

# **BLACK LIQUOR CONCENTRATION SYSTEM**

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## Solution Overview

### **OVERVIEW**

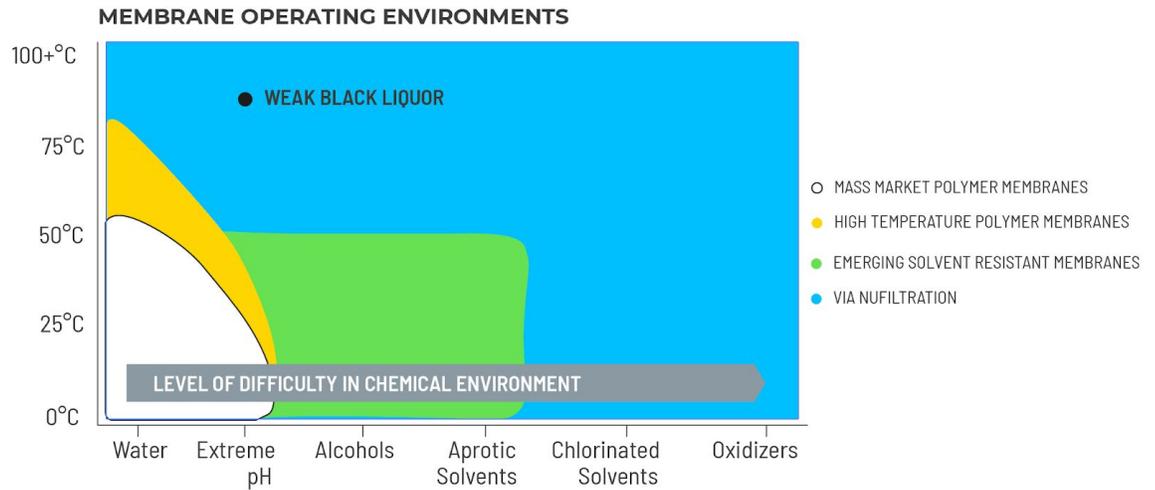
Although evaporators and washers are a mature and reliable technology, the capital and operating costs of this step in the Kraft process remain high. As a result, evaporators are frequently the bottleneck for total mill production. Via Separations has developed a black liquor preconcentration system that increases concentration from approximately 15% to 30% using 10% of the energy required by evaporators. Via Separations reduces overall energy requirements for black liquor concentration by 50%, increases mill throughput by 3-10%, and increases the production of valuable coproducts, such as tall oil for softwood pulp mills. A typical 1,500 ADT/year mill with capacity limitations in washing or concentration can generate an additional \$7-10M of gross profit, annually, by implementing the Via Separations Black Liquor Concentration System (BLCS). The BLCS is modular and compact with only two points of integration into the pulping process. Moreover, integration and implementation are straightforward, and can occur during normal production without downtime.

### **THE EVAPORATION CHALLENGE**

The evaporation step within the Kraft pulping process has been used worldwide for over 100 years; it is effective and robust, and tolerates the high temperatures and caustic properties of black liquor. However, evaporation has high energy costs and requires significant capital infrastructure -- the energy costs associated with black liquor evaporation are about 10% of all the direct material costs of producing pulp. Moreover, a concentration system lacking excess capacity to reach target firing solids for the recovery boiler limits the mill's total productivity. Expanding evaporator capacity is complex and capital intensive. The industry has long recognized that alternative processes for black liquor concentration would yield significant operational, financial and environmental benefits. Until now, however, no such advance has been available.

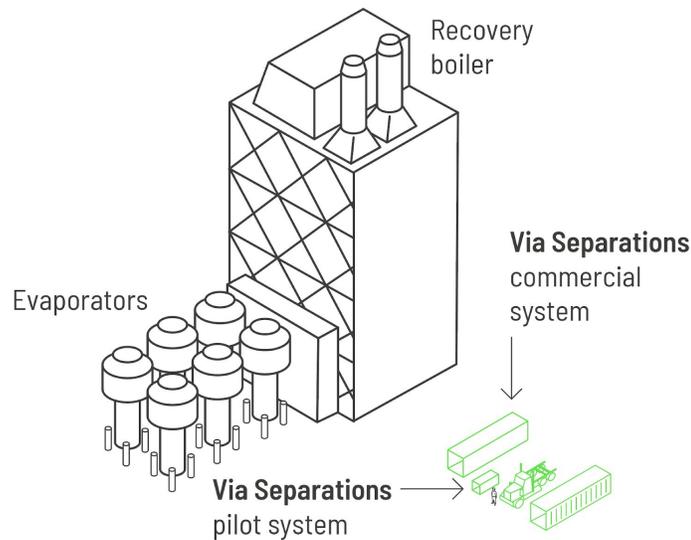
## THE VIA SEPARATIONS BLACK LIQUOR CONCENTRATION SYSTEM (BLCS)

