Importance of parameters towards an economical operation of chemical recovery

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ABSTRACT

The operation of the Chemical Recovery in a pulp and Paper miil has a vital bearing on the economics of the mill. The paper deals with the factors that influence the economics of the mill, the variations that effect these factors and the remedial measures that are to be implemented to minimise the variations.

Introduction :

The chemical recovery section of a pulp and paper mill plays a vital role in the over all economics of small and medium paper mills. This paper deals with economic aspect of running the unit on the following lines:

1. Savings in energy
2. Savings in make up chemicals
3. Reduction in consumption of furnace oil.

1.0 **Savings in Energy :** Energy savings in the chemical recovery may be considered in the following areas.

1.1. Furnace
1.1. Evaporators
1.3. Causticizers

1.1. In the furnace the savings in energy is worth considering during the following operations.

1.1.1. Soot blowing
1.1.2. Blow down
1.1.3. Smelt shattering system.

1.1.1. Soot blowing in chemical recovery system is necessary due to the sticky nature of the dust. Frequent soot blowing to clean the boiler surface results in consumption of steam which is a loss, as neither power nor condensate recovery is possible. Also, the requirement of make up water for meeting the soot blowing steam demand is adding upto the operating cost. It is essential to minimise the freqency of soot blowing which is indicated by the steaming efficiency, exit gas temperature and draft across the various sections. Soot blowing of any particular section of the boiler is to be carried out if the draft across the sections vary.

1.1.2. Boiler blow down in high pressure boilers depends on the quality and quantity of make up water. The blow down in high pressure boilers accounts to about 3–4% of steam generated. The amount of boiler blow down is to be reduced by maximum condensate return of acceptable quality. It is imperative to state that all concerted efforts to recover the condensate must be made to have a lower level of blow down.

1.1.3. Recovery furnaces invariably utilise steam as a source for shattering the smelt, that flows out of the furnace. Modern furnaces employ the green liquor shattering of smelt together with steam usage. Recent trends are towards minimising the consumption of steam to a very low level. This also helps in keeping the level of sodium sulfide in the smelt.

1.2 The evaporator section of the chemical recovery unit is a major consumer of steam, next only to the paper machines. Any improvement in the

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economy of evaporators is bound to reflect in the mills economy. The evaporator performance can be studied as under.

1. Effect of scales
2. Effect of free alkali
3. Type of evaporators

1.2.1 Scaling in evaporators is a major cause of reduced evaporator capacity in paper mills. Severe scaling may bring drastic reductions in evaporation capacity and steam economy which will directly reflect on the overall energy management of the mill.

Black liquor evaporators are subjected to scaling on both sides of the tubes of the evaporators. Normally, these are either water soluble scales or water insoluble scale. Water soluble scales are formed as Liquor concentration is increased above the solubility limit to result in precipitation. These scales are mainly due to sodium sulphate and sodium carbonate deposits.

Water insoluble scales can be due to calcium carbonate precipitation, silica scales and fibre deposition. Calcium carbonate scales are formed by the breakdown of calcium organic complexes present in low concentrations of black liquor. Lignin precipitation and coating on the tubes of the evaporators are predominant when the pH of the liquor falls below 11. The formation of scales due to this is further aided by the presence of fibrous content in black liquor, serving as a reinforcing medium.

As a result of scales, variation in the operating rate of the evaporators results in low capacity utilisation. To improve the performance, cleaning is done in the form of water boil-outs or weak wash boil-out or chemical cleaning after a period of time. Hard scales removal requires by passing the scaled unit, for mechanical cleaning or cleaning by very high pressure water jets.

1.2.2 It is imperative to maintain a certain minimum of residual free alkali in the black liquor. The optimum level of free alkali requirement is around 6 gpl as Na_2o. Maintaining this free alkali ensures thin film formation, a basic necessity of liquor boiling and reduction in viscosity.

1.2.3 Literature is available about the use of falling film long-tube evaporators or rising film long-tube evaporators. For high viscous liquor, falling film evaporators give a better performance than rising film evaporators.

