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Forecasting the Usage of Flyash in Indian Thermal Power Plants

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Abstract:
World's second largest populous nation India already is hard-pressed for land availability in its hinterland.
Excess waste generation & resource misuse is further aggravating the problems of land paucity & disposal problems of generated wastes.
Coal-based Thermal Power Plants (TPP's) are the major source of energy for the Indian mainland.
Fly-ash which is the major by-product of coal based TPP's was traditionally classified as wastes until 1991 when an Ash Utilization division was set-up,
Its Utilization as a percentage of generation is a major indicator of how efficiently we are utilizing our wastes.
Forecasting it correctly depicts the understanding & trend necessitating planning & interventions.

1. Problem Formulation

In a thickly populated country like India where almost 17% of the world's population stay in just about 2.3% of land area, excess waste would need extra space for disposal.
World Bank in its numerous reports has already highlighted the paucity of land in our thickly populated & fast growing nation.
The Energy deficit for a developing nation like India is primarily fulfilled by the numerous coal-based thermal power plants (TPPs)
Fly-ash which is the major by-product of coal based thermal power plants (TPPs) needs to be utilized at an increasing pace to prevent from waste disposal problems in future.

1.1. Objective

My aim is to forecast the utilization of fly-ash generated from all Thermal Power plants in India in years 2015-16 & further.

1.2. Solution Methodology

All By-Products generated at each stage of the supply chain are not wasted. If the most voluminous wastes generated from the most polluting or widespread industries are catered for, the problem can at least be addressed quantitatively.
Utilisation % of fly-ash is a major indicator which embodies fly ash generated in all TPPs & presents how much of it has been recycled & put back to re-use & not allowed to make land fallow, as it ultimately is dumped on land in the form of ash-dykes etc.
The data for fly-ash utilisation is available in the public sphere. We have carefully plotted the data on a graph. The shape of the graph gives a striking resemblance to an exponential curve in the early stages. However, the later stages of the graph more closely resembles a natural logarithmic curve.
By using the intercepts we have found out the constants & the exact equation which most closely resemble the available curves in both initial & later stages.
Using the equation & extrapolating the graph both gives us the Forecasted value of fly-ash utilization % for 2015-16.

1.3. Restrictions

Waste is a taboo subject in India. Despite of India's transformation from a socialistic economy into a market economy in the last couple of decades, waste generation has stayed with it as the historic colonial hangover, free from interventions & inspections.
The absence of nationwide guidelines & over-reaching organisation or authority has allowed that every industry to almost either completely ignore its by-products generated at each stage of supply chain or have an indifferent attitude leading to accumulation of wastes in all of ecosphere.

1.4. Relevance

Worldover, ever since the advent of the industrial revolution, human population along with human activity has zoomed like never before. The harmony of nature which is reflected in exactly the right temperature for preventing the escape of essential atmospheric gases & the timings of precipitation patterns on the face of earth have all allowed human beings to adjust to the vagaries of nature & develop agriculture its main source of food requirements in accordance with natural cycle.

However, unprecedented use of natural resources, misuse, damage & wastage has made nature to respond in unprecedented ways. As a result the intensity & frequency of weather phenomena has changed from long-term averages, causing climate change.

With every part of Indian sub-continent reeling under the effects of climate-change with unseasonal rains, Disturbed monsoonal cycle, changing temperature graph, increased frequencies of natural calamities. All has some global connection with misuse or in-effecient use of available resources worldwide, every climate change report has assessed this.

Quicker these fact gets acceptability in the collective-psyche of the nation, faster we can move towards adaptation & mitigation strategies to combat & be better prepared for such a change.

1.5. Assumptions

a) Land area is finite.
b) Resources are limited.
c) By-products generated at each stage of Supply chain are disposed-off as wastes.

2. Why Focus on Fly-Ash in India

The Re-invigorated thrust on 'Make in India' promises to bring industrialisation in a Service & IT dominated economy of India. Any attempt at industrialisation will thus have to be preceded by bridging the energy deficit of the already energy-famished Indian mainland. The availability of huge reserves of coal in India (abt 8% of worlds' reserves) will ensure that Coal will remain the predominant energy source for power production in India, currently generating approximately 70% of total domestic electricity.

Hence, in a primarily agrarian land like India, where the majority of population is still deriving sustenance from agriculture, land is still a novelty. Pressure on agricultural land through increasing industrialization will thus be forever mounting up. As a consequence, no more land can be allowed to become fallow by deposition of fly-ash, which is the largest by-product of coal-based thermal power plants.

Thus, for reasons of Quantitative efficiency any waste management strategy which involves integration of by-product into existing supply chains, fly-ash is a natural choice for intervention due to India's energy dependancy on coal based thermal power plants & its widespread distribution on all of the Indian mainland.

