

Non-Process Elements Leaching From Raw Materials And 95% Causticizing Efficiency



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Abstract: : In this system raw material undergoes for four stage washing, First stage for removing sand, grits removal, Second stage washing employs Na_2CO_3 / weak Green liquor to leach out calcium and magnesium in the form of CaCO_3 from CaCl_2 & MgCl_2 , Third Stage is hot water stage for removal of Soda and free alkali. Last Stage is the IV stage for neutralization of alkali by H_2SO_4 . By Implementation of this we have reduced ash content of wheat straw from 6.6% to 1.5%, Silica 2.5% to 1%, CaCO_3 from 5000 ppm to 100 ppm, Al_2O_3 Nil, Fe_2O_3 nil in raw material.

To achieve high black liquor solids concentration one must lower proportion of Na_2CO_3 and increase proportion of Na_2SO_4 in Weak black liquor. So causticizing efficiency will be increased up to 95% in two stages, in 1st Stage efficiency up to 78% and white liquor produced of 1st Stage is allowed to react up to 95% in stage -2. Lime mud of stage is taken back in slacker -1 of stage-1.

Introduction

Typically, a Kraft paper mill produces 25-35 % steam generation from recovery boiler and 65-75% from CFBC boiler utilizing coal, rice husk, baggage, and other resources. Everyone wants more steam generation from Recovery Boiler as (by product of recovery boiler) , In India paper industry, some of good paper Mills has achieved steam as high as 3.8 Mt/Mt Black liquor solids fired at 75% solids. But most Agro pulp producing mills are limited to 2.8 Mt/Mt at 68% solids. This agro black liquor has as high 15% dead load solids. Due to these dead firing black liquor becomes so viscous that more than 65% solids alone are not possible.

By our process we have been successful to leach out 90-95% dead loads before entering the digester, we have reduced chloride as low as .2% from .9%, silica 2.5% to .98%, Calcium removal efficiency was 98% and Al_2O_3 -99%, This is a four stage washing, In which First stage will Utilize stage no-2 back water to remove sand, silts and other dust particles, in stage no.2 utilizes Na_2CO_3 and back water of stage no-3, In stage no-3 makeup soft hot water or evaporator secondary condensate, in stage-4 H_2SO_4 dosing will be done to neutralize pH.

Black liquor is a colloidal solution of organic and inorganic. Organic content is very important from steam generation point of view in recovery boilers. Inorganic in black liquor can be of two types 1. Desired inorganic like NaOH , Na_2CO_3 , Na_2S , Na_2SO_4 , other which contributing to Na_2O . Undesired inorganic like CaO , CaSiO_2 , NaCl , KCl , MgCl_2 , CaCl_2 , SiO_2 , R_2O , Al_2O_3 , Fe_2O and others.

Paper industry considers Soft Black wood liquor as the best, then Hardwood Black liquor and then Bagasse liquor to be of intermediate quality and Consider wheat straw, Sarkanda, Rice straw liquors as the worst.

Why worst?, is very simple, because wood content contains 0.5% ash, Bagasse up to 5% ash, Wheat straw as 7.5% ash where as rice straw as high as 13-15% ash content.

Lesser the ash content, lesser the non process element in black liquor and better will be the black liquor.

As Industry desire to achieve more firing black liquor solids concentration from MEE. But Na_2CO_3 and Na_2SO_4 tends to Precipitates above 60% solids concentration of black liquor

Na_2SO_4 scale (disulphate) can be cleaned by hot water but Na_2CO_3 Scale (dicarbonate) needs only hydro jetting. See optimum level of Na_2CO_3 and Na_2SO_4 ratio in fig.2. It is therefore Quintessential that proportion of Na_2SO_4 to be more than Na_2CO_3 in Black liquor. Proportion of Na_2CO_3 can be reduced by increasing Causticizing efficiency up 95% in two stages without letting the free lime to increase in lime mud. See fig.1

