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FLY ASH UTILIZATION IN COAL MINES

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ABSTRACT: Coal is the most important and abundant fossil fuel in India, with Jharkhand having 97% production. Power plants in India produce 600,000 tonnes of fly ash per day, which is equal to India's total cement consumption in a year. Fly ash is a sustainable material used in the construction field to fill voids, and is used for backfilling in the coal mines. It is especially attractive for embankment construction over weak sub-soils. Fly ash production in India is expected to reach 300-400 million tons by 2025.This paper examines the physical properties and chemical properties of Indian fly ash, comparing it with international fly ash.

Keywords: Mines, Geo polymer, pozzolanic material, gypsum

INTRODUCTION: Industrial waste material is disposed of in landfills or disposal ponds, leading to the leaching of heavy metals into the environment, which can lead to health hazards. Flyash is a cementitious material containing silica and alumina compounds, which can be used as a construction material due to its pozzolanic properties.**(Yadav et al. 2018)**.The World Earth Summit held in 1992 and 1997 declared that increased emission of greenhouse gasses to the atmosphere is no longer environmentally and socially acceptable. The Kyoto Protocol was adopted in 1997 to reduce global warming by reducing greenhouse gas emissions in the atmosphere. Various emission reduction targets were implemented in countries worldwide as a result of the Kyoto Protocol**(Malhotra 1999)**.Cement manufacturing is responsible for 4% of global warming due to CO2 emissions, resulting in a rise in global temperature.
(McCafrey 2002).Environmental issues are essential for the sustainable development of the construction industry. The most important issue is cement production, which has four major emissions: dust, sulfur, nitrogen oxide (NOx), and carbon dioxide (CO2). Around 3% of total dust emissions are added by the cement industry globally, and sulfur and NOx emissions are not significant on a global scale, but sulfur is currently playing a role in global cooling through the formation of aerosols.**(McCafrey 2002)**.Mining sites are often filled with stowing materials such as sand, fly ash, mine tailings, and mill tailings, which have been used for a long time.**Anamika Masoom, Manish Kumar Jain, and Rayasam Venugopal(2019)**Scientific advances in fly ash characterization and up-cycling have enabled the development of value-added applications, such as fly ash-based geopolymer, SCM and zeolite

synthesis. These applications include flowable fill, embankment, roadbase, blasting grit, catalysis, mining application, waste stabilization, agriculture and oil field service. **(Zhuang et al., 2016).** Fly ash is a byproduct of coal combustion from coal-fired power plants, captured at the top of boilers and used in concrete to reduce emissions, air pollutants and wastes.**(Provis et al., 2015).**Traditional caving mining is unable to meet the needs of production, so backfill mining is the main technical approach to solve the problem of "threeunders" mining. **(QIAN Ming-gao; XU Jia-lin; MIAO Xie-xing 2003)**Scientific advances in characterization and up-cycling technologies have enabled the development of value-added applications of fly ash, such as geopolymer, SCM and zeolite synthesis. These applications include flowable fill, embankment, roadbase, blasting grit, catalysis, mining application, waste stabilization, agriculture and oil field service. **(Zhuang et al., 2016).**

II. LITERATURE REVIEW

1.Enhancing the use of coal-fly ash in coarse aggregates concrete

Shanmugan,S. Deepak, V (28 May 2020) Studied The"Experimental work has been done to determine the operation of coal-fly ash as acceptable and coarse aggregates with the regular Portland cement of 53 grade." Initial research has focused on the chemical and physical properties of coal-fly ash particles, including chemical compositions, comprehensive significance, XRD, and SEM pictures. In terms of particle and cement absorption of coal-fly ash, the impact of acceptable to the coal-fly ash on the movement characteristics of the palletization process has been examined. Additionally, the experimental results are demonstrated by replacing the acceptable components with prepared cement and fly ash in a 20:80:0.3 water binder ratio, and observing the results after 32 days. Experimental research on the characteristics of fly ash coarse fragments (FCA) focused on the aggregate soundness test, crushing value, impact value, abrasion value, and water absorption. The impact value test study of their two synthetic products, including I fly ash coarse aggregate concrete (FAC-100%FCA), (ii) The suitability of conventional coarse aggregate (CC-100%CA) and partly replaced fly ash coarse aggregate concrete (PRFAC-50%CA + 50%FCA) for microanalysis was confirmed using IS methods for M30 grade. In order to contrast the effects of FACA and conventional concrete's fresh, hardened, and durability qualities, fly ash is used in FACA concrete.

2.A Comprehensive Review of Development and Properties of Fly Ash-Based Geopolymer as a Sustainable Construction Material

