

ASIA PACIFIC CONCLAVE



On

DRY EXTRACTION AND EFFECTIVE UTILIZATION OF BOTTOM ASH
& TECHNOLOGICAL ADVANCES IN OTHER COAL COMBUSTION
PRODUCTS AND EMISSIONS IN THERMAL POWER PLANTS

PROCEEDINGS

17 - 18 MARCH 2017

HOTEL PRIDE PLAZA
KOLKATA, INDIA

Organised By
COAL ASH INSTITUTE OF INDIA

In Association With
ASIAN COAL ASH ASSOCIATION, CHINA

Prepared And Compiled By
MADHURI BHATTACHARYA, BENIMADHAB KUMAR & ANIKENDU KUMAR



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PREAMBLE

Coal Ash Institute of India, a not-for-profit professional society registered in West Bengal for promoting gainful but Eco-friendly application, disposal and overall management strategies for coal combustion products and emissions, welcomes you to the **Asia-Pacific conclave on Dry Extraction and Effluent Utilization of Bottom Ash & Technological Advances in Other Coal Combustion Products and Emissions in Thermal Power Plants on 17-18 March 2017 at a premier hotel in Kolkata.**

More than two decades back in September 1994 the institute was established by the professionals and experts in the field of power generation in the State of West Bengal in order to tackle the environmental problems caused by the generation of massive quantities a arrange and organize lectures, debates, discussions, seminars and other awareness programs; to publish useful literature, papers, magazines, books, monographs, etc.; to maintain or manage schools, colleges, libraries etc. for the benefit of public from the institutional perspectives; and several other acts and deeds in the utilization and disposal of ash generated by power plants. Over the last two decades many of the above objects of the society have been successfully met by the institute. For example, apart from holding the previous two Asia -Pacific Conclaves in 2007 and 2013 on different aspects of coal combustion products, the institute has organized many other important seminars such as the Decennial Anniversary Exhibition & Symposium, Sino-Indian Initiatives for coal ash management, national seminar on use of fly ash in agriculture, etc. and it has also organized expert lectures, provided solutions to various field problems, and published monographs on selected themes. The institute has been bringing out a quarterly newsletter and also a journal on a periodic basis. Thus, the institute has provided a very useful platform to the professionals of different interest groups dealing with coal combustion products.

Such a platform has been found to be very relevant and important in today's context as much as it was when it was founded, as in all countries and regions the power plants are increasingly operating in a more competitive climate and in a world, short of mineral resources, coal continues to be the fuel of choice and correspondingly by-products from coal combustion are increasing. This, as we all know, is more pertinent to India, where there is an overwhelming dependence on high-ash coal for power generation. Use of high ash coal in power generation has led to three major environmental problems, particularly in India-one, a huge gap between the quantity of ash generated and the amount of dry ash that is effectively and gainfully utilized; two , a lingering problem of collecting the bottom ash in a dry state so that it could be beneficiated and used effectively; and the third, the air pollution control in terms of particulate matters, emissions of sulfur dioxide and nitrogen oxides and discharge of heavy metals.

If we have to bridge the gap between the generation and utilization of coal ash-a task which is imperative from the environmental management perspective-we have to focus on the more effective use of the bottom ash that constitutes tentatively 20% of the total coal ash generated, the balance 80% being the more widely known component fly ash. The extensively prevalent practice of wet extraction of the bottom ash obviously comes in the way of achieving its properties that are required for its gainful use. The ash handling and engineering companies, however, in recent times have designed and implemented systems by which the bottom ash can be extracted, cooled and conveyed in a dry state. Many of these systems are operational worldwide but with limited appearance in the Indian TPPs. This edition of the Asia-Pacific Conclave has therefore chosen the dry extraction and effective utilization of bottom ash as the primary focus area.

Another important area of environmental management in TPPs is the adoption of stricter regulatory norms particularly for emissions. According to the Ministerial notification of December 2015, TPPs to be commissioned after 1 January 2017 will have to observe the following emission norms: Particulate Matter 30mg/Nm³; SO₂ 100mg/Nm³; NO_x 100mg/Nm³ and Hg 0.03mg/Nm³. In fact, the PM, SO_x and NO_x values in the new plants are prescribed to be substantially lower than the existing units, for which the PM, SO_x and NO_x limits are 100,600 and 600 mg/Nm³ respectively. It is therefore extremely important to take a stock of the technological options and our preparedness to meet the future regime of flue gas emission norms. It should also be borne in mind that the process of desulfurization of flue gas is likely to generate calcium sulfate or gypsum as a by-product, which also will have to be gainfully utilized. Hence, the conclave intends to deal with also the best available technologies for emission control including that of mercury in the TPPs. Further, the requirement of water per megawatt of power generated also will have to be drastically reduced.

Last but not the least is the imperative need of enhanced use of fly ash, as the overall utilization of coal ash in India has been hovering around 56%. Broadly it has been observed that while the generation of coal ash from the TPPs has been increasing in the recent years at the rate of 9-10 million tonnes per year, the rate of growth of ash utilization falls behind to a level of 6-7 million tonnes annually. Hence, there is, on one hand, the accumulation of unused fly ash in ponds and, on the other hand, there is a pressure of increasing generation of coal ash due to growth of coal-based power generation capacity. In order to meet this critical situation, a high degree of innovation and research is called for along with commercialization of new products and technologies. It may be relevant to mention here that certain technologies like the Geopolymer products, high volume fly ash concrete, and ultrafine grinding of fly ash for expanded use of the material have been worked upon in pilot scale with even field trials in some cases but for various reasons these technologies are still not in the regular commercial streams. The conclave, therefore, intends to take a stock of the status of these technologies as well in a global perspective.

The coal ash institute of India wishes all the delegates a very healthy and gainful deliberation of two days in the course of this conclave.

