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(FA) Fly Ash And (CAD) Coal Ash Dams: A Potential Hotspot For Environmental Pollution Study Of Resources Emission And TheirConsequences Among Humans Inhabiting In Developmental Areas Of Over Bridges Across National Highway India

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Abstract

FA (FA) is a major output of Thermal Power Plants (TPP) formed when coal is burnt it produces Fly Ash (FA) trapped in Electrostatic Precipitator termed as EPA and left over at bottom of power plants. As per Government of India, this Fly ash can be directly used as better option for landfill material during any construction of Overbridges and Underpass in and around Maharashtra State. During our study, we do find apart of its major use as Land filler option it create havoc in environment. Study comprises two distinct methods Direct Observation and Line Transect Methods. To accomplish objective overall six villages were selected in and around site of construction. Our result suggest chemical contents of FA are extremely hazardous for local villagers it contains mercury,antimony , silica, aluminum oxide , ferric oxide and other oxides material acting as passive contributing factor in physical environment causing all three major types of pollution viz. air pollution ,water pollution , and soil pollution resultant consequences of human health problems .residing nearby construction highway areas .For sustainable power production there are recommended package and practices as measure to be adapted by Government of India .

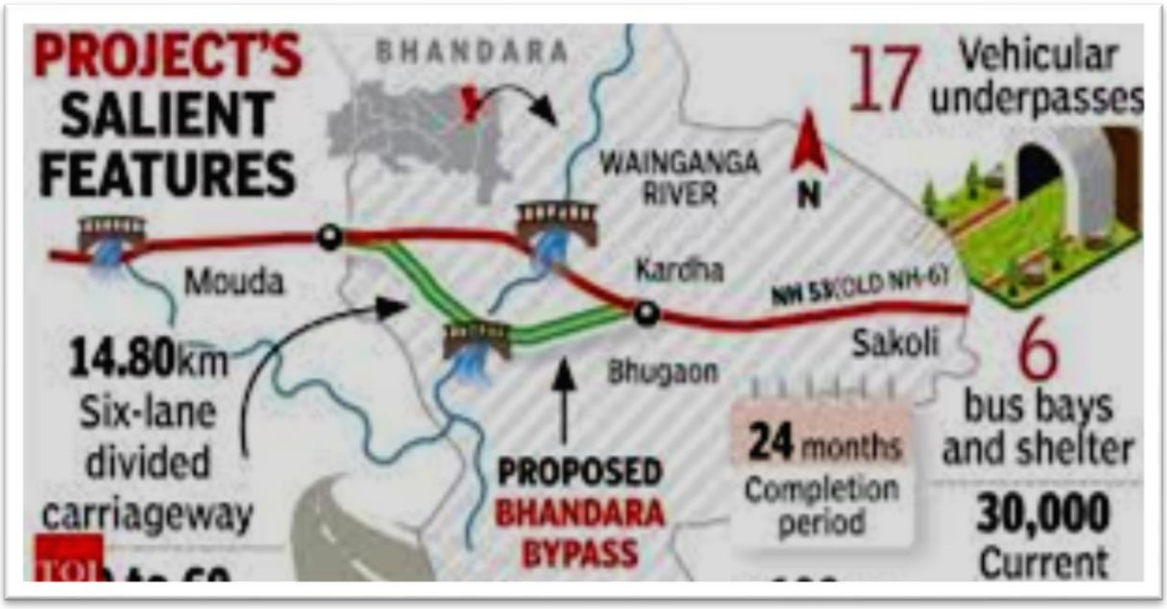
Keywords: Fly Ash, Coal Ash Dam, Avifauna, Environment impact, Human Health

Introduction:

With ever increase in Urbanization , globalization rising cementry and population explosion demands of construction raw material increases day by day ,and with ever-increasing demands supply chain becomes unsupportive to meet ends ,henceforth with trio of RRR concept government focuses on Reduce ,recycle and Regenerate where they urge society ,industrialist, government

bodies to dispose their waste in sustainable manner . As a solution as per G.R. Government of India recommends us of Fly Ash (FA) in all construction of flyover, Overbrigdes, Underpass wherever , whichever possible. As the power production increases, fly ash generation from coal/lignite based thermal power stations also increases. To stack these waste resources (CAD) Coal Ash Dams were created to impound FA in sludge form for longer time. The two power plants along with the related infrastructure including two (FA) Fly Ash ponds of the Koradi TPS and (FA) Fly Ash pond of Khaparkheda TPS. According to U.S. Environmental Protection Agency, 21 of the nation's 45 high hazardous CAD Coal Ash Dams are hold more than 118 billion gallon of FA. CAD are created when Coal Ash is mixed up with water to form sludge that is stored in huge impoundments spread in Acres in size. It is recommended during Landfills Liners are required to prevent leakage of toxin into ground waters .Koradi and Khaparkheda thermal power plants are Feather to a Cap like for Maharashtra State have been important for the Maharashtra State Power Generation Company (MAHAGENCO) in meeting its goal of providing adequate power to the state.

