THE PROFILE : KEY TO REENGINEERED SCREENING

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Abstract :

The Screen basket affects every aspect of Pulp Screen performance, including capacity, fiber loss, debris removal efficiency, Power consumption, runnability. Fundamental studies have typically focussed on the development of PROFILE basket. The role of intensity of turbulence created by profile wire in screening efficiency and plugging free runis critical. The influence of profile on screen basket is multifaceted and plays an effective role in compromising contradictory objectives focus around screening efficiency and runability.The effect of three variables namely profile height, profile width and slot width are leading to reengineered screening.

There are many applicable where a standard profile screen basket design is less than ideal. This paper also addresses the adoptable profile with constant slot width basket design which ensures the optimum profile height at any vertical position on the basket. Actual mill example and report reported on.

Introduction

Every Pulp and Paper Mill has screens at different stages of Pulping and Paper making; screens are present in Pulp mill, Stockpreparation, Chemical recovery, Broke handling etc. Pulp screening is an essential operation in the production of high value Pulp and Paper products. A large increase has already been seen in the use of recycled fibreworldwide and without doubt, further increase will follow. This will be great benefit to the Indian industry as a whole, which, with a cheap ,reliable fiber source at its front door, will be able reduce pulp imports considerably. However,to obtain maximum use of the fibers from cradle to grave, recycling must carried out intelligently with full understanding of the contaminants, came along with secondary fibers.

The importance of Pulp screening is increasing because of the increasing stringent demands for high quality paper and board products. The challenge of providing increasingly higher level of cleanliness is compounded by the increasing quantity and variety of contaminants in recycled paperfurnishes. The basic parameters used to asses pulp screening are Through put(Capacity), Runnability,Effi ciency,Yield,Energy.

The two performance components in a pulp screen are the Basket and The Rotor. The screen baskets have either holes orslots. “Accept” pulp flows through these apertures and leaves the screen through accept port, while the oversize contaminants and reject pulp do not pass and exit from the reject port. Rotor facilitates appropriate flow conditions adjacent the feed side of the cylinder surface and also back flushes the apertures and keep them clean.

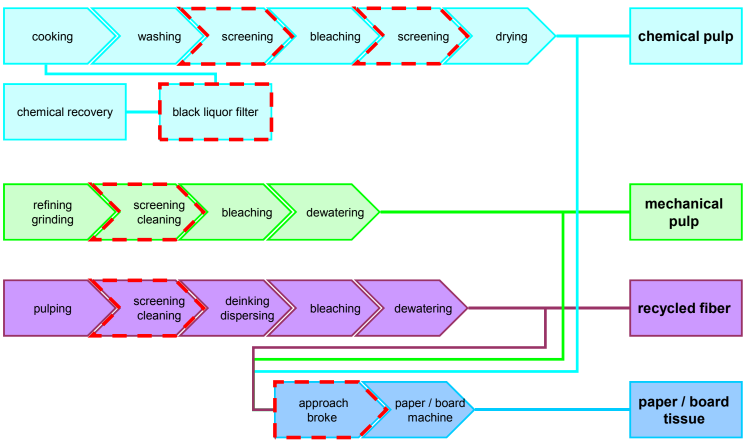


Fig.1 Screening location in paper making process

WHAT ISPROFILE ?

Screen aperture design is intrinsic to overall performance with size being the primary variable. Smaller the size higher the level of removal of contaminants but it also decreases the throughput. Development of CONTOURS on feed side of basket made even small apreturessignificantly practical. This contour is known as THE PROFILE. Basically the profile streamlines the flow through the slot ,inducingturbulence to disperse fiber flocsand any fiber that accumulated at the slot entry and reducing the potential for fibers to become immobilized at the slot entry.

The screening action that prevents the passage of contaminants can be divided in to two fundamental mechanisms: “:Barrier Screening “ prevents the passage of oversize debris that cannot fit through the apertures regardless of their orientation. “ProbabilityScreening”, on the other hand ,restricts the passage of contaminants that could pass through the apertures if presented in a particular way, but that tend not to pass because their size, shape or stiffness makes it difficult for the contaminants to follow the flow streamlines through the apertures.These problems can be controlled to greater extent by optimizing induced turbulence withPROFILE.

