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# An Assessment of the Recent Trends of Coal Washeries in India

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**Abstract—***Coal Washing Assessment in India has been there from 1900's which involves the most widely used technologies of washing categorised into; Coking Coal Washing and Non-Coking Coal Washing India is the fifth largest energy consumer and approximately 63 percent of India's total energy requirement is met using coal. The plants generally use steam coal which is a grade between anthracite and bituminous having high calorific value and less ash content. To further increase the efficiency of the coal, physical cleaning and washing of coal is done which in total is known as Coal Beneficiation which involves separation of inert matter from coal. Thus, to increase the washability index, coal washeries are set up in India by both Public and the Private Sectors in order to increase the efficiency of the washed coals and reduce ash content. The Indian Coal Washing industries still are dependent on the imported equipment which is capable of treating the coals that are different from the Indian coal of drift origin. The development of coal washeries in India are progressively keeping pace with the growing demand for washed coal. The paper would highlight few of the trends and technologies that are followed in coal washeries in India.*

**Keywords***: Coking Coal Washing, Non-Coking Coal Washing, Coal Beneficiation, High calorific value, Washability Index*

## 1. INTRODUCTION

India being the fourth largest energy consumer and one of the countries which has abundant domestic reserves of coal, is utilising this source of energy in a very efficient way. For better utilisation of this energy source for greater production of electricity, this coal is first purified by number of ways and then used for power generation. Coal, which as of now, records for over half of aggregate primary commercial energy supply in the nation and for around 70% of aggregate power era, is probably going to remain a key vitality hotspot for India for in any event the following 30–40 years**[8]**. In India most of the coal reserves is situated in the states of Jharkhand, Orrisa, West Bengal, Bihar, Chattisgarh, Telangana and Madhya Pradesh. To make the coal suitable for use in power generation, it goes through different processes in the coal handling plant such as Handling, Sampling, Washability, Crushing, Screening, Gravity Separation etc. Indian coal has drift origin, it has brought about private blending of mineral matter with coal, which additionally offers ascend to ash**[1]**. In India, almost 30% ash is produced from one kg of coal thus making it incapable for it's full usage. To reduce this defect, coal washing is done in coal washeries which is a establishment where coal is cleaned from slate and other impurities by mechanical processes which use water and take advantage of the difference in specific gravity of the coal and it's impurities.

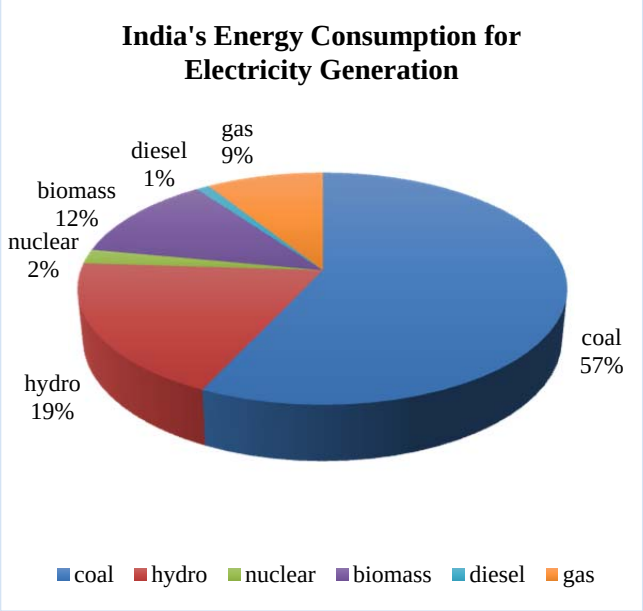
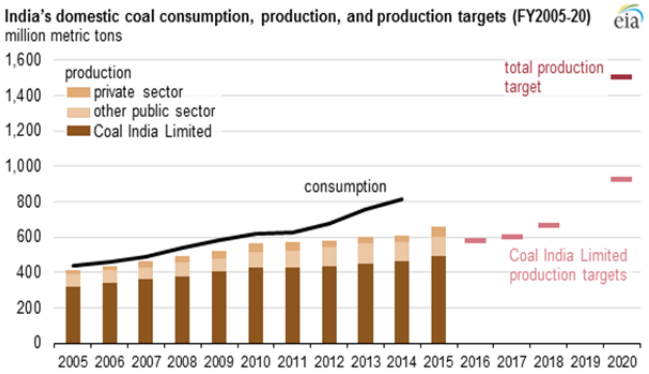
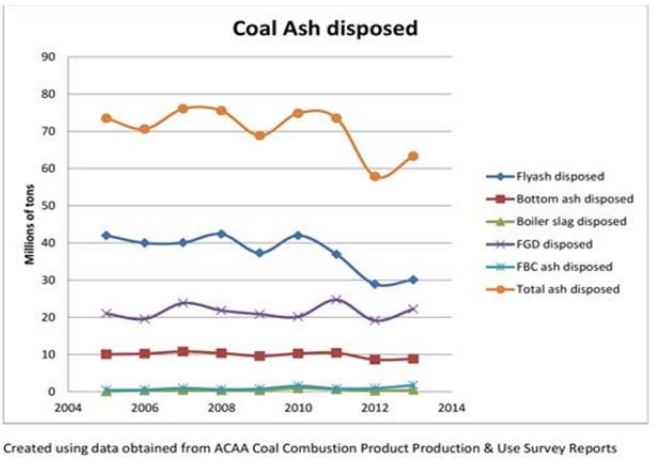