Fig 1. Road map for construction of Bypass on Bhandara National Highway 53 showing underpass and Bridges. (Sources: Times of India)



Methodology:

To study impact of use of Fly ash (FA) used as Land filler option regular survey were undertaken on NH -53 overall 10 villages were selected from site of beginning of project upto the endpoint of project . Of same starting from the MoudauptoSakoli National Highway as selected construction sites, on each construction sites and adjoining villages were significantly noted. During survey, two methods were implied as Direct Survey methods and Line Transect methods to check impact FA on roosting and nesting behavior of Avifauna at construction site of Forest patch were purposed under pass is constructed. To observe and record data use of Sony Alpha DSLR Camera with lens 55-300 is used to check .Direct survey methods involves interaction with villagers based on discussions with selected site and resident peoples were done. It also involves direct perception of villagers before and after situation of construction of Flyovers and over bridges. Similarly, peoples with farm stack holder were also selected to check the impact of FA on their cash crops .Farmer profiles based on survey of 5-10 farmers in each village to capture the impacts of pollution on agriculture faced by individual farmers. It is applied to record impact of (FA) on Natural Vegetation and Forest Patches across pavement of Highways, Overbrigdes by walk in Line transect method of

1 km distance, and images were captured by using Sony DSLR Alpha 57 Camera 55-300 mm lens. During survey observation were also noted w.r.to Avifauna and their Roosting Pattern across Forest patch of **Sakoli -Mohgoan Forest** where UnderPass for Wild animal is under construction mode.

Geo Tag Location

Site 1: Bhilewada [Lat 21.13343Long 79.695286]
Site 2: Mohgoan [Lat 21.067646; Long 79.930979]
Site 3: Mohgoan UnderPass [Lat 21.067953 Long 79.931475]

Result and Discussion

Fly ash emissions from coal combustion units show a wide range of composition with present of elements below atomic number 92 and considered as major source of air pollution. The ultrafine particle of fly ash will behave like cumulative poisons after remain for long periods of time when reaches the respiratory region [13][28]. As a result, several physiological disorders and other related health problems such as respiratory problem, cancer, anaemia, hepatic disorder, gastroenteritis and dermatitis will arise [13][23] In road and fly overs approximate 5% of fly ash is utilized. Road plays a crucial role in the development of the country. In this sector, it has a large potential for fly ash utilization. Hence, especially for soft sub grade soil, more research is required for use of fly ash in road construction.

According to statistics, fly ash rate of production is clearly far outweighs consumption due to increased amounts of energy being generated by coal-fired power plants and widely available across the globe as shown in Table 1 [17][21]. These bad situations will interrupt the entire ecological cycles if not properly disposed [14][25][26], therefore good waste management practice needed to sustain a healthy environment [20].

Table .1. Chemical composition of Indian Fly Ash

Chemical composition of Indian Fly ash		
Sr. No.	**Constituent**	**Percentage Range (%)**
1	Silica (SiO2)	49-67
2	Alumina (Al2O3)	16-29
3	Iron Oxide (Fe2O3)	4-10
4	Calcium Oxide (CaO)	1-4
5	Magnesium Oxide (MgO)	0.2-2
6	Sulphur (SO3)	0.1-2
7	Loss on ignition	0.5-3

Health consequences:

Fly ash emissions from coal combustion units show a wide range of composition with present of elements below atomic number 92 and considered as major source of air pollution. The ultrafine particle of fly ash will behave like cumulative poisons after remain for long periods of time when reaches the respiratory region [13][28]. As a result, several physiological disorders and other related health problems such as respiratory problem, cancer, anaemia, hepatic disorder, gastroenteritis and dermatitis will arise [13][23] Fly ash is one of three general types of coal combustion byproducts (CCBP's).