INFLUENCE OF THE PROFILE ON SCREEN BASKET:

a. The basket surface is bigger

b. “Compulsory guide” of the fiber suspension

c. Turbulence generated vertically to the screening area

d. Higher throughput

e. Sharper separation of fiber material and impurities

f. Better distribution over the screen area

g. Rejects gets better discharged

h. Lower plugging tendency

i. Slot reduction is possible

j. Lower energy consumption

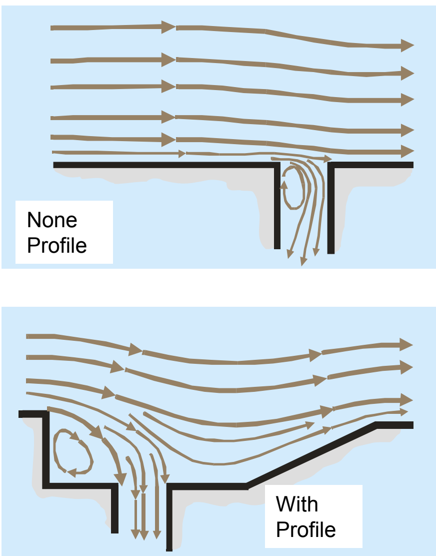


Fig.2 Influence of the profile on screen basket

FACTORS INFLUENCING PROFILE WIRE:

A).Effect of bar width – Lower the bar width higher the open area distribution of basket and lower the slot velocity .Both will facilitate highersticky reduction. But limitation of bar width isstapling. Iffiber length is more than sum of bar width and profile height, there is all risk of stapling.

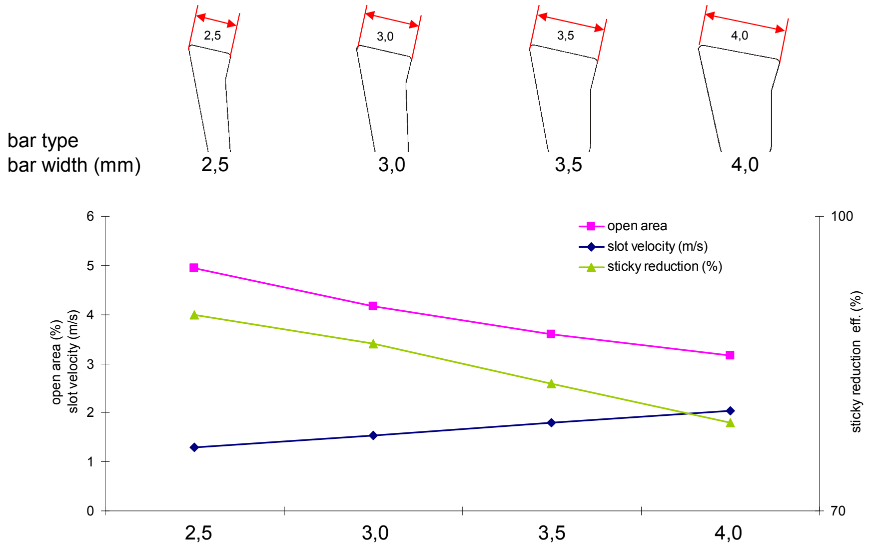


Fig.3 Effects of bar width

Fig.4 Limitation of bar width

B) Effect of Profile Height– One of the main challenges in screening process is thickening of the stock as it moves from the feed end to the reject end of the screen. Profilestep creates turbulences and it is directly proportional to height. Turbulence increases with the profile height. Low profile height results in improved efficiency, higher thickening and low capacity where as High profile height yields reduced reject thickening, improvedrunnability,lower impurity reduction and higher capacity. The design of the wire in a slotted screen basket wire has a major effect on both screening capacity and stock quality. Turbulence created on the screen basket surface ,which is affected by the profile height, has a crucial effect on the behaviour of the fiber suspension in the stock. If the turbulence is too large ,especially low consistency applications more contaminants will pass through the basket which reduces the stock quality. Figure 5(ii) Effect of profile height on sticky removal and thickening shows this trade off. In a traditional basket design , the Paper maker must accommodate this compromise between screening efficiency (sticky removal) and runnability (thickening factor, plugging)with a fixed slot width and profile height that is uniform from the top to the bottom of the basket.

