

Desilication of Black Liquor - An Emerging Technology For Cleaner Production

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ABSTRACT

Indian Paper Industry continue to use silica rich raw materials and silica continues to be a major nonprocess element in pulping & chemical recovery loop. Despite many mills, having increased proportion of woody raw materials, the need for removal of silica from the recovery cycle is still felt seriously, especially in today's scenario when non wood fibres like bagasse & straws are being used in large proportions by a number of mills.

While various technologies and processes have been tried for reduction and removal of silica in the system, the removal of silica from the black liquor is still a preferred stage & the technology developed by CPPRI, demonstrated at Hindustan News Prints Ltd., (HNL), Kerala for desilication of bamboo black liquor & subsequently being promoted by M/s ENMAS PROCESS TECHNOLOGIES is a well accepted technology by virtue of scale at which the technology has been demonstrated and its ability to remove silica to a level of 90-95%. Further the technology was successfully applied on pilot scale for other silica rich black liquors. The filtration of silica sludge which was the sensitive area, was improved with balancing equipment like clariflocculator. The experience gained and refinement of technology has resulted in a process ready for commercial scale adoption.

The present paper highlights the joint efforts of CPPRI, HNL & ENMAS in making this technology, and acceptable one.

INTRODUCTION

High quantity of silica, a non-process element in the raw materials, has always been a matter of great concern as it gets dissolved in the black liquor and poses severe problems in the pulping and chemical recovery loop. During last 5-6 decades number of processes and technologies have been tried, tested & demonstrated on different scales for reduction and removal of silica from the system through raw material cleaning and green liquor desilication etc. However, none could live up to expectations and still confusion

continues to prevail about technology & process to be adopted and the stage at which silica has to be removed, despite the fact that the most appropriate

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stage to get rid of silica is the desilication of black liquor.

Central Pulp and Paper Research Institute (CPPRI) did extensive research on desilication of black liquors and developed a desilication technology for selective precipitation of silica adopting stepwise gentle carbonation technique employing flue gas from the recovery stack. With joint efforts of CPPRI/HNL/UNIDO/SIDA, the technology has been successfully demonstrated for silica rich bamboo/reed black liquor and a mill size prototype demonstration desilication plant was operated with a capacity to process nearly 30 m³/hr at Hindustan Newsprint Ltd., Kerala wherein desilication efficiency upto 90% has been achieved.

The system of black liquor has proved beyond doubt that desilication of black liquor is no more a old story but a reality. Based on the performance of desilication plant and confidence in technology, ENMAS Process Technologies Ltd. agreed to promote the technology.

The present article describes the continuing need for desilication of black liquor as well as the experience & consorted efforts of CPPRI, ENMAS and HNL in refinement and promotion of desilication technology for silica rich raw materials.

OVERVIEW OF DESILICATION TECHNOLOGY ⁽¹⁾

Literature survey shows that during last 5-6 decades number of technologies and processes were studied and tried on different scales to get rid of silica from the system which are -

- Raw material cleaning
- Silica removal by two stage pulping
- Massive lime treatment
- Green liquor desilication and
- Carbonation technique for black liquor desilication.

DESILICATION OF BLACK LIQUOR - TECHNOLOGY DEVELOPED BY CPPRI

CPPRI initiated work on the desilication of silica rich black liquors in early 80's and with the extensive basic research on mechanism of silica lignin precipitation, it became possible to evolve a technology for selective precipitation of silica by adopting stepwise gentle carbonation technique in submerge bubble reactor (SBR). In this reactor the black liquor to be reacted flows with flue gas in a tubular system by

Table-1

RESULT OF DESILICATION OF SILICA RICH BLACK LIQUOR FROM VARIOUS RAW MATERIALS & ITS STATUS

	Reeds/bamboo based mill	100% Bamboo based mill	100% Rice straw based mill	Wheat Straw & Sarkanda (Turkey Mill)
1. Status of process	Commercial demonstration	Commercial scale	Semi pilot scale	Semi pilot scale
2. Initial silica in the black liquor, g/l	3.7	3.7	12.3	3.7
3. Final silica in the black liquor after desilication, g/l	0.6	0.5	0.28	0.17
4. Desilication, %	85	87	98	95