Fly ash is the unburned residue that is carried away from the burning zone in the boiler by the flue gases and then collected by either mechanical or electrostatic separators [4][16][17] The use of fly-ash in road construction is permitted as per the Standards & Specifications evolved by the Indian Road Congress/ Ministry. The physical and chemical Properties of fly ash and the design methodology to be adopted for embankment construction has been specified in IRC:SP:58:2001 "Guidelines for use of fly-ash in road construction". Section 305 i.e. "Embankment Construction" of MoRT&H Specifications for Road and Bridge works lays down the specifications for use of fly-ash in embankment construction.

There is a huge generation of fly ash in the country and substantial portion of it remains unutilized which is an environmental concern, creating health hazards apart from occupation of large areas of precious land for its storage/disposal. Disposal and utilization of ash generated at the thermal power plants has become a pressing and urgent task. Bulk utilization of the fly-ash is possible in the field of civil engineering applications, especially construction of road embankments. (MoEF, 1999, 2001 & 2011).

3.2. Utilization of Fly Ash in Road and Embankment Construction:

Utilization fly ash in road and embankment construction has many advantages compared with the conventional method. Saves top soil which otherwise is conventionally used, avoids creation of low lying areas (by excavation of soil to be used for construction of embankments) [54]. Fly Ash may be used in road construction for filling purposes, stabilizing and constructing sub base or base [13][17] [20][28][55]. In recent years, cement and marble industries have raised concerns regarding the adverse impact on the environment due to the release of carbon di-oxide and disposal of marble sludge, respectively. Embankment can be constructed using fly ash as fill material. Fly ash (FS) used as a partial substitute for cement is acquired from a nearby situated plant of ready mix concrete, Jaipur, Rajasthan, India. FS was added in a percentage range of 0–50% with an interval of ten percent by weight of cement in the concrete blend. The results indicate that 10 % MP and 20% FS were the optimum percentages of replacement for sand and cement, respectively. Significant outcome obtained from the results will have a potential impact on the manufacturing of sustainable concrete with a solution to an environmental problem[21]. The results indicate that 10 % MP and 20% FS were the optimum percentages of replacement for sand and cement, respectively. Significant outcome obtained from the results will have a potential impact on the manufacturing of sustainable concrete with a solution to an environmental problem. However, the graters concern using fly ash as a fill is the potential of leachate and an associated contamination to the ground water. There are several techniques such as a site grading, compaction, and surface water control, that can be used to prevent leachate from happen [32]. The well-compacted fly ash shows good shear strength comparable to normal soils used in earth-fill operation. Fertilizer. Fly ash can be used in combination with chemical and / or organic carbon to get additional benefits in terms of improvement of soils physical characters for increased yield of crops. In a study it was concluded that mixing of up fly ash to 20% with clay loam and upto 30% in the sandy soil is useful to improve soil physical properties as well as to increase the yield of wheat[8].

Fly ash also has good permeability and even moisture-density curve therefore, it's become desirable material use for embankment construction, backfilling and land development works [36]. Fly ash alone or in combination with lime, is used to stabilize the subgrade in order to reduce plasticity, enhance strength, and improve workability of weak soils [17]. Soil mixed with fly ash and lime will increases California Bearing Ratio (CBR), increased (84.6%) on addition of only fly ash to soil [13][55]. For construction of base and subbase courses for pavements, fly ash is used either with lime or portland cement, and aggregate [17]. Concrete containing large amounts of fly ash

can be proportioned to meet strength and durability requirements for road paving work. The 50% fly ash Class C mixture provides an excellent alternative for paving even though this mixture gained strength more slowly at the beginning [56].

As per the notification of MoEF&CC, it is mandatory to use fly-ash in the construction of road or flyover embankments within a radius of 300 km of a thermal power plant.

The availability of fly ash at various stations of National Thermal Power Corporation (NTPC) is available at NTPC official web site www.ntpc.co.in under the Tab "Ash Availability".

