The Efficient Utilisation of Water For Brown Stock Washing- Eight Years of Successful Operation of The Delkor Horizontal Pulp Washer

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ABSTRACT

The successful operation of three large Delkor Horizontal Pulp Washers in South Africa has led to the installation of a 70 m² unit in Indonesia, and the orders for two 27 m² units for pulp washing applications in India.

The criteria for the selection of the Delkor Pulp Washer has been the cost effectiveness achieved by obtaining high washing efficiencies, low maintenance costs and ease of operation of the Delkor washers.

INTRODUCTION

The modern Horizontal Vacuum Belt Filter was introduced to South Africa in 1974 for use in the Uranium Industry, where the efficient recovery of acid leached uranium from waste slimes, with minimal dilution, was essential.

During the years 1974 to 1985 over 150 Belt Filters ranging in size from 0.5 m² to 120 m² were installed on a variety of mineral duties, establishing South Africa as a world leader in this technology.

Involvement in the Pulp and Paper industry started with pilot plant tests instigated by Sappi Fine Papers (South Africa) at their Enstra Mill in the early 1980's and lead to the installation of an 18 m² LimeMud Filter where Caustic recovery was significantly improved for the same wash water usage.

The benefits of counter-current washing on a Horizontal Belt Filter were recognised by Sappi and various pilot plant programmes on brown stock washing were motivated. These programmes lead to the installation of a full scale brown stock pulp washer at Enstra Mill in 1989, to replace 3 stages of ageing drum washers. After the successful commissioning at Enstra, a 400 tpd NSSC pulp washer was installed and commissioned at Tugela Mill. Subsequently, during 1993, Sappi installed their third Delkor washer (54 m²) at their Stanger Mill to replace three stage drum washers.

THE DELKOR HORIZONTAL VACUUM PULP WASHER

The Delkor Pulp Washer (vacuum filter) is designed to withstand operating under the most arduous conditions. It has been simplified for easier operation, yet all the wearing parts remain easily accessible for routine maintenance purposes.

Frame

Filter frames are manufactured in standard rolled and pressed metal sections. Materials are selected depending on the operating conditions and includes mild steel (painted) or stainless steels.

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Transporter belt

The transporter belt supports the filter cloth and provides drainage channels and drainage holes for filtrate removal.

Most Delkor transporter belts have a carcass free centre zone. This development was made to ensure long life, even when handling hot and corrosive liquors.

Continuous flexible curbs are bonded to either edge of the transporter belt. The filter cloth is supported by the curb, forming an effective dam for the feed pulp and wash water.

Vacuum boxes

The drainage holes located in the centre of the transporter belt coincides with the slot in the vacuum box allowing filtrate and vapour to be removed into the filtrate manifold and receiver.

The vacuum boxes are made from stainless steel, GRP or HDPE. Wear strips are bolted on to the vacuum boxes.

These strips are made from highly wear resistant, low friction material resulting in very low power requirements and exceptional life. Delkor uses a loose wear belt system (not bonded to the main transporter belt) which allows rapid replacement. A typical wear belt life of 12 months is expected and the new, inexpensive, set of wear belts can be installed in less than one hour using the simple counter weight system for raising and lowering the vacuum.

The Delkor vacuum box is designed so that any excess seal water, used to lubricate and cool the vacuum seal, is collected and drained away immediately eliminating all spillage on the frame.

Transporter Belt Support

The transporter belt is supported on a cushion of air provided by the airboxes. Low pressure air is distributed across the width and length of the belt reducing drag to a minimum. The use of air for this duty makes the operation clean, with no risk of water spillage.

An alternative system of belt slides can be used under certain circumstances.

Filter Cloth

A variety of filter cloths are being used on Delkor filters ranging from coarse monofilament cloths to tight dimensionally stable needlefelts.

A significant advantage of the belt filter is the possibility of continuously cleaning the cloth. This results in maintained throughput over the cloth life as blinding is reduced. This feature is particularly important in filtration of precipitation prone solutions such as Blank Liquor.

Cloth Tracking

The Delkor cloth tracking system has been designed for the very arduous environments in mineral processing and chemical plants. It consists of a cloth tracking roller activated by a rugged, fully enclosed positional sensor.

PROCESS ADVANTAGES OF THE DELKOR WASHER

The advantages of using the Delkor Horizontal Pulp Washer can be summarised as follows:

multiple wash stages on an undisturbed pulp sheet on a single machine

The horizontal configuration of the Delkor washer allows for the implementation of multiple wash stages on an undisturbed pulp sheet. The digested pulp is fed onto the washer on the feed end, where the Strong Black Mother liquor is first removed under vacuum to form a pulp sheet at 13 to 15% consistency. The washes (generally 3 stage) are then applied over the remaining length of the filter.