**Fig. 1: The above pie-chart shows the total energy consumption in India in 2016 and the below graph shows the total coal consumption in India , particularly in the power sector.**




**Graph(1):-From the above graph, it can be seen that from 2005-2012, the coal production in India grew only by 4.7% per year to about 600 million metric tonnes while the coal fired electric power capacity in the country grew by a much faster rate(approximately 9.4% per year), reaching 150 Giga-watts.**

For this, Clean Coal Technology, is utilized to depict advancements that decrease the natural impressions of coal power plants are being rehearsed in coal washeries in India, as pre-ignition procedure of Clean Coal Technology is for the most part centered around cleaning and mixing of coal by removing ash from coal subsequently, expanding it's calorific value and utilizing it to it's higher proficiency. In short, washing reduces the ash content by seven to eight percent. Quality and environmental concerns are causing a shift towards higher utilization of washed and blended coal. Washing is carried out to reduce the ash content and the sulphur and minerals present in the coal in high amount. Washes coal has higher calorific value than the unwashed coals and hence, usage of washed coals helps in improving the efficiency of steel, cement and power plants. Earlier coals were coked and washed because making of steel needs coking coal of ash of 17% to 18% where coking coal is the steel - making coal which is baked in a coke oven which forces out impurities to produce coke, which is almost pure carbon. In Indian coking coal the raw coal ash varies from 25% to 30%.




**Graph(2):-The above graph shows the different types of ash disposed-off and also the total ash disposed.**

## 2. EXISTING TECHNOLOGIES

Earlier Prof William Galloway attempted the systematic coal washing in India using a pre- Baum type Jig washer before the First World War on tested Assam coals. Later a similar test was conducted on Jharia Coals in Jharkhand. However, for the first time systematic washability study was made by Rev.E.H Roberton at the Bengal Engineering College, Shibpur during World War 1.

Again, a chemist from London named E.C Evans, in 1920, conducted experiments for washing of Jharia coals in Draper Washer. The conclusion that he made was that, Indian coals cannot be washed to a level of British coals. It is then that the present day Float and Sink method was invented by K.Reinhardt from Germany in 1926**[2]**. Before this period the washability characteristics were determined by pulsating crushes coal on a perforated pan, dipping in water and then finally simulating jigging. In spite of the fact that the primary coking coal washeries in India was set up after independence, coal washing in India goes back to 1900s. The vast majority of these coking coal washeries were claimed by Public Sector and the non-coking washeries by Private Sector.

According to the concern and perspective of GOI and developing interest of coal utilization in India the requirement for more number of washeries to supply plentiful measure of washed coal in future has expanded. The current technologies in trend are:-

1. Using Jigs
2. Using Heavy Media Baths
3. Using Heavy Media Cyclones
4. Using Froth Floatation
5. Using Water only Cyclone

