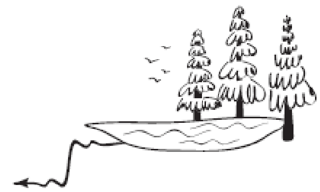
ENVIRONMENTAL FOOTPRINT COMPARISON TOOL

A tool for understanding environmental decisions related to the pulp and paper industry



H2O

EFFECTS OF DECREASED RELEASE OF CHLORINATED COMPOUNDS ON WATER USE

Barriers to Recovery of Bleach Plant Filtrates

Reducing Bleach Plant Filtrate Discharges: Water is critical to operating an effective bleach plant. In a conventional open bleach plant, all water entering the bleach plant is discharged as wastewater or exits with the pulp.

Bleach plant filtrates are extensively recirculated within the bleach plant. An essential prerequisite for further filtrate recovery is volume reduction. The amount of water required in the fiberline and recovery systems of kraft mills is small relative to the volumes generated in most bleach plants. For this reason, recovery and use of a significant fraction of bleach plant effluent requires that bleach plant water use be minimized (Stratton, Gleadow, and Johnson 2005).

Reducing bleach plant water use must be done carefully. Extensive recycling of water in the pulp washing and bleaching process increases the concentrations of dissolved organics reaching the bleach plant with the unbleached pulp, so some increase in bleaching chemical usage is expected to occur. In addition, dissolved organic matter initially solubilized in the bleach plant is carried back into the first stage of bleaching through normal pulp washing inefficiencies. These organics consume bleaching chemicals, reducing their efficiency and effectiveness, especially for ozone and peroxide (NCASI 2003). The primary means of mitigating the effect of organic matter on bleach chemical use is efficient washing, especially after oxygen delignification. In this regard, the performance of pulp washing equipment is the most important consideration (NCASI 2003).

Filtrate Recovery and Reuse: Progressive bleach plant closure involves collection of filtrates for use elsewhere in the fiberline, kraft recovery system, or some external recovery process. Recovery of bleach plant filtrates is not easy to accomplish, and the impacts can be substantial. These impacts arise from the fact that filtrate recovery represents a simultaneous loss of capacity to purge contaminants and gain of new material inputs to the recovery system (Stratton, Gleadow, and Johnson 2005).

Both elemental chlorine free (ECF) and totally chlorine free (TCF) mills recycle alkaline filtrates. It is likely a little easier for TCF mills to recycle alkaline filtrates, due to the lower chloride levels in these filtrates. There are, however, demonstrated technologies that have been successfully applied in a number of mills for controlling chloride levels in the kraft recovery system (AMEC 2006).

An approach at some mills involves recovery of extraction stage filtrate by routing it to the post-oxygen washers. Recovering filtrates in this manner may either increase the evaporative load or reduce washing effectiveness, or a combination of both, unless other water conservation measures are implemented in the fiberline. The volume of filtrates that can be recovered via the fiberline is, however, limited by the existing washing and evaporation capacities in a given mill (NCASI 2003). Therefore, existing mills would be constrained by their existing capital intensive infrastructure.

Recycling of acidic filtrates is rarely practiced. It is likely easier to recycle acidic filtrates in ECF mills, since in TCF mills the build-up of metals results in ineffective bleaching. Both ECF and TCF mills must overcome calcium (Ca)- and possibly barium (Ba)-based scales associated with acid filtrate recycle (AMEC 2006). Apart from chlorides, the buildup of dissolved substances in closed water systems can pose obstacles to mill operability and product quality, when using either type of bleaching sequence.

Accumulation of Non-Process Elements (NPEs): Partial closure of the bleach plant (and other mill systems) leads to increased concentrations of organics (dissolved wood compounds) and inorganics, often called non-process elements (NPEs). Raw materials, especially wood, water, and makeup chemicals, are important sources of NPEs. NPEs are often classified according to the kinds and locations of impacts they have (NCASI 2003).

1. Chlorides and potassium have adverse impacts on recovery furnace operation, and contribute to increased corrosion in digesters, evaporators, and recovery boilers.
2. Calcium and barium can form scale deposits in the bleach plant and at locations where acidic bleaching filtrates are recovered.
3. Manganese, iron, and copper consume certain bleaching chemicals and the subsequent degradation products can cause pulp strength losses.
4. Silicon and aluminum form scale deposits on heat transfer surfaces.

In addition to increased consumption of bleaching chemicals, the efficiency of chelation in a Q-stage in removing transition metal ions is reduced by extensive system closure (STFI 2003 as cited in AMEC 2006).

A key to successful recovery and recycle of bleach plant effluent, therefore, is management of non-process elements. Controlled purges are required for chloride, potassium, sulfur, phosphorus, silica, aluminum, calcium, magnesium, manganese, and iron (Axegård et al. 2003) and a variety of technologies are available to manage the impacts of NPEs (NCASI 2003).

The challenges in managing the problems with increased concentrations of organic and inorganic compounds (i.e., the need for their control and removal) is the same as or greater than in TCF bleaching relative to ECF bleaching. This is because NPEs have a greater impact on pulp quality and brightness in TCF bleaching. In some mills, the build-up of metal levels (particularly manganese (Mn)) due to filtrate recycle is so high that H_2O_2 bleaching, an important part of any TCF sequence, loses effectiveness and this makes strength and brightness targets unobtainable. Bleaching with ClO_2 is not subject to this limitation (AMEC 2006). Experience with alkaline effluent recovery shows ECF-based sequences would likely be more effective because chlorine dioxide is more selective and is less sensitive to carryover of organics and transition metals.

References

AMEC Ltd. 2006. *Study report for review of ECF and TCF bleaching processes and specific issues raised in the WWF report on Arauco Valdivia*. Melbourne: Beca AMEC Ltd. http://s3.amazonaws.com/zanran_storage/www.aet.org/ContentPages/2827017.pdf

Axegård, P., J. Carey, J. Folke, P. Gleadow, J. Gullichsen, D. Pryke, D. Reeve, B. Swan, and V. Uloth. 2003. Minimum-impact mills: Issues and challenges. In *Environmental impacts of pulp and paper waste streams*, ed. T. Stuthridge, M.R. van den Hueval, N.A. Marvin, A.H. Slade, and J. Gifford. Pensacola, FL: SETAC Press.

National Council for Air and Stream Improvement, Inc. (NCASI). 2003. *Pulp mill process closure: A review of global technology developments and mill experiences in the 1990s*. Technical Bulletin No. 860. Research Triangle Park, NC: National Council for Air and Stream Improvement, Inc.

Stratton, S., Gleadow, P., and Johnson, A. 2005. Pulp mill process closure: A review of global technology developments and mill experiences in the 1990s. *Water Science and Technology* 50(3): 183-194.

Swedish Pulp and Paper Research Institute (STFI). 2003. *Ecocyclic pulp mill – "KAM" – Final report 1996–2002*. KAM Report A100. Stockholm: Swedish Pulp and Paper Research Institute.