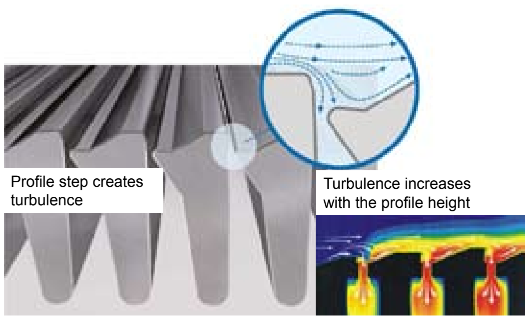


Fig.5 (i)
Effects of Profile Height on creation of Turbulence

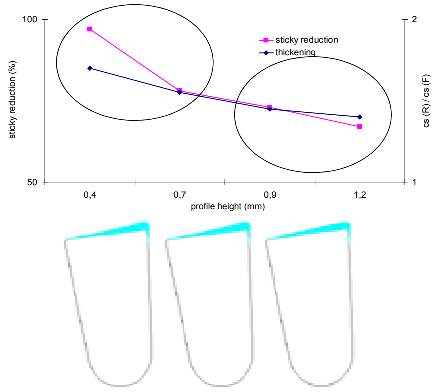


Fig.5(ii)
Effects of Profile Height on sticky reduction and thickening

C) Effects of Slot Width - In normal conditions, as slot width increases sticky removal efficiency decreases ;almost same trend observed in case of thickening too.

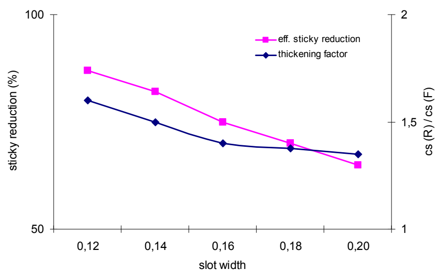


Fig.6 Effects of slot width

D) Comparison Step height versus slot width - Sticky reduction found improvedas step height decreases in spite of higher slot width indicates optimised turbulence has key role in screening efficiency than aperture size.

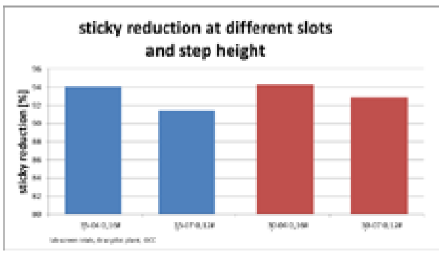


Fig.7
Sticky reduction at different slots and step height

E) Comparison of slot size versus Thickening factor - As the slot size increases thickening reduces due to high throughput through higher opening . But for higher bar widths thickening found remained constant after certain level in spite of increased slot size. Lower the bar width better results in reducing thickening .The below trial has been conducted in our Pilot plant with different bar width keeping same profile height.

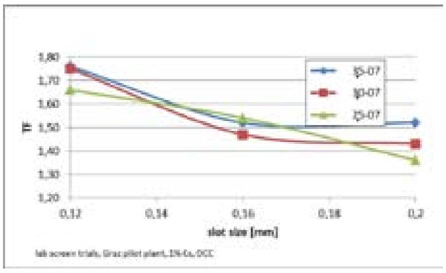


Fig.8 Slot size vs Thickening factor

F) Effect of Slot Velocity on Sticky reduction - Best results in sticky removal found in low Slot velocity .As the slot velocity increases there ,downward trend of sticky removal observed when tested in pilot plant with same profile but different bar widths 2.5 /3.0/3.5mm. It is found Bar width has no considerable influence on sticky reduction at slot velocity lower than 0.7m/s .But as the stock velocity increases higher bar width shown higher drop in sticky reduction.

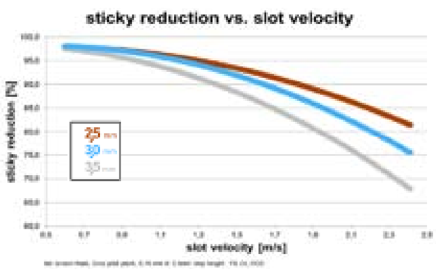
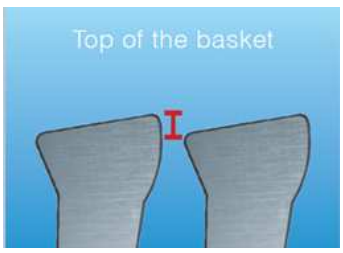


Fig.9 Sticky reduction vs. slot velocity

G) Adaptable profile with constant slot width screen baskets for Screening efficiency and runnability

As mentioned, it is inevitable that thickening of the stock as it moves from the feed end to the reject end of the screen which may lead to plugging and unexpected shut downs. Screening efficiency and runnability are contradictory objectives in traditional uniform top to bottom profile baskets. Hence, recent development to tailor the profile height along the length of the wire –from feed to rejects .The ability to adjust the profile height is unique .It allows adjusting low profiles close to the feeding zone to increase screening efficiency and a higher profile in the following zone to avoid critical thickening.So far, Andritz patented profile geometry succeeded in getting variable profile across the length of basket by tilting the wire without impacting slot width which is named as U-Twist.