Dr. Anjan K Chatterjee
President Emeritus
Coal Ash Institute of India

SUMMARY

The third Asia-Pacific Conclave on certain important aspects of coal ash combustion products took place in a premier hotel in the city of Kolkata in India during 17 and 18 March 2017 under the auspices of Coal Ash Institute of India, a not-for-profit professional society devoted to promoting gainful but eco-friendly application, disposal and overall management strategies for coal combustion products and emissions. The event had the technical support from Asian Coal Ash Association, China, as well as from different industrial corporations and technical institutions in India. The objectives of the conclave were to address three environmental issues: one, to narrow the gap between the quantity of ash generated and the amount of dry ash that is gainfully used; two, to popularize the system and equipment for collection of bottom ash in dry state so that it could be beneficiated and used effectively; and three, to bring out the technological advances achieved for air pollution control in terms of particulate matters, emission of sulphur dioxide, nitrogen oxides and discharge of heavy metals. The conclave evoked a high order of response from within and outside India. More than 100 delegates took active participation in this event including delegates from Europe and China. The conclave was inaugurated by Shri Shobhondeb Chattopadhyay, the Honourable Minister of Power and Non-Conventional Energy Sources, Government of the State of West Bengal in the presence of dignitaries from the industry, academia, research institutions, policy makers, etc.

The key-note addresses were presented in a Plenary Session by Mr B Sengupta, former Member Secretary of the Central Pollution Control Board, New Delhi on environmental norms and regulations; Mr Tomasz Szczgielski, Warsaw University of Technology, Poland on zero-waste coal power strategy; Mr G Thakur, Chief Engineer, Central Electricity Authority, New Delhi on fly ash utilization in India; Mr Andrei Gorjup of RUDIS, Slovenia on flue gas desulfurization technology; and Professor V K Agarwal, Indian Institute of Technology, New Delhi on future research vision on fly ash handling. Thereafter, over the two days of the conclave, four Technical Sessions were organized on themes such as "Dry Bottom Ash Extraction and Utilization", "Innovative Technologies in Coal Ash" "Abatement of Air Pollution in Thermal Power Plants and Other Processing Industries" and "Fly Ash transport, Management and Processing Equipment". In addition, the conclave programme included a Panel Discussion on Coal Ash Based Products and Technologies, moderated by Mr David Harris, President, Asian Coal Ash Association, and it ended with a Valedictory Session which was addressed by the Mr T. Chakravarty, a Senior Environmental Consultant, formerly of Steel Authority of India.

The major highlights of the conclave are summarized as follows :

- The Ministry of Environment, Forest and Climate Change and the Central Pollution Control Board of Government of India have formulated various standards and guidelines for air and water pollution control from coal based thermal power plants, the implementation of which would result in reducing the emission of SO₂,

NO_x, PM and Hg from the existing and new power plants; reduced water consumption and adoption of rigorous standards for effluents; application of zero liquid discharge to thermal power plants, implementation of fly ash management regulations including increased use in cement making; adoption of continuous monitoring of emissions and effluents.

- Concept of circular economy and its application to solving the coal ash problems.
- Urgent need to expand the scope of utilization of fly ash from the present level of about 60% to 100%. It seems that areas like road and bridge construction, laying of railway tracks, agriculture, forestry, cement and concrete making, mine filling, ash-park development, etc. have further opportunities of increasing the use of fly ash.
- For expanding the scope of fly ash use, the development and use of Geopolymer products appears to be a very promising avenue. Geopolymers are a technologically interesting group of materials that are already being used in various niche concrete applications such as coastal protection armours, fire and heat resistant building components, toxic wastes encapsulation, etc. Further application development efforts need to be directed towards its use in pavement blocks, shotcreting, acid-resistant surface coating, sewerage pipes, instant road repair, etc.
- It was reported by the National Metallurgical Laboratory of India that they had set up the first pilot plant to produce paving blocks by the Geopolymerizing process. The laboratory is now engaged in developing paving blocks with fly ash Geopolymer as the binder and LD slag lumps as aggregate. They are also exploring the possibility of developing a lightweight flexible Geopolymer product from fly ash for making prefabricated dry walls as well as the technology for making a two-component saleable binder.
- The National Aluminium Company in India, being a large generator of coal ash from its captive power plant, has been exploring eco-friendly technologies for bulk management of ash. One of the technological options being examined by this company is the extraction of smelter grade alumina and high purity alumina from fly ash as there would be adequate scope for in-house consumption of such products.
- For increasing the proportion of fly ash in the blended cement, already being produced in India in large quantities, certain technological options were presented. One such technology is the adoption of LNT vertical roller mill which is capable of handling both fly ash and bottom ash for grinding purposes. Another option is to adopt the technology of classification and processing of fly ash with the help of steam jet mill developed by Shandong Pingyi Kaiyuan, New Building Material Company of China so that fine and ultrafine fly ash could be used in the blended cement and concrete in enhanced proportions.
- A presentation has been made on the development of abrasion-resistant ceramic floor tiles from coal ash comprising both fly ash and pond ash with proper particle size distribution. The proportion of total coal ash in green tiles could be increased to 60-70%, the balance being made up of different plastic clays in the composition. Use of 10-12% pyrophyllite in the composition was recommended in order to supplement alkalis which are generally low in coal ash.

- Quite different from fly ash, the bottom ash is a dark grey granular sand size material that is generally collected wet from the furnace bottom and conveyed to a disposal pond by high pressure water jets. The technological advances have now opened up opportunities of transferring the bottom ash to a decanting basin for dewatering, crushing and stockpiling. In fact the possibilities of drying, decarbonizing and further processing of the dry bottom ash are now available. The dry processed bottom ash can serve well as sand substitute in cement concrete or in asphalt concrete, apart from its use as a raw feed for cement kilns, laying of road base and sub-base, etc. Since 20% of the total coal ash is collected as bottom ash, the technological advances in this field are of great economic significance.
- Issues relating to ash handling have been discussed. Although dry fly ash handling systems are well established, most plants face the problem of achieving the design capacity. Another aspect of concern is the power consumption. The variation in the quality of ash is known to be one of the reasons for the poor efficiency of the handling systems. In order to overcome these difficulties, a system of internal by-pass with two annular pipes, the internal one having holes at regular interval, has been proposed.
- In another presentation the technological needs for successful implementation of High Concentration Slurry Disposal systems for both bottom ash and fly ash have been emphasized. The significance of determining the economic slurry concentration, evaluating the slurry flow behaviour, assessing the settling characteristics has been elaborated and some of the pre-requisites for proper implementation of the systems have been explained.
- The stringent regulation of SO₂ emission in power plants and process industries like cement has now compelled the plants to look into Flue Gas Desulfurization process. The major FGD technologies that include wet and dry scrubbing, sorbent injection, and sea water scrubbing and multi pollutants removal have undergone significant evolution in terms of process integration and cost-effective implementation. These aspects have been discussed and compared.
- The technology of Selective Catalytic Reaction for reducing the NO_x emission and the researches carried out in China on the denitration technology have been presented by a few speakers. The recent process improvements have been specifically highlighted.
- So far as the emission reduction technologies are concerned, the primary concerns are the high investment and economic viability. These concerns are more for the captive power plants in the process industries than in the large thermal power plants.