Waste thus is only a relative term. Instead, all by-products emerging out from an industrial complex should be properly classified & information made available compulsorily to any prospective entrepreneur who intends to turn it into a resource & integrate it backwards into the supply chain.

3. The Main Work

The Numerical data of By-product of TPPs i.e. fly-ash was collected & analysed graphically. Case study of Fly-ash was done at NTPC Unchahar & then data for all india fly-ash utilisation was was analysed.

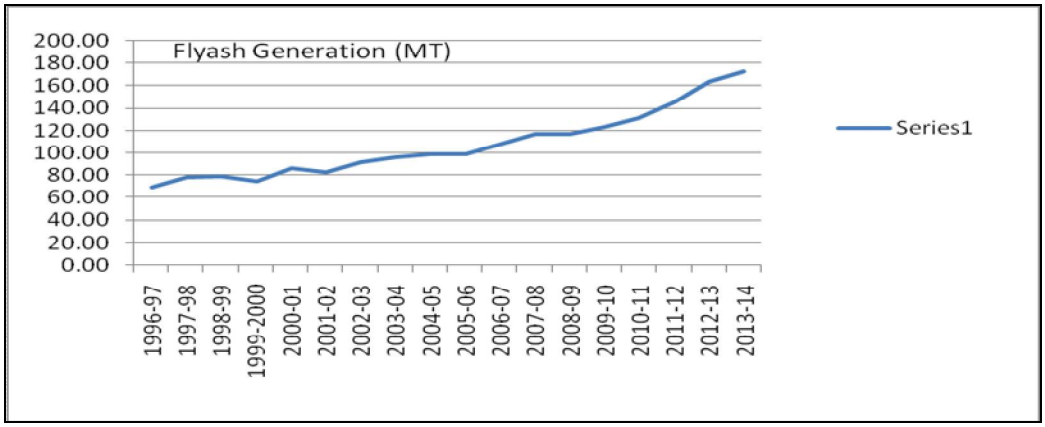

Figure 1

Flyash generation at TPP in India post 1996-97 is shown in Figure-1 above:

Y = Flyash generated in MT X = Accounting year post 1996-97

Flyash Utilisation in million tonnes is represented by the Following Figure 2.

