COAL & ASH SITUATION IN INDIA

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CURRENT SCENARIO OF COAL : POWER IN INDIA

- INDIA IS SECOND LARGEST PRODUCER OF COAL IN THE WORLD
- COAL FIRED POWER GENERATION CAPACITY IS ABOUT 220 GW
  : INCREASINGLY LOSING ITS GROUND TO RENEWABLE ENERGY
- RENEWABLE , INCLUDING HYDRO POWER, IS ABOUT 260 GW
- OTHER FOSSIL FUEL BASED POWER GENERATION IS ABOUT 30 GW

ENVIRONMENTAL HAZARDS FROM TPP COAL ASH

The generation and improper disposal of fly ash pose significant environmental, ecological, and public health concerns. Unscientific dumping of fly ash can lead to:

- Air pollution through the suspension of fine ash particles, causing respiratory and cardiovascular issues in nearby populations.
- Water contamination due to leaching of heavy metals into groundwater and surface water bodies.
- Soil degradation and loss of agricultural productivity in surrounding areas.
- Land use concerns, as large tracts of land are occupied for ash ponds and disposal sites.

Therefore, scientific and large-scale utilization of fly ash is essential not only for reducing the environmental footprint of thermal power generation but also for converting waste into a valuable resource for sectors such as cement, construction, roads, and mine filling.

