ID2/ID3 A new technological decisive step in the screening processes

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INTRODUCTION

This paper deals with the technological development in the screening process, especially for waste paper, patented by Kadant Lamort to achieve cleaner patented by Kadant Lamort to achieve cleaner pulp in a cost effective manner with relatively lower specific energy consumption.

The continuous R&D programme conducted by us has

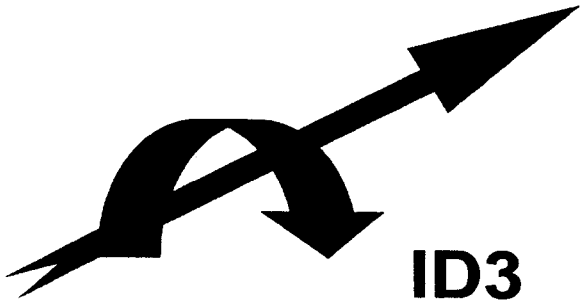


Figure 1 :

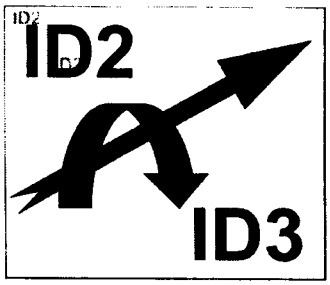


Figure 2 :

Huge technological jump in the screening processes

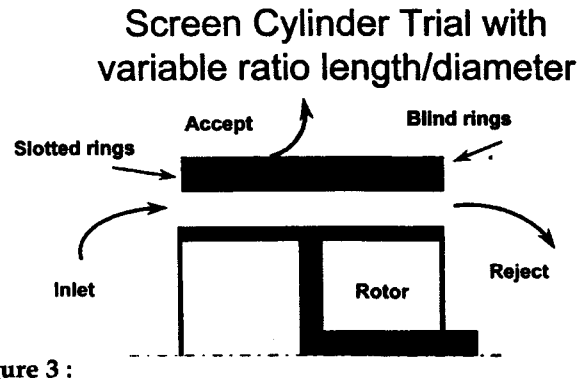


Figure 3 :

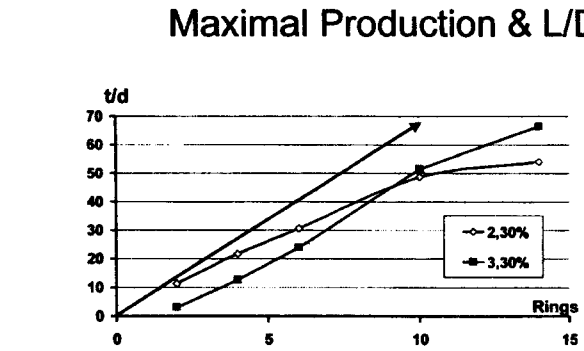


Figure 4 :

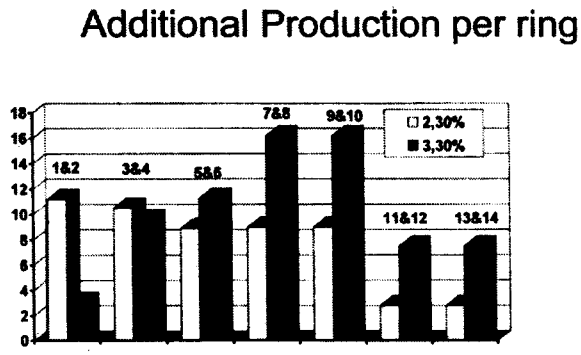
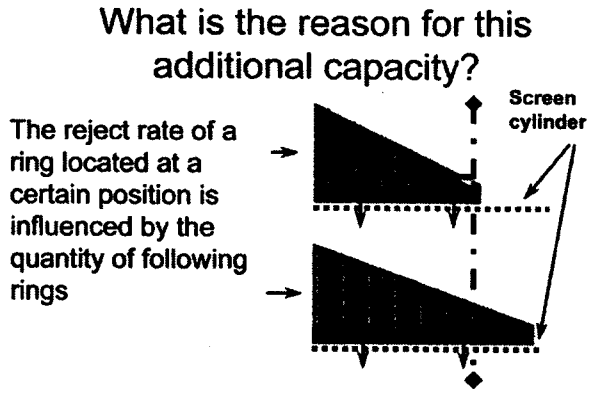


Figure 5 :



led to the perfecting of this new screening technology.

