**Report**

**on**

**Third Party Audit on Fly Ash Generation & Utilization from Thermal Power Plants (TTPs) in Odisha**

**(for 2016-17)**

***Submitted to:***

**State Pollution Control Board**

**Bhubaneswar**

IIT Logo.wmf

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**Third Party Audit on Fly Ash Generation & Utilization from Thermal Power Plants (TTPs) in Odisha**

**(in the year 2016-17)**

**1.0 Context of Fly Ash Third Party Audit**

State Pollution Control Board, SPCB, Odisha, is conducting third party audit on Fly Ash generation and utilization since 2012-13. Vide letter No.: 13643/IND-IV-PCP-FARC-121 dated: 11.10.2017, SPCB has awarded a job of undertaking the Third Party Audit on the Fly Ash generation & Utilization from 40 Thermal Power Plants (TPPs) in Odisha to IIT Bhubaneswar for the year 2016-17. The audit is carried out independently.

Electricity generation in Odisha is predominantly coal based. One of the important aspects of any coal based TPPs is necessity of combustion of coal. However, the coal combustion generates two categories of by-products i.e., bottom ash and fly ash. Indian coal is of low grade having very high ash content in the range from 30-55%. Bottom ash is collected at the bottom of the boiler. While, fly ash is collected in the electrostatic precipitators as well as in economizer hoppers. Generally, the combustion of coal produces approximately 20% of by-product in the form of bottom ash and remaining 80% in the form of fly ash. Thus, fly ash generation is significantly large in quantity than the bottom ash. Therefore, utilization of fly ash that has generated in huge quantity is a challenge. A large number of technics and methods have been developed for gainful utilization and safe management of fly ash. The unutilized ash requires substantial precious land for its storage and its physical presence is a threat to environment and ecosystem, as it can become source of pollution of both air and water. To reduce the requirement of land for storage and disposal of fly ash into ash ponds and to address the problem caused by physical presence of fly ash, a holistic approach is needed. Notifications have been issued by MoEF&CC, Government of India, so as to achieve 100% utilization of fly ash. In order to assess the percentage utilization of fly ash across the state of Odisha, State Pollution Control Board has been conducting an audit every year. This report is prepared based on the audit carried out by visiting 40 TPPs in Odisha.

Ministry of Environment & Forestry (MoEF), Govt. of India, has issued Notifications country mandating all TPPs for achieving 100% utilization of fly ash in diverse sectors. Adhering to the guidelines of Ministry, most of the TPPs are thriving to achieve 100% utilization of fly ash. In this connection, SPCB of Odisha issued a notification to different TPPs across the state to provide month wise report on coal consumption, fly ash generation & utilization. This audit is intended to ascertain the correctness of the information supplied by TPPs and in compliance with MoEF guidelines.

**2.0 Objective of the Work**

The objective of the study is to audit & validate of data on Fly Ash generation and utilization by 40 thermal power plants of Odisha during the year 2016-17.

**3.0 Scope of the Work**

The scope of the work involves the following activities:

1. To audit the data available on fly ash generation & utilization by all the 40 thermal power plants in Odisha, in different sectors, for the year 2016-17.
2. To scrutinize and verify the documents and data submitted by 40 TPPs in Odisha to SPCB for the year 2016-17.
3. To make field visits to all 40 TPPs and have interaction with the plant authorities on fly ash generation and utilization.
4. To assess the present practices of ash management being adopted by different thermal power plants in Odisha.