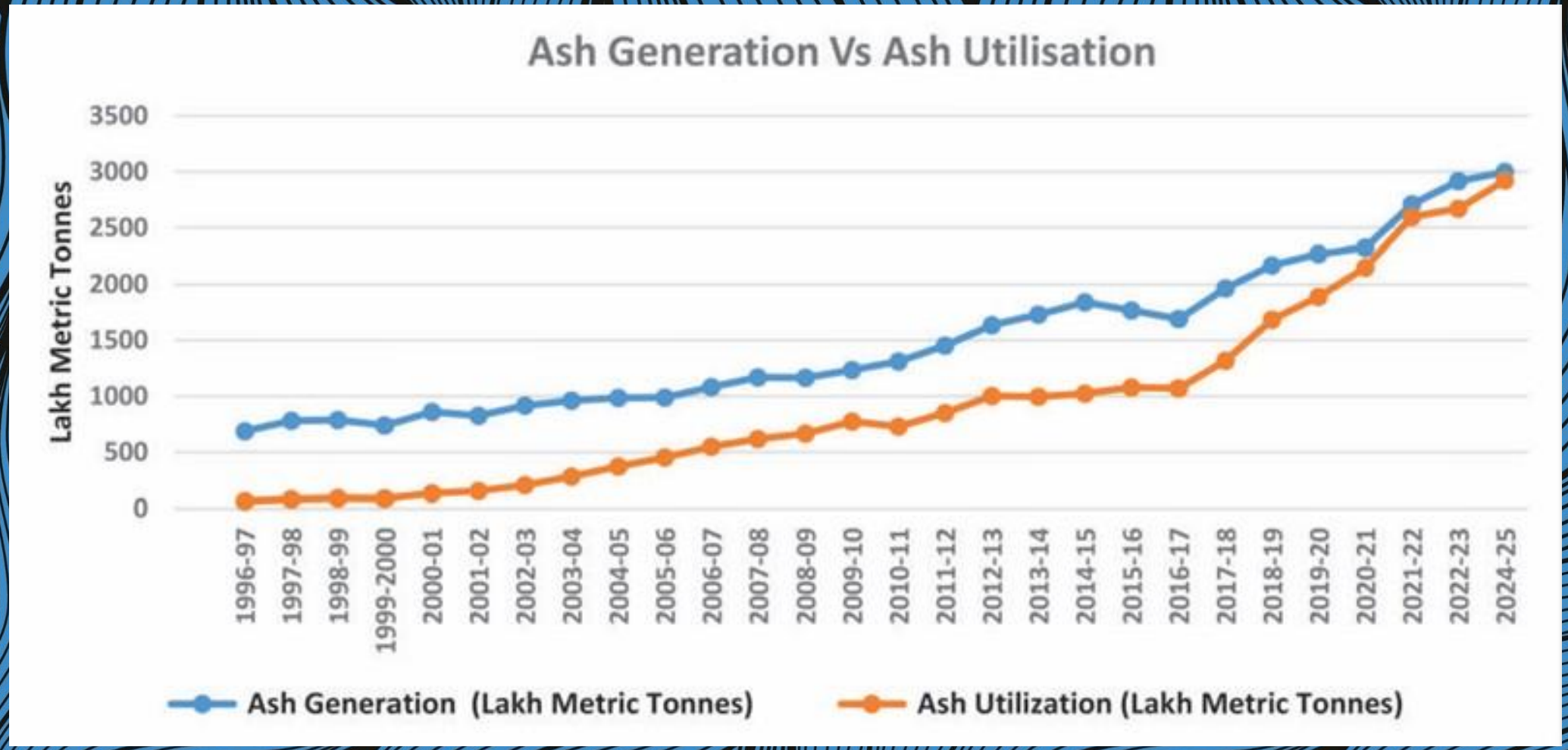
REGULATORY FRAMEWORK IN INDIA

To address the growing environmental challenges associated with fly ash generation and disposal, the Ministry of Environment, Forest and Climate Change (MoEF&CC) has implemented a series of regulatory interventions and policy measures over the years.

The first comprehensive notification on Fly Ash Utilization was issued on 14th September 1999, laying down mandatory provisions for its gainful use. This notification was subsequently amended through notifications dated 27th August 2003, 3rd November 2009, and 25th January 2016, respectively. Each amendment progressively expanded the scope of utilization, set time-bound targets, and strengthened compliance mechanisms for thermal power plants and allied industries.

To streamline and consolidate all previous directives, the MoEF&CC issued a comprehensive Fly Ash Notification on 31st December 2021, which came into effect from 1st April 2022 and Subsequent amendments to this notification were issued on 30th December 2022 and 1st January 2024.

ASH UTILISATION TREND OVER YEARS



FLY ASH UTILISATION IN CEMENT PRODUCTION

Cement :

Fly ash is widely used as a supplementary cementitious material in the production of cement and concrete. When mixed with cement, fly ash reacts with calcium hydroxide released during the hydration of cement to form additional calcium silicate hydrate (C–S–H), which enhances the strength and durability of the concrete. The use of fly ash improves workability, reduces permeability, and increases resistance to chemical attacks such as sulfate and alkali-silica reactions.

FLY ASH AS REPLACEMENT OF CEMENT IN CONCRETE

Concrete:

Fly ash is extensively used as a partial replacement for cement in concrete. When added to concrete, it improves workability, reduces water demand, and enhances long-term strength and durability.

Use of ultra-fine fly ash (UFA) enables high-strength concrete exceeding 100 MPa, suitable for demanding infrastructure.

FLY ASH UTILISATION IN GEO-POLYMER CONCRETE

Geopolymer Concrete:

Geopolymers made from fly ash are an innovative class of eco-friendly construction materials. In these materials, fly ash reacts with alkaline solutions such as sodium hydroxide and sodium silicate to form a geopolymeric binder that replaces traditional cement. Fly ash geopolymers exhibit superior strength, durability, and chemical resistance, along with significantly lower CO_2 emissions. They are increasingly being explored for use in precast elements, pavements, and structural applications as a sustainable alternative to ordinary Portland cement.

IIT Delhi demonstrated geopolymer concrete with around 70% CO_2 reduction, and NTPC has built demonstration roads at Ramagundam, Rihand, Kahalgaon, and Farakka using this technique.

BOTTOM ASH UTILISATION AS AGGREGATE

Lightweight Aggregates

Fly ash can be used to produce lightweight aggregates through processes such as sintering or pelletization. These aggregates are used in lightweight concrete, which is ideal for structural components where weight reduction is important, such as high-rise buildings and precast panels. The resulting concrete offers good thermal insulation, fire resistance, and ease of handling, while utilizing fly ash helps minimize environmental waste.