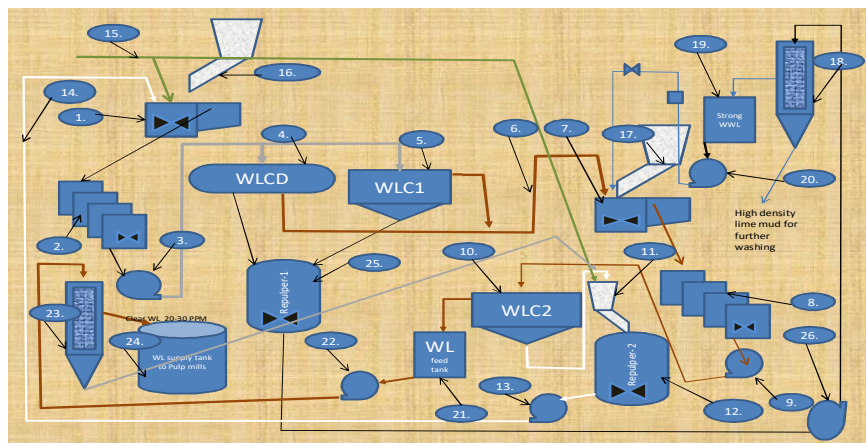


Figure 1

Non-Process Elements Leaching From Raw Materials And 95% Causticizing Efficiency

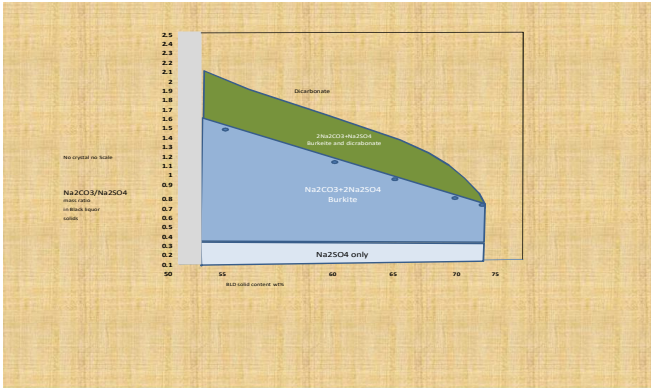


Figure 2

More chloride in HBL actually not only prevents evaporation but also retards more steam generation from recovery boiler even at higher solids.

To leach out non process element M/s Henchmen recommend 4 Stage washing of raw material especially to agro raw material like Bagasse, wheat straw, Sarkanda, Rice straw with soft water or Evaporators secondary condensate. This wash water will be once through and will come back only after regeneration.

This is a four stage washing, In which First stage will Utilize stage no-2 back water to remove sand, silts and other dust particles, in stage no.2 utilizes Na₂CO₃ and back water of stage no-3, In stage no-3 makeup soft hot water or evaporator secondary condensate, in stage-4 H₂SO₄ dosing will be done to neutralize pH. See Fig.2

If paper industry want to reduce its operating cost then must go for this wet washing system to reduced viscosity of heavy black liquor and as high solids concentration as 80% from evaporator.

Back Ground:

Indian Pulp and Paper industry is the major manufacturing industries and provides jobs and living to Janta crowd, there are many pulp and paper mill those are based on the agro raw material like wheat straw, Bagasse, rice straw, Sarkanda and many other grassy fiber material. These raw materials are economically available compared to wood chips, if someone analyze, will find that these are the crops which have short harvesting period and residue of these must be handled wisely instead of burning in the land. Selling these residue to paper millers give handsome revenue to farmers, jobs to many also sustainable in every aspects.

Greatest problem to handle these agro raw material compared to wood chips in pulping is due to high non process elements (ash content) of the agro raw material. For example Rice straw contains highest ash.i.e

		Bagasse	Wheat	Wood Chips	Rice Straw
Ash	Gm	65.0	70.0	6.0	150
SO ₃	Gm	0.3	0.8	0.1	0.255
P ₂ O ₅	Gm	0.6	1.6	0.3	1.275
SiO ₂	Gm	30.5	42.6	1.6	140.76
Fe ₂ O ₃	Gm	10.0	0.4	0.1	0.09
Al ₂ O ₃	Gm	13.4	0.6	0.3	0.075
CaO	Gm	8.3	10.6	3.5	5.965
MgO	Gm	2.1	1.3	0.3	0.525
Na ₂ O	Gm	0.6	0.3	0.0	0.15
K ₂ O	Gm	1.1	11.8	0.7	2.1
TiO ₂	Gm	2.5	0.0	0.0	0.3

Table-1

Rice straw - content-13-17% ash, Wheat straw-7-8% ash content, Bagasse-4-5% ash content, Wood chips contains only 0.5-0.6% ash content, this why wood chips are considered the best for pulp and paper industry, Refer to Table.1.

Below is the tabulation of various raw material and its non process elements in 1000 gram of raw material:

Indian agro pulp and paper industry is crumbling with since long time as there is till no viable solution to get rid of these non process elements completely. Due to this millers are losing lot of money. and to run the mill they are utilizing high amount of coal consumption and raw material to generate and meet the mill steam demand

In Prior art technology, these miller used a specific tank called aqua separator and a sediment clarifier to remove dust sand and other materials but that older technology utilizes a portion of the water to be recycled back to this system ,due to this Clarifier water becomes dirtiest, cloudy. Chloride concentration in this clarifier water become as high as 1-1.2% or 2300-2500 mg/lit, Hardness as high as 1000 mg/lit. Due to all this prior art technology has failed now to extract these non process elements.

Impact of non process element on pulping system:

1. Due to non Process element resulted WBL posses high silica, high chloride and high calcium hardness and high alumina content and it limit the black liquor solids dryness up 65-68% maximum from kraft multiple effect evaporation system.
2. Severe scaling occurs in evaporator heat transfer surface areas which results in frequent tubes cleaning.
3. Low solids from Multiple effect evaporation system result low steam generation from kraft recovery furnace.
4. High chloride results in high flue gas passage jamming of recovery furnace.
5. Due to passage jamming, draft run on higher side in recovery furnace.