Fly ash has been used in low lying areas as structural fill for developing residential sites for mine.Embankments for roads and highway bridges were constructed using the fly ash to generate from coal fired power plants. Fly ash has also been used as backfill materials behind the retaining walls (Gray, 1972). Literature suggests that fly ash has been also used as Geotechnical properties for supporting structural loads (Leonards and Bailey, 1982). They have stated that load tests carried out on compacted fly ash beds show that fills materials can support large loads with small settlements. Local soil at a backfilled site may be too weak to support. For this purpose, local soil is replaced by compacted fly ash material as fill to provide the needed bearing capacity and strength. The use of fly ash in highway embankments and fills is the second highest use of this material. It behaves like a fine sand material but has a lower density (Murthy et al, 2000; Mckerall et al., 1982). Embankments and fills are also the highest use application of bottom ash. Bituminous (Pozzolanic) fly ash is more frequently used to construct embankments and structural backfills than sub bituminous or lignite (self cementing) fly ash (ADAA, 2009). This is due in part to the self-cementing characteristics of the latter type, which hardens almost immediately after the addition of water (CCAA, 2011).

The global fly ash utilization scenario states a utilization rate upto 96.4% but the average figure is 53.5%. It appears from the data that the higher utilization rate is in those countries which have low amount of fly ash generation since the European countries collectively indicate 90.9% of utilization. In India, we have seen utilization rate from30.09% to 93.72% in different states of the country [Table 2]. Different states have different patterns of fly ash utilization. The quantum of fly ash utilized and residual left for each state reflects the need of support in terms of technology, awareness, execution potential etc. There are states such as Rajasthan,Tamilnadu and Punjab that do not need anysupport per se,asappropriate frameworkforflyash utilizationis available, and no special effort is required, though the efforts being made are to be continued.

Table2:State-WiseResidualFlyAshduring2010-11to2013-14

No	State	Fly Ash Generation (Million- Ton)	Fly Ash Utilization (Million-Ton)	% Utilized	Residual Fly Ash (Million Ton)	Ratio of %Utilized to Residual	*Su*pportFramework
1	Chhattisgarh	59.90	23.22	38.77	36.68	1.06	Highsupport required
2	UP	88.34	45.82	51.87	42.52	1.22	Highsupport required
3	Andhra	70.06	36.48	52.06	33.58	1.55	Highsupport required
4	Odisha	46.93	21.30	45.38	25.63	1.77	Highsupport required

5	Madhya Pradesh	42.79	20.51	47.94	22.28	2.15	Sufficientsupportreq d.
6	Maharashtra	55.87	32.83	58.76	23.04	2.55	Sufficientsupportreq d.
7	Bihar	16.49	4.96	30.09	11.53	2.61	Sufficientsupportreq d.
8	Haryana	20.69	8.05	38.90	12.64	3.08	Sufficientsupportreq d.
9	Karnataka	15.13	6.57	43.39	8.57	5.07	Sufficientsupportreq d.
10	WestBengal	65.82	54.37	82.60	11.45	7.21	Supportrequired
11	Jharkhand	24.52	17.03	69.47	7.48	9.28	Supportrequired
12	Gujarat	29.17	21.51	73.75	7.66	9.63	Supportrequired
13	Delhi	11.99	7.42	61.86	4.57	13.53	Supportrequired
14	Punjab	12.78	9.99	78.13	2.80	27.95	Nosupportrequired
15	TamilNadu	31.02	28.10	90.59	2.92	31.04	Nosupportrequired
16	Rajasthan	21.42	20.08	93.72	1.35	69.67	Nosupportrequired
	Total	612.92	358.23	58.45	254.69		

Conclusion :

Fly ash is a valuable alternative material in construction engineering, used to enhance soil engineering properties, reduce disposal demands, control pollution sources, and protect the environment. It solves landfill problems and provides geomechanically stable material, making it an economical alternative in construction engineering. Fly ash is used in cement, construction, and polymer industries, and in pollution control due to limited water resources and increasing pollution levels. Adsorption methods are widely used to remove pollutants from wastewater, and fly ash has been successfully used in over ten highway embankment construction projects across the country.

The challenge to achieving a sustainable concrete future requires a paradigm shift from an accelerated construction schedule approach to focusing on increasing durability, service life, and embodied energy through natural resource conservation. Fly ash is a waste residue released from coal combustion processes in electric power stations, which can cause air, water, and soil pollution if not treated properly. However, it can be turned into valuable material when properly utilized in various sectors, providing economic, ecological, and technical benefits. Further study is needed to explore the recovery of products from fly ash with a wide range of characteristics. Human populations residing in proximity to these developmental areas are particularly vulnerable to the health consequences associated with prolonged exposure to such pollutants. Respiratory issues, cardiovascular diseases, and various forms of cancer are among the serious health risks identified.

Additionally, the socioeconomic implications of pollution-related health issues underscore the urgent need for effective mitigation strategies.

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