ASH UTILISATION IN ROAD CONSTRUCTION

Roads and Embankments:

In road construction, fly ash is used to improve the strength and stability of sub-base and embankments. When mixed with soil and lime, fly ash enhances the load-bearing capacity and reduces swelling in expansive soils. It acts as a stabilizing agent that helps in reducing the thickness of pavement layers and overall construction cost. Fly ash can also be used in asphalt paving and as a filler material

Ash supply to Road projects from NTPC stations

ASH UTILISATION IN BUILDING BLOCKS

Fly Ash Bricks, Blocks, Tiles:

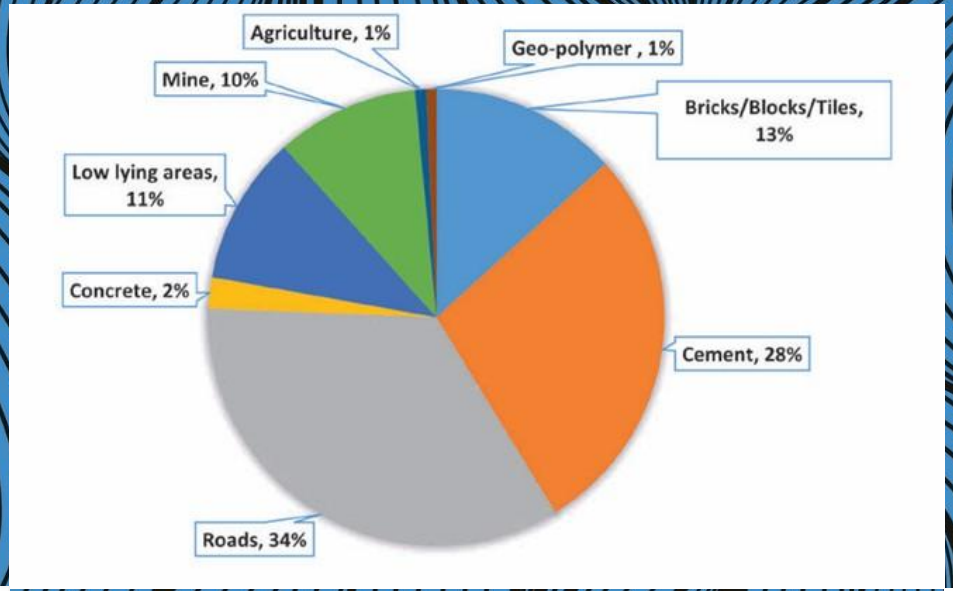
Fly ash is a key ingredient in the production of fly ash bricks, which are an eco-friendly alternative to traditional clay bricks. These bricks are made by mixing fly ash with lime, gypsum, and sand, followed by compression and curing. Fly ash bricks have uniform shape and smooth surfaces, high strength, and better thermal insulation compared to conventional bricks. Additionally, their manufacturing process saves topsoil.

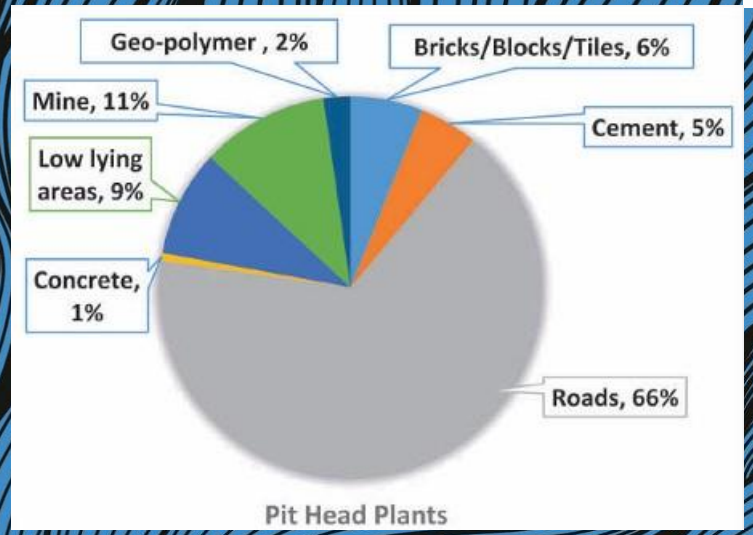
Fly ash is increasingly used in the manufacture of ceramic tiles, mosaic tiles, and paving blocks. When mixed with other materials such as cement, sand, and additives, it produces strong, durable, and aesthetically pleasing tiles. These fly ash-based tiles are cost-effective, lightweight, and offer better resistance to wear and weathering.