## 3. TYPES OF COAL WASHING IN INDIA

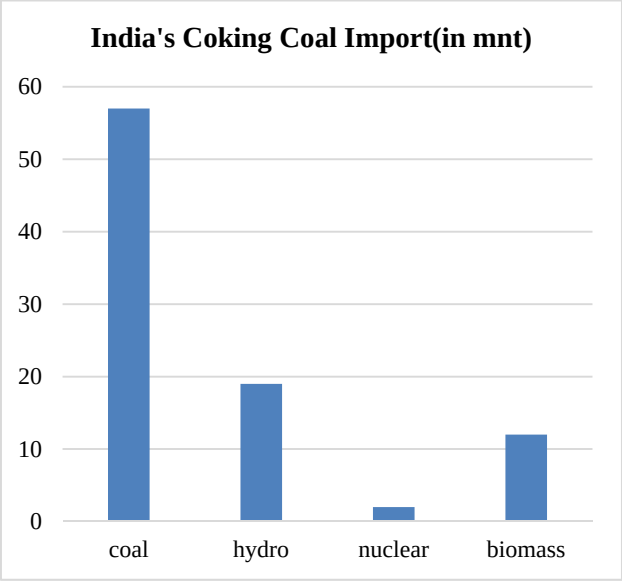
### 3.1 COKING COAL WASHING

One of the method of coal washing is coking the coals which is further used for making coke for steel industries. For this situation the ash percentage of the coal for making coke which is additionally utilized as a part of the blast furnace of the steel industry ought to be inside 18%. In this case mining and handpicking were the main methods to adhere to the qualities of the company. Coal washery waste waters are cleared up in a two-stage process in which coal particles are first agglomerated and expelled from the water. From that point, the inorganic mineral constituents contained in the waste water are isolated to leave a cleared up water stream reasonable for reuse**[5]**. As the steel making industries grew to a greater heights, the Tata and Steel Company installed the first two coking coal washeries at West Bokaro in 1915 and other at

Jarnadoba in 1952. The coking coal requirements for the Indian Steel industries are estimated to be 64 Mt in the year 2016-2017 according to GOI (2005). And the average ash of the clean coal is between 18-24%.

**Table(1):-The below date shows the India' sully for coking coal for year 2012-15.**

| YEAR | WORLD COKING COAL IMPORTS | INDIA'S COKING COAL IMPORTS(IN TONNES) | SHARE IN WORLD IMPORTS(%) |
|---|---|---|---|
| 2012 | 262.5 | 31.8 | **12.1** |
| 2013 | 286.5 | 35.5 | **12.4** |
| 2014 | 291.7 | 36.8 | **12.6** |
| 2015 | 276.3 | 43.7 | **15.8** |



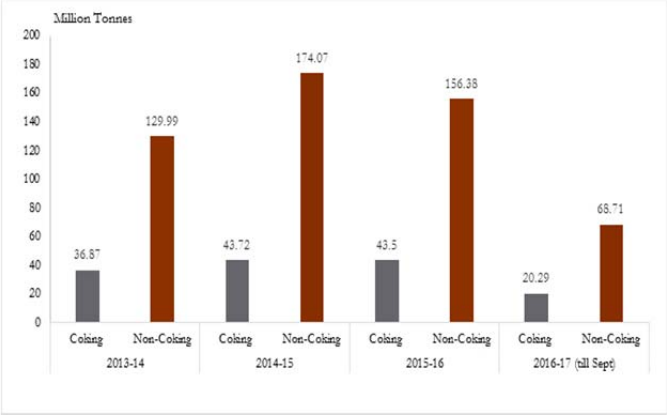

**Graph(3):-The above graph shows the supply of India's supply of coking coal from year 2014-2017.**

### 3.2 NON-COKING COAL WASHING

Railways was the major consumer of the non-coking coal till 1960. Mining of poor quality non-coking coal has turned out to be attainable with the substantial speculation and coming up of expansive opencast mines which was before ignored by the private operators.There are till now three non-coking existing coal washeries of India Coal Limited which has the limit of 13.50 million tons for every year and 31 non-coking coal private washeries of limit of 87.20 Million Tons for each year**[7].**This method is used in the cement, fertilizer, glass, ceramic, paper, brick manufacturing etc. These are such types of coal that does not have properties like coking coals**[5].**

**Table2: The list of coal washeries with their capacities are given in the below table:-**

| Sl. No | Type of Coal | Sector | No. | Capacity(Mty) |
|---|---|---|---|---|
| 1. | **Coking** | Coal India | 11 | 19.68 |
| | | Other PSUs | 3 | 4.85 |
| | | Private | 4 | 6.42 |
| | | **Sub Total** | 18 | 30.95 |
| 2. | **Non Coking** | Coal India | 7 | 20.20 |
| | | Private | 21 | 50.15 |
| | | **Sub Total** | 28 | 70.35 |
| | | **Total** | **46** | **101.30** |