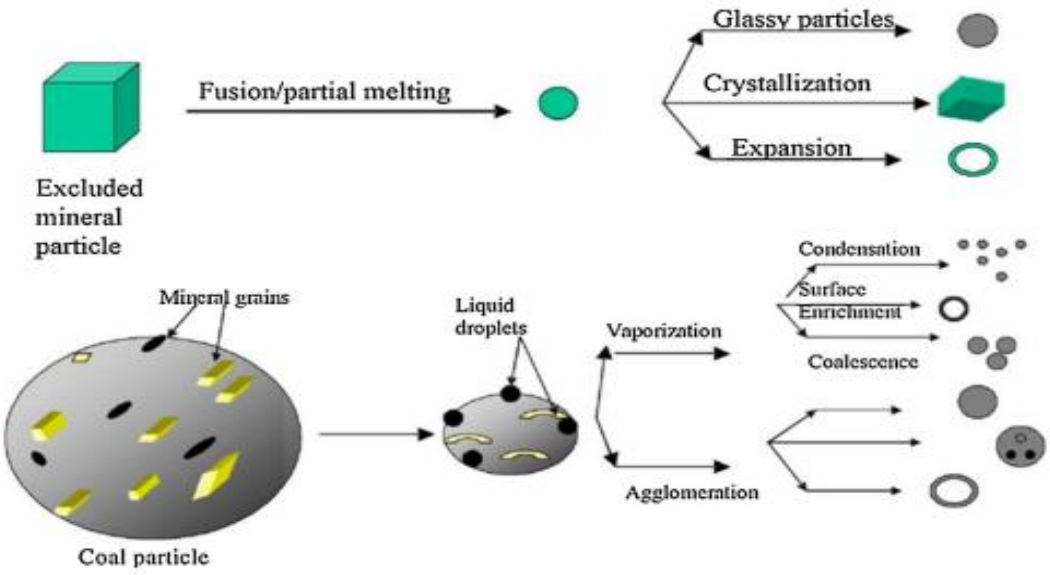
Shekhawat, Poonam, Sharma, Gunwant, Singh, Rao Martand(25 June 2022) Cement is the pozzolanic material used in building the most frequently worldwide. As a result, massive amounts of regular Portland cement are produced every year all over the globe. Cement production is a resource- and energy-intensive activity that releases a significant amount of the greenhouse gas CO2 into the atmosphere. By substituting another by-product of cementitious material with equal or greater mechanical strength and durability, the use of regular Portland cement in building can be reduced. This essay examines the environmental effects of cement production and explains the need for the development of substitute binders for cement and other traditional binders. Numerous researchers have made an effort to create the "Geopolymer," an ecologically friendly binder. In order to develop geopolymer as a sustainable building material, this paper seeks to provide an overview of previous and current studies on the use of flyash and other waste materials. Review of microstructural analysis and its connection to mechanical strength and durability of geopolymer, as well as a description of geopolymer production. Additionally, the evaluation and reporting of the impact of the inclusion of waste material based on calcium. Many experts found that a geopolymer composite based on fly ash was stronger than a composite made of traditional cement.

3.Fly Ash as a Resource Material in Construction Industry: A Clean Approach to Environment Management-Mohammad Nadeem Akhtar and Nazia Tarannum In Sustainable Construction and Building Materials: (2019) Studied The maximum amount of electricity produced by most of the thermal power plants by burning coal at their operating facilities. Due to this activity, various types of secondary materials are generated. Any material resulting from coal-combustion processes may be called a coal-combustion product (CCP). Among different CCPs reported worldwide by coal-burning power plants, fly ash is the most common one. As per the characterization report, fly ash is considered as a powdery material being collected by dust collectors installed in the thermal power plants with the use of coal as fuel. There are different problems related to flyash like requirement of large area of land for disposal and toxicity caused by fly ash which leach to groundwater. The study has established fly ash as an air and water pollution source. It is considered as waste that may act as a resource material in the construction industry, thereby acting as a resource for waste and environment management. Till a decade back, fly ash was treated as waste material worldwide, but now it is developed as an environment savior.

4.Utilization of Fly Ash in Construction

Ghazali, Norhaiza, Muthusamy, Khairunisa, Wan Ahmad, Saffuan in (2023) gave inference ofSix coal-fired electric power plants in Malaysia produced about 6.8 million tonnes of fly ash in 2016, and this number will rise due to a high demand for electricity. Fly ash is a waste product from the combustion of pulverized coal used to generate electricity and is thought to be a contributing component in the soil, water, and air pollution that causes issues for both human health and the ecosystem. However, if used correctly, fly ash can be turned into a valuable and practical product, and numerous studies have been conducted to increase the use of fly ash in a variety of industries, particularly the construction industry. According to the present state of the economy, all construction projects must be both affordable and of high quality. Fly ash can therefore be used as an alternative raw material to supplement or replace the current building material. Due to the material's high oxide content, it is used to make construction material for numerous industries. The possibility for managing fly ash waste by using it as building materials will be covered in the paper.

5.Characteristics and applications of fly ash as a sustainable construction material: A state-of-the-art review by Gang Xu, Xianming Shi, Resources, Conservation and Recycling.136(2018) Due to their good performance and environmental friendliness, fly ash-based construction materials have great potential as alternatives to ordinary Portland cement. To realize sustainable development and beneficial use of fly ash in the construction industry, this paper presents a comprehensive review of relevant literature to evaluate the properties and performance of fly ash, with a particular focus on recent advances in characterization, compositional understanding, hydration mechanism, activation approaches, durability and sustainability of fly ash as a construction material. Several key aspects governing the performance of fly ash, including chemical composition, activator type and hydrate evolution in concrete, are highlighted. Finally, the important needs, pertinent to the optimal and broad utilization of fly ash as an integral part of sustainable construction materials, are identified for further research and development, where large-scale application studies, further classification of fly ash, advanced characterization tools and technology transfer to biomass fly ash are recommended.



6.Fly ash-An emerging alternative building material

Malaviya, S K, Chatterjee, B, Singh, K K(1999)59-67 Thermal power plants generate fly ash, a waste product, as they burn pulverized coal to produce electricity. Since Indian coal includes up to 40% ash, which is higher than that of other nations, fly ash is widely available in India. The environmental and ecological impact of this waste material's disposal is a major issue. One of the study areas over the past few decades has been the safe and profitable use of this material. This essay aims to emphasize the various uses of fly ash as a building material, including the partial replacement of traditional building materials by lime/clay fly ash bricks, Portland Pozzolana cement, and light-weight aggregates.

