Section 1: General

Document Title

Standard Operating procedure for recycling of lithium using deep-eutectic solvent (DES)

Purpose

Recycling of lithium from retired lithium-ion batteries by using environmentally friendly solvent.

Scope

To recover valuable materials from spent lithium-ion batteries using environmentally friendly methods.

Location

LAB 23. 111

Responsibilities and Authority

Zhenhong Chen (operator)
Asad Ali(supervisor)

Equipment, Materials, and Consumables

Sr.No	Chemical Name	Product number	Tentative quantity	Container	Storage location	Quantity application
1	Lithium iron phosphate	759546	10gm	Poly bottle	23. 111 Tightly closed	100 gm
2	Lithium Nickel Cobalt Manganese oxide	761001	10gm	Poly bottle	23. 111 Tightly closed	100 gm
3	L-ascorbic Acid	255564	10gm	Poly bottle	23. 111 None-Hazardous	250gm
4	Oxalic Acid	194131	100ml	Poly bottle	23. 111 Corrosive cabinet	500mL
5	Choline Chloride	C1879	10gm	Poly bottle	23. 111 None-Hazardous	250gm

6	EG (Ethylene Glycol)	03747	100ml	Poly bottle	23. 111 Tightly closed	500mL
7	Nitric acid	02650	50ml	Poly bottle	23. 111 Corrosive cabinet	500ml

Procedure/Description

Leaching process:

1) Preparation of DES: Choline Chloride (ChCl)and organic acid (oxalic acid ,L-ascorbic acid)will be mixed in different molar ratios (1:1,1:2 etc) at a constant temperature and stirred continuously for 20 minutes until they are well mixed and dissolved.
2) valuable battery materials such as lithium will then be leached using DES
3) For leaching: I will conduct the leaching process at temperatures ranging from 25℃ to 90 ℃, typically 60 to 120 minutes.
4) Mechanical stirring will be applied to enhance the leaching efficiency.
5) The pH of the solution will be adjusted appropriately using (sodium hydroxide or 30% nitric acid) to optimise the leaching of metals.
6) After leaching, we will separate leachate and precipitate by using filter papers and characterise them by using ICP-OES, XRD, and SEM.

Risk Management

Riskware Reference Number #5990

Risk Rating

Low

Required training

Chemicals and hazardous materials

Manual tasks and ergonomics

Engineering controls (check all that apply and provide a detailed description)

Engineering Controls	Check box if applicable	Description
Fume hood or glove box	☑	Fume hood slash level will be kept below the face level
Special ventilation	☑	At full capacity

Engineering Controls	Check box if applicable	Description
HEPA-filtered vacuum lines	☐	
Non-reactive containers	☐	
Pressure relief devices	☐	
Temperature control	☐	
Bench paper, pads, plastic-backed paper	☐	
Special signage	☐	
Safe sharp devices	☐	
Radiation proof enclosure	☐	
PC1 containment	☐	
PC2 containment	☐	
Others	☐	

Administrative controls (check all that apply and provide a detailed description)

Controls	Check box if applicable	Description
Designated areas	☑	LAB 23. 111
Procedures for requesting emergency assistance	☐	
Emergency phone numbers	☑	ECU security (08 6304 3333),000
Locations of fire alarms, fire extinguishers, fire blankets, eye washes, showers, etc.	☐	
Emergency responders	☑	Veena Bobade, 0406310608
Workers on shifts	☐	
Training on all experimental techniques and experiments	☐	
Restricting access; locks	☐	
Housekeeping	☐	
Lockout/tagout[a] procedure plan	☐	
After-hour procedures	☐	

Controls	Check box if applicable	Description
Preventative maintenance	☐	
Others	☐	

[a]*Lockout/tagout refers to specific procedures to safeguard researchers from an unexpected startup of machinery and equipment, or a release of hazardous energy during service or maintenance activities.*

Personal protective equipment

Personal Protective Equipment	Check box if applicable	Description
Gloves	☑	chemical-resistance gloves
Lab coats	☑	
Suits	☐	
Aprons	☐	
Long pants	☑	
Close-toed shoes	☑	
Long sleeves	☑	
Safety glasses	☑	
Goggles	☐	
Face shields	☐	
Respirators (include cartridge type and cartridge change-out schedule)	☑	Based on the chemicals' SDS
Hearing protection (include level of protection needed)	☐	
Special equipment (i.e., blast shields, special enclosures)	☐	
Others	☐	

Monitoring

Monitoring	Check box if applicable	Description
Personnel exposure monitoring	☐	*e.g., wearable sensors for toxics, radiation badges*
Leak checking	☐	
Gas and spill release monitoring	☐	
Temperature and pressure	☐	
Alarms	☐	
Others	☐	

Spill and accident procedures:

- Spill containment facilities are available so if split, put the spill kit on the area.
- Contact the technical staff (Veena Bobade, 0406310608).
- The spill kit should be placed in the specific container for disposal in the end.

In addition to the above procedures, in the event of any spills or splashes, laboratory personnel will also be responsible for isolating the source of the spill, alerting others in the vicinity of the emergency, and following established protocols for containment and clean-up(use of mops, absorbent pads etc).

Waste disposal procedures:

The chemical and solution waste must not enter the drains and wastewater. Hazardous chemical waste needs to be collected in a specific glass bottle (with a label) for disposal that is approved by the relevant technical staff. There are 3 different waste containers currently available in the lab: organic waste, acid waste, and alkali waste. In this experiment, all the chemical waste and waste from washing the used glassware would be transferred to the organic waste container. The empty chemical containers will be disposed of after rinsing with ethanol and then water. The solution, after rinsing the container, must be disposed of into the organic waste container as well. No chemical waste goes into the sink during the procedure.

Transportation procedures:

- The fume hood and the storage cabinet are in one lab (23.111) and placed opposite to each other, the distance between them is about 3 meters. It will be planned to move them while no one is standing in this distance on the way.
- The chemical containers will be transferred one by one using double containers while wearing personal protective equipment including enclosed footwear, lab coats, gas masks, gloves, and eye protection. (The mask and gloves must be worn in full contact with the following characteristics: material: butyl-rubber, minimum layer thickness: 0.7 mm, and break-through time: 480 min)
- No ignition sources will be around, including open flames, spark-producing switches/tools, heaters, naked lights, pilot lights, mobile phones, etc., when handling the chemicals.

Approval History

Identification of changes, date of review, and approval and version of the document should be included in accordance with the established practice for document control

Revision	Author	Date approved	Changes made to document	Approved by
1	Zhenhong CHEN	29/01/2025	/	

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