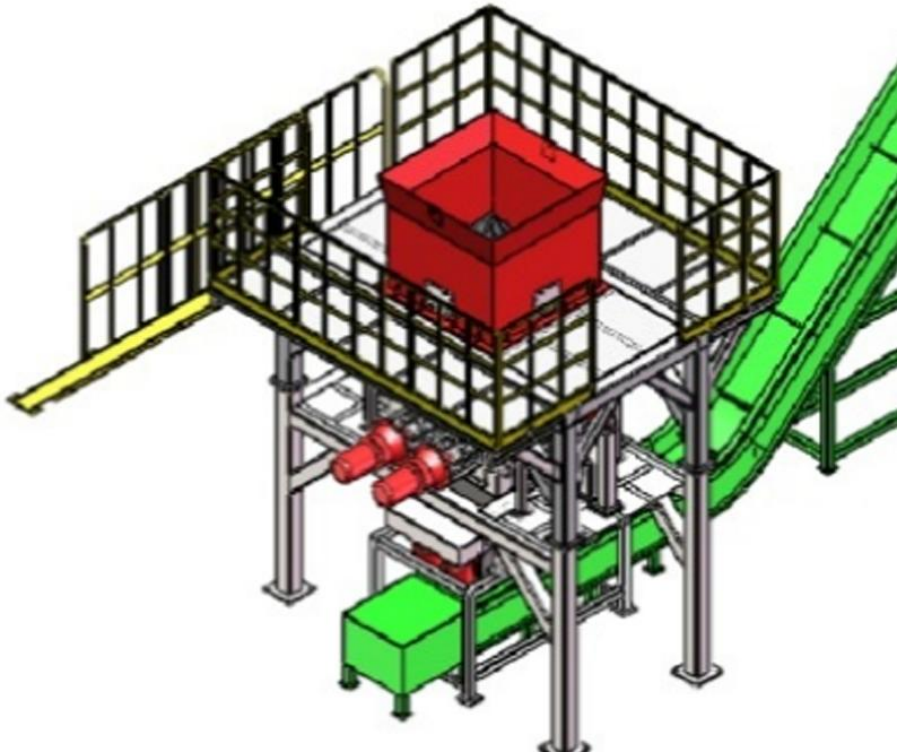
Increase in level of automation

Automatic electrolyte discharging maching for used lead acid batteries



Automatically unpack machine for ton bags

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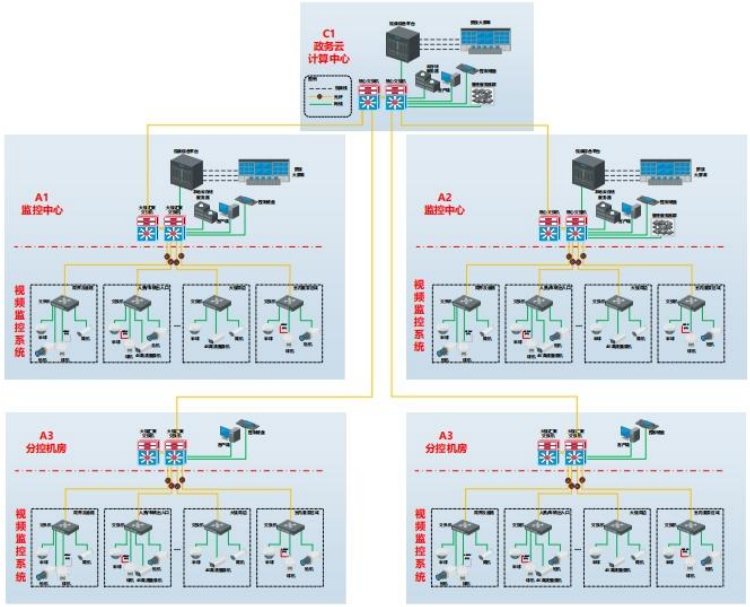
Increase in level of automation