The Via Separations Black Liquor Concentration System uses a reverse-osmosis-like process to directly remove hot, clean water from weak black liquor. The BLCS's proprietary filtration membranes efficiently remove water and concentrate valuable liquor solids at conditions far exceeding those of any other membranes. The cornerstone of the BLCS is a membrane made of graphene oxide, a highly robust material that can handle the near-boiling temperatures and extreme chemical environment of black liquor (see Figure 1).



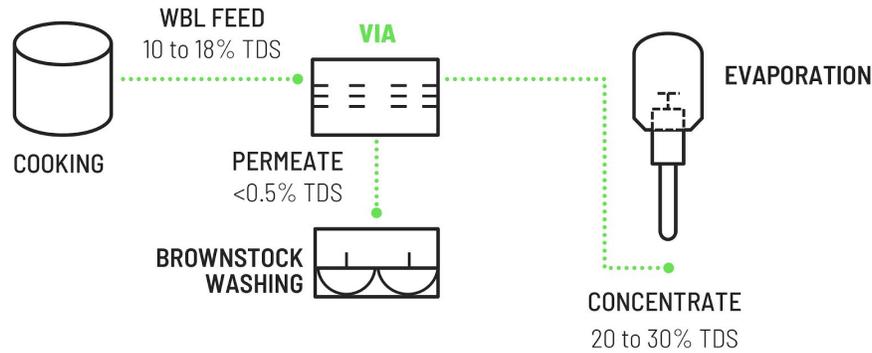
**Figure 1.** Via Separations Technology is the only membrane technology operable in weak black liquor.

The BLCS is modular and compact; a unit the size of a 40' shipping container can provide a 10% increase in evaporation capacity for a 1500 ADT/day mill (Figure 2).



**Figure 2.** The Via System is modular and low footprint to fit easily and minimize cost.

The BLCS is implemented in-line between weak black liquor storage and evaporation and integrates with the liquor cycle in three places: weak black liquor feed in, pre-concentrated black liquor feed out, and clean water for reuse within the mill (see Figure 3). Once installed, the implementation of the BLCS and rebalancing of the evaporators is executed in concert, ensuring a smooth transition to higher concentrated black liquor throughput.



**Figure 3.** The Via Separations Black Liquor Concentration System removes water directly from weak black liquor.

## BENEFITS

The Via Separations BLCS has a significant financial impact. For example, a 1,500 ADT/day softwood mill with constrained steam or evaporator capacity would see the following annual benefits:

Benefit	Summary	Net Benefit (&/year)
Pulp Production	Production increase of 3-10%	\$2-7 M/year
Electricity Generation	Electricity generation up to 20 MW	\$2-4 M/year
Steam Savings	40 tons of steam per hour	If not used for electricity, \$2 M/year
Soap Collection	5000 tons/year, for softwood mills only	\$1 M/year
Average total per mill		\$7 - 12 M/year

In addition, the BLCS provides a number of operational benefits. The Via system provides hot, clean water from the weak black liquor which can be reused without reheating in applications such as brownstock washing. The BLCS also delivers a steady and controlled feed concentration to the evaporation system at the ideal solids for operation, which may reduce fouling and improve uptime for the evaporation system and mill.

## QUALIFYING MILLS

The benefits of a BLCS depend on the capacity of a mill's capital equipment. The BLCS is equally suited to hard and softwood mills and both bleached and unbleached Kraft pulp. Mills which are operating at capacity limitations in their pulp washers, evaporators, and recovery boilers are typically able to increase production by integrating a BLCS. Mills with high energy demands are also applicable – for example, those which use natural gas or other fuel for steam production are able to save the cost of those fuels. Conversely, mills with production limited by their paper machines, digesters, or other parts of the liquor cycle typically do not benefit as greatly from a BLCS.



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Based in Boston, Massachusetts, Via Separations is the world's leading provider of advanced membrane concentration solutions for industrial processes. Via Separation's partners include Massachusetts Institute of Technology, ARPA-E, MassCEC, APPTI, BioRenewable Deployment Consortium, and the DOE RAPID Institute.

To learn more about the Via Separations Black Liquor Concentration System, or determine if your mill is a fit for a BLCS, contact [info@viaseparations.com](mailto:info@viaseparations.com).