

Sustainability of the Indian Aluminium Industry through Circular Economy

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Abstract



Worldwide there is a growing recognition of the circular economy-based development approach, reflected in the United Nations Sustainable Development Goal Agenda 2030 about Ensuring Responsible Consumption and Production. Versatile applications of aluminium form the backbone of economic development, and India looks into the opportunities for establishing a “Circular Economy in Aluminium Metal Sector” for a sustainable future.

India has 3.8 billion tonnes of bauxite deposits which make it the fifth largest in the world but these resources are limited. The competent use of these resources is a must to ensure the acceptance of the basic principle of sustainable development. A resource-efficient circular economy is a must which may require a regulatory framework that integrates various aspects across life cycle stages with adequate focus on efficient extraction of resources, fostering design for resource efficiency and circularity, enhancing the implementation of waste management laws, and ensuring product recycling across sectors so that the aluminium metal remains in use even after end-of-life products.

Aluminium metal is a key material in the transition from a linear economy to a circular economy as it is highly recyclable and can be an excellent substitute for metal produced from virgin mineral resources without compromising on basic properties. With an initiative to work on the circular economy, there are efforts to map the scrap markets, waste generators, waste aggregators, waste processors, and sellers. Attempts are being made to develop Integrated Metal Recycling Zones that co-locate different recyclers with end-use producers having common facilities and shared infrastructure.

A circular economy model for the Indian aluminium sector will be restorative or regenerative by intention, and design and will replace the ‘end-of-life’ concept with restoration. It will shift the Indian aluminium sector towards the use of renewable energy, eliminate the use of toxic waste, which impairs reuse, and aims for the elimination of waste through the superior design of materials, products, and value addition.

The presentation will deliberate the ensuing policy and framework associated with circularity to attain sustainability in the aluminium industry in India

Keywords: Aluminium, Sustainability, Circular economy, Recycling.

1. Introduction

The Indian aluminium industry is committed to achieving the nation’s ambitions for a climate-neutral and circular economy. The relationship between circular economy and sustainability in the Indian aluminium industry is well established and supported by research and industry initiatives. By embracing circular economy framework, the Indian aluminium industry can achieve resource efficiency, promote recycling and reuse, extend product life, foster

collaboration, and minimize waste generation, thereby contributing to a more sustainable and resilient Indian aluminium sector.

India is a bauxite-rich nation, but the resources are finite and resource efficiency in aluminium sector can play a key role in the transition from a linear economy to a circular economy as the aluminium metal is highly recyclable and can be a good substitute for primary metal without compromising on basic properties. The treatment and utilization of wastes generated from mining to finished aluminium metal production and issues in effective recycling of the aluminium metal thereafter is the path to a circular economy in the aluminium sector. A strong aluminium recycling industry is required where domestically available scrap must be collected and processed scientifically and in an environmentally safe manner.

Thus, to bring the recycling business into an organized system, the integration of scrap collectors/aggregators/rag pickers into the formal system is planned. A strong scrap metal recycling industry shall go a long way in establishing a circular economy in the aluminium metal sector which shall not only create large employment opportunities but will also help in mitigating climate change by complying with the commitment made in COP21 and meeting sustainable development goals (SDG) goals [1].

The Indian aluminium industry has high significance in the Indian economy as, a result of its widespread use across several industries of both economic and strategic significance. It forms a significant part of economic growth as it provides basic raw feed to a wide range of key industries including defence, engineering, electrical and electronics, infrastructure, automobile, and railways. These sectors also form the core of the Government's schemes and programmes such as Make in India, Power for All, Smart Cities Scheme, National Solar Mission, and Housing for All among others.

For efficient utilization of wastes generated in the aluminium sector and for the transition from the present practice of a linear economy to a circular economy, a Multi-Disciplinary and Multi-Ministerial approach involving all the stakeholders has been adopted, due to multiple and complex issues involved.

2. Framework for Circular Economy

The share of secondary production in total finished metal output has generally increased over time in aluminium sector. This pattern, combined with concerns about domestic supply risks, the negative environmental consequences of primary aluminium metal extraction and processing, and the management of steadily growing waste streams have led to increased interest in how to move towards an economy in which waste materials from aluminium sector are captured and fed back into the economy.

Because of large environmental and social benefits, fiscal/policy support is being extended by Government to the aluminium secondary sector to attract investment and to promote resource efficiency practices in the country as well as to show the country's commitment towards sustainable development goals (SDG). Similarly, the government is framing waste management policies – zero landfill, extended producer responsibility (EPR) schemes, and the public provision of separated aluminium scrap recycling collection systems which can induce and encourage transfers to the aluminium secondary sector, albeit without any direct financial outlay for governments.

The primary aluminium industry produces large wastes like overburden and low-grade ores during mining, tailings in beneficiation, solid wastes like red mud, and spent pot lining which have a large environmental impact. Thus, by encouraging a circular economy, all these wastes

providing a structured framework for the country's carbon market. Under the scheme, the Indian aluminium industry will play a major role in contributing to India's emission reduction goals. The government will assign Indian aluminium industries carbon emission targets to meet for promoting a circular economy through carbon credits.

8. Green Credit Programme

The Green Credit Programme is an incentive provided for a specified activity for delivering a positive impact on the environment. The Green Credit Programme is a mechanism that complements the domestic carbon market. While the domestic carbon market focuses solely on GHG the Green Credit System aims to meet other environmental obligations as well, incentivizing circular economy actions by companies, individuals, and local bodies. The green credits will be tradable and those earning it will be able to put these credits up for sale on a proposed domestic market platform.

9. Integration of AI and Industry 4.0

The integration of artificial intelligence (AI) and Industry 4.0 technologies in the Indian aluminium industry is enhancing efficiency, optimizing resource usage, and facilitating the implementation of circular economy practices. By leveraging data-driven decision-making, predictive maintenance, smart sorting, supply chain optimization, product lifecycle management, and collaborative networks, the industry is achieving higher levels of circularity and sustainability.

Overall, the circular economy is instrumental in driving sustainability in the aluminium industry. By embracing circular economy principles and practices, the industry can optimize resource use, reduce and utilise waste, promote recycling, and collaborate across the value chain. This not only enhances the industry's environmental performance but also supports its long-term economic viability and social responsibility, making it more sustainable in the broader sense.

10. Conclusions

A circular economy's impact is based on the broad principles of tackling waste and pollution, making sure products and materials are kept in use maintaining natural systems in aluminium sector. It extends beyond recyclability, focusing on keeping products as resources at the end of their lifecycle and giving a similar output as its linear counterpart with minimal ecological and environmental impact.

Government is examining policies and strategies that allow maximum resource use, tackle pollution concerns, and open up various business opportunities. Consequently, aluminium industry projections indicate that by following a circular economy model, India could move directly to a more effective system and avoid getting locked into linear models and infrastructure, as is the case of mature markets.

11. References

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