At no stage during the operation is the pulp sheet disturbed, as there is no need for repulping on the horizontal washer.

The benefits of this include.

- A single low maintenance washer to do multistage washing.
- Elimination of large interstage dilution liquor pumps
- Flexible yet simple operation.

Highly efficient plug flow displacement washing

The primary reason for the Delkor Horizontal Pulp Washer achieving high washing efficiencies and black liquor recovery is the use of highly efficient displacement (plug flow) wash.

In plug flow washing, the wash liquor is added to the top of the pulp sheet. The wash liquor displaces the more contaminated liquor in the cake as the wash liquor is drawn through the cake.

The following simple illustration demonstrates the increase in wash efficiency of Plug flow washing compared to Dilution washing. Using a displacement ratio of 1 (i.e. same volume of wash liquor to the volume of liquor in cake)

- DILUTION WASH EFFICIENCY=50% (Max).
- DISPLACEMENT EFFICIENCY = ± 80%

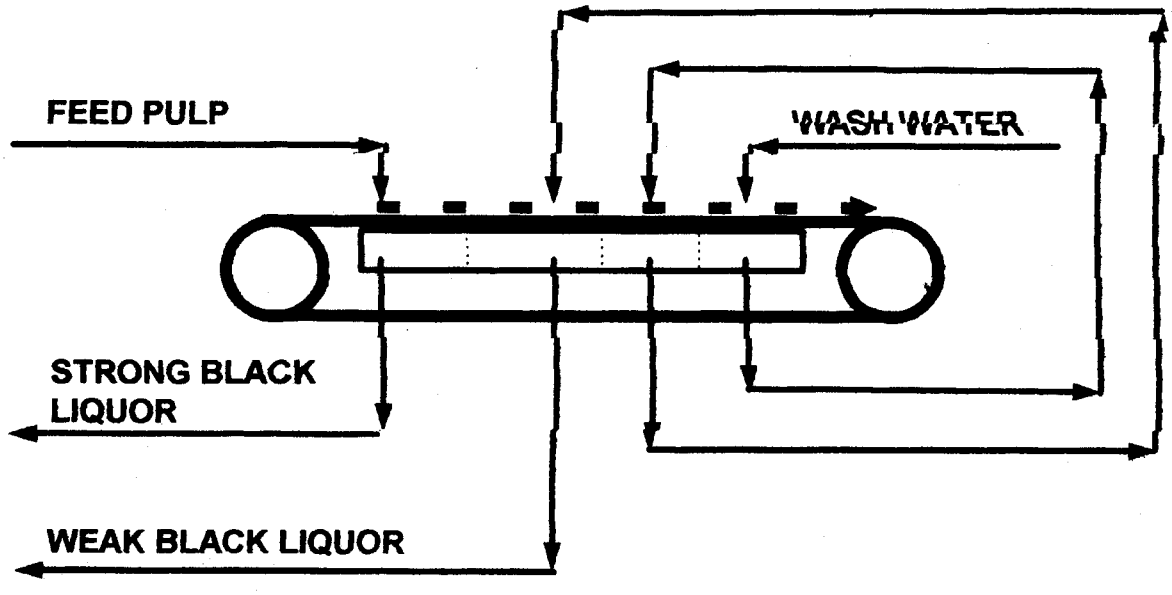
This increased efficiency results in:

- Lower wash water requirements
- Higher Black Liquor solids

Low wash water usage due to counter-current recycle of wash liquor

On the Horizontal Pulp Washer, the wash liquor is applied directly onto the formed pulp sheet. The clean wash water is added as the last wash stage (before the pulp is discharged). The wash liquor from this stage is collected and can be recycled upstream of the clean wash in a counter current fashion. This counter-current application of wash liquor allows extremely efficient use of the wash water, but there is diminishing effectiveness for each additional wash stage.

Generally Delkor has found that three stage washing is the most economical; however, each mill will have different requirements and criteria, and should be assessed individually.