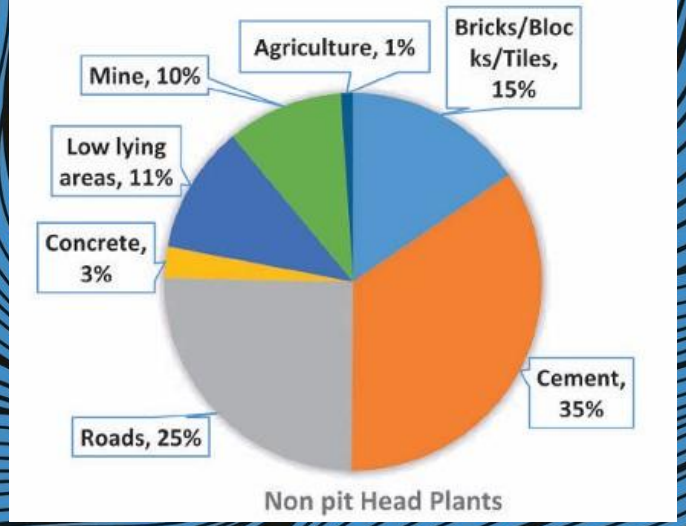
BOTTOM ASH AS REPLACEMENT OF SAND IN CONCRETE

Calcutta Electric Supply Corporation Limited(CESC), in collaboration with SDG Consultants and with technical guidance from Jadavpur University, Kolkata, has developed an innovative process technology for the use of coal bottom ash as a partial replacement of natural sand in concrete, particularly for road works and allied infrastructure.

AVENUE – WISE ASH UTILISATION IN INDIA







INNOVATIVE UTILISATION ASPECTS OF COAL ASH

Soil Amendment:

Controlled application of fly ash improves soil texture, porosity, and nutrient content, especially in barren or degraded lands. NTPC, in collaboration with the Indian Institute of Soil Science (IISS), Bhopal, is running a long-term project on the "Use of Fly Ash in Agriculture for Sustainable Crop Production and Environmental Protection."

Mine Void Filling:

Stabilized fly ash slurry is used to reclaim abandoned mine voids, improving land usability and enabling green belt development.

ASH UTILISATION IN SOIL AMENDMENT

Indian Institute of Social Welfare & Business Management have reportedly implemented an AGRIVOLTAIC project, whereby farming is taking place with Fly Ash AMENDED soil in various proportions under and beyond Solar PV panels to cultivate diverse range of crops, flowers, medicinal plants, spices, bio diesel crops

SOIL AMENDMENT BY FLY ASH

Modifies soil texture.
It loosens heavy clay soils and improves the water-holding capacity and aeration of sandy soils

Nutrient Supply: Acts as a source of vital plant micronutrients including phosphorus, potassium, calcium, magnesium, boron, zinc, and molybdenum

Liming Agent: Alkaline coal ash is highly effective at neutralizing acidic soils, raising the pH to levels more favorable for plant growth

Pest and Disease Suppression : Some studies indicate that certain fly ash formulations can help control specific soil-borne pests

COAL ASH INSTITUTE OF INDIA

THANKS YOU ALL

NAMASTE

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