



ACTIVATED CARBON INDIA PRIVATE LIMITED

Improved Steam Efficiency through Insulation, Capacitor Banks and Parallel Mode Steam Connection

SUMMARY OF THE OPTION

Activated Carbon India Private Ltd., located in the southern part of India with a plant installed capacity of 1500 tons/yr, is a leading manufacturer of granular activated carbon produced from coconut shell charcoal. The plant operates two rotary oil fired kilns parallelly. The kiln represents the heart of the process wherein raw carbon (roasted coconut shells) is activated by steam to form granular activated carbon. Based on the discussions and feedback, the Team identified steam generation and distribution as one of the main focus areas, wherein it was perceived that there existed a significant margin for improvement on the energy and environment front.

The option, 'Efficient Steam Generation and Utilization', was evolved based on the following observations:

- High exit flue gas temperature in Waste Heat Boiler (WHB) # 2
- Uninsulated steam pipe lines
- Non-availability of steam traps for the steam using equipments
- Series mode of connection of steam line instead of parallel mode for the tray driers.

The option envisaged an annual saving of around 0.1056 million kWh worth of US\$ 14,156. The option was implemented with a one-off initial investment of US\$ 3,674, which has been paid back within four months of its implementation.

KEY WORDS

India, Chemicals, Steam Generation and Utilization, Capacitor Banks, Insulation

OBSERVATIONS

Various observations were made that hindered the process of efficient steam generation and its utilizations. They are as follows:

- The steam generated in the WHB # 2 was of the order of 650 – 700 kg/hr, compared to WHB #1, where the steam generated was around 850 –950 kg/hr for the same conditions of waste heat from the kiln.
- The steam pipe network in the entire plant was un-insulated and there was no system for draining condensate from the steam network.
 - When kiln # 1 was in operation, the waste exhaust heat generated sufficient amount of steam in the WHB #1. However, due to poor quality of steam which was due to inefficient boiler operation resulting in insufficient heat in steam from WHB # 1 the tray driers were forced to operate on steam as well as on electricity.
 - When kiln # 2 was in operation the tray driers were required to operate entirely on electricity. This was due to the fact that the steam generated from WHB # 2 using waste heat from kiln was insufficient in quantity and quality to meet the requirement of the tray driers. (Due to very low efficiency of WHB #2).



- Owing to the additional use of electricity (in the tray driers, electrical heater was used for NH₃ removal from the impregnated activated carbon and other intermittent electrical loads like circulating fans etc.), the unit was consistently exceeding the contract maximum demand (electricity).
- The steam connection to the three chambers of the tray drier were in series mode i.e steam used to enter the first chamber and then pass on to second chamber and finally the third. By the time the steam enters the third chamber it used to be very wet with a high degree of wetness fraction.



Plant Overview



Rotary Kiln



Cochran (WHB)

OPTIONS

- As the heat transfer area of WHB # 1(of kiln # 1) was higher than that of WHB # 2 (of kiln # 2), the flue gas path's of kiln # 1 and 2, were inter-connected to facilitate use of WHB 1 for steam generation regardless of which kiln was in operation. Sufficient care was taken to ensure proper isolation of non-functional kilns and WHB's.
- The bare steam lines were insulated with 2 inch mineral wool, bonded by wire mesh and clad with 24 gauge aluminum cladding sheet.
- Thermodynamic type of steam traps were installed in key identified locations of the steam pipeline network, of which one trap per kiln was placed before the steam entered the kiln.
- In order to mitigate the dip in plant power factor, from the existing 0.99 to 0.77(a feature noticed when the resistive electrical heater loads were removed in favor of steam heater coils) capacitor banks to the tune of 50 kVAR (2 x 25 kVAR) were installed at the Power Control Centre.
- The drier steam connection of "Series mode" was modified to "Parallel mode" with a float valve installed on the common return condensate line to the boiler. In series mode the steam used to enter at one section of the dryer and used to pass over to the other section laid over it, and from there to the third and so on , thereby heating the section it first entered the most and least the top most section. In parallel mode the steam is simultaneously fed into the different sections so that drying of the product is uniform all through the dryers.



Steam line Modification
(Electrical Heating
Eliminated)



Installation of Capacitors



Interconnection between
two kilns



Efficient Steam
Distribution
(Steam Traps)



RESULTS

The impact of the above measures resulted in steam generation quantity and quality improvement (thermal energy in this case is free as it is sourced from kiln waste heat) thereby manifesting as electrical energy saved by avoidance of its use in preference.

Financial benefits:

- Investment: US\$ 3,674 (Rs.1.58 lakhs)
- Annual cost savings: US\$ 14,156 (Rs.6.09 lakhs), (= 0.1056 million kWh/yr * Rs.5.67/kWh) (@ Rs.43/ US \$)
- Annual operational cost: Same as before
- Payback period: 4 months

Environmental benefits:

- Annual electricity savings: 0.1056 million kWh or 105600 kWh
- Annual GHG reduction: 94 tons CO₂, (= 0.1056 million kWh/yr * 0.000893 t CO₂/kWh) [1]

Other benefits:

- Hot Condensate recovery to the boiler resulting in purer water input and longer life of boiler tube.
- Faster drying of material in the tray driers resulting in reduced cycle times
- Improved power factor resulting in released kVA for accommodating additional electrical loads
- Avoidance of large amounts of money paid to the electricity company by way of penalties for exceeding the kVA limit.
 - Besides the above technical benefits the working environment has much improved (in terms of temperature and cleanliness) and more consistent output product quality.

[1] – sourced from UNEP GHG calculator. Specific to India

FOR MORE INFORMATION

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