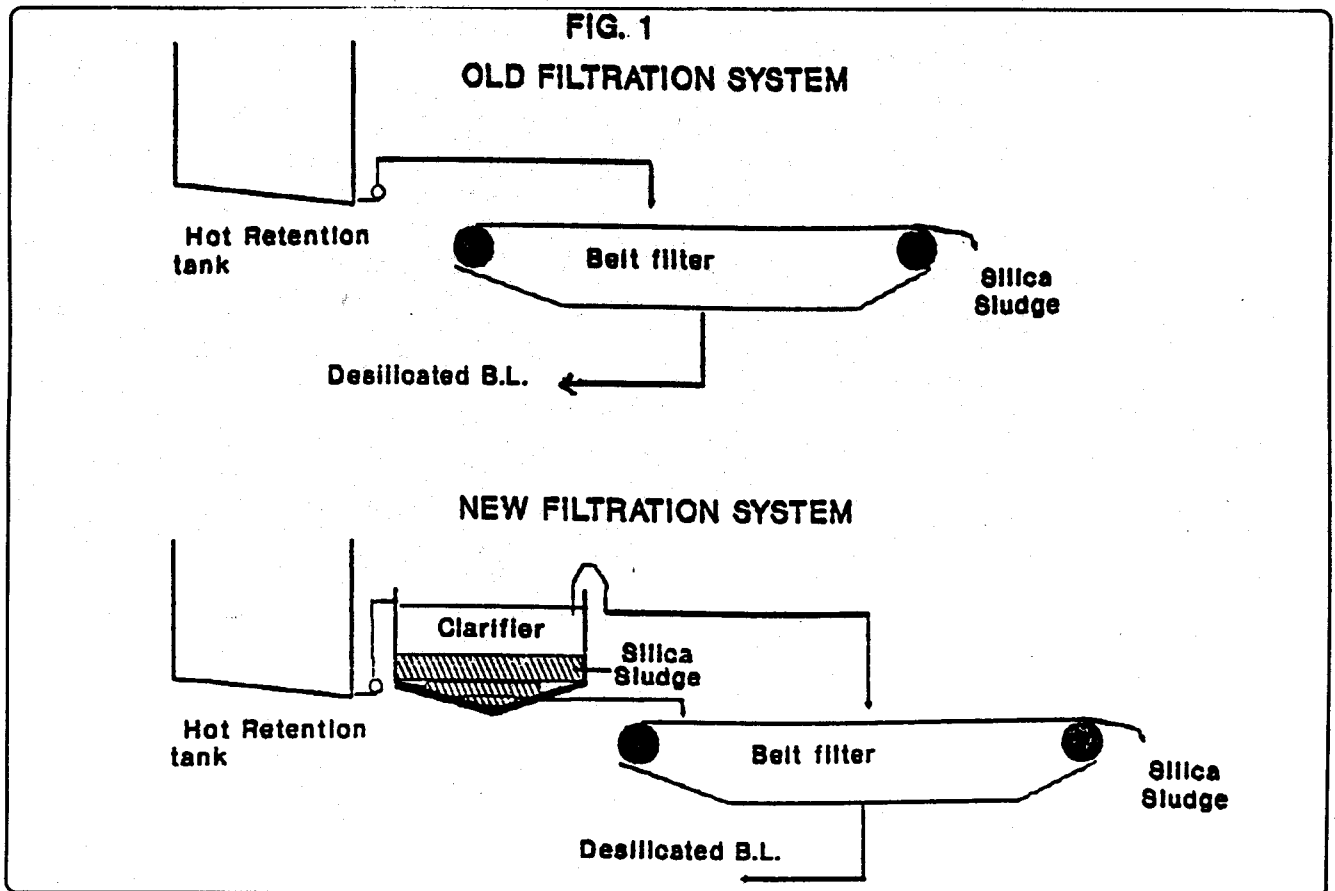
a pump, which on its downward path sucks the gas in the form of discrete bubbles. The shearing action of the flow works the gas bubble in a kneading fashion continuously exposing new gas-liquid interfaces. This ensures high gas-liquid mass transfers and results in slow & gradual reduction of black liquor pH to the desired level⁽²⁾. The process, after successful pilot trials, could be scaled up by 1000 times and a commercial prototype mill-size desilication plant became operational at Hindustan Newsprint Ltd. Kerala in June 1989 with the financial assistance of UNIDO/SIDA and HNL for desilication of bamboo black liquor. The results on the plant were highly encouraging. Further, the technology has been tested on pilot scale in a 100% bamboo as well as straw-based mills. The following Table shows the results of desilication trials.