**4.0 Brief of the Organization**

**Indian Institute of Technology Bhubaneswar** is an "engineering and technology" higher education institute, located at Bhubaneswar, Odisha, India. It is the first among the eight new Indian Institutes of Technology (IITs) established by the Ministry of Human Resource Development, Government of India, and become operational with a sanctioned intake of 40 students each in the disciplines. It started functioning from the campus of IIT Kharagpur on 23 July 2008 and shifted its operation to the city of Bhubaneswar on 22 July 2009. The Government of Odisha has allotted about 936 acres of Government land for permanent campus of the institute. The academic programs of Institute include B. Tech. (Hons.) in Computer Science, Civil, Electrical, Metallurgical and Materials Engineering, and Mechanical Engineering with an intake capacity of 40 each at the undergraduate level. The Institute started the Doctoral program from the academic session 2009-10 and offers admission in the joint M.Tech.-Ph.D. program from July 2012. IIT Bhubaneswar actively interacts with the industry and encourages its faculty to provide paid technical consulting services, vetting, QC &QA, product development, capacity building, etc., to industry and government organizations. IIT Bhubaneswar is also trying to establish long-term tie-up with industries and government organizations, which could work with its students in institute’s facility center.

**5.0 Methodology Adopted for Auditing**

The methodology adopted for the completion of auditing is divided into three parts for convenience and easy of doing.

***Part-A: Data Collection from SPCB***

The information related to data on fly ash generation and utilization and other relevant supporting documents that have been submitted by 40 TTPs for the year 2016-17 was collected from SPCB. The entire auditing has been progressed solely on the basis of these documents only.

***Part-B: Auditing the Data and Information***

Auditing has been carried out by physically visiting all the 40 TPPs from March to May-2018. The schedule of the visit was intimated to all the TPPs well in advance so that the concerned officials can make the necessary documents ready for auditing purpose during the visit. Following the intimation, the visit was made on the said date and audit has been conducted. During the audit, the data provided by TPPs to SPCB month wise has been scrutinized and verified vis-à-vis the records that each plant has been maintaining. Auditing includes verification of data pertinent to the capacity of the power plant, coal consumption, fly ash generation & utilization, ash disposal system, etc. All records giving details on the above parameters have been critically scrutinized and verified against each individual parameter to ascertain that the data and information provided by the TPPs tally with that of information provided to SPCB. Any mismatch in the data and information between that communicated to SPCB and records were noted down and brought to the notice of SPCB in the form of this report.

***Part-C: Field Visits***

Almost all TPPs have intimated to SPCB that they are utilizing the fly ash for a variety of applications. Some of the applications include brick or cement or tile or asbestos manufacturing, agriculture land reclamation, small land filling, land development, dike raising, construction of roads, etc. In order to ascertain whether or not fly ash is being utilized in these applications and to assess the exact quantity of fly ash being utilized, sites where fly ash used for a specific activity was physically inspected and photographs have been captured as evidence. Facts or anomalies identified or found during the site visit have been noted down to include in the final report that is herewith submitted to SPCB.

Following the completion of data auditing and field visits, data obtained was collated and assimilated to make final recommendations. A final report is prepared using compiled data and submitted to SPCB as per scope of the work vide office letter No.: 13643/IND-IV-PCP-FARC-121 dated: 11.10.2017.

**5.1 Document Verification**

During the audit, the following important documents were verified.

1. Records in support of daily or monthly fly ash and bottom ash generation & utilization for the period from April-2016 to March-2017.
2. Reports of coal and fly ash analysis
3. List of brick manufacturers to whom fly ash has been supplied.
4. Work Order/PO/Contract Agreement/Formal Letter of Requisition released by TPP engaging a transporting agency for mobility of fly ash for brick manufacturing or road making or land fill or dike raise or agriculture land reclamation or land development or cement making, etc.
5. Documents like Payment made to a contractor, who has been engaged for transportation of fly ash.
6. Log books showing the quantity of fly ash transported per day/per month, number of trips, entry, and exit of the vehicle, etc.
7. Weigh bridge documents depicting actual quantity of fly ash transported daily/monthly.
8. Documents related to fly ash utilization in diverse sectors.
9. Layouts, diagrams, maps, photographs, etc.