COUNTER-CURRENT WASHING SCHEMATIC

CHART 1 : THE EFFECT OF THE NUMBER OF WASH STAGES ON WASHING EFFICIENCY

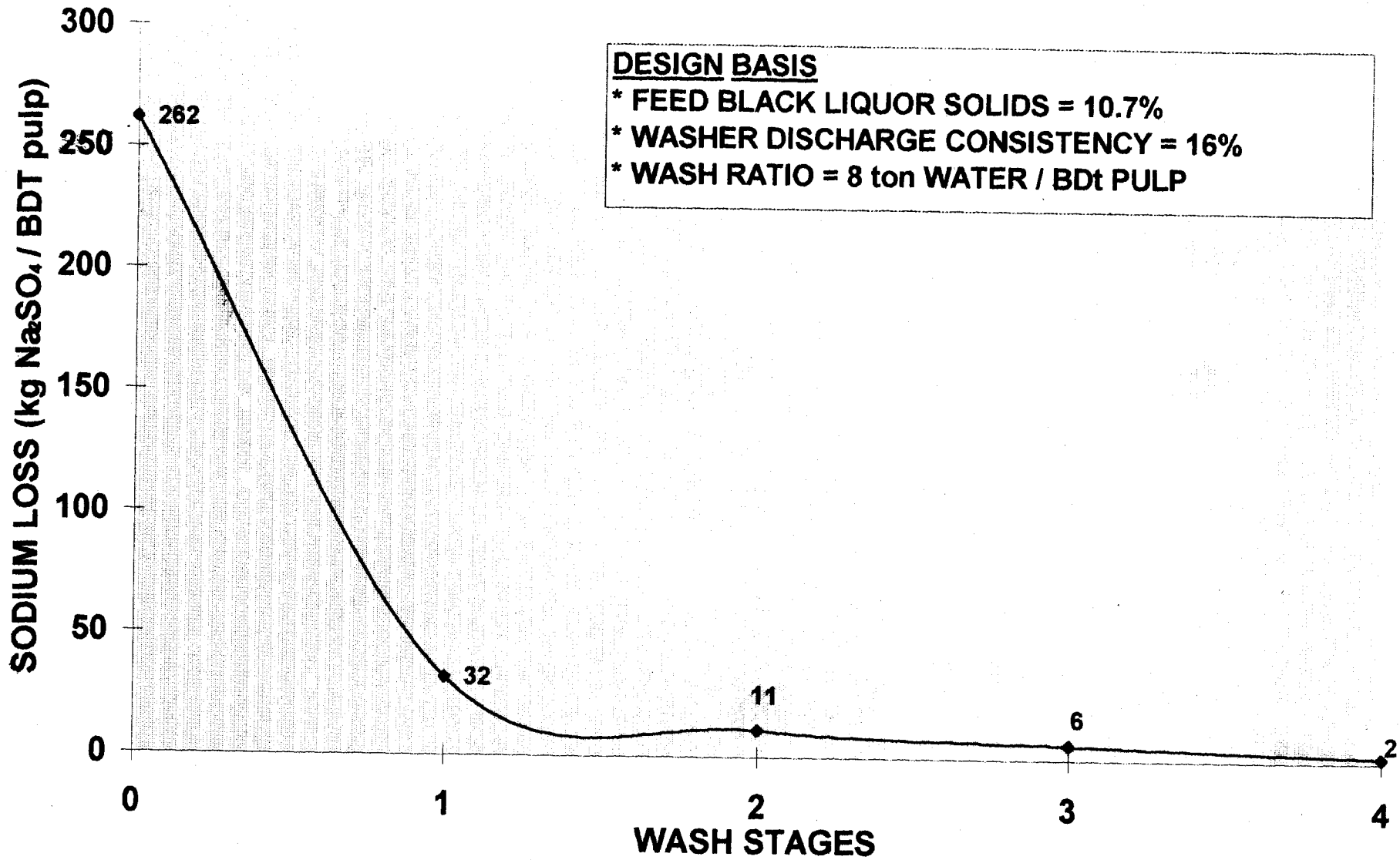
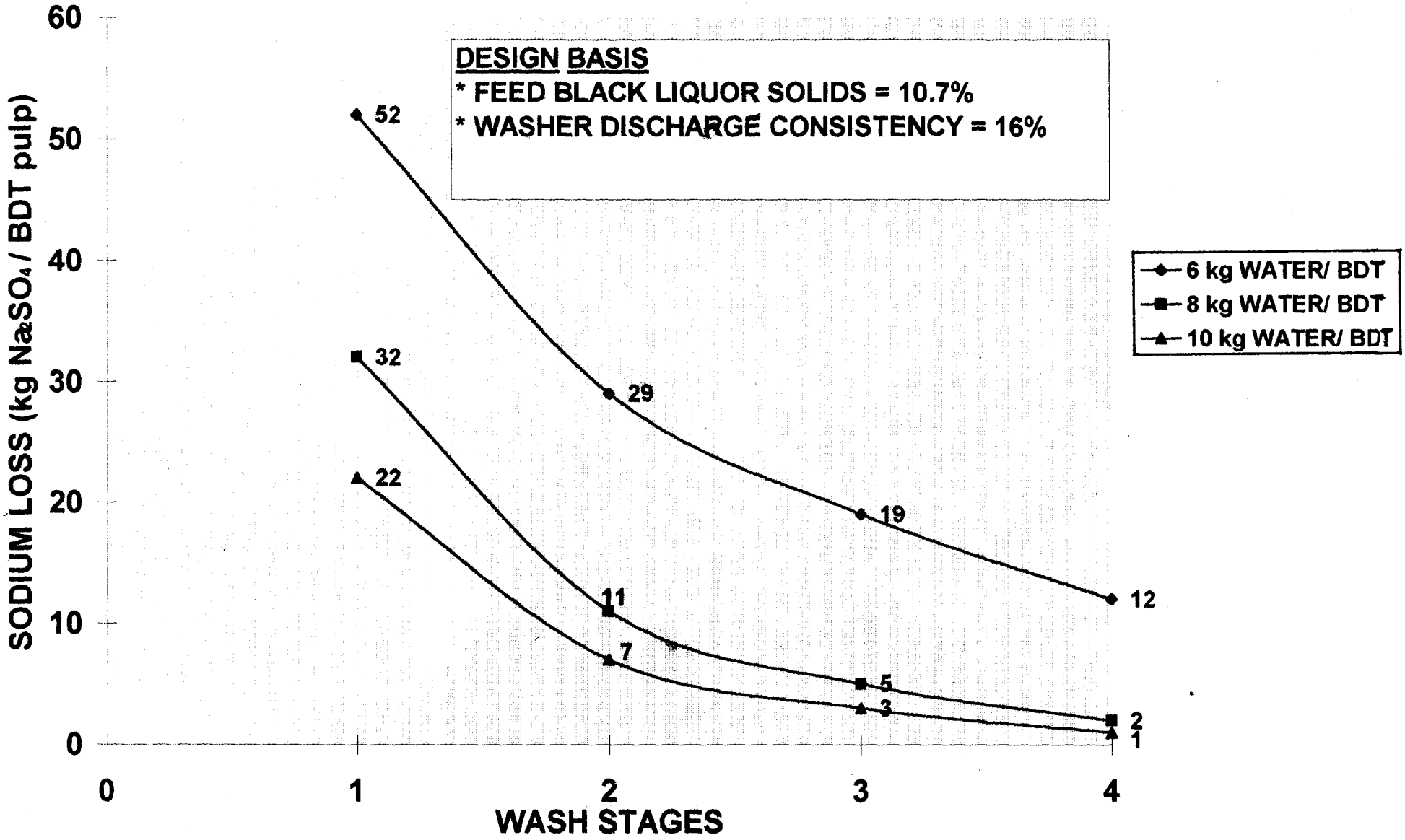