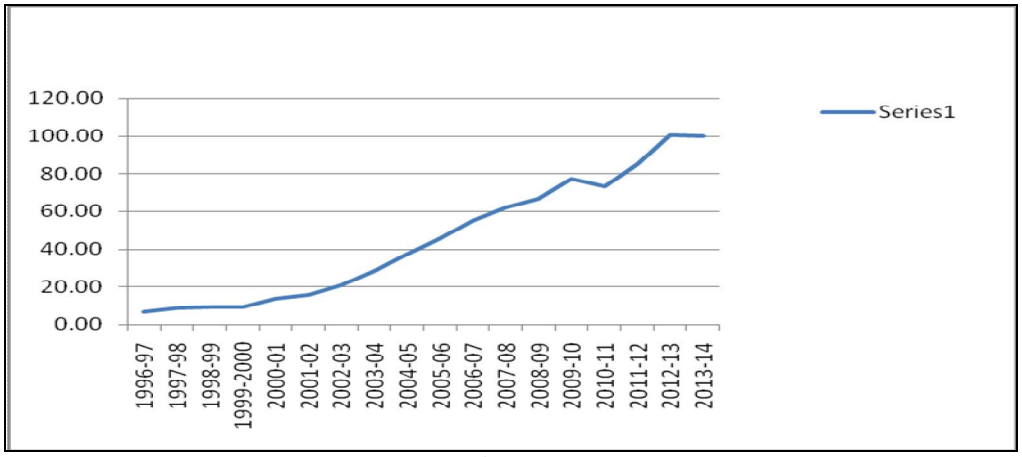

Figure 2

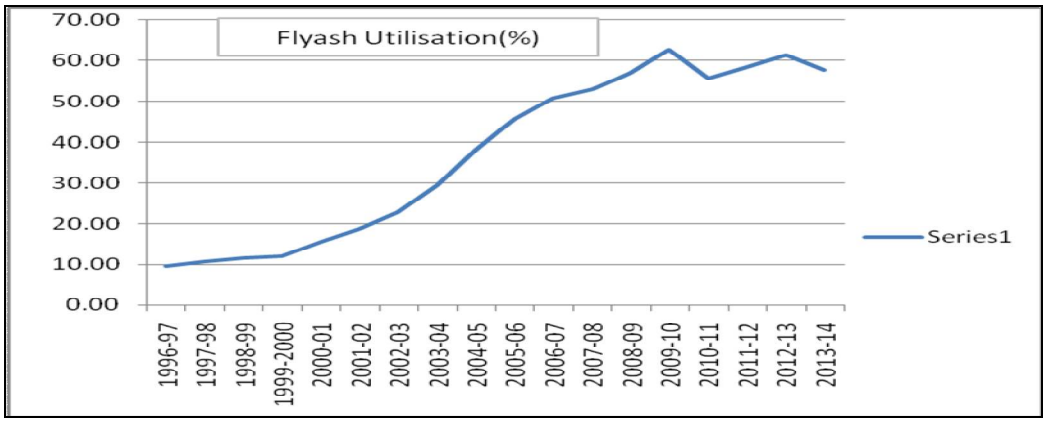

Figure 3

Fly-ash Utilisation % is represented by above Figure 3 in the above time period. A single mathematical curve, which can represent the above behavior may not be easy to find as the initial stages, it represents an exponential curve while gradually it becomes more closely like a logarithmic curve.

So, we have proposed two mathematical curves which can very closely represent the above utilization pattern of fly-ash fairly accurately.

This we have done after closely observing the Figure-3. The X-intercept at 2006-07 which represents the Y-intercept 50.86 is the clear point of demarcation, as beyond this point the slope of the curve evens out or moderates. Until this point the curve resembled more of an exponential natured curve. However, beyond this point the curve resembles much closely with the logarithmic curve. The curves are hence drawn separately & can be seen closely portraying the Figure-3 as shown in Figures 4 & 5.