**5.2 Interaction with TPP Officials**

During the audit and physical visit to the various TPP, active interactions have been made with officials working in Environmental Divisions and those who are dealing with disposal and utilization of fly ash. The officials include civil engineers, environmental engineers, administration, security, lab technicians, etc. It has been noticed during the interactions that several of personnel’s dealing with ash disposal and utilization, unaware of recent developments on ash utilization and manufacturing of value added products from fly ash. In addition, the various physical and chemical properties of fly ash produced by respective TPP were verified and generic suggestions were made to the best knowledge of the auditor. For ex: the area of the pond and its premises can be used for growing bamboo or teak wood or babool trees, which have the potential to generate revenue for the company.

**6.0 Fly Ash Generation & Utilization by TPPs**

The audit has been conducted on 38 numbers of TPPs, except Action Ispat Limited and Bilt Graphics, which have been closed and no official is available for auditing purpose. Summary of ash generation and utilization is listed in Table 1.

**Table 1 Summary of fly ash generation and utilization during the year 2016-17**

|  |  |  |
| --- | --- | --- |
| **SI No.** | **Description** | **Value** |
| 1. | Number of thermal power plants from which data has been collected | 40 |
| 2. | Fly ash generation (MT) | 30696663.5 |
| 3. | Fly ash utilization (MT) | 20665987.8 |
| 4. | % ash utilization | 67.32 |
| 5. | Total number of ash ponds | 31 |
| 6. | Total area occupied by ash ponds (Acres) | 4533 |
| 7. | Average % ash content (Indian coal) | 40.6 |
| 8. | Average % ash content (Imported coal) | 5.1 |
| 9. | Total power generation capacity (MW) | 15832 |
| 10. | Coal Consumed (MT) | 75 Million (approx.) |

Power plant wise fly ash generation and utilization status are given in Table 2.