7.Investigating the environmental impacts of coal mining using remote sensing and in situ measurements in Ruqigou Coalfield, China

R. Raja & A. K. Nayak & A. kla & K. S. Rao & Priyanka Gautam & B. Lal & R. Tripathi & M. Shahid & B. B. Panda & A. Kumar & P. Bhattacharyya & G. Bardhan & S. Gupta & D. K. PatraK. Shu Thermal power stations in Odisha are causing soil pollution leading to its degradation in fertility and contamination. This study investigates the impact of fly ash- fugitive dust (FAFD) deposition from coal-fired thermal power plant emissions on soil properties including trace element concentration, pH, and soil enzymatic activities. Higher FAFD deposition was found in the close proximity of power plants, which led to high pH and greater accumulation of heavy metals. Pollution in soil profiles and high risk areas were detected and visualized using surface maps based on Kriging interpolation. Observation of relatively high concentrations of heavy metals like cadmium,lead, nickel, and arsenic and a low concentration of enzymatic activity in proximity to the emission source indicated a possible link with anthropogenic emissions**.**

8.Impairment of soil health due to fly ash-fugitive dust deposition from coal-fired thermal power plants

Varinder Saini · Jun Li · Yinan Yang · Jinsong Li · Baoming Wang · Jun Tan This study investigates the impact of mining on the environment in Ruqigou coalfield by using in situ and remote sensing data. Field data collected include temperature, gas compositions, and water samples. Multi-temporal Landsat data of 1991, 2003, and 2019 were used to assess the changes in land cover. Normalized difference vegetation index (NDVI) was used to track the changes in vegetation. Thermal anomalies were extracted from the thermal infrared data using a dynamic thresholding technique.The results of in situ analyses show that water quality is unfit for domestic, industrial, and agricultural use, and gas sampling sites emit noxious gasses such as CO2,CO, NO2 and degrade the

local air quality. The classified maps and vegetation indices show a significant decrease in vegetation, and thermal anomalies show an increase in fire areas over the years.

9.Assessment and Characterization of Mine Waste and Fly Ash Material for Effective Utilization in Opencast Coal Mines

Bishnu Prasad Sahoo, Himanshu Bhushan Sahu. Studies in the Coal mining are a major source of nonrenewable energy in India, and to meet the energy demand, voids are often filled with overburden (OB) and waste materials. To evaluate the impact of backfilling the voids with coal mine wastes and fly ash, overburden and fly ash materials have been collected from Talcher coalfield. After addition of fly ash, the maximum dry unit weight of OB mixture decreases while optimum water content increases with the fly ash. The grain size analyses results show OB sample is poorly graded and contains heavy metals such as Fe and Al in high quantity, mild concentrations of Zn, Cr, and Mn, and low amounts of Cu, Co, As, and Se.

10.Assessment and suitability for the dumping of flyash in an abandoned mine

Saba Shirin, Ph.D. , Akhilesh Kumar Yadav, Ph.D. The acid mine water body is a major problem of high sulfur coal mining areas that generate acidic water. This research has tried to develop a treatment method of acid mine water using flyash at a laboratory scale. Water samples have been collected from an abandoned mine (Gorbi) and flyash samples from the various thermal power plants of Singrauli Coalfield. The water sample has been analyzed by analytical techniques and the Morphological, geochemical and mineralogical characterization of flyash has been done using standard techniques SEM, XRF and XRD. The laboratory investigation of the pH value of flyash indicates this has appreciable neutralization potential and may effectively be used to neutralize acid water. The purpose of studying is to assess their suitability for dumping in pits suffering from acid mine drainage.

11.NEUTRALIZATION OF ACIDIC MINE WATER USING FLY ASH AND OVERBURDEN

Saba Shirin* and Aarif Jamal(2018) In today's Era, energy planners are aiming to increase the use of Oil, Gas, Nuclear and also Renewable Energy sources to meet the electricity demand in India. Coal-based thermal power plants are the major source of electricity generation, but their disposal problem of Fly Ash is a major issue. NTPC, DST, CPRI, CSMRS, BARC, CBRI, etc. are working with the Ministry of Environment & Forests and the Ministry of Power, Government of India to formulate a strategy to find out the proper use of this waste material. Fly Ash is being effectively and economically used in building components such as bricks, doors, door-frames, etc. It is also being used in construction of roads and embankments with some design changes, and as raw material in agricultural and wasteland development programmes. Through development & application of technologies, Fly Ash has shifted from "Waste Material" category to "Resource Material" category. This paper provides an overview of disposal and utilization of Fly Ash and its beneficial potential in application of civil engineering construction as well as others.

In this paper Utilization of **fly ash in agriculture**Fly Ash utilization has numerous advantages, such as saving space for disposal, saving of natural resources, energy saving, replacing material which otherwise would need to be produced, and protecting the environment. It can also partly replace cement, which requires energy consumption and CO2 emissions globules from Fly Ash. This application helps to widen the gap between two watering cycles, improve the pH value of soil, and supplement the utility of chemical fertilizers. Various crops have been grown and harvested in varying agro-climatic conditions and different soil-crop combinations, resulting in an increase in crop yield.

Crops	Percent Yield increase
Wheat, Mustard, Rice, Maize,	6-18
Pearl Millet	32
Seed cotton, Sorghum, Gram, Soybean	10-46
Sunflower, Groundnut	10-26
Paddy, Potato	31
Sugarcane	22
Vegetables	15
Banana	30

Table:Increase in crops yield

USE OF NEW MATERIALS

Depletion of natural resources is a major environmental concern in a highly technological society, leading to deterioration in quality of life. To maintain technological development, alternative materials such as fiberglass, reinforced plastics and glass, reinforced gypsum have a great potential to be used as building materials in place of conventional materials like timber, steel.

ENERGY SAVING AND ENVIRONMENTAL BENEFITS : Developing countries face energy scarcity and infrastructure shortages, so materials for habitat and other construction should be energy efficient to create a pathway for resource efficient, low carbon inclusive growth.

Building Materials	Composition	Material Compared	Energy saving (%)
Portland Pozzolana cement	75% ordinary Portland cement and 25% Fly Ash	100% Ordinary Portland Cement	20
Lime-Pozzolana mixture	25% Acetylene gas lime and 75% Fly Ash	25% Lime and 75% calcined brick	75
Calcium silicate brick	90% Fly Ash tailings 10% lime (waste source)	Burnt Clay brick	40
Burnt brick	75% clay and 25% Fly Ash	Burnt Clay brick	15
Fly Ash Brick	50% Fly Ash , 28% Sand, 20% Lime and 2% Gypsum	Burnt Clay Brick	>40

TABLE: Energy Savings in the manufacturer of Building Materials through Use of Fly Ash

12.Strength behavior of surface coal mine overburden–fly ash mixes stabilized with quick lime

Banita Behera &Manoj K. Mishra This article examines the compressive strength and bearing ratio behavior of surface coal mine overburden material and fly ash mixes stabilized with quick lime at varying percentages. It compares the results with results obtained from fly ash-mine spoil and mine parting mixes and fly ash-soil. Fly ash, a coal combustion by-product, has the potential to change the behavior of other similar products when mixed at optimum conditions. Both fly ash and overburden are treated as waste products, but an investigation has been carried out to evaluate the utilization prospects of both combined.