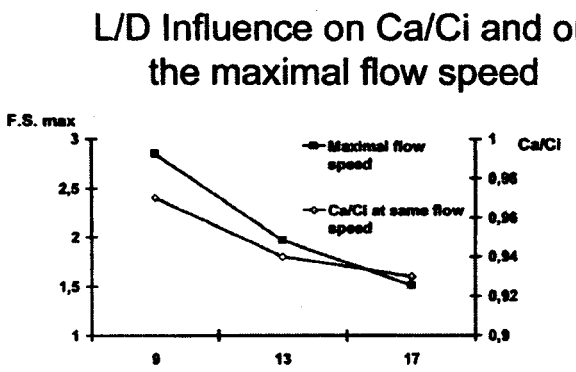
2) ID2 Device

Figure 6 :

A very important point has been the choice for the screen-

cylinder design of the future screens. This design is quantifiable with the ratio of the length (L) compared to the diameter (D) : (L/D).

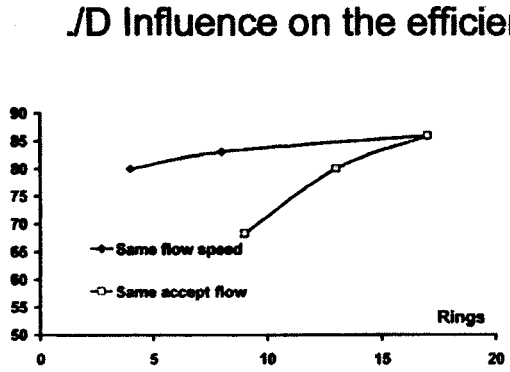
As we already had the rigid cage screen cylinder design RCR, which allows the mechanical assembly of 20 mm high slotted rings in a rigid cage, it has been quite easy to modify the ratio L/D by replacing slotted rings with



blind rings.

Figure 7 :

According the number of rings, we have tried to get out the maximum possible capacity by keeping the same reject rate in volume. The two curves (2.,3% and 3.3%



consistency) are quite different and those differences lead to interesting conclusions.

Figure 8 :

To better visualise the phenomenona, we have built up a curve showing the additional capacity of the cylinder by added slotted ring.

As you can notice, for the pulp at 2.3% consistency, the added production per slotted ring is almost constant since the begining till the 2/3 of the screen cylinder, and then dcreases drastically. In opposite, for the pulp at 3.3% consistency, the added production is poor at the begining, then increases and decreases also at the end of the screen cylinder.

From those trials, we can draw following conclusions :

Pulp Deflocuation

- Intensive defloculation is generated by high-speed difference between rotor and pulp.
- It is well known that higher consistency needs higher energy to get a correct defloculation. If we admit that the high consistency pulp enters the screen being more flocculated than the lower consistency pulp, the defloculation action of the rotor can explain the production increase of the high consistency pulp after the third slotted ring.

Screen cylinder capacity

- Increasing the cylinder length does not increase accordingly the cylinder capacity after a certain distance.
- A high inlet consistency leads surprisingly to a low capacity at the cylinder entrance and to a higher capacity close to the end of the cylinder.
- Any device able to deflocculate the stock during the screening should improve the capacity at the end of the cylinder.
- The flow speed of the pulp through the slots all over the cylinder length is certainly very, variable, in spite of several authors' assessments. This is du to the rotor action (rotating speed and defloculation) and du to throughput rate of the fibres (progressive thickening of the pulp along the cylinder length and flocculation).

Screening efficiency

- Increasing the cylinder length does not increase the screen capacity after a certain point. But, in spite of an almost constant production, the efficiency increases.
- This shows the need for along screen cylinders to be more efficient and the need for devices to get capacity all over the screen cylinder length.

But still we cannot assimilate the additional production per added ring to the real production of this added slotted ring.

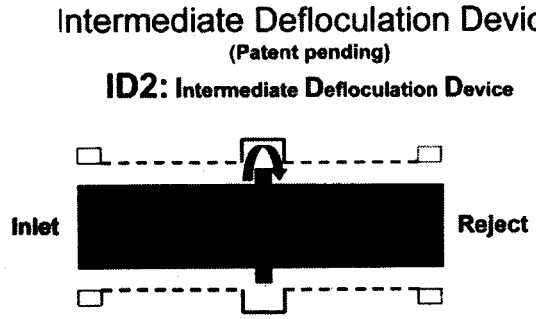


Figure 9 :

In fact, draw the capacity difference and assign the added capacity to the added slotted rings would mean that nothing has changed in the first part of the screen cylinder. But, as the screen reject rate by volume has

been maintained constant, what ever increase, even very small, of the screen global production by the added slotted rings, increases the reject rate of all the slotted rings already installed. This will normally lead to an increase of those rings production.