DCS system
& monitoring
system



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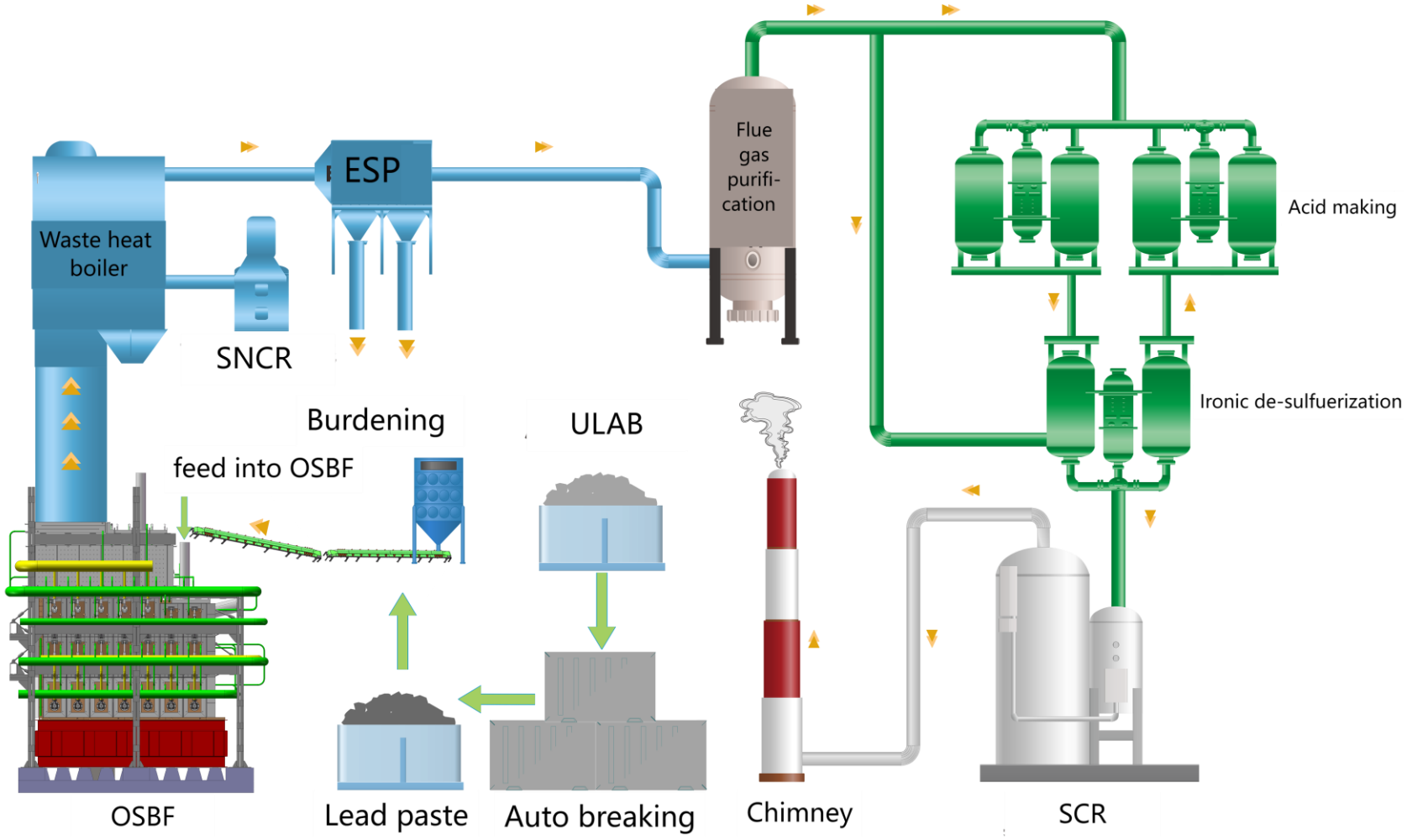
Reduce environmental risk - waste flue gas treatment



