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January 26, 2026

Dr Ajay Sood
The Principal Scientific Advisor
To Government of India,
Technology Bhavan, New Mehrauli Road,
New Delhi-110 016

Dear Dr Ajay Soodji,

Sub: Questionable techno-prudence on REE extraction from fly ash – Analytical Review

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Hearty Republic Day greetings to you and every one proactive in the government towards 'Aatma Nirbhar Bharat' Mission.

Fly ash generated at ~250 million tons annually is increasingly reclassified from waste to secondary raw material for brick, cement and other construction industries. **Unmindful of this gainful utilisation, it is surprising that proposal to extract rare earth elements (REEs) meagrely present at 0.01 to 0.05 wt.% have drawn policy attention.** This review submits that, having 'REE rich resources' in the country, 'REE-centric processing of fly ash' abuses techno-prudence since it degrades the remaining bulk material to an environmental liability. ***It is akin to aiming for cream out of milk-wash-water ignoring pot full of pure milk besides.*** Needless to uphold that, while cement-grade limestone resources get depleted, the Class-F fly ash, accumulated largely in the ash ponds, would be the cementitious source for future generations that cannot be wrecked thoughtlessly by present generations.

This has reference to the note on above subject by Editorial team of Chemical Industry Digest (CID) Dt. 13/8/2025 followed by TOI coverage dt. 19/12/25. There upon we accessed the PIB release and Research Note of MoS&T that contains two fallacious statements saying:

- "Fly ash is **rich source of REEs** and other precious elements".

How REE at 0.04% becomes rich source?

- "The project aims to use fly ash as **alternative to monazite** minerals for REE extraction".

How fly ash with 0.04% is alternative to monazite sands of 55-60% REE content?

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The demand of REEs in various advanced equipment of electronics, space, medical and defence is understandable and the concern of government to augment their indigenous production is appreciable towards 'Aatma Nirbhar Bharat'.

We commend the efforts at PMO to tap every source and opportunity in the country towards self-reliance to keep pace with global advancements and, are committed to support the cause to the best of our ability. But it is equally our responsibility to alert the Government **while such missions skid to untenable passion, as happened with REE extraction out of fly ash**.

In this context, please note our observations as follows:

1. While India is the 3rd largest source of REEs in the world, its production is far behind the countries with poor reserves, as given in the table. So, immediate research is necessary in tapping the proven resources for maximising the production.

Country	**Reserves-REO million tons**	**Production of REO-tons-2024**	**Production of REE tons - 2024**	**Global rank in resource holding**
Global	92-110	463,914	389,844	
China	44	321,171	269,892	1
Brazil	21	--	--	2
India	6.9	3,451	2,900	3
Australia	5.7	15,470	13,000	4
USA	1.9	53,550	45,000	7
Conversion factor of REO to REE varies depending on the metal in the range of 0.878 to 0.806 of its oxide form. For above computation average of 0.84 is taken.				

2. It is reported that monazite sands are the source of ~85% of country's REE reserves and balance of ~15% is accounted for from mineral reserves.

3. The country could not tap the potential of monazite sands reported to contain ~55-60% RE oxides which is the highest among the global bench marks.

4. Even the mineral sources with REO content at ~20% could not be tapped for various technical reasons where further research is necessary.

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5. Instead of addressing the technical bottlenecks on the operational front of 3 and 4 above, **it is astonishing that the meagre extraction of <0.04% of REE out of fly ash has gained policy acceptance**. The techno-prudence of this paradoxical decision **deserves to attract due scrutiny at your level**.

6. The proponents of the project justified REE extraction on the flimsy grounds of ***'Ash Management'***, unmindful of 'useless ash residue' at >99.96% after REE extraction.

7. It is to emphasise that the post-processed fly ash, disturbed of its amorphous phases (silico-aluminate glass) and infested with acid traces, can't be put to use in brick and cement segment. Such insipid fly ash would prove as the ***environmental liability***.

8. As per one computation, while each ton of fly ash results in economic spin off at >Rs. 6,000 in brick segment, the 0.24 kg of REE extracted out of same ton of fly ash fetches only Rs.1856 (*assumed at Rs. 77.35 lakhs/ton of REE*), underscoring the lacklustre commercial viability of REE recovery.

9. Further, REE extraction lands up with negative cost of over a lakh of rupees by putting together the process cost, handling cost of residue and environmental liability costs.

10. It is pertinent to point out that the proven and holistic 'Ash Management Criteria' of the brick sector is blatantly ignored despite prevalence of FaL-G technology with wide range of techno-economic feasibilities.