Finally in the valedictory session, apart from a very positive feedback from the audience, it was proposed that the Coal Ash Institute of India in collaboration with national and international partners should prepare a road map for the total utilization of the coal ash generated in the country which is about 240 million tonnes at present. The Institute should also endeavour to enlist the breakthrough technologies being developed in the field of coal ash application with a rating of their probable commercial success.

PHOTO GALLERY



Registration in progress



Registration in progress



Registration in progress



Registration in progress



David Harris (President, Asian Coal ash Association) with Thomas Szczygieski



Anjan Kumar Chatterjee addressing the session



Dilip Sett addressing the session



David Harris addressing the session



*Welcoming Sri Shobhondeb Chattopadhyay
Minister of Power & Non-conventional Energy Sources,
Government of WB*



*Debashish Bhattacharya with Sri Shobhondeb
Chattopadhyay*



Sri Shobondeb Chattopadhyay lighting the lamp



David Harris lighting the lamp



Debashish Bhattacharaya presenting flower bouquet to Sri Shobondeb Chattopadhyay



Debashish Bhattacharaya presenting flower bouquet to David Harris



Debashish Bhattacharaya presenting flower bouquet to Arun Saraf



Presenting flower bouquet to Dilip Kr. Sett



Delegates at desk



A. K. Chatterjee with delegate



Delegates presenting their technical papers



Audience at Conclave



Arun Saraf delivering speech



Delegates presenting their technical papers



Audience at conclave



Audience at conclave



Audience at conclave



Audience at conclave



A.K Chatterjee with delegates at conclave



Mementos distribution at conclave



Mementos distribution at conclave



Mementos distribution at conclave

CURRENT AND FUTURE ENVIRONMENTAL REGULATIONS AND NORMS FOR THERMAL POWER PLANT IN INDIA

B. Sengupta

Former Member Secretary, Central Pollution Control Board, New Delhi

ABSTRACT :

MOEF and CPCB have formulated various environmental standards and guidelines for air and water pollution control from coal based thermal power stations. Some of the important standards and guidelines are as follows:

1. Emission standards for SO₂, NO_x, PM and Hg from existing and new power plants.
2. Effluent standards including water consumption limit from power plants.
3. Applicability of zero liquid discharge (ZLD system) for thermal power plants.
4. Implementation of coal beneficiation regulation.
5. Fly ash management rules, 2009 and its implication.
6. Ambient air quality standards, 2009 and requirement of monitoring of ambient air quality by thermal power plants.
7. Environmental clearance for new power plants and expansion of existing power plants as per EIA, 2006 of EP Act, 1986.
8. Requirement of continuous emission monitoring system for thermal power plants.
9. Requirement of continuous effluent monitoring system for thermal power plants
10. Dry ash collection system and utilization of ash for cement making to promote co-processing of waste in cement plants.

SPCB/PCC and CPCB are implementing above standard and guidelines in coal based power station in India. In this presentation, the current challenges being faced by Thermal power plants to meet above standard and guidelines are discussed.



TOWARDS ZERO WASTE COAL POWER AS ELEMENT OF CIRCULAR ECONOMY IN INDIA

Tomasz Szczygielski,
Institute for Applied Research, Warsaw University of Technology

ABSTRACT :

1. Global coal production and consumption and legal coal ash issues (REACH)
2. Anthropogenic Minerals (AM) are not waste.
3. Utilisation of CCPs in Poland.
4. GrupaEkotech Company and selected examples incl. TEFRA Project.
5. Global material extraction, cement production process and waste generation in EU
6. Circular Economy approach in India.
7. Circularity Indicators: Measuring Circularity Methodology.
8. Weaknesses of the present approach to the coal ash utilization.
9. Improvement of chemical composition and physical properties of AM to the product in power generation processes.
10. Elements of the Road Map.
11. Role of power generation sector, science, administration and business in this new approach.
12. Implementation of the Zero Waste strategy for power sector

In this presentation the author emphasizes that Anthropogenic minerals in general, and ashes from power generation in particular, can be used instead of virgin resources in numerous applications. It is possible to realistically assess replacement potential and assign CO₂ reduction volumes to products, in which ashes are used as binders instead of cement and lime.

The Global construction industry is the single largest consumer of resource and raw materials, and in India, construction accounts for about 20% of total material demand. The Indian building industry consumes almost 34% of the country's total energy, making it one of the largest emitters of greenhouse gases.

IN CONCLUSION :

- Global Energy Consumption/Production will continue to grow.
- Prospects of coal disappearing from the energy mix are illusory.
- The Circular Economy approach calls for a disruptive re-thinking & re-engineering product-waste perspective.
- Practice of utilization of Coal Combustion Products as a foundation for (low-emission) Zero Waste Coal Power.
- Anthropogenic Minerals to replace part of Natural Minerals.
- Polish concept of Roadmap for making Zero Waste Coal Power an important aspect of the Circular Economy.

FLY ASH UTILIZATION

Neeraj Kumar *Director (TCD) &
Gorakh Thakur, Central Electricity Authority, New Delhi*

ABSTRACT :

Fly ash is a by-product of coal combustion in coal or lignite-fired power plants. As per MoEF&CC notification, "Fly ash" includes all categories or groups of coal or lignite ash generated at thermal power plant, such as ESP ash, dry fly ash, bottom ash, pond ash and mound ash.

In India, about 80% of Power is being met by Coal based Thermal Power Plant. At present the installed capacity of Coal based Thermal Power Plant is about 1,85,000MW which is generating about 190 million tonne of ash. About 72000MW capacity coal based Thermal Power Plant are under various stage of implementation. The expected Fly Ash generation by the year 2020 is about 230 million tonnes.

MAJOR POINTS DISCUSSED IN THE PRESENTATION

I. Methods of Ash collection

Fly ash is generally collected in dry form through ESP (Electro-static precipitator) and stored in Ash Silo. In India, bottom ash which is about 20% of total ash generation is mostly collected in wet form and stored in Ash pond. The excess fly ash from ESP is also stored in Ash pond in wet form. At present, fly ash utilization is about 61% and rest of the ash is stored in ash pond in wet form.

