Some Aspects of Improved Techniques in Recovery Operations to Reach Peak Performance

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Seshasayee Paper and Boards Limited (SPB) commenced operations in 1963 with an installed capacity of 65 tonnes per day of writing and printing papers. The Chemical Recovery Section in this integrated paper mill consisted of a Multiple Effect Evaporator, Babcock & Wilcox Tomlinson Boiler, capable of handling black liquor from a production of 65 tonnes of pulp by kraft cooking. By numerous minor modifications and adopting operating techniques, it is now possible to handle in this Chemical Recovery Section, black liquor solids from a production of 110 tonnes of pulp a day. Even with an overloading of 65 to 70 % the recovery efficiency could be maintained around 90%. This is a short review of the various modifications and techniques adopted to achieve the above result.

In the process of chemical pulping, chemical reagents, in aquous solution, are used for the dissolution of some of the components of noncellulosic nature in the raw material, namely wood and bamboo. In the Kraft pulping process, the cooking liquor contains a mixture of Sodium Hydroxide, Sodium Carbonate, Sodium Sulphide and Sodium Sulphate. The spent cooking liquor in Kraft pulping is not looked upon as an inconvenient waste. As the Mill capacity grows bigger the spent cooking liquor becomes a very important source of heat and recoverable cooking chemicals. In fact the economy of a present day integrated kraft mill depends to a very great extent upon the productivity and efficiency of its chemical recovery section. With the unprecedented rise in chemical costs and all other operating costs, the importance of efficiency in the chemical recovery section cannot be over-emphasised. Another aspect which cannot be neglected, is assuming major proportion in the operation of a Chemical recovery unit. It is the necessity to keep the atmosphere and streams free from pollution. This aspect is being keenly felt by Mills, the Government and the public at large.

SPB launched its first stage of expansion to increase the production of Mill from 20,000 tonnes per annum to 30,000 tonnes per annum in 1967. During this expansion, the Recovery Plant was not expanded. The original Recovery Plant, which was designed to handle about 89 tonnes of Black liquor Solids from a production of 65 tonnes of pulp, has to be overloaded considerably to cope with the pulp production of 105 tonnes a day. This could be achieved in stages by carrying out minor modifications and adopting certain special operating techniques.

Evaporators

Gosolin Briminsham, USA, supplied quintuple effect Evaporator with a spare body for the 1st effect. The total heating area is 12600 Sq. ft. with built in reheaters and with backward feed arrangement. This has a designed capacity to evaporate 70,000 lbs. of Water per hour raising the concentration of weak black liquor from 13.5% to 45% solids. When the black liquor was concentrated to 45% solids in the Multiple effect Evaporators, the concentration of the Black liquor at the cyclone evaporator was not going up beyond 59–60% solids. This necessitated the increase of outlet concentration of Black liquor at the Multiple effect Evaporator to 50% solids. This had affected adversely the performance of the Evaporator by fast scaling in the first three bodies. To overcome this problem, the spare first effect was brought

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into service in series so that the mechanical cleaning operation in the first three bodies could be undertaken at regular intervals. After this modification, the evaporators could handle Black liquor from a production of 75 tonnes of pulp per day.

When the lst stage expansion was envisaged in the year 1967, the bottleneck in the evaporator performance was sought to be overcome by introducing a Venturi-Evaporator-Scrubber in the Recovery Boiler and converting the existing cyclone evaporator into a cyclone separator. The installation of Venturi Evaporator not only helped in scrubbing and recovering the dust from flue gas but also rendered possible the reduction of concentration of Black liquor at the outlet of the Multiple effect Evaporator to about 40% solids.

This resulted in better perfomance of the Evaporator by way of handling Black liquor produced from 95–100 tonnes of pulp/day.

The Evaporators were originally provided with demisters to arrest carryover of Black liquor droplets into the vapor space which otherwise resulted in contaminating the vapor condensate contributing to chemical loss. It was observed that whenever the demisters were clogged with fibres, the carry over of Black liquor was taking place. Periodical cleaning of the Demisters provided in the last two effects helped in reducing the chemical loss at the evaparators and eliminating the contamination of secondary condensate and Barometric condenser water. This clear secondary condensate and the water from the Barometric condenser were effectively utilised for the washing of pulp at the Brownstock washers, and the washing of the sludge at the causticizing section.

The performance of the Evaporator was found to suffer when the schedule of cleaning the evaporator bodies could not be kept up as the evaporator had to be kept running almost continuously to cope up with the production. It was found advantageous to keep out of service two bodies at a time which could be cleaned and put back during the intermediate cleaning of the Tomlinson furnace. This arrangement had no doubt reduced the steam economy, but helped in dealing with black liquor produced out of 105 tonnes of pulp a day.

Further improvements in Evaporator performance was found possible by venting out the non-condensible gas from each effect through a separate header of higher dia. connected directly to the Barometric condenser.

Steady and constant water pressure at the inlet of the Barometric condenser was found necessary to avoid fluctuations of the vacuum in the last effect. This problem was surmounted by utilising the back water from the paper machine which had incidentally reduced consumption of fresh water at the Barometric condenser. With the above minor modification and operating techniques evaporators are able to handle Black liquor from 105 tonnes of pulp/day.

Recovery Boiler

SPB has a Recovery Boiler of B&W make. This boiler is designed to handle 89 tonnes of Black liquor solids a day. The furnace has a hearth area of 89 sq. ft. and the boiler is designed to produce 32,200 lbs. of saturated steam/hr. at 150 psig. The Recovery Boiler was able to handle 90–95 tonnes of solids with a stack loss of 14% on the total alkali supplied to the Pulp mill.