**Table 2 Plant wise fly ash generation & utilization for the year 2016-17**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **S.No.** | **Name and address of the unit** | **Power Generation capacity (MW)** | **Total Ash Generated** | **Total Ash Utilized (MT)** | **% of Fly ash Utilized** |
| 1 | Aarti Steels Limited (Steel & Power), Cuttack-754029 | 80 | 100786 | 77522 | 76.92 |
| 2 | ACC ltd, Bargarh Cement Works, Cement Nagar, Bardol, Bargarh | 30 | 48480 | 47381 | 97.73 |
| 3 | Bilt Graphic Paper Products Ltd., Unit Sewa (Avantha). Po- Jeypore, Dist- Koraput | 13 | 441.0 | 2664 | 604.08 |
| 4 | Action Ispat & Power (P) Ltd, Jharsuguda | 63 | 89561 | 89561 | 100.00 |
| 5 | Bhushan Energy Ltd., Dhenkanal | 300 | 544098 | 472866 | 86.91 |
| 6 | Bhushan Power & Steel Ltd., Vill- Thelkoi, Lapanga, Dist- Sambalpur | 370 | 635081 | 573723 | 90.34 |
| 7 | Bhushan Steel Ltd., Narendrapur, Dist- Dhenkanal | 142 | 503071 | 503065 | 100.00 |
| 8 | Birla Tyres, At/Po-Chhanpur, Kuruda, Balasore | 20 | 71190.84 | 71190.84 | 100.00 |
| 9 | Emami Paper mills Ltd., Balgopalpur, Balasore | 30.5 | 128461 | 128461 | 100.00 |
| 10 | FACOR Power Ltd., Bhadrak | 100 | 107430 | 107430 | 100.00 |
| 11 | HINDALCO Industries Ltd., Sambalpur | 467.5 | 753948 | 389756 | 51.70 |
| 12 | IFFCO Ltd., Paradeep, Dist- Jagatsinghpur | 64 | 110259 | 112911 | 102.41 |
| 13 | Indian Metals & Ferro Alloys Ltd. Choudwar, Cuttack (IMFA) | 258 | 483693 | 483572 | 99.97 |
| 14 | J.K. Paper Mills, Ltd. Rayagada | 30 | 59291 | 59441 | 100.25 |
| 15 | Jindal Steel & Power Ltd., Angul | 810 | 910015 | 756268 | 83.11 |
| 16 | Jindal Stainless Ltd., Kalinga Nagar Industrial Complex, Duburi, Jaipur | 250 | 481351 | 481351 | 100.00 |
| 17 | NALCO Ltd., Captive Power Plant, Angul | 1200 | 2320563 | 876475 | 37.77 |
| 18 | NALCO Ltd., Mines & Refinery Complex, Damanjodi, Koraput | 74 | 677474 | 695932 | 102.72 |
| 19 | Nava Bharat Ventures Ltd., Kharagprasad, Meramandali, Dhenkanal | 158 | 166568 | 166568 | 100.00 |
| 20 | NTPC-SAIL Power co. Ltd., CPP-II, Rourkela | 120 | 496964 | 746837 | 150.28 |
| 21 | OCL Ind. Ltd., Rajgangpur | 54 | 83926 | 83926 | 100.00 |
| 22 | Ib Thermal Power Station OPGC Ltd., Banharpali, Jharsuguda | 420 | 1237357 | 434642 | 35.13 |
| 23 | Rourkela Steel Plant (CPP-I), Rourkela | 100 | 162145 | 162143.68 | 100.00 |
| 24 | Shyam metallics and energy Ltd., Pandloi, Rengali, Dist-Sambalpur | 70 | 321664 | 321669 | 100.00 |
| 25 | Vedanta Ltd., CPP Jharsuguda | 1215 | 3049734 | 2143438 | 70.28 |
| 26 | Talcher Thermal Power Station NTPC Ltd., Angul | 460 | 1174978 | 1183792 | 100.75 |
| 27 | TSTPS, Deepsikha, Kaniha Angul | 3000 | 7121432 | 3072171 | 43.14 |
| 28 | Vedanta Ltd., IPP, Village- Bhurkhamunda, Jharsuguda | 2400 | 2951590 | 2074834 | 70.30 |
| 29 | Vedanta Ltd., Lanjigarh, Kalahandi | 75 | 293768 | 249620 | 84.97 |
| 30 | VISA Steel Ltd., KNIC, Jajpur | 25 | 68689 | 65668 | 95.60 |
| 31 | GMR Kamalang Energy Ltd., Meramundali, Dhenkanal | 1050 | 1438998 | 1220208 | 84.80 |
| 32 | SMC Power Generation Ltd., Hirma, Jharsuguda | 17 | 93560 | 93559 | 100.00 |
| 33 | TATA Sponge Iron Ltd., Bileipada, Keonjhar | 26 | 95090 | 95092 | 100.00 |
| 34 | Aditya Aluminium Hindalco Industries Ltd., Smelter & Power Lapanga, Sambalpur | 900 | 1506361 | 1457257 | 96.74 |
| 35 | ESSAR Power (Orissa) Ltd., Paradeep | 30 | 9005.91 | 9006 | 100.00 |
| 36 | Utkal Alumina International Ltd., Doraguda | 90 | 211595 | 142520 | 67.36 |
| 37 | Jindal India Thermal Power Ltd., Derang, Angul | 1200 | 1717701 | 649986 | 37.84 |
| 38 | Maithan Ispat Ltd., (Unit of Mesco Steel) Kalinga Nagar, Industrial Complex, Jajpur | 30 | 74635.8 | 123911.3 | 166.02 |
| 39 | Bhubaneswar Power Ltd., Althagarh, Cuttack | 135 | 290571 | 134433 | 46.27 |
| 40 | Adhunik Metaliks Ltd., (Formerly Neepaz Metaliks Ltd), Rourkela | 18 | 105137 | 105137 | 100.00 |
|  | Total Fly Ash generation/utilization | 15895 | 30696663.5 | 20665988.8 | 67.32 |

**7.0 Targets for Fly Ash Utilization as per MoEF’s Notification of 3rd November 2009**

The notification set the target for the thermal power station which was in operation before the date of notification i.e. 3.11.2009 as well as the new thermal power station to be commissioned after the notification i.e. 3.11.2009. The same has been brought out below.