II. MoEF Notifications for Ash Utilization

Ministry of Environment & Forests (MoEF) has issued various Notifications on fly ash utilization:

First Notification was issued on 14th September, 1999 which was subsequently amended in 2003 2009 and 2016 vide Notifications dated 27th August, 2003, 3rd November, 2009 and 25th January, 2016 respectively.

The said Notifications prescribe targets of Fly Ash utilization for all Coal/Lignite based Thermal Power Stations in the country with an aim to achieve 100% utilization in a phased manner.



- ✓ At least 50% of fly ash generation within One year from the date of the notification.
- ✓ At least 60% of fly ash generation within Two years from the date of the notification.
- ✓ At least 75% of fly ash generation within Three years from the date of the notification.
- ✓ At least 90% of fly ash generation within Four years from the date of the notification.
- ✓ 100% of fly ash generation within Five years from the date of the notification.

CONCLUSIONS & RECOMMENDATIONS

- Because of higher ash content in Indian Coal, the fly ash generation is on higher side but the quality of fly ash is very good.
- There is huge scope of fly ash utilization in Highway/ Railway tracks. However, Fly Ash is not being used in Railway tracks in India and concerned/ relevant issues need to be addressed.
- The highest level of fly ash utilization of about 62.6% was achieved in the year 2009-10 and it is, however, 60.97 % in the year 2015-16. Efforts are required to achieve the target of 100% utilization of fly ash by 31st December,2017 as stipulated in MoEF's Notification of 25th January,2016.

FLYASH HANDLING : OPTIONS FOR FUTURE RESEARCH

V.K. Agarwal

Indian Institute of Technology, Delhi

ABSTRACT :

CEA Data shows for the Year 2014-15 that the total

- 184.15 million tonne fly ash is generated and 102.54 million tone have been utilised.
- 34 Plants report 100% Utilisation
- 55 Plants >60% Utilisation
- 50 Plants report 30-60% Utilisation.

The author described the various ways of fly ash handling system for plant to the destination of disposal.

He proposed future prospect of handling fly ash in the manner:

- Suggested backfilling of mines for bulk utilization of fly ash.
- Ministry of Coal representative agreed it is possible in abandoned mines.
- Transportation of ash from long distance is an issue.
- Rail wagons only feasible option.
- Availability of suitable wagons and railway track.
- Modified wagons to transport coal in one direction and flyash in return direction.
- Consider: particle size, moisture, sealing of wagon for flyash etc.

ECOLOGY PROJECTS, PROJECTS FOR EFFICIENT USE OF ENERGY, INDUSTRIAL PRODUCTS: EXPERIENCE THROUGH ALMOST 60 YEARS

Andrei Gorjup, RUDIS

*Flue Gas Desulphurisation specialists, competent team of experts,
Engineering company in Europe operating as an EPC company*

THEIR SERVICES

- Complete design
- Technology equipment definition, selection and supply
- Management and supervision of construction site
- Technology equipment assembly and supervision
- Commissioning, performance test
- Training of personnel
- Maintenance during the guarantee period
- Support and consulting during the post-guarantee period

For INDIAN market

- ⊙ Engineering services in Cooperation with local EPC contractor.

The present norms in Indian Thermal Power Plants are:

- ⊙ Thermal Power Plants installed before 31. December 2003:- Sulphur Dioxide (SO₂) 600mg/Nm³ (Pel<500MW), 200mg/Nm³ (Pel>500MW)
- ⊙ Thermal Power Plants installed after 1. January 2004 up to 31. December 2016:-sulphur Dioxide (SO₂) 600mg/Nm³ (Pel<500MW), 200mg/Nm³ (Pel>500MW)
- ⊙ Thermal Power Plants installed after 1. January 2017:-sulphur Dioxide (SO₂) 100mg/Nm³ (RUDIS result 20-30 mgSO₂/Nm³)

According to The Gazette of India, published on **8. December 2015**. Values became in force 2 years after officially published - on **8. December 2017**.

The RUDIS presented a colourful presentation of their works throughout the world for last 60 years, particularly in **SOSTANJ TPP, UGLJEVIK TPP, BOQNA TPP, HERZIGOVINA TPP, TRBOVLJE TPP, MACEDONIA TPP** etc.

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RESEARCH ON DRY BOTTOM ASH HANDLING AND INTENSIVE PROCESSING UTILIZATION TECHNOLOGY FOR COAL FIRED PLANT

QuianYu, Tungalagtamir B, Jianli Guo, Byambagar B, Munkhbaatar P

*State Grid Electric Power Research Institute, NARI Group Corporation, P.R. of China & School of Applied Sciences,
The Mongolian University of Science and Technology*

ABSTRACT:

The environment protection requirements are more and urgent issue in INDIA. In order to reduce the pollution problem and save the valuable water source from the coal fired plants, air cooling steel belt dry bottom ash handling technology, one of innovative way will be more adopted in India for coal fired industry. There is no water consumption during the bottom ash handling. A series of operational and environmental problems will be eliminated by the air cooling dry bottom ash handling technology. The dry solution of bottom ash handling avoids the problems and costs associated with waste water in ash handling process, improves the working performance and boiler efficiency as well as increasing ash comprehensive utilisation value etc. it can realize "zero waste water discharging" from coal fired plant.

The author vividly described the process of dry extraction of bottom ash using various patented handling system like steel belt conveyor plus bucket elevator plus bottom ash silo and steel belt conveyor plus pressurized pneumatic conveying system plus bottom ash silo or grinding and recycling system etc.

CONCLUSION:

At present, the comprehensive utilization of bottom ash in coal fired power plants compared with the past years has undergone significant changes. The ways of comprehensive utilization of bottom ash in the past, are as subgrade filling, concrete admixtures, soil improvement etc., and at present the bottom ash utilization will be as the raw materials of cement, cement admixture, large-scale water conservancy project, pumping concrete, large volume concrete products, even as furniture building materials products. More and more countries in the world have put forward the higher requirements on environmental protection, water saving and to improve the comprehensive utilization rate of solid waste in coal fired power plant.