To step up the percentange recovery, installation of secondary recovery plant was contemplated in the 1st stage expansion in 1967. Venturi Evaporator Scrubber was found preferable to an Electrostatic Precipitator, due to lower cost of installation, its ability to handle black liquor at lower concentrations and the limited space needed for the Venturi Evaporator.

A study of the Steam balance of the Mill revealed that there was excess of steam which could be used for driving the ID Fan of 350 HP required to maintain proper differential across the Venturi Evaporator Scrubber.

The Venturi Evaporator Scrubber was installed in the year 1969 and from that time the Recovery % had gone up from 80 to 90% gradually. The equipment had the ability to receive black liquor at lower concentrations from the multiple effect evaporators.

When the Recovery Boiler was obliged to be overloaded with the black liquor solids produced out of 95–100 tonnes of pulp/day the Boiler passes were getting fouled very often, resulting in unscheduled stoppages, reducing the availability of the Recovery Boiler.

Study revealed that the fouling of the Flue gas passage was acute at the screen tube area and nose baffle area. Openings were made at vulnerable places to dislodge the adhered hard stuff. Provision of many lancing doors facilitated keeping the flue gas passage clean, for maintaining proper draught conditions in the Furnace.

It was often noticed that sudden dislodging of hard lumps from the Screen tube and nose baffle area, was resulting in the improper flow of smelt as the dislodged lumps falling on the hearth and spout area obstructed the smelt flow. This problem was further studied in detail and remedied by introducing a system of continuous steam lancing and rodding of the screen and nose baffle area. By systematising the lancing schedule and with the provision of many additional lancing doors at vulnerable places, the Recovery Boiler could handle blackliquor solids produced out of 95-100 tonnes of pulp/day.

Cleaning of cyclone, its inlet ducting, screen tube area was found impossible when the Recovery Boiler was running with Black liquor. A weekly stoppage of Black liquor firing for a duration of 6-8 hours was found necessary to clear the accumulations in the cyclone ducting. Accumulation and deposits at the screen tube area were removed by steam lancing and rodding. The cleaning of the cyclone and its ducting is carried out with water by continuons circulation. The weekly stoppage helped in keeping up the preventive maintenance schedule and in pushing black liquor solids to the furnace, produced out of 100–105 tonnes of pulp a day. When the Recovery Boiler started handling black liquor solids of the order of 150 tonnes per day, carry over of black ash was found acute due to higher black liquor spray pressures with 30/32″ dia. bore spray nozzle. Carry over was minimised by increasing the spray gun size to 1½″ from 1″ and by reducing the spray pressure from 30 psig. to 20 psig.

This modification not only reduced the problem of carry over but also helped in increasing the black liquor firing rate. Black liquor from a pulp production of 105 tonnes/day could be easily handled by the Recovery Boiler. The increased firing rate of black liquor resulted in higher rate of carry over to the ash hopper from where it is washed down into the black liquor mixing vessel.

The increased inflow of carried over black ash to the mixing tank caused failure of the agitator of the mixing tank, resulting in the interruption of Recovery Boiler operation. This problem was tied over by bypassing the mixing vessel and by injection of black liquor to the furnace carried on directly from the cyclone sump. During this period, addition of salt cake had to be suspended. Study is being carried out to handle black ash outside the mixing tank with semi-concentrated black liquor to be bled to the semi-concentrated storage tanks fitted with agitators.

Another important step taken to relieve the load on the Soda Recovery Section was the reduction of black liquor solids sent to Recovery Furnace. Prior to 1969, the Mill had only Pandia Continuous Digester for making 65 tonnes of pulp per day. Pandia Digester consumes more than 425 kgs. of chemical as NaOH per tonne of pulp. After the expansion in 1969 and the commissioning of the stationary Digesters, the active Alkali per tonne of pulp as NaOH was reduced to about 360 kg per tonne of pulp. This comparatively harder cook helped in reducing the total solids per tonne of pulp sent to Recovery Furnace from 1,500 kgs. per tonne of pulp to about 1,350 kgs per tonne of pulp.

Causticizer

The causticising section of the Recovery Plant of SPB originally consisted mainly of Dorr–Oliver, USA make stationary Slaker, three Causticizers, a Uniclarifier for white liquor, two mud washers for washing the sludge and a sludge filter of precoat type.

Alkali loss at the Causticising section was found high due to the fluctuating load on the white liquor clarifier necessitating in non–uniform withdrawal of sludge with varying consistency from white liquor clarifier and pumping it to the sludge washers. This problem was corrected by bringing down the concentration of green liquor from 115 gpl to 90–95 gpl, which not only improved causticising efficiency but also improved the consistency of the settled sludge in the white liquor clarifier with lesser amount of alkali entrained in the

sludge. This improved settling rate of sludge to higher consistency and faciliitated withdrawal of sludge from the clarifiers at a steady rate, eliminating the problem of unsteady load on the clarifier resulting in lesser alkali loss. It was also observed that concentration of white liquor produced was found to vary. Studies revealed that the feed to the white liquor clarifier was entering into the clarifier almost at the overflow level of the white liquor due to inadequate depth of the feed well.

Modification of the feed well was carried out so as to feed the causticized sludge into the calrifier at a depth where the consistency of the sludge in the white liquor clarifier and the consistency of the feed were almost the same.

This modification had tremendously improved the performancc of the Clarifier and the alkali losses werc reduced considerably, as the solids concentration in the thickened sludge had gone up. During the lst stage expanion of the mill, an additional Lime Mud Washer was installed for flexibility of operation, when white liquor clarifier was expected to produce white liquor for pulping 105 tonnes pulp per day. An indirect heat exchanger was installed in place of a direct heater, which maintained a steady concentration of green liquor, resulting in improved causticizing efficiency.