CHART 2 : THE EFFECT OF THE QUANTITY OF WASH WATER ON WASHING EFFICIENCY



FEED (BAGASSE) CONSISTENCY TO DIGESTER (%)	CAUSTIC CONC (%)	DISCHARGE CONSISTENCY (%)	BLACK LIQUOR (%)	SODIUM LOSS (KG Na_2SO_4/ BDton)
35	45	16	12.6	7
35	45	14	13.8	11
35	12	16	11.0	6
15	12	16	6.5	4

Chart 1 on the accompanying pages shows the effect of the number of wash stages on sodium losses for up to four counter-current wash stages. It must be noted that sodium losses (as Na_2SO_4) of between 4 and 6 kg per BD ton have been proved to be achievable with normal displacement washing, however, below these figures, diffusion of the remaining black liquor solids will become increasingly the rate controlling factor. This would mean additional washer area would have to be allowed to allow time for diffusion to take place.

Chart 2 shows the effect of different wash ratios (tons of wash water per BD ton pulp). Once again, it can be seen that increasing wash water usage has diminishing returns, especially where multistage counter-current washing is employed.

Increased Black Liquor Solids

Due to the fact that the Delkor washer achieves high wash efficiencies at low wash water consumption, the increase in Black Liquor solids in the liquor reporting to the effluent system or evaporators is generally very significant. It was found at Sappi Stanger that replacing the three drum washers with the Delkor washer, reduced the evaporator load while at the same time increasing capacity from 140 tpd pulp to 180 tpd.

It must be stressed that the Delkor horizontal washer is generally installed in order to reduce the amount of wash water used when compared existing washers, and thus there is a significant increase in Black Liquor solids concentration. However, the actual concentration (percent solids) in the Black Liquor is different for each application and is dependent on the amount of water reporting to the digester with the bagasse (wood chips), the steam consumption, the caustic concentration and the wash water quantity.

In addition, the higher the consistency of the discharged pulp, the lower the final Black Liquor solids, since the additional liquor removed has to report to the Black Liquor.

The above table gives an indication of the effect various feed and operating conditions have on the final Black Liquor solids. The table is based on a wash ratio of 8 ton water per BD ton pulp, a live steam consumption of 1.8 ton per BD ton pulp, and a yield of 50%.