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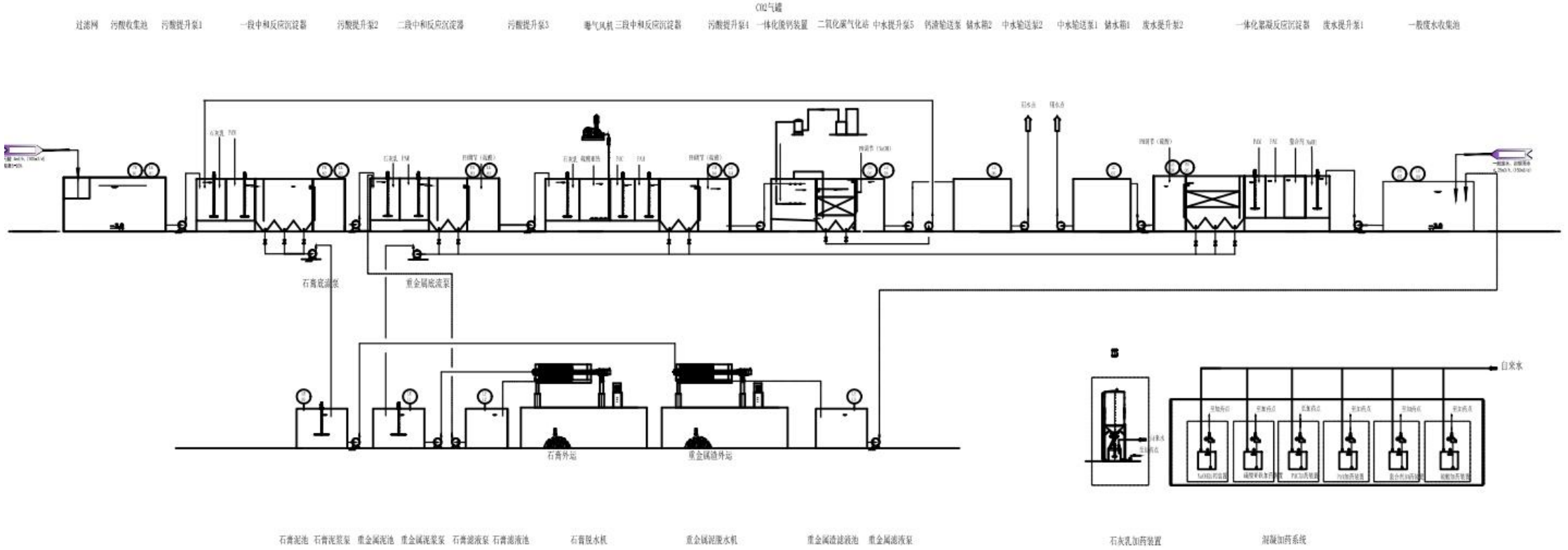
Reduce environmental risk - waste water treatment



Reduce environmental risk - waste slag treatment

PONY

Pony Testing International Group

检 测 结 果

(Test Results)

报告编号(Report ID)：I090131207~121002D　　第 2 页，共 5 页 (page 2 of 5)

样品名称和编号 (Sample Description and Number)	检测项目 (Test Items)		限值 (Limit)	检测结果 (Test Result)
I09013120702D Sslag from smelting furnace	Cu（以总铜计），mg/L		100	0.929
	Zn（以总锌计），mg/L		100	N.D. (<0.006)
	Cd（以总镉计），mg/L		1	N.D. (<0.003)
	Pb（以总铅计），mg/L		5	N.D. (<0.05)
	Cr，mg/L		15	N.D. (<0.01)
	Cr（VI），mg/L		5	N.D. (<0.004)
	Alkyl mercury ng/L	Methyl mercury	N.D.	N.D. (<10)
		Ethyl mercury	N.D.	N.D. (<20)
	Hg（以总汞计），mg/L		0.1	N.D. (<0.0002)
	Be（以总铍计），mg/L		0.02	N.D. (<0.0003)
	Ba（以总钡计），mg/L		100	1.18
	Ni（以总镍计），mg/L		5	N.D. (<0.01)
	Ag，mg/L		5	N.D. (<0.01)
	As（以总砷计），mg/L		5	N.D. (<0.0001)
	Se（以总硒计），mg/L		1	N.D. (<0.0002)
	Inorganic fluoride (exclude CaF2)，mg/L		100	0.88
	(CN)2（以 CN⁻计），mg/L		5	N.D. (<0.001)

The final tailings produced are water-quenched slag, which has been repeatedly analysed and identified as general solid waste under Chinese standard.

However, whether it can meet that of project country's needs to be confirmed.

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Reduce environmental risk - rigid landfill

The small amount of hazardous waste produced in the end is not exported to the outside but is dumped in a self-built rigid landfill, completely eliminating the risk of secondary hazardous waste overflow and solving the environmental protection risks associated with secondary hazardous waste overflow.

Part 3-5.Typical cases in China

Leoch-Dahua energy resource Co. Ltd. (ULABs recycling plant)

Part 3-5.Typical cases in China

Guangxi RE Environmental Technology Co., Ltd.

250,000t/a lead & zinc containing material comprehensive smelting project

(lead containing smelting waste recycling)

Part 3-5.Typical cases in China

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Part 3-5.Typical cases in China

Guangxi RE Environmental Technology Co., Ltd.
250,000t/a lead & zinc containing material comprehensive smelting project

Part 3-5.Typical situation in China

Chenzhou Tengchi 200,000t/a lead and zinc containing material treatment project EPC (mixed smelting)

Part 3-5.Typical situation in China

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It recovers metals such as Pb, Cu, Zn, Sn, Sb, Bi, Ag, Au, In, Re, involves six smelting process flow. The oxygen-enriched side-blown bath smelting is adopted for the enrichment of dispersed metals and the harmless disposal of slag, with a high metal recovery rate. It adopts the most advanced oxygen pressure leaching process to recove Rhenium.

