ITC'S Experience With Light ECF Bleaching (Ozone)

Sharma Keshav Dutt

ABSTRACT

ITC PSPD Unit - Bhadrachalam is the first mill in India to introduce the Ozone Bleaching Technology for bleaching of pulp. The ECF (Elemental Chlorine Free) technology exists in the mill since last seven years. This paper will be confined to the Ozone Bleaching Technology, highlighting the advantages over normal ECF technology. The process of Ozone Bleaching along with Ozone gas circuit is explained with process flow charts. The principles and functioning of the ozone generator are discussed. Parameters influencing the bleaching process, such as consistency, temperature, pH, retention time are elaborated along with their significance in the reaction. The benefits of Ozone Bleaching Technology, viz., reduction in chlorine dioxide and Hydrogen Peroxide consumption, better pulp quality, improved strength properties and reduction in AOX generation are quantified, establishing that this technology is technically, environmentally and commercially superior to conventional ECF technology. The runnability of paper machines improved with Ozone beached pulp.

Introduction

Pulp mill at Unit: Bhadrachalam of ITC Limited has a design capacity of producing 800 MTPD blown pulp from Super Batch cooking plant. Fiberline#1 (Figure -1) commissioned in the year

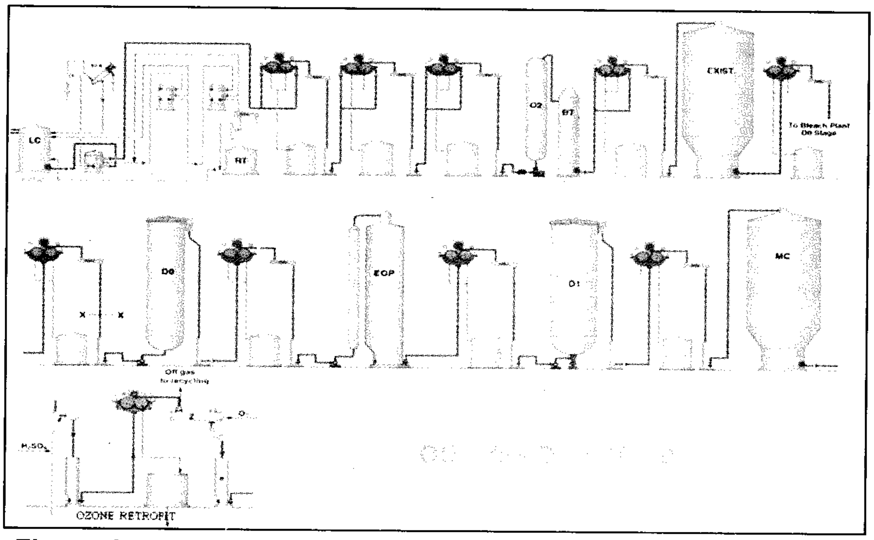


Figure-1

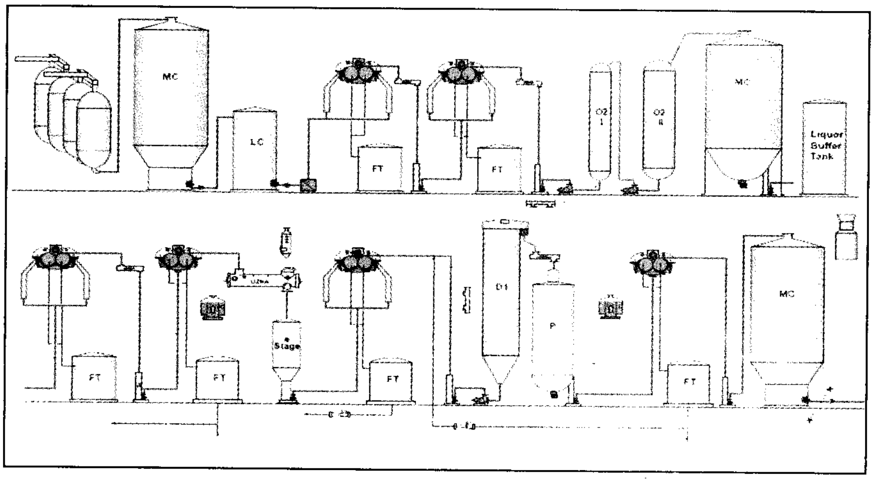


Figure-2

2002 has a design capacity to process 300 TPD of bleached pulp and Fiber line #2 (Figure-2) commissioned in the year 2008 has a design capacity to process 400 TPD of bleached pulp. Fiberline#1 is originally built with ECF sequence of Do-EOP-D1 and is retrofitted with Ozone bleaching in year 2008. Fiberline#2 has a bleaching sequence of Ze-DP.