Therefore, our institute will be integrated our rich domestic ash handling experience and achievements, strengthen cooperation with customers in India, make the research and development on the processing and application of dry bottom disposal technology which will suitable for Indian national conditions, improve the added value of bottom ash, bring considerable economic benefits to the coal fired plant, to contribute to achieve "zero" Emissions from coal-fired power plants.

IMPLICATION OF STIPULATION BY MINISTRY OF ENVIRONMENT AND FOREST (MOEF) ON SELECTION OF ASH CONVEYING SYSTEM IN COAL FIRED POWER PLANTS IN INDIA

Debashish De

Development Consultants Pvt Ltd

ABSTRACT :

In India more than 70% of power requirement is met by generating electricity with coal fired power plants. Incidentally Indian coal, unlike coal in many other countries, contains 40% or more ash. As such any generation of power by burning coal, invites added problem of managing enormous amount of ash. Even with recent stress by ministry on generation of power by harnessing nonconventional renewable sources of energy, mainly solar, their contribution in overall power demand scenario, will remain meager still for long time to come. This along with the fact that India has still substantial reserve of coal to exploit; coal will remain the principal source of energy for power generation in mass scale for few decades more. However this does not obviate the basic issue of pollution to environment by the coal fired power plants. Present concerns throughout the world regarding environment pollution and the recent world meet at Paris with commitments made by all major power including India, more stringent strictures have been drawn on emissions from plant as well as consumption of water which is another natural resource dwindling day by day. In this overall perspectives it needs to review the conventional engineering, hitherto in vogue for plant management in handling ash etc so that the restrictions by MOEF is met and the power [plants continue to run with coal. A revisit across industries for technologies used elsewhere is needed to suit the requirement. The paper deals with these issues discussing the available options.

The author presented a detail calculation on cost of auxiliary power consumption, estimate of water consumption for a conventional 660 MW thermal power unit, usage of Bottom ash handling system, thereby an overall comparison of wet and dry bottom ash system etc. he also elaborately discussed on Mechanical conveying system of ash handling. To conclude, he said "Having bottom ash handling in dry form through mechanical conveying, already proven, industry should take similar initiative in handling fly ash also in less energy intensive mechanical conveying systems. For many smaller plants such systems has already been tried and working satisfactorily. Since a unit saved is an unit sold, with the increase in unit price and auxiliary power consumption due to inclusion of additional auxiliaries, an orientation in utilizing.

DEVELOPMENTS IN FLY ASH UTILISATION IN CHINA AND BEYOND

David Harris, President,
Asian Coal Ash Association, China

Asian Coal Ash Association

- Registered as a not-for-profit organisation in Australia
- Secretariat in Beijing (China Building Materials Academy)
- Worldwide Coal Combustion Products Network

Advisory Board includes:

Dr. Tom Robl, University of Kentucky Center for Applied Energy Research

Dr. Wang Dongmin, China University of Mining and Technology

Dr. Zhou Hao, National Key Laboratory for Thermal Power Engineering (Zhejiang University)

Dr. Zhang Zuotai, Beijing University

Events, Research and Collaboration

Stakeholder Engagement and Policy Maps

World of Coal Ash

Coal Ash Asia 2017

Baotou, Inner Mongolia

700 participants

» Researchers » Investors » Officials » Industry leaders » Entrepreneurs

15 countries VIP Participation

» Chairman of China Building Materials Federation

» China Academy of Sciences

» Foreign trade commissioners

» Provincial governors

Fly Ash : Air, soil and water pollution

- Single largest source of solid waste in China
- 200 - 300 million tons landfilled each year in China » >2.5 billion in landfills/stockpiles
- Globally 600 million tons per year landfilled 5th most abundant mineral resource Cadmium, lead, mercury can leach into soil and water table PM2.5 sources:
- 17-34% from coal combustion
- Collection and Disposal
- ESP design rating is >99% efficiency

Problems:

- Equipment limitations, not suited to Chinese coal (avg. ash 28%) Comprehensive regulations - Non-compliance
- Cost of collecting, transporting and storing fly ash can run 1-2% of power station total operating costs
- Fly ash fed back into coal stream
- Precipitators get turned off at night
- Definition of 'Beneficial Utilisation'
- Strength of enforcement, monitoring and compliance are improving

China fly ash utilization overview : Current status - imbalanced utilization

- Coastal regions recent utilization ratio >100%
- Downstream players compete to secure supply, import fly ash from other regions, or use prior fly ash storage.
- Falling as region shifts from investment driven growth
- Middle and western China: utilization ratio 30% or below

Falling consumption

It is expected that China cement consumption will return to similar patterns in other developing and developed countries, possibly a decline from the 1500kg/capita today to 1000kg or 600kg per capita that we see in developed countries.

Fly ash consumption by cement and concrete producers - the largest portion of consumption in China - will fall accordingly.

This could mean a reduction in consumption of more than 30%, adding an additional 100 million tons per year or more to landfill.

The development of fly ash utilization policies overview.

Early stages (1950s-2000)	Rapid development (2000-2010)	Review, improve and intensify enforcement (2010 and beyond)
The Chinese government started to promote fly ash utilization technologies in 1950 for hydropower projects	Sustainable development, energy saving, and emission control became fundamental national policies	Increasingly focused on environment-friendly development as well as technology upgrades
Extended utilization to the building materials sector in 1960s and 70s	Sped up the legislative process by introducing a set of laws related to fly ash utilization	Reviews existing regulations and policies, draws up specific national plan on industrial solid waste utilization and revises the out-dated administrative measures on fly ash utilization
Started to introduce resource comprehensive utilization policies in 1980s.	Started to draw up national plan, guidance, recognition and registration administrative measures as well as technical policy outlines. Introduced specific tax incentive policies.	Further enhances law enforcement and introduces more incentive policies

THE DEVELOPMENT OF FLY ASH UTILIZATION POLICIES RELATED LAWS

Law on Promotion of Clean Production (2002)	Law of Prevention and Control of Environmental Pollution by Solid Waste (2004)	Circular Economy Promotion Law (2008)
Defines means of clean production.	Comprehensive revision of the original version(1996) by introducing the "Producer Responsibility System".	Provides a legal framework for developing the economy, raising energy efficiency, protecting the environment and realizing sustainable development based on the 3R (reduction, reuse and recycle) principles.
Sets forth incentives for clean production in the forms of tax cuts and subsidies.	Expands producer responsibility, and calls for the establishment of a mandatory recycling system.	

