Innovation and Technology for Smart Sustainable Waste Solutions in Non-Ferrous Metal Industries

Anupam Agnihotri
Director. JNARDDC, Nagpur

WORLD
WASTE-to-WEALTH
SUMMIT & EXPO

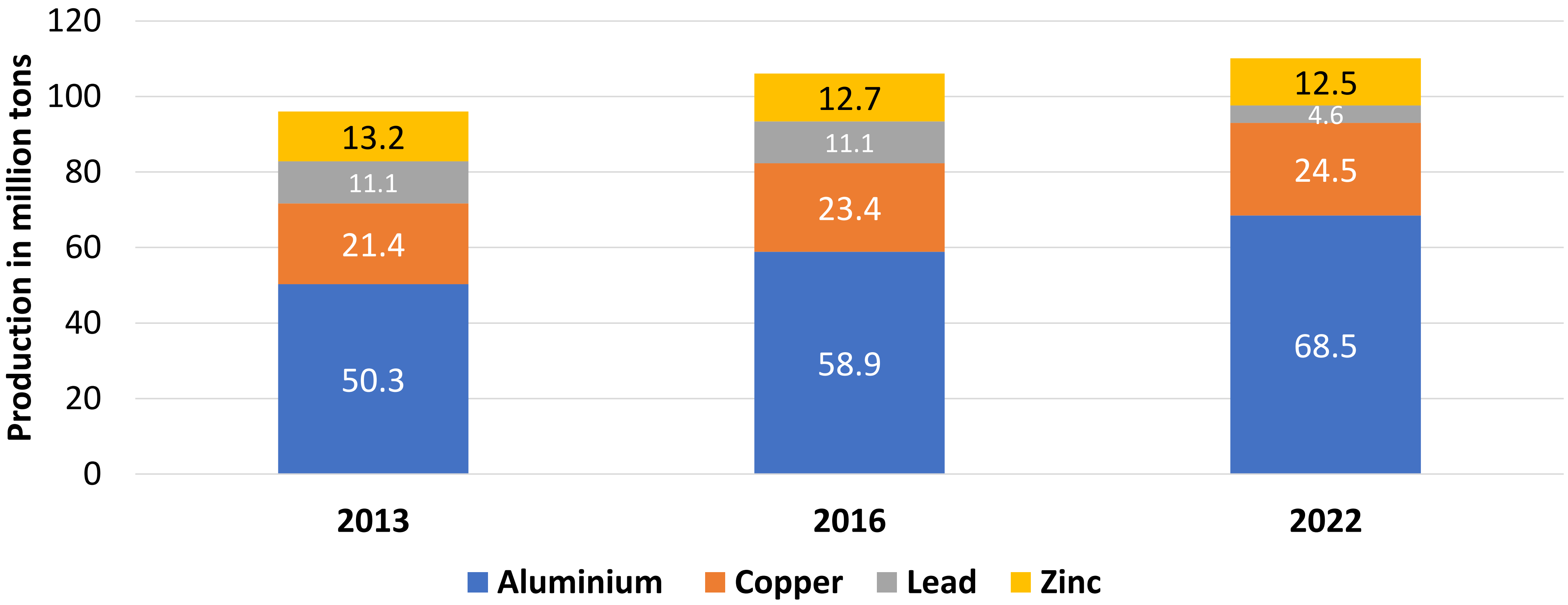
25 26
AUGUST 2023

Dr. Ambedkar International Centre
15 Janpath, New Delhi, India

THEME:

Innovation and Technology for Smart Waste Solutions

Global Non-Ferrous Metal Industry

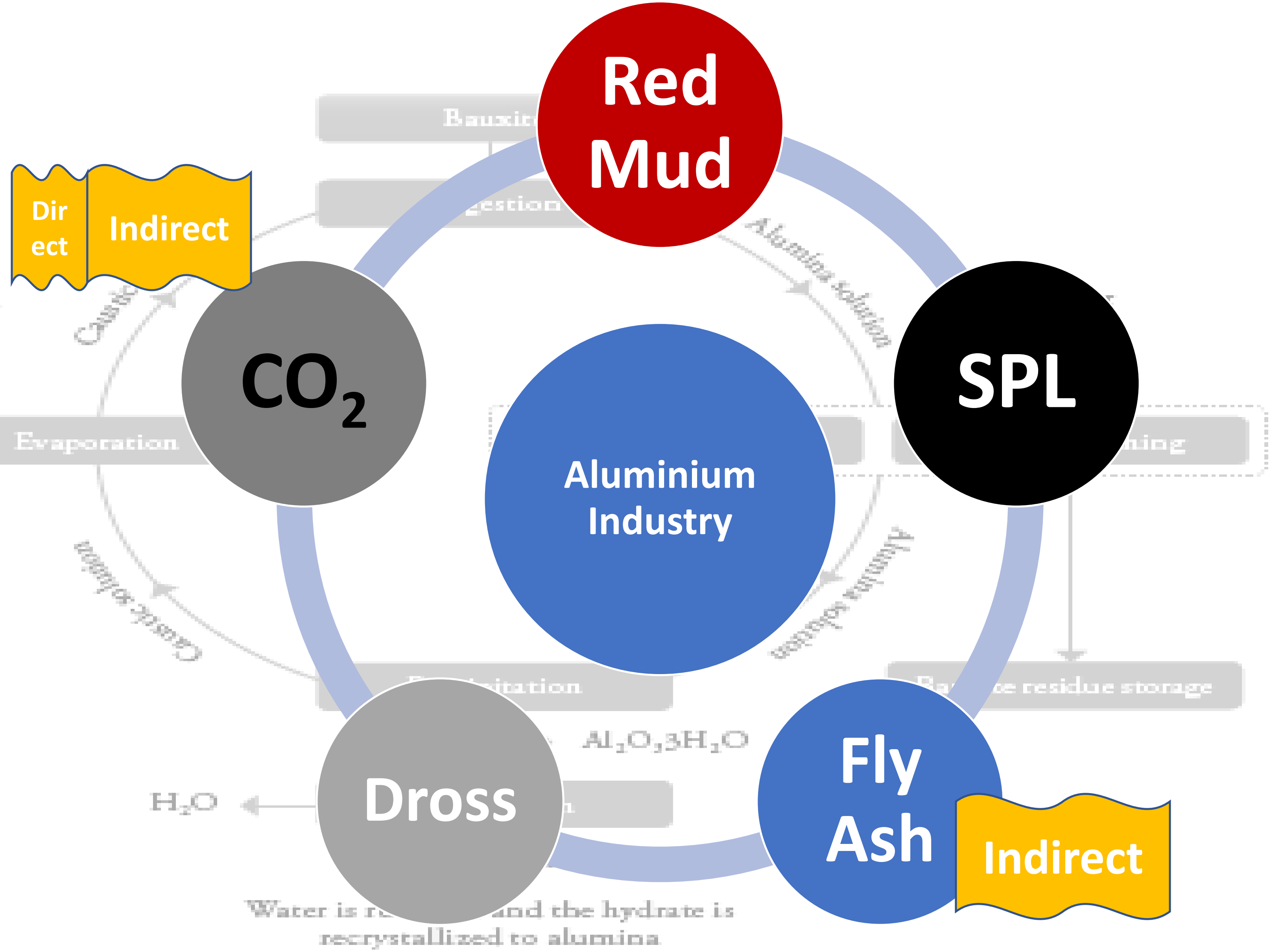


Production & Wastes Generate - 2022

	Metal Production (mT)	Waste Generation (mT/T)	Total waste generated (mT)
Primary Aluminium	4.02	• Overburden:6.5 – 8 tons • SPL: 25 – 35 kgs • Red Mud: 2 – 3 tons • Dross: 5 – 20 kgs	**26-32** **0.1 0– 0.14** **8-12** **0.02 – 0.08**
Primary Copper	0.59	• Overburden: 190 – 210 tons • Tailings: 55 – 125 tons • Slag: 2.8 – 3.3 tons • Anode slime: 2 -20 Kg	**112 – 124** **32 – 74** **1.5 – 2.0**
Primary Lead	0.19	• Overburden: 47 – 124 tons • Tailings: 36 – 106 tons • Slag: ~7 tons	**9 – 24** **7 – 21** **~1.5**
Primary Zinc	0.78	• Overburden: 15 – 20 tons • Tailings: 13 – 17 tons • Jarosite: 0.6 – 0.7 tons	**12 – 16** **11 – 14** **0.5 – 0,6**