Ozone bleaching process description: (refer figure-2)

Ozone bleaching is primarily a delignification stage; however some brightness improvement also takes place. The pulp from the post oxygen stage at a Kappa around 10-11 and brightness of 42-45% is fed to A press after diluting with the backwater from A stage. The backwater pH is maintained in the range of 2-3 to enhance lignin selectivity and purge out metal ions before Ozone stage. A press is a special kind of press which can deliver an outlet consistency of 35-40%. High consistency is essential for efficient utilization of the Ozone gas in the subsequent reactor. At the top of the reactor, the combined shredder/fluffer feeds the pulp to the Ozone reactor.

The fluffed pulp falls through the gas separator part of the reactor into the reactor conveyor tube. In the tube there is a central axially mounted shaft with a large number of paddle type blades mounted at a specific angle to the axis of the shaft. The action of the conveyor is to lift, disperse and convey the pulp forward to the outlet of the reactor. This design of reactor leads to high degree of bleaching and uniformity.

Ozone coming from the ozone generator is dosed at 12% strength in oxygen gas and introduced counter currently of the pulp in the ozone reactor. In order to facilitate the gas circulation counter currently, the gas is

ITC Limited, Paperboards and Specialty Papers Division, Unit: Bhadrachalam, Sarapaka, Andhra Pradesh, India

extracted in the opposite side by a speed controlled fan which achieves a light under pressure in the reactor.

The off-gases from the reaction contain oxygen around 75-80% and a very small quantity of ozone (~0. 5%) which needs to be eliminated prior than the gases are released to the atmosphere. The ozone destruction is done by heating the off gas to high temperature (~300°C) in a catalytic destructor. Due to the fact that those gases also carry fibres, the fibres have to be washed away prior to gas heating to avoid the risk of fire. This is done in a fibre scrubber where gases are washed by an alkaline solution.

This pulp flows from A press carries air into the reactor. It is necessary to maintain this parasite air flow to a minimum value to avoid diluting the ozone gas too much, as this would affect the yield of the delignification reaction. In order to control this air flow, there is a second speed controlled fan which extracts the air from the tight shredder cover.
Both fans operate in the opposite way and their respective speed is controlled to maintain the neutral point somewhere in the pulp chute to the reactor.

The e-stage is an extraction stage in which alkali is added to dissolve remaining lignin fragments. Normal charge is 12-15 kg/odt. Prior to the extraction stage, the pulp is diluted in dilution conveyor. Consistency is adjusted to 6-7% by addition of e-filtrate. By addition of alkali pH is adjusted to around 10-11.

In order to increase the pulp temperature to 70 °C, e-filtrate used for dilution is heated using low pressure steam in a sparger connected to the dilution filtrate pipe.

Wash water is added to the press in accordance with the dilution factor and production rate. Excess filtrate is either drained or pumped to the filtrate tank of post oxygen press depending on the calcium concentration in the system. About 50% kappa reduction takes place in Ozone stage and brightness enhancement of 10-12 % is achieved. 1 Kg of ozone is practically found to replaces 4-5 kg's of ClO2 as active chlorine. 50% reduction in ClO2 and peroxide consumption are achieved after ozone bleaching. (refer table-2). A significant improvement in strength

Table -1 Key process parameters

Parameters	UOM	(Z	e)
Temperature	°C	55-60	75-80
pH	-	2.5-2.8	11.0-12.0
Pulp Consistency	%	35-40	7-8
Charge	Kg/ODT	5-6	12-15
Residence Time	Min	~1	~5
Pressure	mm WC	-50	