**Graph(4):-The above graph shows India's supply demand of non-coking coal till 2016.**

## 4. RECENT DEVELOPMENTS

Around 21 washeries, appeared on private speculation on 'Build Own Operate' (BOO) idea amid the most recent five years. GOI supports setting up of washeries in India on the idea of BOO to be developed on company's territory keeping in view the future demand of the washed coal**[3]**. Past few decades encountered a colossal development in Indian coal washing industry and is relied upon to quicken sooner rather than later as well as showed by the recent policy changes and arranged coal washery extends by both government and private sectors**[4]**. The Indian Coal Washing Industry present and future developments are listed below:-

1. Overview of the coal washing industry and global scenario.

2. Key drivers of coal washing with special focus to Indian market.

3. Key challenges and opportunities in developments of coal washaries.

4. Power generation from washery rejects with profiles of power plants using rejects as fuel.

5. History, current status and future outlook of Indian coal washing industry.

**Table 3: Data Obtained From Coal Washery Under BCCL, A Subsidiary of Coal India Limited**

**Washery and their Capacity**

| Washing Process: | | |
|---|---|---|
| Washery | System of Washing | |
| Sudamdih | 2 Stage HM Cyclone (37-0.5mm), Flotation (-0.5mm) | |
| Patherdih | Deshaling Jig(75-0mm), HM Bath(75-13mm), | |
| Moonidih | 2 Stage HM Cyclone (30-0.5mm),W/O Cyclone(-0.5mm) | |
| Mohuda | HM Cyclone (25-0.5mm), Flotation (-0.5mm) | |
| Madhuban | Batac Jig (13-0.5mm), Flotation(-0.5mm) | |
| Dugda-II | HM Cyclone (13-0.5mm), Flotation (-0.5mm) | |
| Bhojudih | Deshaling Jig (75-0mm), HM Bath (75-25mm), | |
| | Batac Jig (25-0.5mm), Flotation (-0.5mm) | |
| | HM Cyclone (13-0.5mm) | |
| Details of Existing Washeries : | | |
| S. No. | Name of Washery | Year of Commissioning | Operable Capacity MTY |
| A. Coking Coal | | | |
| 1 | Dugda-II | 1968 | 2.00 |
| 2 | Bhojudih | 1962 | 1.70 |
| 3 | Patherdih | 1964 | 1.60 |
| 4 | Sudamdih | 1981 | 1.60 |
| 5 | Moonidih | 1983 | 1.60 |
| 6 | Mohuda | 1990 | 0.63 |
| 7 | Madhuban | 1998 | 2.50 |
| TOTAL (Coking Coal) | | | 11.63 |
| B. Non-Coking Coal: | | | |
| | Dugda – I | 1961/1998 | 1.00 |
| TOTAL (Non-Coking Coal ) | | | 1.00 |

## 5. CONCLUSION

Thus, coal washing is seen as a way of making coal burn more efficiently and in a more cleaner way. There are diversities of coal prevalent in India such as Anthracite, Bituminous, Lignite and Peat, however the challenge with Indian coal is its ash content. Most of the coals after mining contains impurities associated with sit. Coal washery rejects, which is a strong waste material produced in coal preparation procedures, is used to get ready, carbonaceous sorbents for evacuation of toxin gasses SO2 and NOx from vent gasses**[6]**. These impurities are further removed by washing the coal in Coal Washeries. These washeries should be designed as such that they are located close to the mine. The sites of the coal washeries should be chosen considering the content of the coal bearing area and possibility of future mineability. Coal Washing grinds the coal into smaller pieces and separates the coal from impurities. The impurities left from coal washing end up in sludge ponds left in the holes of Mountain Top removal sites.

The main objectives of Coal Washing are:-

1. Reducing it's ash content

2. Reducing it's transportation and storage costs

3. Increasing it's heating value

4. Increasing the fusion point of ash by removing alkali chlorides

5. Reducing it's clinkering tendency

6. Reducing it's sulphur and phosphorous content**.**

Hence, continuous and development efforts, are being done to improve the quality of the Indian coal so that it can be used to the maximum efficiency and contribute to the power generation in a more better than it did. Significant development in the coal washing system practices are yet to be achieved, as there has not been any noteworthy development.

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