TAXES, FINES AND INCENTIVES : EXAMPLES

R&D

Shanghai municipal government levied R&D fee of 0.4 RMB per ton of fly ash output
All local power stations to pay, support the research of fly ash utilization in Shanghai.
Working with cities to establish incubator fund

Power station

30 RMB per ton Levy on power stations who do not meet the environment protection standards on fly ash handling and storage
Power Producers must demonstrate a plan for 100% fly ash utilisation before a license to build a new power station is issued.
Restrict participation in the market growth

Building material buyers

Designation of new walling materials using >30% fly ash.
10 RMB /m2 levy on any new construction projects that doesn't use these
Goes to special fund for promotion of new walling materials

Building material manufacturers

Ban on producing clay bricks in 250 cities across China
Products with >70% raw materials from fly ash = Taxable income reduction of 10%
Products with >30% of raw material from fly ash = VAT exemption (17%) on bricks, tiles, etc
Manufacturers with innovative technologies can qualify as a "New and High-tech Enterprise"
Corporate Income Tax reduction from 25% to 15%

Dr. Harris goes on presenting ash utilization overview in China, problems in ash handling, analysis of this versatile non-virgin material etc. He further throws light on different extraction processes like Aluminium extraction (Datang power), Cera Tech (zero carbon cement), blue plant (capture & utilization of CO₂) etc. He also furnished the example of Vecor Limited for manufacturing Aggregates, Sintered bricks, Water absorbing pavers, Industrial Ceramics, Engineered sands, Refractories, Ceramic tiles (40-80% recycled content, 30-40% less energy, 80% less water, Very strong and durable, 15% less production cost).

FC MULTIROOM GYPSUM CALCINE SYSTEM

Li Yushang

Pingyi Kaiyuan New Building Material Co., Ltd.

Gypsum Processing Technology List

- Building gypsum processing technology
- FC Multi-chamber calciner system (hot wind type - 2 step)
- FC Multi-chamber calciner system (steam type - 2 step)
- FA dispersal dry calcining system (hot wind type - 1 step)
- High-strength gypsum processing technology
 - i) Dry method a gypsum preparation
 - ii) Wet method a gypsum preparation
- Mould gypsum processing technology
- MH Vertical calcination system
- Gypsum board processing technology
- Hot air type heat conduction oil Gypsum block processing technology
- Continuous rotary type gypsum block preparation
- Machinery gypsum block preparation
- Plastering gypsum processing technology
- Tower-type distribution double mixing machine spray technology
- Special gypsum formula technology
- Precision casting gypsum Dental gypsum.

Equipment list

- Calcining equipment
- Hot wind-type FC multi-chamber gypsum calciner Steam-type FC multi-chamber gypsum calciner MH Vertical calciner Water heating continuous autoclave
- Drying equipment
- FA hot wind-type self dispersion air drying machine Steam rotary drying machine Cooling equipment
- Fluidized bed-type cooling tower Heat source equipment
- High efficiency coal-fired boiling furnace High temperature condensed water flash tank Transfer equipment



- Anti-blocking air lock valve High/middle pressure air transfer system Modified equipment
- Double rotor gypsum modified mill Forming equipment
- Continuous rotary type gypsum block forming machine Machinery gypsum board forming machine

Mr. Li Yushan representing the company PingyiKaiyuan New building material co. ltd presented details of different gypsum plants using different technologies. They have installed gypsum plant in following projects:

1. Taishan gypsum building material Co., Ltd Use FC-multi-chamber calciner system. Annual capacity: 100,000 tons of natural gypsum production line.
2. Inner Mongolia Gypsum Industrial GuangSha Co., Ltd. Use FC-multi-chamber calciner system. Annual capacity: 100,000 tons of FGD gypsum production line.
3. Honglu building materials Co. Ltd. 100,000 tons of fluorine gypsum project.
4. Nanjing Jiangsu Yifu new material technology Co., Ltd. 100,000 tons of FGD gypsum project
5. Sichuang Hongda chemical Co. Ltd. 1000,000 tons of phosphorus gypsum reconstruction project
6. Hubei Chunxiang chemical industry Co. Ltd. Annual output of 200,000 tons of phosphorus gypsum production line. Production line of cement retarder with annual output of 200,000 tons. Annual production of 15 million square meters of gypsum board production line.
7. Shandong Humon Smelting Co., Ltd. Annual output of 200,000 tons of phosphorus gypsum project. Annual output of 300,000 tons of cement retarder project.
8. Guizhou Lufa Industrial Co., Ltd. Annual output of 200,000 tons of building gypsum project. Annual output of 300,000 tons of cement retarder project
9. Kingenta International. With an annual output of 80,000 tons of beta gypsum. 100,000 tons of high pure gypsum powder. 20,000 tons of wet alpha gypsum powder. 50,000 tons of series gypsum productix production line.
10. Saint-Gobain India Pvt. Ltd. (Gyproc Wada Plant, Mumbai). Use steam as heating source, 20 T/H beta gypsum powder production line. Use FC multi-chamber calciner system. Application for gypsum board production line.

Corporation Name:

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ADVANCES IN GP PRODUCTS

R. V. Ramani

Director—Research and Innovations Kiran Global Chems Limited, Chennai

ABSTRACT :

Geocement (Geopolymer cement) is a promise to reduce global warming by reducing carbon dioxide emission using a proprietary liquid Geobinder with various industrial by products viz. fly ash, blast furnace slag etc. (Geopowder), an environment friendly Green Product. The environment must be protected by preventing dumping of waste by-product materials in uncontrolled manners and by stopping carbon dioxide emission.

Kiran Global Chems Limited with its mastery over the alkali activators have establishes a Geocement based concrete product manufacturing facility to showcase the products that can be produced, optimize the technical & ecological parameters, reduce cost of production and to offer training to channel partners. The technology is developed in-house for over 3years with ambient curing doing away with the earlier research of high temperature steam curing.

Geopolymers are a technologically interesting group of materials that are already being used in various niche concrete applications viz. Coastal protection armours, Fire & Heat resistant buildings, durable roads, toxic waste systems it can comply with technical and economic requirements (or even exceed them) and also drastically reduce the environmental impact.