Table-2

Parameters	UOM	With Ozone	Without Ozone
Initial °SR	-	22.2	21
Final °SR	-	30	30
Bulk	cc/g	1.6	1.6
Burst Factor	-	27.9	35.2
Tear Index	-	59.4	65.6
Breaking length	meters	4333	5962
Strength Index	-	30.7	60.4
Brightness	% ISO	87.6	87.7
Viscosity	cps	8.8	7.6

Table-3

Parameters	UOM	Before Ozone	After Ozone
Effluent Discharge	m3/ton of product(pulping section)	32	23
AOX	kg/ton (Bleaching section)	0.24	0.054
Specific ClO2	kg/ton	55	25
Hydrogen Peroxide	kg/ton	7.0	4.5

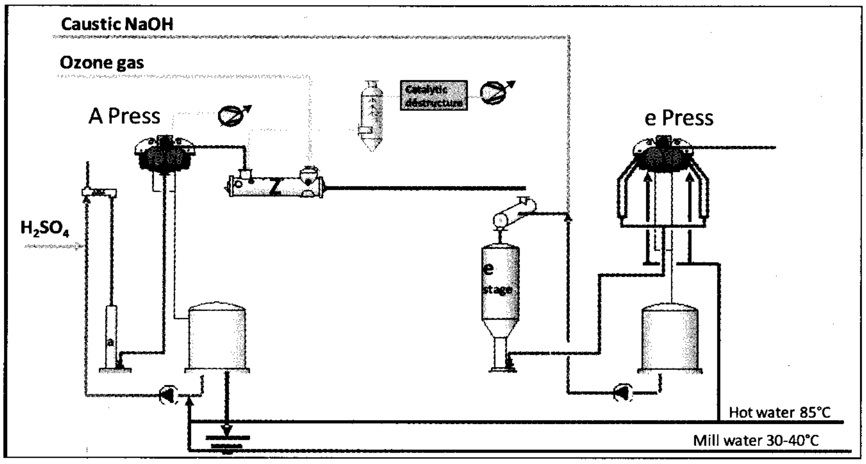
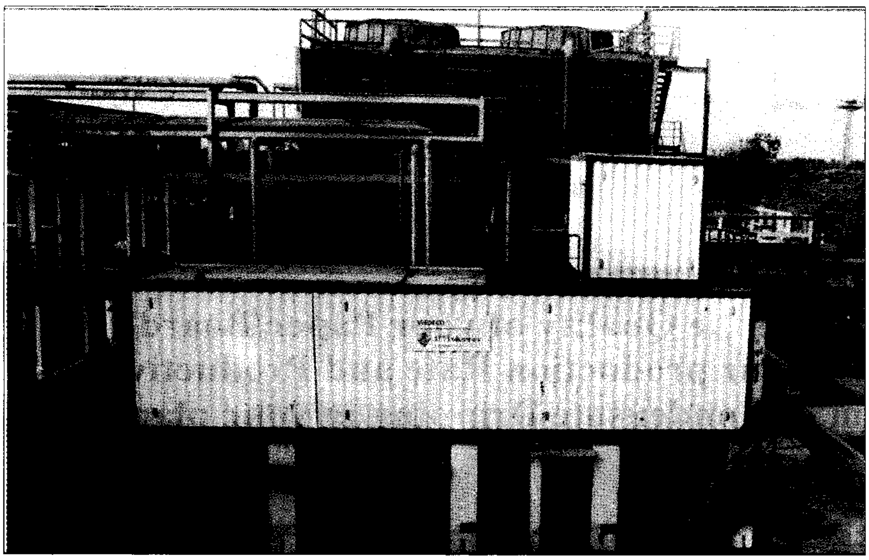