Recycle Pb, Zn
——
Duplex OSBF + fuming furnace (pyro)

Recycle Ag, Au, Bi precious metals
——
Pyro+hydro metallurgy

Recycle dispersed metal such as In, Ge
——
Hydrometallurgy

Recycle Sb
——
Pyrometallurgy

Recycle As
——
Pyrometallurgy

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3

Who Are We?

- Hunan RE Technology Co. Ltd.

Part 4-1.Who is RE TECH — Member of IUR technology innovation alliance

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Hunan RE Technology Co., Ltd. was founded in 2017, Changsha city, Hunan Province, P. R. China

- It is an “industry-university-research” engineering company cooperate with Central South University (China) of which metallurgy major is ranked top of the world.
- It dedicates to provide turn key solutions for the low carbon resource of non-ferrous mental industry.

China Industry Technology Innovation Alliance of Nonferrous Metals is a technological innovation cooperation organization jointly initiated by more than 70 colleges and universities, scientific research institutes, enterprises and institutions, including Central South University, Kunming University of Science and Technology, and Institute of Process Engineering, Chinese Academy of Sciences.

•solve the key technical problems in the development of the non-ferrous metalurgyl industry

•industrialization of scientific research achievements

•realize the sustainable development.

NMIU
China Industry Technology Innovation Alliance of Nonferrous Metals

Part 4-2.The role of RE TECH —— Make a greener future

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Integrated development of advanced industrial equipments

R&D in Metallurgy

Environmental cleanup system integration

Low carbon toolkit

OSBS Technology:

Secondary lead | Copper containing material treatment | Recycle of heavy mental containing hazadous waste | Extract high nickel matte from Laterite nickel ore

Low Temperature Pyrolysis Technology:

Lithium battery break | PCB break | Steel scrap disposal | Recycle waste tires

Pure Oxygen Converter Technology:

Secondary tin | Secondary silver | Copper Nickel | Antimony | Bismuth recycling | Aluminum ash recycling

Vacuum Distillation Technology:

Sn-Pb,Sb seperation | Bi-Ag seperation | ……

Fuming Furnace Technology: extract Zn from slag, extract Sn from slag ……

Electical Furnace

Consulting → Engineering → Core equipment fabricating/toolkit intelligent upgrading → EPC Contracting → Operation

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Part 4-3.Main scenarios of RE industrial application

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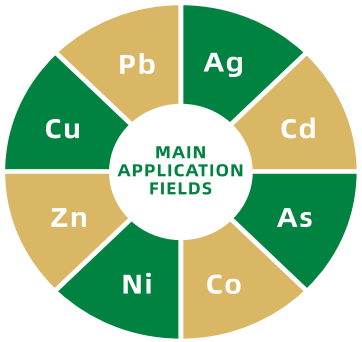
Recycling of resources

- Valuable metal recycling
- Lithium battery Recycling
- Waste electronic product recycling
- Copper containing material recycling

Harmless treatment of hazardous waste

- Smelting waste
- Other hazardous waste



Metal extracting

- Lead (Pb), Copper (Cu), Zinc (Zn),
- Laterite nickel & nicke matte (Ni)
- Tin (Sn) , Antimony (Sb)
- Silver (Ag), Gold (Au), etc.
- Preciouse metals, such as In, Bi, Pt,

Part 4-5. Cases that we have done

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Part 4-5. Cases that we have done

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Part 4-5. Cases that we have done

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Part 4-5. Cases that we have done