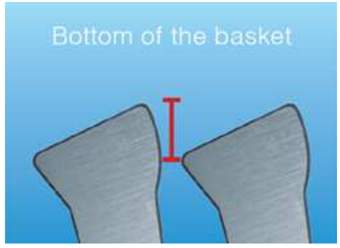


Fig.10
Different profile heights in different sections of the basket

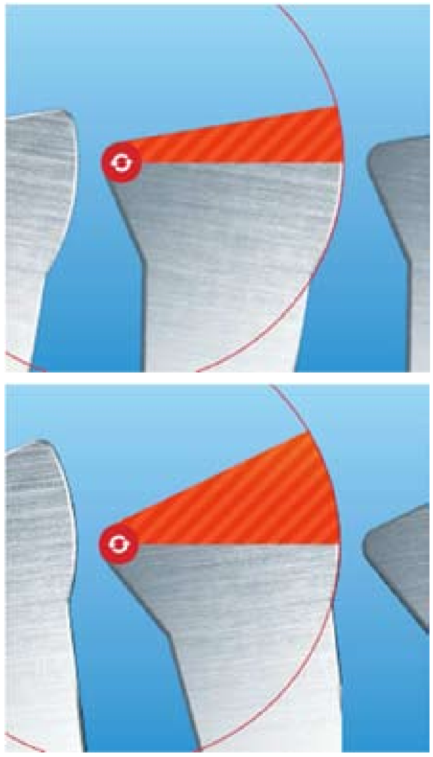


Fig.11.Tilting of U-Twist wire

U-Twist concept was first introduced to mills from Europe.Thefeed back was shown much interest to mills who want to improve the performance of DIP FINE SCREENING, OCC FINE SCREEENING and FRACTIONATION applications.

CASE STUDY 1 ----DIP FINE SCREENING (Similar basket with and without " U"-Twist)

The U-Twist design performs well as a replacement basket in screens of all major screen manufacturers. For example, a mill in Central Europe wanted to improve the screening efficiency of its Lamort CH 7 fine screen in its deinked pulp line (OMG/ ONP furnish). Due to capacity targets, it was not possible for them to reduce the slot width or profile height in order to reduce contaminants.

The mill elected to install a Nobilis U-Twist basket in its primary fine screen with variable profile height (0.7 mm at the top up to 1.0 mm at the bottom). The results can be seen in Table 1. Stickies removal efficiency increased from 76.3% to 84.7% (11% improvement) while the reject rate was slightly reduced (from 31.7% to 30.0%). At the same time, capacity and runnability remained at the targeted levels.

Table 1: *Case Study in DIP: Same Basket with and without U-Twist*

Lamort CH 7	Nobilis	Nobilis UTwist
Position	Primary fine screen	Primary fine screen
Rotor	RO-TEC LCs (Foil120)	RO-TEC LCs (Foil120)
Tip speed (m/s)	19.7	19.7
Profil height (mm)	0.9	0.7/0.8/0.9/1.0
Slot width (mm)	0.18	0.18
Feed consistency (%)	2.8	2.8
Thickening factor (after reject dilution)	1.05	1.00
Reject rate RRw (%)	31.7	30.0
V Slot (m/s)	0.65	0.65
Sticky reduction (%)	76.3	84.7

CASE STUDY 2 ----OCC FINE SCREENING

Mill –In Europe Grades –Packaging Paper boards Goal is to improve stock quality in first stage Fine screening (Andritz F60 screen). It was decided to run side by side comparison test with the screen in Line 1 equipped with their standard basket (Bar Tec valeo with 0.15mm slot width and PG wire with 0.9mm profile height) and the screen in Line 2 equipped with a U-Twist design (Bar Tec U twist PGR wire with a profile height of 0.7mm on Top and 0.9mm on bottom).The rotors in both screens are identical with tip speed of 20.6m/s. Figures (a) ,(b) and (c) show the results.