The technique of stepwise carbonation has proved beyond doubt the art of precipitation of silica from black liquor. The technique was further extended to other black liquors & desilication was highly efficient. The only drawback of the system is that the process is difficult to stabilize if the black liquor contained silica less than 2 g/l.

TRANSFER OF TECHNOLOGY

As desilication technology was developed under a specific UNDP programme for a specific purpose, it was rather difficult to accomplish all the requirements of the commercial-scale application & resulting in a need for identification of an engineering company to further refine the technology and at the same time promote the technology. The competent authorities, after careful examination, approved the participation of M/s ENMAS Process Technologies, Madras as a technology promoter by way of licence agreement. Now this company together with CPPRI has come out with a solution to some of the teething problems encountered in the demonstration plant. The company with its expertise in the chemical recovery & related areas is much better placed today to offer an integrated chemical recovery system including desilication & lime sludge reburning systems. Following were the critical areas where technology upgradation took place after the company associated.

Installation of a Clarifier before Filtration for Build-up of Silica Particle Size & Effective Utilization of the Filter Area.



Silica mud filtration is an important stage to be accomplished efficiently without use of too much dilution water and also at the same time not allowing the silica mud to be carried over with desilicated black liquor. Installation of clarifier serves two purposes-building up of silica particles and the underflow coming out of settled silica mud is more easy to filter rather than filtering the unsettled silica sludge in black liquor. This also facilitate in effective utilisation of filter area and arresting the suspended silica in supernatant Fig.-1 shows schematic diagram of old filtration and new filtration systems incorporating a clarifier in between hot retention tank and the belt filter.

Installation of the clarifier technique may subsequently replace the existing filtration system resulting in a more compact silica mud filtration system. The company has identified some of the potential clients & negotiations are in progress.

RELEVANCE OF DESILICATION TECHNOLOGY AS ON TODAY

Need for desilication is required to be reviewed with changing raw material scenario as well as energy & environment impacts. In an integrated paper mill, the raw material situation has totally changed compared to early 80's when desilication activities were initiated at CPPRI and today most of the mills are not using more than 20-30% of bamboo in their raw material furnish except a few who still continue to rely on major proportion of bamboo. The agro based mills will continue to use increased proportions of straws & chemical recovery is becoming the mandatory option. There is no alternate except to desilicate black liquor whether they go for the chemical recovery or effluent treatment employing biomethanation.

The energy impact, particularly by way of steam in evaporators & oil requirement in lime kiln, has become a serious concern and efforts will have to be made to get rid off silica before lime sludge reburning. This will keep oil consumption in lime kiln operation at a level which is economically acceptable. There is a serious environmental concern due to solid waste disposal either due to no recycling of the lime sludge or due to high proportion of the purge out being

practiced in some of the mills in lime reburning operations. Looking in to the changing situation, the black liquor desilication has become more relevant in today's context.

CONCLUSION & PERSPECTIVES

With the successful development of the thechnology for desilication of silica rich black liquor, the existing nonwood based pulp and paper mills, employing silica rich raw materials, could operate their conventional chemical recovery system more efficiently in terms of evaporater steam economy, lower soda loss and improved lime sludge dryness and possibility of recovery of lime through lime sludge reburning.

Further, the successful demonstration of the technology on pilot scale at different mills including the one in Turkey has removed all the apprehensions about its adaptability for black liquor desilication from different silica rich raw material and the technique has also confirmed that the efficiencies of silica removal are very high with increased concentration of dissolved silica. With considerable expertise going in from Enmas Process Technologies, it is possible to provide tailor made systems for different raw materials and plant sizes.

Considering the environmental issues and energy impacts, desilication technology developed by CPPRI and promoted by Enmas has a potential to overcome several of the problems in chemical recovery operations. The desilication technology, which is now readily available for commercial scale adoption, should promote the establishment of more pulp mills based on nonwood plant fibres like straw etc.

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