Material and methodology: This system employs four stage counter current washing of raw material with either soft water (definitely free from chloride) or Kraft MEE's Secondary condensate. This wet washing is different from other prevalent wet washing that here in water is once through (COC-1), also utilizes weak green liquor (soda ash) to leach out chlorides and Calcium and Magnesium carbonates. Refer fig.3

Stage-1: Stage-1 utilizes back water of stage-2, In this stage, silt, sand silica other coarse particles are removed, this water can have hardness as high as 1000 PPM and TDS up to 1500 PPM. This water (including all sand, grits, and silt) is sent to a clarifier, over flow of clarifier is allowed to pass through the pre-filter and sent back to the water regeneration plant. From regeneration plant recycled water is reused and mother liquor is treated separately.

Stage-2: Here raw from centrifugal basket is again diluted till 3% consistency and weak green liquor / Soda ash is used to react with free calcium and magnesium ions. Underflow of it sent to stage-1 in control manner and over flow of 3 -5 % consistency is sent centrifugal basket.

Stage-3: Here raw from centrifugal basket is again diluted till 3% consistency and Evaporator hot water or soft water is used for washing. Underflow of it sends to stage-2 in control manner and over flow of 3 -5 % consistency is sent centrifugal basket.

Stage-4: Here raw materials from centrifugal basket of stage-3 is again diluted till 3% consistency and Evaporator hot water or soft water is just used to neutralize the pH and remove the metal ions of the raw material. The treated raw material having moisture 20-25% is sent to digester.

Digester plug screw water is taken back in to stage-3.

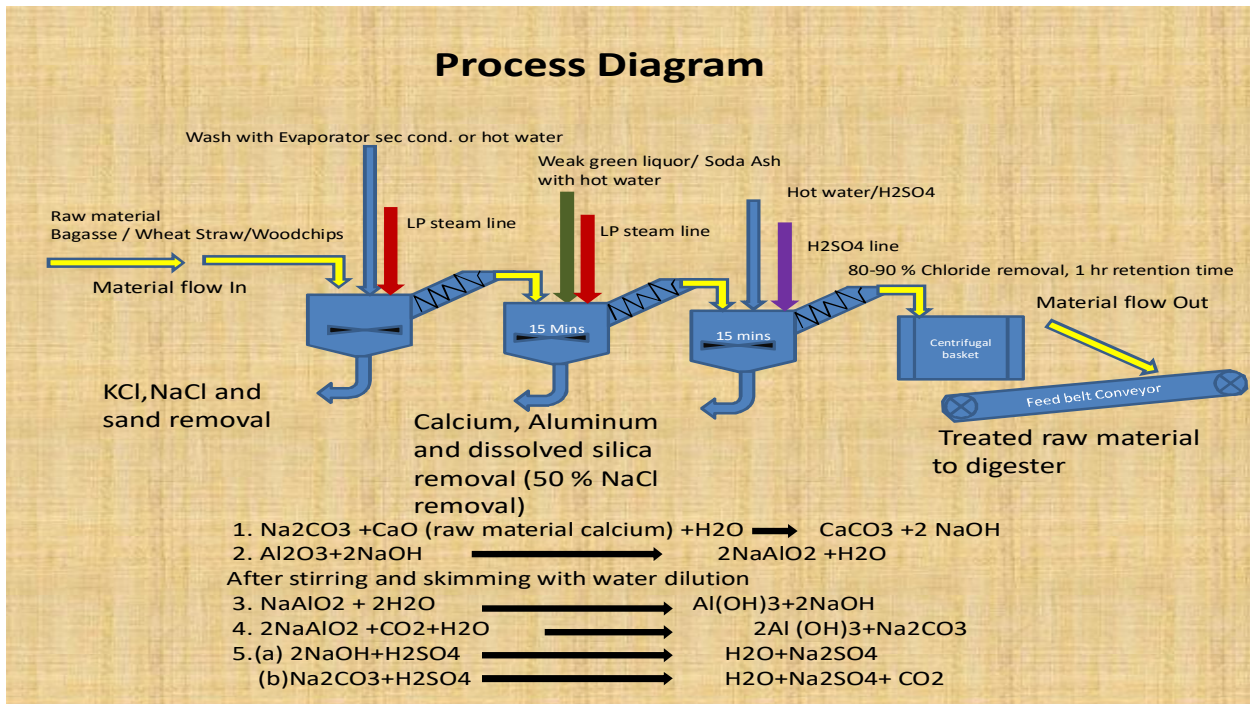


Figure 3

Results: All results are really promising on lab scale.

Sample: Wheat straw

S.No.	Particulars	As Such(before treatment)	After Treatment	% Reduction
1.	Ash Content	6.6%	1.4%	79%
2.	Silica (SiO ₂)	2.0%	.98%	51%
3.	Chloride (Cl)	4.8 gm/kg	.17 gm/kg	96%
4.	R ₂ O ₂	.11%	.08%	26%
5.	Calcium	1075 mg/kg	51 mg/kg	95%
6.	Al ₂ O ₃			Nil
7.	Fe ₂ O ₃			Nil

Conclusions: if one paper miller want black liquor dry solids content as high as 85% and almost free from chloride, Silica, Calcium, magnesium, Al₂O₃, Fe₂O₃ must implement Wet washing of raw material by this system followed by 95% causticizing efficiency, which is very much important to combat increasing fuel prices.