13.Disposal and Utilization of Fly Ash to Protect the Environment

I. Nawaz(2013) Investigated thatCoal-based thermal power plants are the major source of electricity generation, but their disposal problem of Fly Ash is a major issue. NTPC, DST, CPRI, CSMRS, BARC, CBRI, etc. are working with the Ministry of Environment & Forests and Ministry of Power, Government of India to formulate a strategy to find out the proper use of this waste material. Fly Ash is being effectively and economically used in building components such as bricks, doors, door-frames, etc. It is also being used in construction of roads and embankments with some design changes, and as raw material in agricultural and wasteland development programmes. Through development & application of technologies, Fly Ash has shifted from "Waste Material" category to "Resource Material" category. This paper provides an overview of disposal and utilization of Fly Ash and its beneficial potential in application of civil engineering construction as well as other aspects.

14.A Review on fly ash generation, its composition and Environmental Impact for Durg - Bhilai Twin City industrial Region

Manoj Kumar Tiwari Dr. Samir Bajpai, Dr. U. K. Dewangan (April 2016) The study seeks to determine the environmental effect and utilization of fly ash as a light construction material in Durg – Bhilai Twin City region based on its chemical and physical characterization. The physical properties classification of fly ash suggest that it is suitable for geotechnical applications and can be used for constructing precast concrete units for low cost construction. Chemical composition suggests the possible applications for coal ash, as all Indian fly ashes contain silica, alumina, iron oxide and calcium oxide.

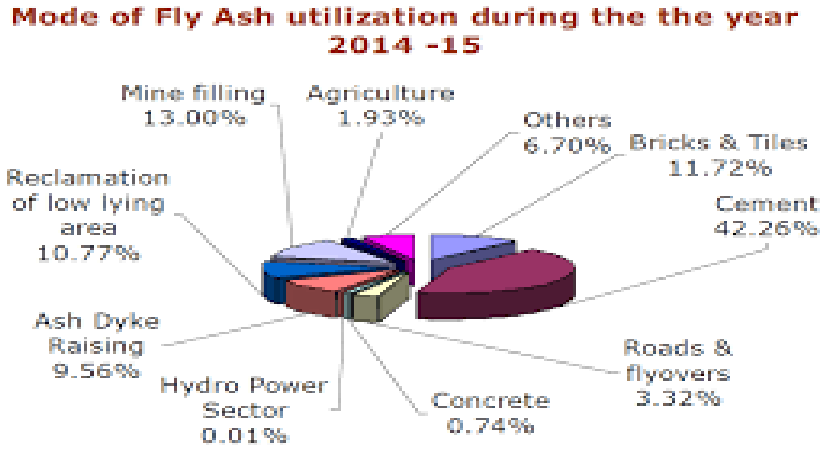
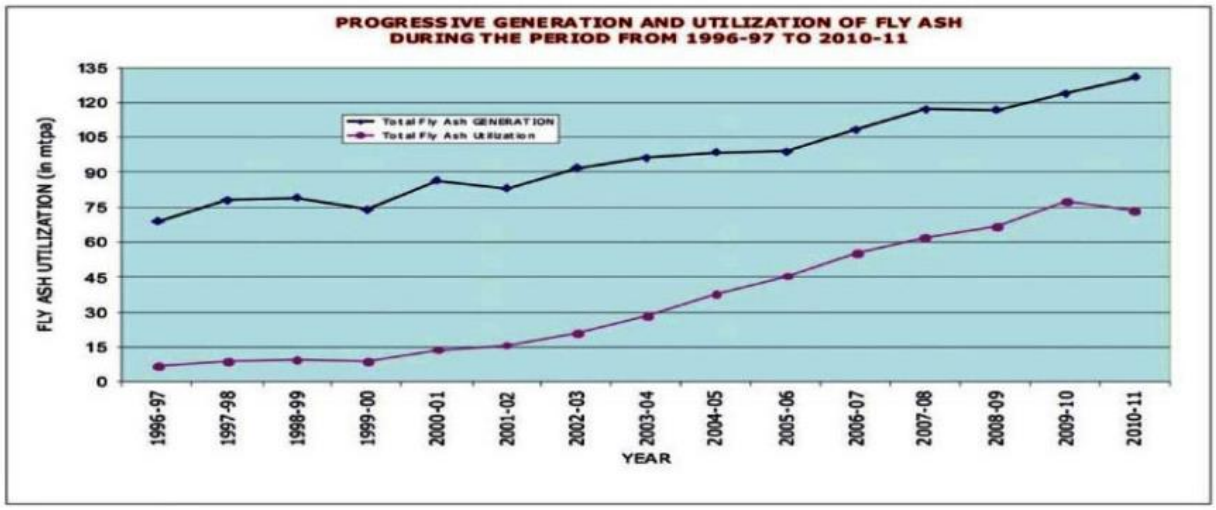


Figure : The pie diagram showing the modes of utilization of fly ash during the Year **2014-15**



Fly ash is being used by Cement Industries as a pozzolanic material for manufacturing Portland Pozzolana Cement (PPC). It is highly value-added, with 2.45 million-ton of fly ash used in 1998-99 and 43.33 million-ton in 2014-15, constituting 42.26% of total fly ash utilization.