Draft documents Submitted under CE action plan Assignment

Waste from Aluminium Industry



Sustainable Options for Aluminium Waste Utilisation

Over burden	Red mud	Spent Pot Lining (SPL)	Dross
Raw material: construction and cement	Cement	1st cut SPL: CPPs & Cement	Recovery of Al, Alumina, Salt
Bauxite blending	Metal Recovery	2nd cut SPL in Cement	Production of gases
Backfilling	Construction	Brick manufacturing	Alum / PAC
	Adsorbents	Ramming mass	Anode cover / bath making
	Soil amendment medium	Raw material in steel making	Castable refractory
	Catalysts	Mineral wool	Slag conditioner in steel making
	Paints & pigments		

Smart Red mud Management

Area / Application	Description
Predictive Analytics for Red Mud Generation, Composition and utilisation	• AI for RM generation prediction based on ore composition, processing methods & production • ML models to forecast compositions for and utilisation strategies / applications.
Process Optimization and Control	• ML algorithms can analyze real-time data from production processes and adjust variables to reduce the caustic content in the red mud
Automated Monitoring and Reporting	• AI-powered sensor networks and IoT devices to provide real-time monitoring of RM storage ponds • They can detect changes in pH, temperature, moisture levels, etc. enabling early detection of potential leaks or environmental risks. • AI can also automate reporting to regulatory authorities.

Smart Aluminium Dross **Management**

Area / Application	Description
Advanced Process Control	• AI algorithms can optimize parameters like temperature, alloy composition, and casting speed to minimize the formation of dross
Real-time Monitoring and Analytics	• Utilize IoT sensors and AI analytics to monitor key process variables in real-time • Detect deviations from optimal conditions and take immediate corrective actions
Predictive Analytics for Dross Formation	• Develop AI models that predict dross formation based on historical process data, enabling proactive adjustments to prevent or minimize dross generation
Virtual Process Simulations	• Create digital twins of the aluminum production process using AI-driven simulations

Smart SPL Management

Material Characterization and Recycling Pathways	• AI can analyze the chemical composition to identify potential utilisation pathways.
AI-Powered Sorting and Segregation	• AI-based robotic systems can be employed to sort and segregate different components of SPL, such as carbon, refractories, and other materials
AI-Powered Process Optimization	• Utilize AI algorithms to optimize the aluminum production process, adjusting parameters such as electrolyte composition, cell voltage, and operating temperature.
Predictive Analytics for Process Deviations:	• Implement AI models that predict potential process deviations leading to increased SPL generation

Challenges Abatement by Smart Waste Utilisation

- **Diverse Composition**: Varying composition, no one-size-fits-all solution for utilization
- **Technical Expertise**: Efficient & safe methods for waste utilization requires specialized technical knowledge
- **Economic Viability**: Some methods may not be economically viable due to high processing & logistics costs, etc.
- **Risk Assessment**: The potential risks of emissions, leaching, & safety need to be assessed and managed.
- **Public Perception**: Potential environmental and health impacts on public by waste processing/recycling.
- **Lack of Awareness**: Lack of awareness on waste utilization technologies and their benefits, hinder adoption.
- **Scale and Consistency**: Achieving consistent waste supply and processing at scale can be challenging.
- **Logistics and Transportation**: Transporting can be logistically challenging, if the waste is hazardous or needs specialized handling.

Conclusion

AI & ML MODULES AND ENGAGEMENT PLATFORMS AT INDUSTRIAL & PUBLIC LEVEL FOR WASTE REDUCTION STRATEGIES AND THE IMPORTANCE OF THEIR ROLE IN THE CIRCULAR ECONOMY

FOSTER A CULTURE OF DATA-DRIVEN DECISION-MAKING BY USING AI ANALYTICS TO IDENTIFY TRENDS, PATTERNS, AND OPPORTUNITIES FOR VALUE ADDITION AND UTILISATION

DEVELOP TECHNOLOGY-DRIVEN SOLUTIONS TAILORED TO THE SPECIFIC CHARACTERISTICS OF DIFFERENT NON-FERROUS METAL INDUSTRY WASTES.

ENCOURAGE COLLABORATION BETWEEN ACADEMIA, R&D INSTITUTES AND INDUSTRIES TO DEVELOP SMART AND SUSTAINABLE WASTE UTILISATION OPTIONS

GOVERNMENT INTERVENTION PLAYS A CRUCIAL ROLE

Thank You

Anupam Agnihotri
Director

Jawaharlal Nehru Aluminium Research Development & Design Centre, Nagpur
director@jnarddc.gov.in
+91 9404084435
+91 7104220763

www.jnarddc.gov.in

सत्यमेव जयते
Ministry of Mines
Government of India

25 Years of Commendable Service to the Aluminium Industry
JNARDDC
Silver Jubilee Year
1989-2014