Table 2: *Case study OCC fine screening*

Basket	Bar-Tec Valeo # 0.15 mm slot	Bar-Tec Valeo # 0.15 mm slot
Profile height (mm)	0.9	0.7/0.9
Tip speed m/s	20.6	20.6
Reduction of impurities	74%	91%

Figure 12(i) shows overall reduction of impurities in three separate sample runs. Reduction was found >10%

Figure12 (ii) shows Sticky reduction observed in six different samples which is found to be >8%

Figure12 (iii) shows percent sticky reduction in terms of the size of the contaminants for those same six production runs. The average reduction was 6-8%

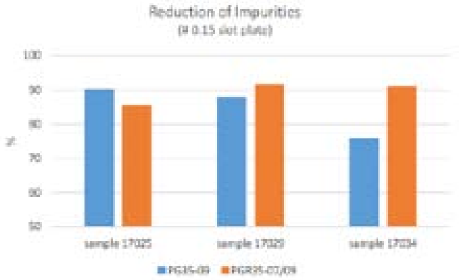


Figure 12(i) Reduction of Impurities in three separate samples with one profile throughput top to bottom and with two different profiled Wires

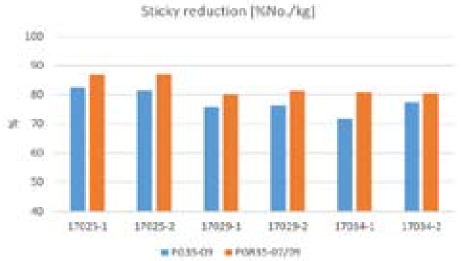


Figure 12(ii) Percent Sticky reduction six different runs with one profile throughput top to bottom and with two different profiled wires

Figure 12(iii) Percent Sticky reduction in terms of Size of Contaminants for same six different runs with One Profile top to bottom throughout and with two different profiled wires

CASE STUDY 3 ---- DIP FINE SCREENING

(Different baskets with and without “U” –Twist)

Mill in Europe producing very demanding Printing/ Writing grades from deinked pulp.. Goal –to increase their high quality standard. The main focus was to reduce sticky in the DIP fine screening line with Voith screen.

The mill replaced the existing C-Bar screen basket (0.5m profile height and slot width 0.15mm) with U-twist adjust able profile height design (0.4mm on the Top and 0.7mm on the bottom slot width 0.15mm).The results show an improvement in sticky removal efficiency from 63.4% to 70.6%(11.4% improvement)at the same throughput, reject rate and thickening factor (Table 2).

Table 3: *Existing Basket replacement with UTwist with same slot width: Improved Sticky removal but no change in throughput, rejects rate and thickening factor*

Primary screens Voith Size 30	Primary screen (1)	Primary screen (2)
Screen basket	Voith C-bar	ANDRITZ U-TWIST
Profile	C-Bar QE	PGR30 04-07
Profile height, mm	0.5	0.4 (top) - 0.7 (bottom)
Slot width, mm	0.15	0.15
Accept flow, l/min	~ 11000	~ 11000
Accept consistency, %	1.2	1.2
Reject flow, l/min	~ 2100	~ 2100
Reject consistency, %	1.5	1.5
Reject rate (RRw), %	20.4	20.9
Thickening factor	1.25	1.29
Sticky removal efficiency (mm²/kg), %	**63.4**	**70.6**

CONCLUSIONS

Thereengineered screening by development of PROFILE on feed side of basket influence significantly on efficiency of screening, throughput, runnability, energy consumption. Profileheight, profile width and Slot width are crucial for screening efficiency. Low profile height facilitates higher sticky removal in spite of higher slot width, thus confirming the role of micro turbulence created by profile height.

The Profile influences decisively in Barrier screening and Probability screening by making even the small slots practical. Recent advances in adaptable profile technology for screen baskets are now making it possible for the screening process to reach new levels of performance in terms of contaminant removal and stock throughput. Profile adaptability removes the potential for a huge compromise inherent in One-Profile-Fits All basket design by setting the wire profile height low enough starting from feed end portion to ensure good stock quality by capturing rejects and yet profile height is high enough at reject end high thickening portion of basket to maintain throughput without plugging ,ensuring high runnability. Case studies in DIP Fine screening and OCC Fine screening with usage of baskets having different profiles are few examples to illustrate the proven concept.

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