15.Preparation of Fly Ash Granules with Respect to Mine Filling

Anamika Masoom, Manish Kumar Jain, and Rayasam Venugopal(2019) The present study has focused on the bulk utilization of fly ash at the mining sites for the purpose of backfilling by agglomerating the fly ash fines with the help of suitable binder and water. The use of fly ash as a stowing material has been justified by studying the physical, morphological, chemical and geotechnical properties of the fly ash. Rheology of the fly ash slurry has also been studied which deduced consumption of a lot of water during its hydraulic transportation. To overcome the drawbacks, spherical granules have been prepared with the help of a Disc Pelletizer in which the requisite amount

of water and binder (lime) have been finalized as 35% and 30% by weight of the fly ash. Granules have been obtained at various combinations of disc speed (35, 40, 45 RPM) and disc inclination (42°, 45°, 48°) and each combination has been analyzed for Green Compressive Strength and Drop Number. It has been concluded that the granules prepared at 45 RPM and 45° inclination gave the best results. This utilization of fly ash granules for the purpose of mine backfilling could effectively replace sand which has been conventionally used by providing better flowability, compaction and permeability.

16.Utilization of Fly ash for sustainable environment management

Soma Gorai*(2017)Fly ash is a fine powder generated during the burning of pulverized coal in thermal power plants, which creates significant environmental problems when released into the atmosphere. In recent years, technologies have been developed for the beneficial utilization of fly ash in different fields, such as construction, mine backfill, road sub-base, agricultural field, paints, wood substitute composites and as a low-cost adsorbent for the removal of organic compounds. This article aims to find new areas that will increase the positive use of fly ash and reduce the environmental pollution impacts.

Fly Ash market is expected to reach **US$ 64,761.9 Mn by 2022**, growing at a CAGR of 7.3% during the forecast period.

Figure : Global Fly Ash Market Revenue and Growth

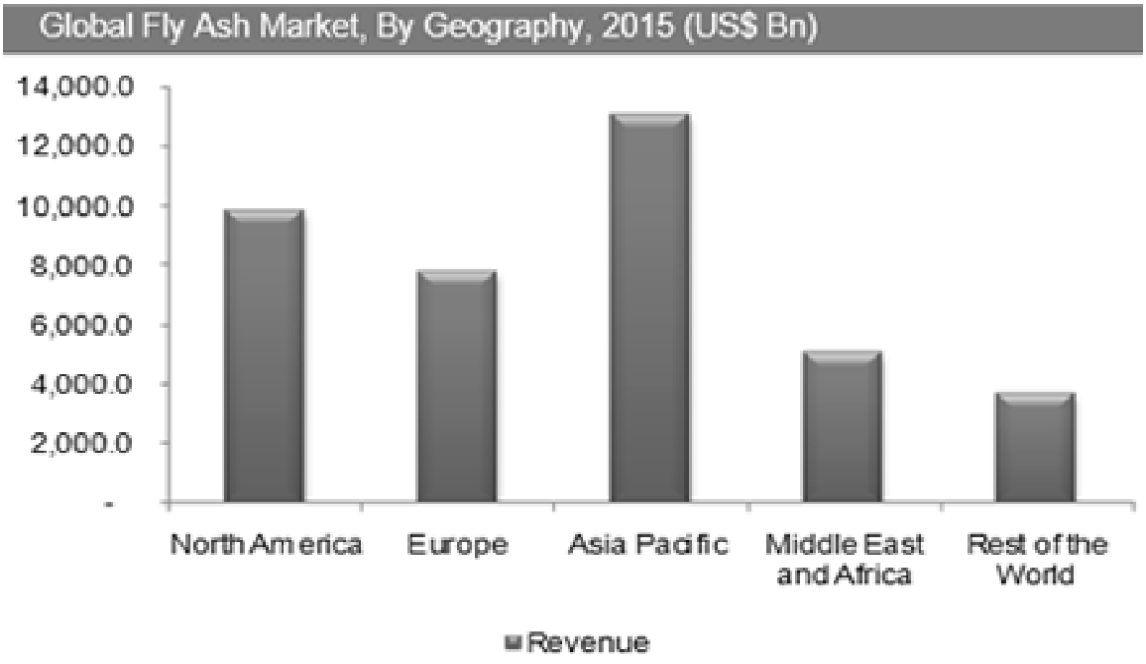
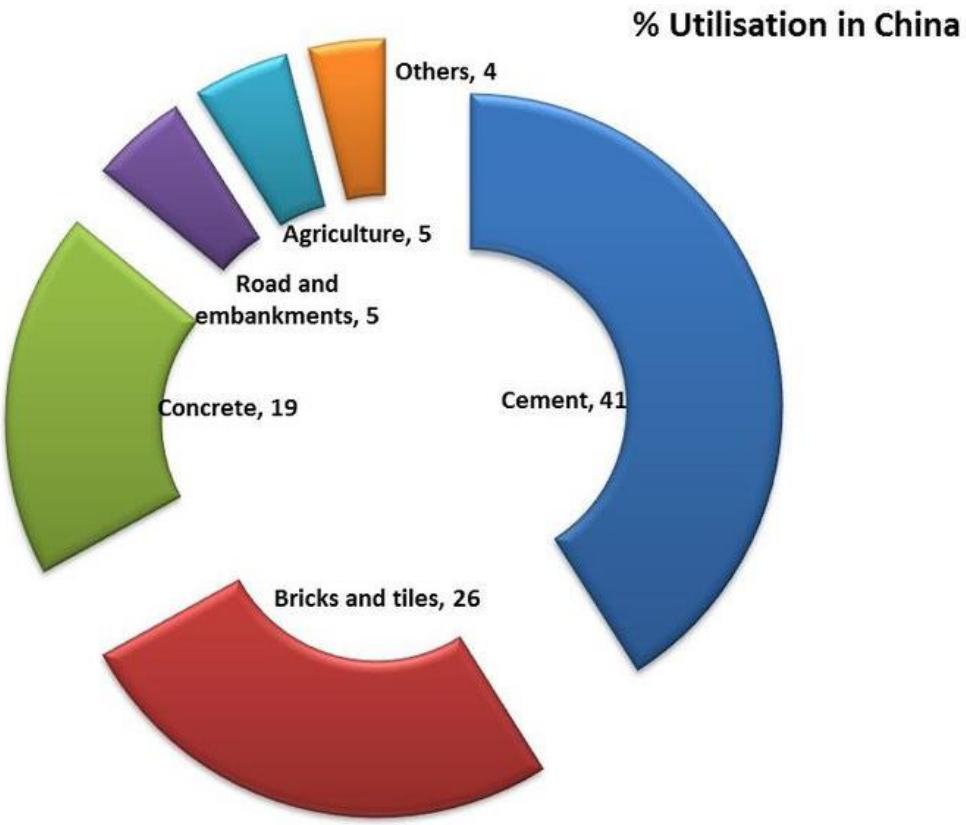
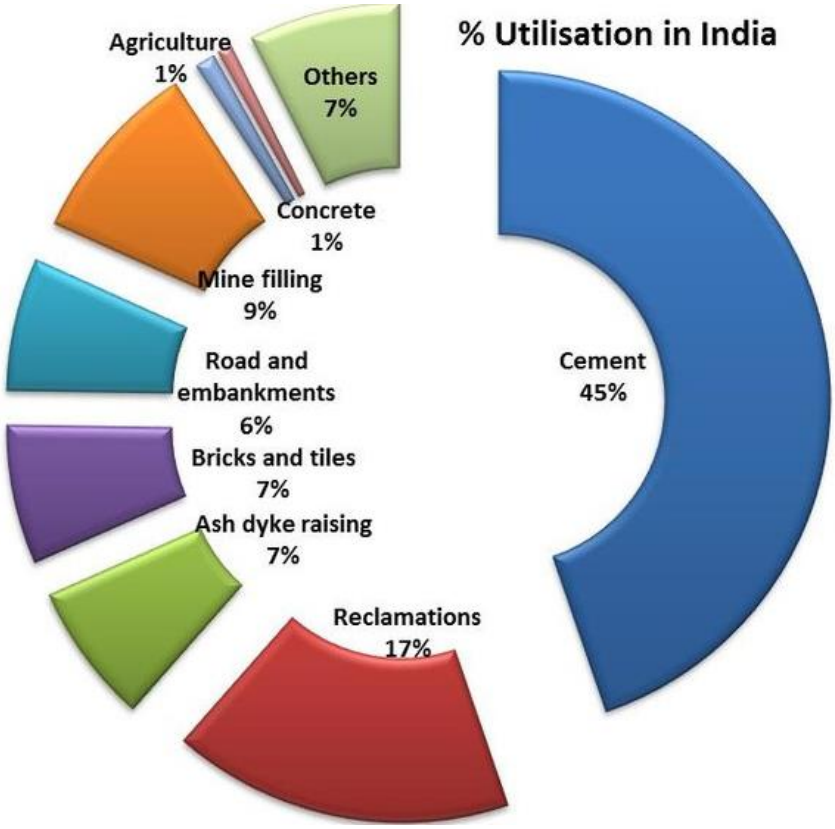


