

Effluent Color Reduction using Boiler Fly Ash from Pet Coke Fired Boiler (A Preliminary Study)

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Abstract:

Effluent color in case of paper mills producing colored paper using dyes is a major problem. Dye removal is often costly, and mills face effluent discharge problems.

In the present work, some initial studies are reported where we can use fly ash from pet coke fired boiler.

Introduction:

Color reduction from effluent has always been a headache for process plant owners. Mills have tried different options, but some are very costly, others are not so effective.

The described work started when a friend suggested that using activated carbon, color of dyes from paper mill effluent can be fully removed and a nearby mill has installed such a system, which is working excellent.

On telephonic enquiry from the mill, we found that the mill was really trying to tackle this problem, and planning to have activated carbon filter. But they dropped the idea as use of activated carbon is too costly. The activated carbon is a good adsorbent for most of the dyes used in pulp & paper mills. However, there are two problems associated with its use-

1. Typically the cost of activated carbon is very high, due to which mills often find the decision to install a filter based on this.
2. The life of activated carbon is low and generally it is required to replace the activated carbon after its capacity is exhausted.

But, whatever costs are involved, increasing pressure to maintain effluent color within limits forces any mill to seriously consider the use of activated carbon.

On surfing the internet, it was found that regeneration of activated carbon can be done using heating of activated carbon at 500 deg C in presence of KOH. This gave an idea "In the boiler, temperature goes more than 1000 deg C, can we use fly ash?"

A Pet Coke Fired Boiler:

There are different fuels in use for boiler. While it is generally convenient for the mills to use the locally available fuels such as bagasse, rice husk, coconut shells etc., the problem appears if such locally available fuels are not available for few months in a year. Some mills have switched over to pet coke for the same reason.

Pet coke is a byproduct of petroleum refineries and is easily available throughout the year. Typically, the pet coke contains almost no ash, and there is no ash disposal problem. However, due to inefficient combustion, some of the pet coke dust passes with flue gases, which is recovered in dust collector of the boiler.

As this fly ash is only the unburnt carbon, the boiler operators put it again into the boiler for combustion. We decided to use this fly ash for our experiments.

Experimental Setup:



Image 1: Experimental setup

The basic idea was to replicate the action of downward flow dual media filter in laboratory. For the same, a cold drink (2L) bottle was taken, and the bottom of it was cut. Holes were drilled in its cap. After turning the bottle upside down, we put bigger stones, fine stones, a little dust from boiler (around 25mm thick layer), again some coarse sand.

A similar setup was also prepared using activated carbon. The activated carbon in use was obtained from a recent supply to a nearby mill along with dual media filter.



Image 2: Filtration in progress. Left: Activated Carbon; Right: Pet coke fly ash

In this photograph, we see left side activated carbon results, while on the right, there is fly ash from a pet coke fired boiler, in the bottle. Colored water was prepared using 5PPM Rhodamine dye dissolved in treated effluent. Activated carbon filtration rate is, as seen from the photograph itself, is very high.

But, on the right side, where we have used fly ash, the water is very clear.



Image 3: Filtered water kept for comparisons.

Left: Using pet coke fly ash

Middle: Untreated sample

Right: Using activated carbon

In next step, the experiment was repeated using different dyes using 5ppm samples. The next image indicates different dye solutions before and after discoloration.



Image 4: Filtered water kept for comparisons. (Top untreated, Bottom filtered)

Left: Using 5 ppm Rhodamine
Middle: Using 5 ppm B. Brown
Right: Using 5 ppm M. Blue

Poor Results by Activated Carbon:

As the results by the activated carbon were not as expected, we did ask a question, “Why?” We had a doubt on the quality of the activated carbon, but had no means to check or verify this. Maybe the quality of activated carbon was poor or maybe it was just granulated charcoal.

Other Observations:

It was observed that the filtration rate was very low. The initial calculations showed that the filtration rate was to the tune of 150-170 m³/m²/Hr.

To increase the filtration rates, it was decided to increase average particle size, so the dust was filtered using 200mesh laboratory sieve. The part of dust that passed through the screen was rejected and remaining part was used for filtration. This proved very beneficial. The rate could be increased to 700-800 m³/m²/Hr.

Future Scope:

As clear from the initial experimentation, use of fly ash from a pet coke fired boiler is very economical and useful. The experimentation should be further tried for effluent from agro based paper mills or wood based paper mills where effluent color is a serious problem. As the filtration rates are low, screening and size separation of fly ash can be

done and optimum particle size selection for efficient filtration as well as color reduction efficiency is necessary.

However, considering the poor filterability of the fly ash used, in case size separation is not adequate, we need to develop good filtration equipment that provide faster filtration rates by enhancing the filtration area. The equipment suppliers may use a multi-level filtration vessel, which provides different layers of filtration each working in parallel, or consider use of pressure filtration.

Conclusion:

This gives an initial idea that fly ash from a pet coke fired boiler can be used as a color adsorbent. Costing is very less as after the adsorption capacity of this dust is exhausted, it can be resented to boiler as a fuel, and we can ask for more fly ash from boiler house.

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About the Author

Born in 1968, **D K Singhal** is B.E., M.E. (Pulp & Paper, 1993) from Deptt. of Paper Technology, University of Roorkee (now IIT, Roorkee), India. He is a Certified Energy Auditor and Chartered Engineer. He is also serving IPPTA as a member of Editorial Board as well as Member of Executive Committee; and has nearly 6 dozen publications in IPPTA, on energymanagertraining.com and paperonweb.com etc. He is with Chandpur Enterprises Ltd., as Director (Technical).

An initiative by D K Singhal, a cyber campaign initiated against unjustified targeting of paper industry by "Idea" mobile, in their "**Sirjee**" advertisement campaign, after which this advertisement was taken off air.

He has also moderated a Yahoo group, "**PaperTechnology**" with more than 350 members from India and abroad to discuss problems related to pulp & paper making.

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