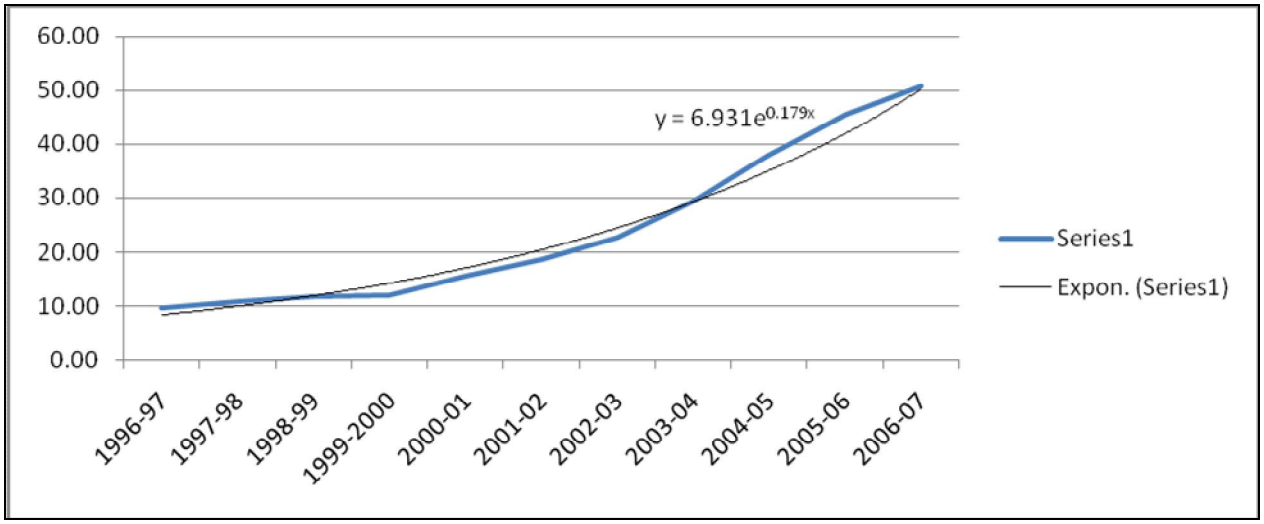

Figure 4

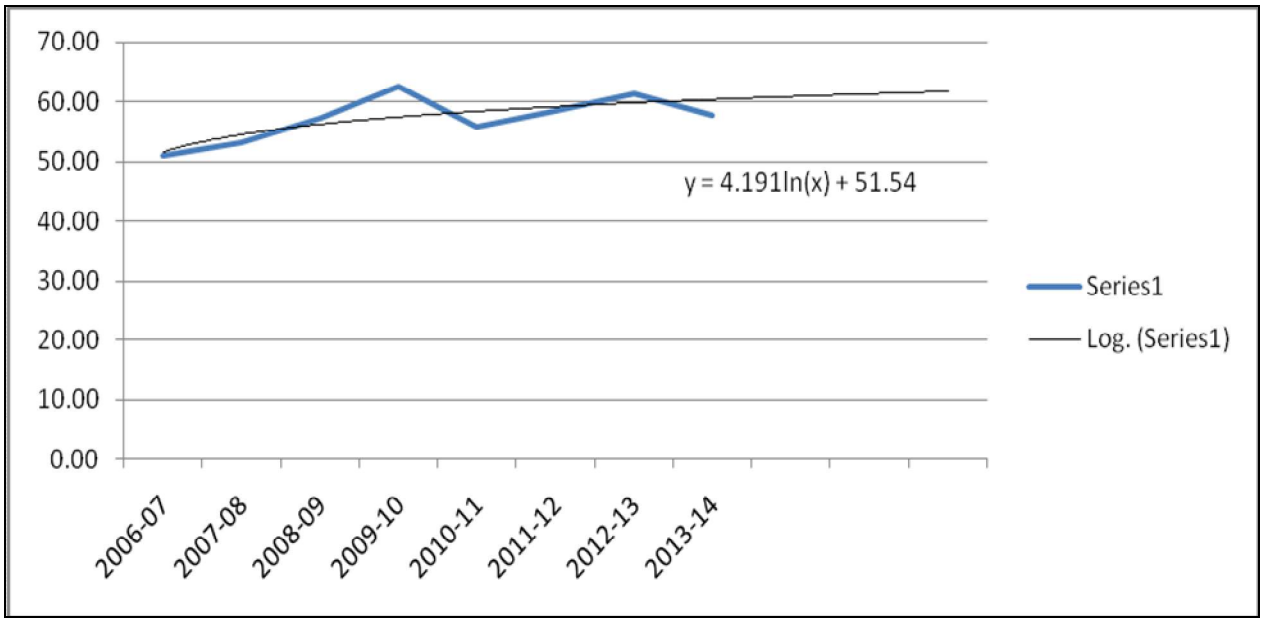

Figure 5

4. Reason for Such a Change in Nature of Curve

The initial exponential utilization of flyash can be attributed to the sudden discovery of flyash as a viable alternative in corporate India in the Cement Industry, Brick Industry, mine-filling etc. This was supported by governmental programs guided by World Bank guidelines. The initial growth was furthered even by the horizontal growth of its usage owing to more corporate & businesses getting associated with its utilization for it being a cheaper alternative & being environmental supportive too.

Subsequently, its shortcomings were exposed like its lacking compaction strength in bricks & lack of Humus in agriculture & reduction in mining activities due to stricter environmental norms. Further, due to lack of any major governmental programs, the exponential growth ceased. The changing nature of curve can be attributed to the exhaustion of avenues for fly-ash to be utilized profitably in the existing industries. Growth beyond this point was more or less flat owing to capacity expansion of existing projects or natural coming into operation of newer projects. All these & Lack of serious support from governmental programs allowed dying down of initial euphoria of utilization of fly-ash.

Thus the combination of above two curves embodies the fly-ash utilisation % pattern for All TPPs in India in the given time period. This curve & the equation representing it, is at the same time handy as it can be used to forecast the future fly-ash utilization pattern for India in the coming years.

This is indicated in the Figure -5.

The forecasted value from the equation & Figure comes to near 61% in 2015-16.

5. Result

Fly-ash utilization % is seeing a sluggish growth. This is partly due to saturation of the available infrastructure to absorb fly-ash & minimal addition. Lack of incentives by the government & lack of newer research for further improving re-utilisation. New Usage methods need to be developed & research work incentivized to improve the utilization %.

By-Product integration into Supply chain is a Worldwide intervention strategy. It is not just a qualitative construct, but a quantitatively proven methodology. It may not have brought windfall profits to its stakeholders, but equable change which is both economical & environmentally not polluting & bringing social justice in a country like India with tremendous amounts of income inequality exists.

6. Conclusion

By-products integration into the main supply chain should be adopted into the waste management strategies in the Indian policy making document. Turning waste into resources should be more incentivised by the government & added into the corporate social responsibility document of the MNC's.

7. References

i. UCN. 2006. The Future of Sustainability: Re-thinking Environment and Development in the Twenty-first Century. Report of the IUCN Renowned Thinkers Meeting, 29-31 January, 2006 http://cmsdata.iucn.org/downloads/iucn future of sustanability.pdf

ii. FLY ASH UTILIZATION IN NTPC & EXRACTING CASH IN ASH BY NVVN Rakesh Kumar, Ex-General Manager-NTPC

iii. Report of the Committee to Evolve Road Map on Management of Wastes in India Ministry of Environment and Forests New Delhi March, 2010.
iv. Bureau of Energy Efficiency- Energy scenario-1ch1.pdf from bee india. in
v. Report on fly ash generation at coal/lignite based thermal power stations and its utilization in the country for year 2013-14 (april, 2013 to mar, 2014) Central electricity authority new delhi.
vi. http://www.cbrienvis.nic.in/flyash.generation.htm
vii. http://www.economywatch.com/business-and-economv/coal-industry.html
viii. http://en.wikipedia.org/wiki/Flyash
ix. http://www.fly-ash-information-center.org.iiVindex.php?id=3