Figure : Global Fly Ash Market by Geography



Utilization of Fly ash in china

According to the annual report of China comprehensive resource utilization (2012) released by the National Development and Reform Commission (NDRC) of China, the coal fly ash generation and utilization were 540 and 367 million tonnes in 2011 respectively. The utilization rate reached 67.96%, higher than that for the US (46.74%) and India(55.79%). Among the section of utilization, the top 3 were cement(41%), brick and tiles (26%) and concrete (19%)



Utilization of Fly Ash in India

The generation of fly ash in India has increased from 68.88 million tonnes in 1996 to 163.56 million tonnes in 2012–13, of which only 100.37 million tonnes was utilized. However, nearly 40% of the ash is still unused.

17.Influence of fly ash on performance of high concentration cemented backfill material in coal mine

Yang Baogui, Li Yongliang, Dang Peng, Peng Yanghao and Wang Yukai(2015) Done an experimental investigation on High concentration cemented backfill mining is employed in Xinyang Mine to solve the problem of coal mining under villages. Fly ash is an important factor that affects the material's performance. To determine the reasonable proportion of fly ash in backfill material, the material's mechanical and transmission performance was analyzed with dosage of 18%, 20%, 22% and 24%. Results showed that the strength of the backfill body increases with the dosage's increase, but the growth is not obvious. The dosage of fly ash has greater influence on frictional resistance than local resistance.

18.Leaching Behaviour of Fly Ash: A Review

Chanchal Verma*† and Ranjeet Verma Studied that the Fly ash produced in a large quantity is a major problem in coal fired thermal power plants due to its high levels of toxic elements. During transportation, disposal and storage phases, residues from coal combustion may pollute both ground and surface waters through leaching. Fly ash enriched in Ca, Ni and Fe showed greater leachability in acidic or ion exchangeable conditions. Principal mechanisms of metal leachability are the dissolution of primary solids under aggressive environment and/or precipitation sorption reactions, which are primarily dependent on pH. Fe is tightly bound to the ash and does not leach easily while Ca is highly soluble and leaches out almost all the mediums. The leachability of trace elements in fly ash is time dependent and pH values of the leachant.

19.Analysis of Fly Ash Disposal Problem In Coal Fired Steam Power Plant: Study At Pltu XYZ,Indonesia

Heri Wibowo 1, Etty Riani 2* and Budi Kurniawan The Pembangkit Listrik Tenaga Uap-PLTU coal-fired Steam Power Plant (PLTU) was built to meet the national electricity demand. Activity running on PLTU generates waste which is categorized into hazardous and toxic substances (B3 waste) in large quantities every day. This study aimed to analyze the main problems related to B3 waste management such as fly ash and bottom ash which were generated by PLTU. It used primary data derived from interviews with expert stakeholders, and interpretive structural modeling to identify the main problems. These include an open handling system, weak regulation of TPS permits by local government, TPS designs which should be silos that do not interact with water, fly ash handling which not well planned, fly ash disposal which conduct after piling up thus make an expensive cost, fly ash services which focused on Java and wet waste which cause complicated handling and expensive cost, and the problem of linkage.