**Table -3 Targets for Fly Ash Utilization for Thermal Power Stations in Operation Before 3rd NOVEMBER, 2009**

|  |  |  |
| --- | --- | --- |
| **SI No.** | **Target fly ash utilization (%)** | **Target data** |
| 1. | At least 50% of fly ash generation | One year from the date of issue of notification |
| 2. | At least 60% of fly ash generation | Two years from the date of issue of notification |
| 3. | At least 75% of fly ash generation | Three years from the date of issue of notification |
| 4. | At least 90% of fly ash generation | Four years from the date of issue of notification |
| 5. | 100% of fly ash generation | Five years from the date of issue of notification |

**Table -4 Targets for Fly Ash Utilization for Thermal Power Stations in Operation after 3rd NOVEMBER, 2009**

|  |  |  |
| --- | --- | --- |
| **SI No.** | **Target fly ash utilization (%)** | **Target data** |
| 1. | At least 50% of fly ash generation | One year from the date of issue of notification |
| 2. | At least 70% of fly ash generation | Two years from the date of issue of notification |
| 3. | 90% of fly ash generation | Three years from the date of issue of notification |
| 4. | 100% of fly ash generation | Four years from the date of issue of notification |

The unutilized fly ash, if any, in relation to the target during a year would be required to be utilized within next two years in addition to the targets stipulated for those years and the balance unutilized fly ash accumulated during first five years (the difference between the generation and the utilization target) would be required to be utilized progressively over the next five years in addition to 100% utilization of current generation of fly ash.

**Table 3 Compliance to MoEF’s notification by TPPs**

|  |  |  |
| --- | --- | --- |
| **SI No** | **Percentage utilization** | **No. of TPPs** |
| 1 | 100 | 21 |
| 2 | 90 to 100 | 5 |
| 3 | 70 to 90 | 7 |
| 4 | 50 to 70 | 2 |
| 5 | less than 50 | 5 |
| **Total** | | **40** |

**Table 4 Percentage utilization of fly ash based on installed capacity**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **SI No** | **Installed capacity (MW)** | **Range of % utilization** | **Average % utilization** | **No of TPPs** |
| 1 | < 100 | 67.36 to 100 | 98.5 | 19 |
| 2 | 100 to 200 | 46.27 to 100 | 99.4 | 6 |
| 3 | 200 to 500 | 35.13 to 100 | 80.7 | 7 |
| 4 | 500 to 1000 | 83.11 to 96.74 | 89.92 | 2 |
| 5 | > 1000 | 37.84 to 84.8 | 57.57 | 6 |

Fig. 1 depicts the sector wise utilization of fly ash by TPPs across the state of Odisha. First, it is worth appreciated that fly ash is being utilized in diverse sectors, although percentage utilization varies from plant to plant. The order of fly ash utilization from greatest to least is found as dike/embankment raising, brick manufacturing, land development, quarry filling, small landfill, road making, cement manufacturing, coal mine void filling, asbestos making, aggregates and agriculture purpose. Largest quantity found to be utilized for the purpose of dike raising and least has been utilized for agriculture purpose. Figs. 2 to 9, respectively, present the number of TPPs along with the percentage proportion, engaged in ash utilization in different sectors. It is worth noting here that TPPs like NALCO (at Angul), IB Thermal-OPGC (at Jharsguda), TSTPS-NTPC (at Kaniha) and Jindal Stainless Ltd (at Jajpur) have utilized 37.4, 11.34, 19.03 and 32.33% for asbestos manufacturing. A reasonable amount is also found being utilized for road making purpose. The maximum utilization for brick manufacturing by any power plant is 12.72%. Whopping 66.69% of ash was utilized for cement manufacturing by Aditya Aluminum, Lapang, and 64% of ash was utilized for road making by Vedanta Ltd, Jharasguda.