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No	Item	No	Item
1	Hunan Tengchi Environmental Protection Technology Co., Ltd. 300,000 t/a non-ferrous metal waste rare metal comprehensive recycling project	21	Guangxi Ruiyi Environmental Technology Co., Ltd. 250,000 t/a comprehensive recovery and safe disposal of rare and precious metal materials project general contracting
2	Dongguan Xindongxin Environmental Protection Investment Co., Ltd. 200,000 t/a copper-containing sludge disposal project	22	Yunnan Ruiyi Environmental Technology Co., Ltd. 50,000 t/a smelting hazardous waste disposal project
3	Zhejiang Runhong Environmental Technology Co., Ltd. 150,000 t/a copper-containing sludge disposal project	23	Guiyang Kangze Environmental Technology Co., Ltd. 160,000 t/a used battery disposal project
4	Leoch International Taihe Dahua 300,000 t/a secondary lead production project	24	Guangxi Zhenyu Environmental Technology Co., Ltd. 250,000 t/a used battery disposal project
5	Anhui Tianchang Metal Materials Co., Ltd. 300,000 t/a waste battery disposal project	25	Shandong Laiyang 150,000 t/a copper-containing sludge disposal project
6	Leoch International Guizhou Dahua 300,000 t/a used battery disposal project	26	Anyang Minshan Huanneng Hi-Tech Co., Ltd. 130,000 t/a lead-containing secondary resource recycling project
7	Zhejiang Tianneng Power Supply Co., Ltd. 130,000 tons of annual recycled electrolytic lead and 60,000 tons of annual desulfurization product extension clean technology transformation project	27	Wuzhou Sensheng Nonferrous Metals 5,000 t/a metal tin recycling project
8	Hunan Tengchi Environmental Protection Technology Co., Ltd. lithium battery recycling project	28	Hanyuan Huafeng Environmental Technology Co., Ltd. 250,000 t/a solid waste harmless resource Comprehensive utilization of lead resources
9	Guangxi Jixin Recycling Resources Utilization Co., Ltd. 200,000 t/a used lead battery recycling and regeneration project	29	Anyang Minshan Nonferrous Metals Co., Ltd. Comprehensive technical transformation project
10	Shandong Heze Caoxian Huixin Metal Co., Ltd. 600,000 t/a lead-acid battery recycling and regeneration lead	30	Feasibility study of Jiangxi Xinya Alloy Materials Co., Ltd. 100,000 t/a recycled lead expansion project
11	Zhejiang Taitong Recycling Resources Utilization Co., Ltd. annual processing of 100,000 tons of surface treatment waste resources comprehensive utilization project	31	Hanzhong Zinc Industry Co., Ltd. Comprehensive recycling production line technology upgrade and transformation project
12	Yunnan Tianzha Technology Co., Ltd. recycling 150,000 tons of used lead-acid batteries and lead recycling project	32	Guizhou Gravity Technology Environmental Protection Co., Ltd. Annual treatment of 100,000 tons of lead-containing hazardous waste comprehensive disposal smelting system general contracting
13	Henan Ruiyi Environmental Technology Co., Ltd. arsenic smelting hazardous waste disposal project	33	Shandong Haowei 200,000 t/a used lead-acid batteries, lithium batteries resource recycling comprehensive utilization project
14	Yunnan Gejiu Tianli Smelter low-grade lead and silver waste comprehensive utilization project	34	Guizhou Qizhen Environmental Protection Technology Co., Ltd. annual production of 200,000 tons of secondary lead project
15	Jiyuan Xinxin Industrial Co., Ltd. nickel resource comprehensive utilization side-blowing furnace to replace blast furnace energy-saving and environmental protection upgrade project	35	Anhui Pengran Recycling Resources Co., Ltd. 130kt/a multi-metal smelting intermediate material processing and comprehensive utilization project
16	Inner Mongolia Guona Recycling Resources Technology Co., Ltd. National used battery recycling resource utilization industry-university-research phase I project	36	Anhui Chaowei Environmental Protection Technology Co., Ltd. Lead alkali slag converter system
17	Zhongde Environmental Protection Self-produced Hazardous Waste Comprehensive Utilization and Technical Equipment Upgrading Project Smelting System General Contracting	37	Anhui Tianshuo Metal Materials Co., Ltd. annual production of 100,000 tons of recycled lead project burdening and smelting system general contracting
18	Wuzhou Huaxi Environmental Protection Technology Co., Ltd. Lead Enhanced Smelting Energy Saving and Emission Reduction Technical Transformation Project Equipment General Contracting	38	Guizhou Lukong Environmental Protection Technology Co., Ltd. Taijiang County lead-acid battery resource recycling integrated project
19	Xiangcheng Haoxin Metal Recycling Co., Ltd. used Battery Comprehensive Utilization Project	39	Jiangxi Jiangtong Environmental Resources Technology Co., Ltd. Environmental protection equipment manufacturing and resource comprehensive utilization project
20	Nigeria 100,000 tons of used batteries	40	Liaoning Teli Environmental Protection Technology Co., Ltd. annual treatment of 250,000 tons of used lead-acid batteries side-blown furnace project

Thank you for listening !

Welcome to visit us!

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