20.Fly Ash: Production and Utilization in India - An Overview

Aadil Yousuf 1, Shahzada Omer Manzoor 1, Mudasir Youssouf 2, Zubair A. Malik 3, * and Khawar Sajjad Khawaja (2020) Fly Ash is the fine particulate residual outcome of pulverized coal burning obtained primarily from coal-based electricity generation plants. With the exponential increase in population around the world, the electrical energy demand is at an all-time high and coal-based power plants are responsible for satisfying a major part of this demand. This has led to a significant increase in the production of fly ash from these plants and the disposal of fly ash which is considered a deleterious product for the environment

. This paper provides a brief review of the composition, production and utilization of fly ash in India, as well as several options for its effective usage in various fields.

S.NO	Mode of utilization	Utilization (Million tons)	utilization
1	Cement	58.3401	26.88
2	Mine Filling	10.1002	4.65
3	Bricks and Tiles	21.6097	9.96
4	Reclamation of Low Lying Area	29.3177	13.51
5	Dyke Raising	21.5734	9.94
6	Roads and Flyover	9.7244	4.48
7	Agriculture	1.3769	0.63
8	Concrete	1.7742	0.82
9	Hydro Power Sector	0.0000	0.00
10	Others	14.5809	6.72
11	Unutilized Fly Ash	48.6405	22.41
	TOTAL	217.0380	100.00

*Source: CEA annual report 2018-2019.

There is a 100% utilization on fly ash in year 2018-2019

21.A Review on Potential Use of Coal Bottom Ash as a Supplementary Cementing Material in Sustainable Concrete Construction

Sajjad Ali Mangi1&2, Mohd Haziman Wan Ibrahim1*, Norwati Jamaluddin 1, Mohd Fadzil Arshad2, Fareed Ahmed Memon 3, Ramadhansyah Putra Jaya 4, Shahiron Shahidan 1 (2018)

The demand for concrete is increasing rapidly due to worldwide growth in infrastructural development. This has raised the demand for Portland cement, which is the fundamental material in concrete construction. To meet this demand, it is important to develop supplementary cementing materials from industrial waste by-products, such as coal bottom ash, produced by coal-based thermal power plants. A literature review has found that the original coal bottom ash is porous in nature, but after the proper grinding, it possesses the good pozzolanic property and could be utilized as replacement of cement in concrete. The aim of this review is to summarize the previous findings on the utilization of coal bottom ash as supplementary cementing materials in concrete construction and provide key information and valuable material for researchers looking for the supplementary cementing material in the field of advanced concrete technology.

22.Fly ash in India: Generation vis-à-vis Utilization and Global perspective

Surabhi (2017) Global energy demand is set to increase by almost 50% in the period 2016 to 2040, with much of this growth concentrated in the developing world, primarily China and India. Indian coal is of low grade having high ash content, producing large quantities of fly ash at coal/lignite based thermal power stations. In the past decade, there has been a tremendous increase in the generation of fly-ash since more than 70% of the country's demand for electricity is met by coal-based thermal power plants. The management of fly ash has been troublesome

due to its potential of causing pollution of air and water. This paper also gives an overview of the global scenario of fly ash generation and its utilization apart from India.

23.BRICKS WITH TOTAL REPLACEMENT OF CLAY BY FLY ASH MIXED WITH DIFFERENT MATERIALS

J.N Akhtar1 J.Alam2 and M.N Akhtar(2011) Fly ash is a powdery substance obtained from the dust collectors in Thermal power plants that use coal as fuel. It contains 80-90% of glass and is used as a raw material to total replacement of clay for making Fly ash bricks. This study studied the effect of Fly ash with high replacement of clay mixed with different materials at a constant percentage of cement i.e 10%. Three Categories of bricks were studied namely Plain Fly ash brick, Treated Fly ash brick (TFAB) and Treated Fly ash stone dust brick (TFASDB). The quantity of Fly ash was kept constant at 80%. It was found that the compressive strength of plain Fly ash brick was higher with 5% coarse sand and 15% sand combination at 10% cement. The gain in strength was also higher with 10% stone dust and 10% sand combination. Variations in the quantity of fly ash were also attempted and it was found that 25TFASDB with 50% fly ash, 25% stone dust, 25% sand and 10% cement achieved highest compressive strength.

24.A REVIEW ON STATUS OF COAL ASH IN INDIA-PRESENT SCENARIO & FUTURE PROSPECTS

SOUMYA RANJAN MALLICK & Dr. MANOJ KUMAR MISHRA(2011) The rapidly increasing demand for energy in India is leading to the commissioning of new thermal power plants. This has led to the disposal of coal ash from combustion of coal, which is an acute environmental issue. Indian coal contains 35-50% ash, and the generation of coal ash can go up to 350 MT by 2025. To address this, development of an eco-friendly Technology capable of utilizing coal ash in bulk is necessary. This paper represents various approaches adopted by thermal power plants, coal ash consumers & Government as well as private agencies for increasing utilization of coal ash.

Area Of Utilization	Utilization(MT)	Utilization(%)
Manufacture of cement	35	44
Construction of Road Embankment	15	19
Substitution of Cement	10	12
Backfilling in Mines	7	09
Reclamation of low lying areas	6	07
Raising of Ash Dykes	3	04
Brick Manufacturing	3	04
Agriculture	0.5	0.5
Others	0.5	0.5

Table:Utilization of Coal Ash in Various Sector

In this paper they compared Past scenario and present scenario of fly ash utilization for the year 1944 and for 2003-04 **3%**(one million tons) in **1994** to **27%** (22 million tons) in **2003-2004**. **47%** of utilization in **2006-2007** as

against a generation of **130 million tons per year.** The use of fly ash in mine filling, construction of roads/flyover embankments, hydraulic structures, raising of dykes, manufacture of building components, and agriculture is increasing. In 2009-10, 160 MT of coal ash was produced and 80 MT was used in various areas.