Evidently, mere 13.84% of fly ash is being utilized for brick manufacturing and however, there is a need to increase the ash utilization in this particular sector. Similarly, mere 7.04% is being utilized in road making and strong push is required to enhance the fly ash utilization in this scheme. Also, a mere 6.2% of fly ash is being utilized in combined cement and asbestos manufacturing and there is a need to increase the percentage utilization, especially in these sectors.



**Fig. 1 Sector wise utilization of fly ash by different TPPs in Odisha**



**Fig. 2 Utilization scheme of fly ash for internal dike raising purpose by different TPPs**



**Fig. 3a Utilization scheme of fly ash for manufacturing bricks by different TPPs**



**Fig. 3b Utilization scheme of fly ash for manufacturing bricks by different TPPs**



**Fig. 4 Utilization scheme of fly ash for small land filling by different TPPs**



**Fig. 5 Utilization scheme of fly ash for quarry filling & coal mine void filling by different TPPs**



**Fig. 6 Utilization scheme of fly ash for land development by different TPPs**



**Fig. 7 Utilization scheme of fly ash for manufacturing of cement by different TPPs**



**Fig. 8 Utilization scheme of fly ash for road making by different TPPs**



**Fig. 9 Utilization scheme of fly ash for manufacturing asbestos by different TPPs**

**8.0 SUMMARY AND RECOMMENDATIONS**

* Auditing for fly ash generation and utilization was done for 38 TPPs, except for M/s. Action Ispat & Power (P) Ltd, Jharsuguda, and M/s. Bilt Graphics Limited, Jeypore for the year 2016-17, as these two remained closed.
* The actual fly ash generation is 30696663.5 MT and utilization is 20665987.8 MT. **100%** utilization of fly ash is achieved by ***Bhusan Steel, Dhenkanal; Birla Tyres, Balasore; Emami Paper Mills, Balasore; Facor Power Ltd, Bhadrak;*** ***IFFCO Ltd., Paradeep; IMFA, Cuttack; J.K.Paper Mills, Rayagada; Jindal Stainless Ltd, Jajpur; NALCO, Damanjodi; Nava Bharat Ventures Limited, Dhenkanal; NTPC-SAIL, Rourkela; OCL India Ltd., Rajgangpur; Rourkela Steel Plant CPP-1, Rourkela; Shyam Metallics and Energy Ltd., Rengali; Talcher TPS NTPC, Angul; SMC Power Generation Ltd, Jharasguda; TATA Sponge Iron Ltd, Keonjhar; ESSAR Power (Orissa) Ltd., Paradeep; Maithan Ispat Ltd., Jajpur; and Adhunik Metaliks Ltd, Rourkela.*** TPPs namely ***NALCO Captive Power plant, Angul; IB Thermal Power Station-OPGC Ltd., Jharsguda; TSTPS, Kaniha;*** ***Jindal India Thermal Power Limited, Derang, Angul***; and ***Bhubaneswar Power Ltd., Cuttack***, have less than 50% fly ash utilization.
* Out of 40 TPPs, **21** numbers of TPPs achieved 100% ash utilization while remaining are yet to achieve 100% utilization. It has been noticed that TPPs having low capacity could able to achieve 100% utilization, while that of high capacity TPPs lags behind in achieving 100% utilization. It has been noticed that fly ash generation per day by bigger TPPs (i.e., greater than 500 MW capacity) is higher than those of low capacity, TPPs annual ash generation. **This emphasizes the necessity of devising a new set of rules and guidelines based on the plant capacity, instead of the present practice.**
* The maximum percentage utilization of fly ash is in **Dyke/Embankment Raising** sector with **23.71%**, followed by brick manufacturing (**9.32%**) and land development & land filling (**14.78%**), while least is consumed in **Agriculture** sector with **0.001%**.
* The sector-wise utilization of fly ash is found to be:

|  |  |  |
| --- | --- | --- |
| **Sector** | **Ash Utilization (MT)** | **% Utilization based on the Total generation** |
| Brick Making | 2820194 | 9.20 |
| Cement | 1276208 | 4.18 |
| Asbestos | 124354 | 0.41 |
| Quarry Filling | 2163674 | 7.08 |
| Coal Mine Void Filling | 1156006 | 3.77 |
| Dyke/Embankment Raising | 7175083 | 23.37 |
| Aggregates | 584 | 0.002 |
| Road Making | 1452385 | 4.73 |
| Small Land fill | 1796554 | 5.85 |
| Land development | 2676529 | 8.73 |
| Agriculture | 114 | 0.0004 |