Precast low-tech building products, Shotcreting in tunnels & coastal protection, Acid resistant surface coating in sewerage pipes & plants, Foundations, Instant road & concrete repair kit (DIY), Geopolymer based fly ash aggregates, low energy refractory and insulating products are some of the ideal range of products best suited for this technology. Most of the above applications have been showcased in The World of concrete 2015, The Indian road congress 2015, Redecon 2015 and in the Big5 2016- Dubai.

The evaluation of the different products are being done at CRRI, CBRI, SERC, NTH and by the Highway research station using similar binder paste aggregate in Portland cement and to similar testing standards achieving better quality of concrete and grading curve. There is no special requirement of admixtures / chemicals in Geopolymer concrete.

Workshops, in-plant training programmes and project support were given to more than 12 diploma / engineering colleges in association with the students chapters of ICI.

The keynote and the presentations in the 2016 GeopolymerCamp provide updated information on the development and applications of geopolymers all over the world

<https://www.geopolymer.org/conference/gpcamp/gpcamp-2016/>

At present, channel partners are appointed franchising the manufacturing of products using Geocement with transfer of technology, training and raw material support. A range of retail products under the brand SPOTCRETE are proposed to be launched in the next 3 months.

Marketing Geocement as product can be made only after the acceptance of various products over a period of time. A general purpose Geocement can be manufactured on volumes competing with OPC in about 3 to 4 years. According to experts with the depleting sources of lime stone, this will be extinct in about 30 years.

GEOPOLYMER CEMENT FROM FLY ASH: FROM NANO SCALE TO PLANT SCALE

Sanjay Kumar

CSIR-National Metallurgical Laboratory

ABSTRACT:

National Metallurgical laboratory is One of the five national institute of India under the Council of Scientific & Industrial Research, Govt of India, Inaugurated in 1950 by the First PM of India, Pt. Jawaharlal Nehru.

NMI's research mandate is:

Mineral, Metal, Material and Waste Materials, Construction & Demolition Waste, Granulated Blast Furnace Fly ash Slag & Bottom Ash Clay & Metakaolin Corex Slag Red Mud, LD Slag Tailings AOD Slag Volcanic Ash, Zinc Smelter Slag, Copper Smelter Slag, Silicomanganese Slag, Induction Furnace Slag etc.

NML's Journey of Scales Starting from Nano Scale.

Mr. Kumar graphically presented Particle Reactivity Influence Nano Structure, Self Glazed Tiles by Geopolymerisation, Geopolymer Cement from fly ash, development of Paving tiles, Geopolymer Pilot plant, Prefabricated sandwich panels etc.

- The future directions of NML is Geopolymer with tailored properties
- Porous Geopolymer products as replacement for AAC
- Organic-inorganic hybrid Geopolymer composite for fire resistant applications
- Fast setting Geopolymer grouting material
- Self glow ceramic like tiles by low temperature Geopolymerisation process
- Fiber/ Textile reinforced Geopolymer composite materials

SUSTAINABLE INDUSTRIAL SOLUTIONS TO COAL COMBUSTION BY-PRODUCTS

SuiTongbo

Sinoma Research Institute (SRI), China

Main Contents:

Sinoma Int'l - A Brief on Sustainability

Current Situation in China for Dealing with CCBP

Sustainable Industrial Solutions to CCBP

Project 1: Wet Process for making higher performance plaster using IBPG

Project 2: Dry Process for Making Plaster using IBPG

Project 3: Combined Production of H₂SO₄ Acid with PC from IBPG (PG)

Project 4: Energy Efficient Superfine Grinding Solution to Ash (LVNT)

Concluding Remarks

The author presented some of their process technologies for cement, gypsum (IBPG), wet process of IBPG, dry process of IBPG, combined production of sulphuric acid with PC from IBPG, Rotary kiln etc.

APPLICATION AND DEVELOPMENT OF DENITRATION TECHNOLOGY IN COAL-FIRED PLANT

QuianYu, Tungalagtamir B, Jianli Guo, Byambagar B, Munkhbaatar P,
*State Grid Electric Power Research Institute, NARI Group Corporation, P.R.of China & School of Applied Sciences,
The Mongolian University of Science and Technology*

ABSTRACT:

Nox produce by the coal-fired power plant has become one of the main sources of air pollution. Based on the formation mechanism of NO_x, this paper provides the analysis on main characteristics of flue gas de-nitration technology and the existing problems which applied in power plants in china. Finally to outlook the future development prospects of flue gas de-nitration technology in India.



TECHNOLOGIES FOR PARTICULATE & GASEOUS EMISSION CONTROL FOR COAL FIRED POWER PLANTS

Ajay Vajpayi
*Senior Engineering Manager,
 Clean Combustion Steam Power Systems India*

Indian trends:

- Strong GDP growth @7.0%+
- Coal dominant, substantial
- Renewables planned - Need for grid reliability & flexibility
- Low sub critical coal plants efficiency <30%
- Narrowing Demand Supply gap- Getting energy surplus
- Global pressure to reduce GHG
- Govt Focus: Power for all, affordable power, sustainable growth
- New emissions norm in place for Coal plants.

Global Emission 2015	India's Global Rank in contribution %	Power sector contribution %
GHG	3rd	43%
SO ₂	2nd	53%
NO _x	3rd	50%
PM 2.5	3rd	5%

The author presented with various statistical data and graphical representation for emission reduction technological advances like NO_x reduction, reagent used for NO_x reduction, DeSO_x technology etc. He also suggested to consider critical issues while addressing emission control in existing power plants like Space, Water, Reagent Availability, Disposal or end use of byproduct, Execution & shutdown time required, Details and design of existing equipment, air preheater, ID Fans, Stack etc. and their potential upgrade opportunities, Lowest lifecycle cost of the plant after life extension, Flexibility of the solution to ratchet down emissions.

REVISED EMISSION NORMS AND THE CHALLENGES BEING FACED BY CAPTIVE POWER PLANTS

K. K. Das Nag

Consultant – Birla Corporation Ltd.

ABSTRACT :

Until end of 2015, the emission from the power plant stack was limited to suspended particulate matter (SPM₀). Through a circular in Dec 2015, the Government specified new regulation for emission through the power plant stack. The new regulation now includes particulate matter (SPM), SO₂, NO_x and Hg. The operation plants need to meet the specified limits within two years i.e by Dec 2017.