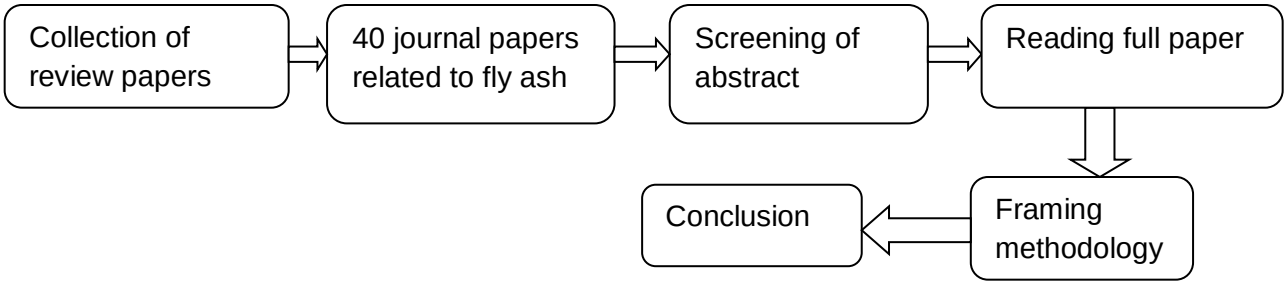
PROPERTIES OF FLY ASH: Fly ash is an amorphous mixture of Ferro-alumino silicate minerals, with physical and chemical properties that depend on the type of coal used, combustion methodology, and temperature regulation. It has a minute average diameter, low bulk density, high surface area, and light texture. The size of fly ash particles varies from 10 to 100 microns, and the color of the particles depends on the mineral composition of the coal source. The specific gravity of fly ash depends on the degree of coal pulverization, particle shape, and coal type.

FLY ASH CLASSIFICATION:

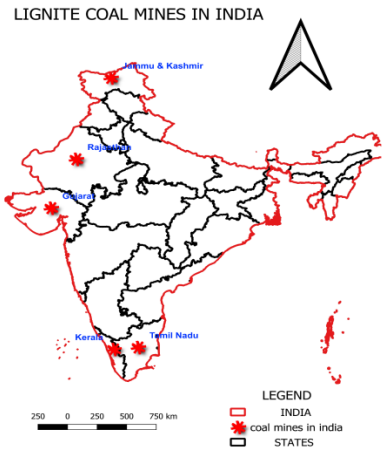
- Class C Fly Ash is formed from the burning of subbituminous coal and has lime in excess of 20%.
- Class F Fly Ashes are generated from the combustion of bituminous and anthracite coals and have less than 10% lime content.
- These ashes need an activator like Portland cement, quick lime, etc. for the formation of cementitious compounds.

LIGNITE MINES IN INDIA: Tamil Nadu, Puducherry, Kerala, Gujarat, Rajasthan and Jammu & Kashmir. India is the second largest producer and consumer of coal after China, with Jharkhand being the largest and top coal-producing state. Coal accounts for 55% of the country's energy needs.

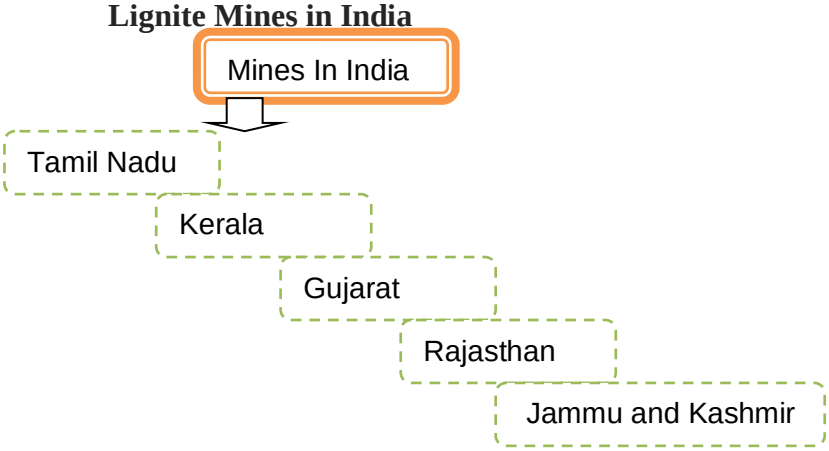
METHODOLOGY:



Map of coal mines in :



Lignite Mines in India



Collecting the fly ash from the excavated mine area and transported and taken for testing, they checked the chemical and physical properties and compared them with other impurities like GGBS, Silica, Gypsum.

Checking what percentage should be mixed with cement, sand, class F & class C bricks, mosaic tiles, and hollow blocks, Use of Fly Ash for Road and Embankment Works, Fly ash in flow able fill, Fly Ash as Wood Substitute Composites, Floor Tiles and Wall Tiles.

ADVANTAGES:

Fly Ash utilization has numerous advantages, such as saving space for disposal, saving of natural resources, energy saving, replacing material which otherwise would need to be produced, and protecting the environment. It can also partly replace cement, which requires energy consumption and CO2 emissions.

Fly ash produced by coal-fired power plants is an excellent prime material for blended cement, mosaic tiles, and hollow blocks. It is an expensive replacement for Portland cement, but improves strength, segregation, and ease of pumping concrete.

CONCLUSION:

When the dosage of fly ash in high concentration filling material is unchanged, the resistance loss of filling slurry increases with the dosage's increase. During transportation of the high concentration filling slurry, the frictional resistance increases with the increase of fly ash, while local resistance decreases first and then increases. When the dosage is 20%, the filling material has good mechanical performance and transmission performance.Fly Ash has been more utilized in foreign countries. They use Fly Ash for many construction companies like tiles company with suitable percentage, in brick companies. The Fly Ash is used more in Brick manufacturing companies.

Thermal Power Stations must modernize their coal/lignite based Thermal Power Stations to utilize fly ash in the construction of embankments, railway lines and roads, and agriculture and waste land improvement. To do this, they must explore and promote all possible modes of fly ash utilization by establishing an in-house research cell.

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