11. The market potential of over 400 billion bricks **capable to consume total fly ash generation of the country** can never be ignored by the Government, against the backdrop of over 30,000 fly ash brick plants already in operation at Pan India level.

12. Based on the above analysis, REE from fly ash appears to be a '***project of appeasement***' rather than a 'project after assessment'. We emphasise that the facts of the project were disguised with hyperboles.

13. **Techno-commercial research on REE extraction should be the need** of the hour at present juncture, **but not the academic research** as pursued with fly ash.

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14. The comparative statement of operations for extraction of REOs out of Monazite sand and fly ash is given below:

Parameter	**Beach Sand (Monazite)**	**Fly Ash**
REO content in %	55–60%	0.03–0.05%
Mass processed per kg REE	~2 kg	2–3 tons
Separation	Majorly physical	Majorly Chemical
Acid/alkali use	Moderate	Extremely high
Energy demand	Low–moderate	High
Solvent extraction (SX) stages	Low	Very high
Residue liability	Manageable	Severe
Residue quality	Acidic	Acidic, as well disturbed of the reactive phases
Regulatory certainty	High	Low
Technology maturity	Industrial (>70 years)	Experimental
Cost drivers	Mining & beneficiation SX separation Thorium compliance High recovery (55-60%)	IL/Acid consumption Waste neutralization Multi-stage SX Low recovery (at ppm) Residue disposal
Extraction cost/kg of REO	**USD 10–25**	**USD 120–200**

15.

Indicative Global Mkt Prices of different REOs/kg	
Dysprosium Oxide (lowest)	USD 0.18
Lanthanum Oxide	USD 0.57
Erbium Oxide	USD 45.72
Neodymium Oxide (highest)	USD 79.34
*Prices vary significantly based on purity and status of the material as Light (LREO) or Heavy (HREO). Above are average spot prices as of **January 9, 2026**: (Source: Shanghai Metals Market).*	

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16. Indian Rare Earths Limited (IREL) operates the Chavara Mineral Separation Plant. It is reported that the plant on monazite sands, started in 1952 and upgraded in 2012, is continuing to saddle with disorders and statutory violations for not optimising its operational diligence, attracting NGT penalties.

17. Strict environmental regulatory compliance for IREL's Kerala facilities (Chavara and Aluva) needs to address various issues monitored under EPA, CRZ, AERB, and NGT orders. Key areas include engineered tailings storage, groundwater restoration, beach nourishment, and radioactive waste handling, with potential operational halts or penalties up to ₹1-10 crore.

18. Because of the **inadequate operational methods at Kollam, it seems, enough confidence is not mustered to tap the rest of the coastlines**, as evident out of table vide point 1 above, recording very low production against the potential.

19. We strongly uphold that **fly ash route for REE extraction shall be shelved down** and, the strategic **research path** may focus on the following:

    I. The country has no other option than to prove its mettle in the rat race of REEs at global level for which tapping the monazite sands is only the immediate solution. But it violates sensitive coastal regulatory zone (CRZ) with cascading pollutants to damage the flora and fauna along the coast as happened with the Kollam plant. Hence, the 1st priority of research is to optimise coast-based plant engineering towards blemishless operations, starting with Kollam plant.

    II. Upon attaining the diligent operational discipline at Kollam, plans may be drawn to replicate plants along the coast, based on monazite sands.

    III. Thereafter, research may be focused to establish most efficient technology in tapping the mineral resource.

    IV. To address the concern for fly ash management, please extend policy decision to pilot project studies of ***irradiating fly ash to manufacture complementary cement materials (ICCM)*** for its holistic utilisation with impressive value addition.

Having endeavoured for fly ash utilisation in the country over the last 35 years, it is our privilege to alert the government *against any attempt in jeopardising its 'holistic use'.*

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If the government is committed for diligent fly ash management, **it may support the proliferation of fly ash brick industry to its full potential with conducive administrative policies**. Otherwise, at least allow the fly ash brick segment to proliferate on its own by relieving it from the hassles of monetized fly ash supplies and high GST tax slab at 12% (at par to the eco-hostile clay bricks under perceived obligations to clay brick lobby).

In view of the importance, this letter is opened up to the attention of stakeholders of fly ash utilisation in the Country.

Looking forward to your kind attention to this review in right earnest followed by an early response,

With the best regards,
Sincerely yours,

Dr N Bhanumathidas and N Kalidas

Copy to:

Dr Jitendra Singh,
Hon'ble Minister of State (I/C), Ministry of Science & Technology.

Dr V K Saraswat
Member, Niti Aayog, New Delhi

With a request for taking due corrective steps, and implementing the suggested research path.