Figure-3

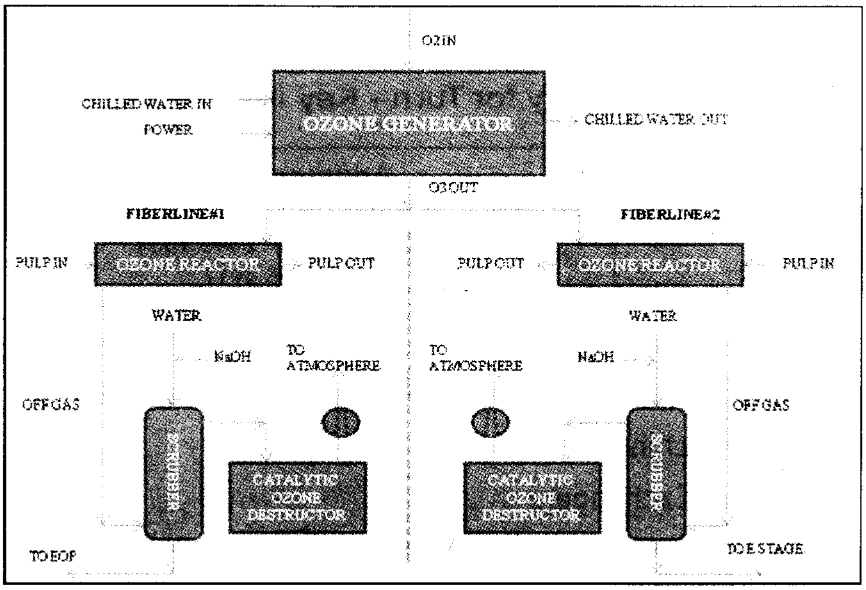
properties is observed though viscosity is slightly on lower side. Runnability and brightness stability on paper machines is also proven to be improved.

Ozone generation:

Ozone sometimes called activated Oxygen contains three atoms of oxygen and is the second most powerful oxidising agent next to flourine.



Picture-1



Technically production of Ozone is through silent electric discharge of Oxygen rich feed gas using special generator. During the ozone synthesis process oxygen molecules are initially split through the supply of energy. The resulting oxygen atoms then react to create ozone with oxygen molecules and release heat which must be dissipated by cooling. Ozone formation takes place between two electrodes, which are isolated from each other by a dielectric made of glass or ceramic and by a small gap. A high voltage, medium frequency, unilaterally grounded alternating voltage is applied to the electrodes. The Oxygen gas flows through the gap, resulting in ozone generation in the electric field.

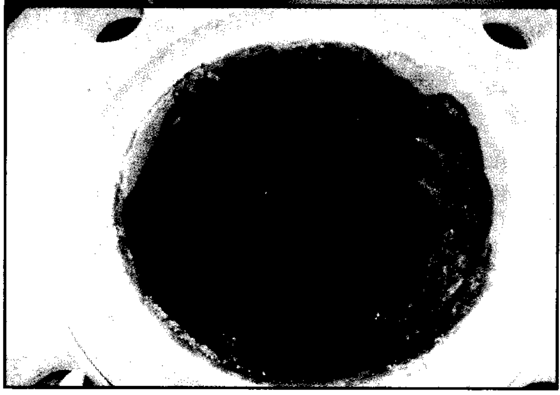
The generator at ITC has a capacity to produce 200 kg/Hr Ozone at 12% concentration and can reach upto 230 kg/Hr at 10% concentration. The three pillars of Ozone generation are Feed gas, power and cooling water. 1500 nm3/hr oxygen compressors supply 93% pure oxygen produced from onsite VSA plant. Two chillers of 600 TR each serves the cooling water required.Specific power consumption per kg of ozone is 8- 9 kWHr.

Challenges:

The A stage press is prone to scaling if calcium content in the incoming pulp from PO stage is high. Calcium sulphate and oxalate scaling deposits on the low pH loop which causes drop in press outlet consistency. Once the consistency drops below 35% from the A press going to Ozone reactor the efficiency of ozone reactivity drops drastically increasing the consumption of ClO_2 and H_2O_2 in later stages. Better washing and pH control of A stage are very critical for avoiding scale formation in the system. Calcium carbonate scale forms in the high pH loop of e stage if calcium content in the incoming pulp is high. Though calcium carbonate scaling is easier to clean it causes reduction in dilution water flow due to deposits in backwater lines thereby reducing production rate. Use of antiscaling chemicals prolongs the deposition rate but adds to the production cost.

Due to the fact that calcium concentration is more in the backwater of e stage it cannot be used for closure to PO stage thus increasing the water consumption in bleach plant and laod on effluent.

Continuous usage of 100% debarked



raw material has been proven to give relief regarding calcium deposits.

Conclusion:

This project is replicable for expansion and modernization of large pulp and paper mills to improve the Environmental Performance, Energy conservation, Operational excellence.