1.3 In the causticisers section of the chemical recovery, the areas of energy conservation in mainly in the causticising tanks which need to be thoroughly insulated to maintain a temperature of 95°C for the completion of the reaction. Steam is required to maintain the temperature at this level. Also, the system outputs namely white liquor and weak wash will have a sufficient temperatures of 70°C by properly maintaining this temperature and insulation of all tankages and white liquor lines. Increase in the temperature of these outputs will reduce the steam requirements in pulp mills. Also any improvement in the strength of the white liquor supplied will reduce the load on evaporators due to increased usage of black liquor in the digestors.

1.2 **Savings in make up chemicals :**

Chemicals losses in recovery mainly depends on stack losses and the reduction efficiency. For efficient recovery of chemicaly, good performance of the electrostatic precipitator is a prerequisite requirement. The factors that influence the working of precipitator are :

1. Inlet temperature of flue gas
2. Draft across ESP
3. Gas distribution
4. Proper working of rapping mechanism.
5. Good voltage build up across the electrodes.

An inlet temperature of 150°c is the minimum required, to avoid low temperature corrosion. Also the draft across the precipitator must be maintained at the required level with good distribution of flue gas, preventing creation of uncharged pockets of flue gas. It is very much essential to adjust the frequency of both the rapping mechanisms to remove the dust adhering to the electrodes. This will ensure a very good voltage build up for efficient operation of the elect rostatic precipitator.

1.2.2 The make up chemical to compensate for the sulfur loss in the system is mainly done by the addition of salt cake. A reduction efficiency of 92% is

expected in the furnace, due to the formation of No_2S. Any drop in the reduction effiiciency by improper bed height will prove costly to the economics of the mill as chemicals may be lost in the washing operation of the causticising and as scales in evaporators. Increasing the dead load of the system is deterimental to the running of subsequent units of mill.

1.2.3 Losses through the dissolver vent is minimised by scrubbing with weak wash or water at the demister provided across the vent. The clarity of weak wash must be such that it does not clog the demister screen.

1.3 Reduction in consumption of furnace oil :

Increasing cost of fuel oil and its scarce availability add to the increasing cost of the unit due to the usage of furnace oil. Extra usage of furnace oil is mainly attributed to the fire side problems of recovery furnace.

1.3.1 Reasons for using furnace oil :

Furnace oil is used in the furnace mainly for

1. Start–up
2. Melting down and stopping
3. To sustain the furnace heat and to clear out blocked air passages.

Every care is to be taken to minimise the consumption of furnace oil during start up and shut down, even though the use of this oil is a necessity.

Oil requirement to sustain the furnace conditions results due to variations in liquor concentrations or as a result of air-ports blockage. The variations in concentrations and quality of liquor is to be minimised at the evaporators by the required necessary creation of conditions like free alkali, pH and increased concentration.

Airport blockage due to furnace wall accumulation and sliding down the furnace, requires a careful study of paramenters in the furnace. The heat transfer surface fouling due to slag formation on furnace wall, flue gas passage blockage, ash coating on boiler bank and economiser tubes and formation of big lumps of fused chemicals in secondary zone are a few of the fire side problems encountered.

A study taken up to find out the causes of these fouling invariably indicate the necessity of maintaining a low pressure firing of black liquor with the minimum temperature of black liquor needed to have a 'pop corn' size spsay.

It is observed that an increase in 'dead load' recirculated in the system, due to less causticizing efficiency and less reduction hinders, the operating parameters like firing pressure, temperature, type of spray (coarse or fine) and hence the furnace condition gets distrubed.

Increased firing pressure, increased firing liquor temperature and a fine spray results in a heavy carry-over of chemical particles across the flue gas passage. Also, the ratio of primary air to secondary air, if not correctly maintained to create the draft in the primary air zone and secondary air zone, plays a vital role in the formation of 'ledges' in the secondary air zone. Increase in air temperature (air being the sole major contribution to the furnace mass balance calculations) results in an appreciable improvement in the furnace conditions and improved steam output. Air temperature of the order of 160°-170°c is preferred, even though in practice a temperature of 140°-150°c is obtained.

All the above discussed parameters play a vital role in the recovery operation. Any wide variation in the parameters cause disturbances in furnace condition requiring oil usage. Hence it is important to have a close monitoring of the parameters like firing pressure, firing temperature, residual free alkali, required air flow to create the necessary drafts and air temperature so as to have a coarse spray and a good bed of solids in the hearth for sustained operation of furnace without oil support.

In conclusion, close and regular monitoring of the parameters of the recovery without allowance for wide variations will improve the economics of the mill in the long run.

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