Total percentage utilization of fly ash in various sectors out of the total generation is **67.32%** for the audit year **16-17**, up from **58.73%** of the previous audit year of **15-16**.

* Except for IMFA and Jindal Steel, who is manufacturing value added products like light weight aggregates, none of the TPPs ventured or interested to induct into an exploration of developing such type of value added products from fly ash.
* It has been noticed that only 9.20, 4.73, 4.59 and 0.002% of ash is being utilized in brick manufacturing, road making, cement & asbestos and aggregates manufacturing, respectively. **There is an urgent need to enhance the percentage ash utilization in these sectors by TPPs.** In this regard, SPCB by acting as a nodal agency should coordinate between respective TPPs and various Government organization like Works Department/R&B/NHAI to chart an action plan for increased utilization.
* Several TPPs are using fly ash for land development followed by the plantation. Such practice seems to jeopardize the sanctity of ash disposal as one can treat this as ‘controlled open dumping’ practice. Moreover, it is difficult to state that this utilization perspective is a holistic approach to ash disposal. There seems to have a serious environmental impact on soil and water in the due course of time with repeated exposure to seasonal fluctuations. FARC of SPCB should ensure that such dumping is practiced after providing the liner system or it may forbid according approvals to such practices in the future (Fly ash notification 1999).
* Fly ash in cement manufacturing found to have a great potential. FARC of SPCB can suggest the Govt of Odisha to establish cement manufacturing units at places where fly ash utilization is significantly low. For ex: Jharasguda location
* Several of the ash ponds occupying large areas, almost hundreds of acres, and some of the ponds are even abandoned long back, currently under dry condition favoring for the growth of plants that have commercial value (ex: teak wood, sal wood, mindi wood, bamboo, babool trees, etc.).

**9.0 AVENUES FOR NEW or ENHANCED UTILIZATION OF FLY ASH**

* **Extraction of oxide compositions from fly ash**: no effort is being made to explore possible extraction of different oxide compositions like SiO2, TiO2, MgO, Fe2O3, etc.
* Separation of sand size or inert particles from fly ash using gravity separation technology and use of them as a substitute to sand in regular construction activity. This can conserve a lot of natural materials like sand, top soils, etc.
* Manufacturing of wall and floor tiles using fly ash. Technology in this regard is already well developed by IIT’s. FARC of SPCB can disseminate such information to all power plants and can coordinate in technology transfer.
* Development of zeolites from fly ash could be another potential area of fly ash utilization. A variety of zeolites that have a wide range of applications from chemical to metallurgical engineering can be manufactured.
* Currently, less percentage of fly ash is being utilized in the construction of roads. There is a need to take into the confidence of Departments like Works, R&B, Irrigation, NHAI, and Rural Roads and involve them actively for enhanced utilization of fly ash.
* Fly ash can be as a wood substitute
* Paints and enamels are another important areas where fly ash can be used in reasonable quantity. However, this needs persistent efforts from Government as well as Industry side.
* Fly ash is an ideal material for manufacturing of light weight foamed blocks. These blocks because of their smooth surface also do not require plastering and can give aesthetic look to the building, apart from saving the cost of cement for plastering.
* Manufacturing of paver blocks, divider blocks, kerbs, pipes, etc., can enhance further utilization of fly ash.
* Synthesis and development of geopolymer concrete, considered as cementless concrete, is another vital area that can consume a large amount of fly ash.