Due to economic considerations, the captive power plants high level of Sulphur which leads to very high emission of Sox through the stack. Also, it has been observed that with use of 100% pet-coke in AFBC boiler, the NO_x level increases substantially.

Hence, this new regulation has come as a real challenge to the existing power plant operators. This presentation gives an over-view of the issues that are being faced by the operating captive power plants and use of available technology properly tailor-made to address the issue within the economic frame-work of the plant operation.

BULK FLY ASH MANAGEMENT AT VEDANTA JHARSUGUDA – NEW INITIATIVES

Jugal Kishore Mishra, Head Waste To Wealth, Aluminium and Power sector
Durga Prasad Padhy, Manager, Ash Management

ABSTRACT:

Aluminium smelting process is power sensitive and power intensive also. To produce one ton of aluminium it requires around 13,500 units of DC energy. The energy contributes 95% of total energy consumption in a smelter. Usually all smelters have got assured power supplies by way of either Captive power units or from the grids. The large coal based power plants come with inherent issues of generation of the huge quantities of fly ash. Traditionally, the approach has been to discharge the ash in the ash ponds and allow it to accumulate by drying out.

There have been initiatives to utilize the fly ash in road construction, cement units, brick units, Void filling etc. at Vedanta, Jharsuguda we have taken initiatives in line with the FA notification, GOI causing zero harm to the environment. There has been headway by way of strategic partnering in technology, business or contracting. There has been significant efforts for the investment in plant set up for niche products and having focused approach on R&D work to create innovative products.

Fly ash contains 23-25% of alumina which can be extracted through patented orbite process to make smelter grade alumina and high purity alumina (HPA). Some countries have gone ahead and now producing smelter grade alumina from coal fly ash route. Being the producer of primary aluminium producer this can be utilized in house raw material.

These initiatives have got the potential to make fly ash utilization a 100% waste approach and will make the unit green and sustainable.

GRINDING OF FLY ASH FOR USE IN CEMENT INDUSTRY IN INDIA

Vinod Kumar Singh
LNV Techonology Pvt. Ltd.

ABSTRACT :

Electricity generation in India has been predominantly dependent on coal based thermal power plants and would remain so in the coming future also even though government has taken initiative towards solar power generation. India has approximately 300 billion metric tonnes of coal and is the fifth largest reserve and with average production of around 535 million metric tons of coal is the fourth largest producer in the world. But the irony is that due to high demand of coal India has to import coal for meeting out the high demand due to low quality and high ash content available in India.

This has been ever increasing phenomenon of fly-ash generation which was 6.64 million tons in 1996 to 108 million tons in 2014-15. As in 2014-15, the fly ash generation was approx., 177 million tons and with the government directives we have to utilize 100% fly-ash in various industries.

Cement industry has been doing a great service to the nation by utilizing as much as 30-35% of fly-ash added to their cement production. The cement production in India is approx., 400 MTPA so even consider using 35% of the generation fly-ash the cement industry can utilize approx., 140 MTPA which is not being used as only finer fly-ash is being mixed with cement to make fly-ash based cement. This is because of the reason that around 50% of fly ash generation is coarse and can be mixed with cement. It requires grinding which is a big issue in India.

In India Sinom-LNVT can help the industry in increasing consumption of fly ash as well as bed ash by introducing a successful grinding technology in India. This presentation covers the grinding circuit of fly-ash and bed ash.

METSO FLY ASH CLASSIFICATION

Amitesh Ranjan
Metso India Pvt. Ltd.

METSO—A WORLD LEADING INDUSTRIAL COMPANY

We deliver solutions for

- MINING
- AGGREGATES
- PROCESS INDUSTRIES

16,000 committed employees world wide

Net sales : EUR3.5 billion in 2016

63% of revenue from service Business

- Leading technology and services provider for end-to-end minerals processing
- Leading flow control provider with offerings for oil & gas, mining and process industries
- Building on 150 years of engineering passion and pioneering innovations

We have manufactured locomotives, sports-cars, paper machines, power plants, and more.

Key milestones

- 1868 Sunds Brukin Sweden established, marking the beginning of our story.
- 1999 Metso established through the merger of Rauma and Valmet.
- 2013 Demerger of Metso and Valmet 2014 Metso continues as a focused industrial company.

Today, it's all about knowledge, people and solutions-making the big difference in end-to-end minerals process.

The author presented Metso's centrifugal classifiers systems, configuration, benefits, design, return air system, filters etc. – with their various advantages in grinding and flow control.



DISCUSSION ON EFFECTIVE IMPLEMENTATION OF HIGH CONCENTRATION SLURRY DISPOSAL SYSTEM (HCSD) IN POWER PLANT

Sunil Kumar Ghosh

Power (cell), Development Consultants Pvt. Ltd., Kolkata

ABSTRACT :

Coal based thermal power plant is a major source of power generation at present and will continue in near future until alternative source of power generation are implemented competitively in a large scale to replace / compliment future power requirement. In coal based thermal power plant even with use of certain blending of imported coal with available Indian coal, the power plant produces generally 30-35% of ash which is amounting to two (2) million tons per annum for 1000 MW capacity.

Ash handling system being an important package largely contributing to the power plant performance, continuous development of equipment design, system engineering, proper operation and maintenance has become a necessity of the day. The ash evaluation system and its disposal management have become more complex with increase in unit size, with the emergence of concept of ash utilisation, commercial and environmental consideration. In view of this, it is imperative to adopt effective ash handling system design in which impending difficulties of ash disposal and management can be tackled in right direction.

The present discussion aim's towards to disposal of Bottom ash and Fly ash in power plant with emphasis on latest technology adopted on High concentration slurry disposal (HCSD). The discussion on HCSD shall include slurry rheology analysis, establishing equipment parameters, designing slurry preparation and pumping processes & control system, designing disposal area and planning disposal area operation procedure. The presentation on HCSD shall be based on case study of 3x500 MW unit executed by NTPC Aravali Jhajar, Hariyana, India.

Keywords: High concentration slurry disposal(HCSD), Slurry rheology, Slurry preparation, Pumping system & control, Management at dyke, Matra power plant, Hungary.

PRESENT GOVERNING BODY MEMBERS, 2017-18

Sl. No.	Name	Designation	Occupation
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13	Smt. Madhuri Bhattacharya	Joint Editor	Research Scholar

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