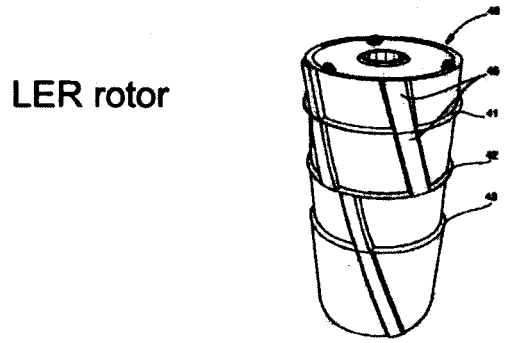


Figure 10 :

This graph shows that longer the cylinder, more difficulties the fibres have the pass the slots. The means a flow speed reduction as well as a throughput rate reduction. As a consequence of this low fibre throughput, the reject consistency will gradually increase. If this reject consistency becomes too high, the screen can plug gradually, even totally. For those two process parameters a short screen cylinder in much better than a long one.

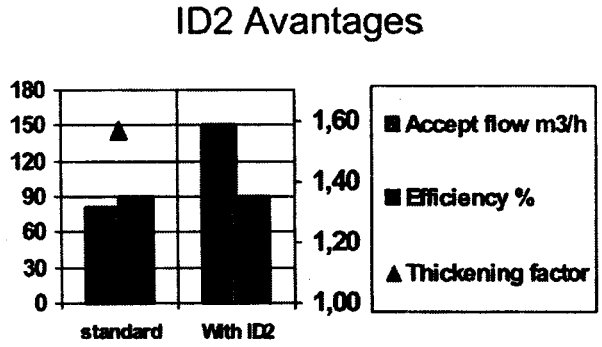


Figure 11:

On the other hand, this graph shows clearly that a long screen cylinder is much more efficient than a short one, regarding the contaminant elimination, either for the same flow seed or for the same accepts flow!

So, according to the mill main target, the screen cylinder will be short to run with low fractionation and low rejects or the screen cylinder will be long for a better efficiency.

The actual trend in the market is more oriented to have short screen cylinders in order to improve the fibre throughput to the detriment of the efficiency, which can be improved by using very fine slots (0.15 to 0.8 mm).

We have tried to get even a better efficiency by increasing the fibre throughput with a long screen cylinder. To achieve this target, we have tried to use the potential energy of the stock for it's own defloculation.

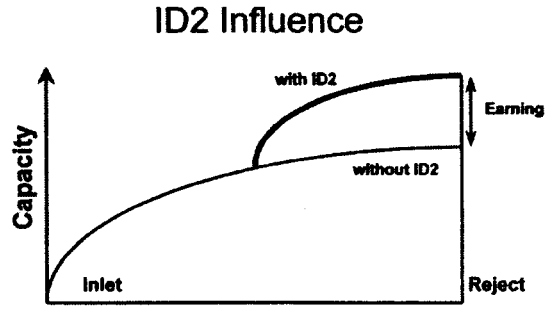


Figure 12 :

In fact the baffle bar cylinders are based on the same concern. However putting obstacles (baffle bars) on the screen cylinder surface implies a compromise between the obstacle efficiency and the cleaning effect of the rotor. If the size of the obstacle is increased to get a better efficiency, the rotor then will be more far away from the screen cylinder surface, which reduces the cleaning effect. In top of that, a much higher energy will be spending all along the screen cylinder without being rally necessary every where.

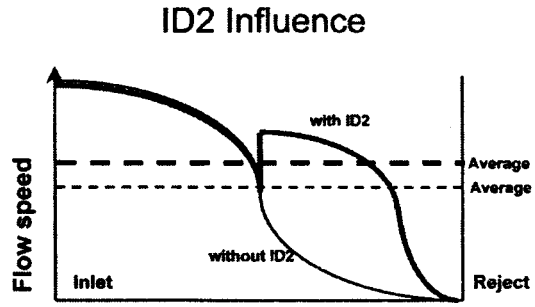


Figure 13 :

So, we have installed a defloculation device in a cavity located inside the screen cylinder. A deflector obliges the pulp to penetrate into this cavity. We have named this device ID2 meaning Intermediate De-flocculation Device.

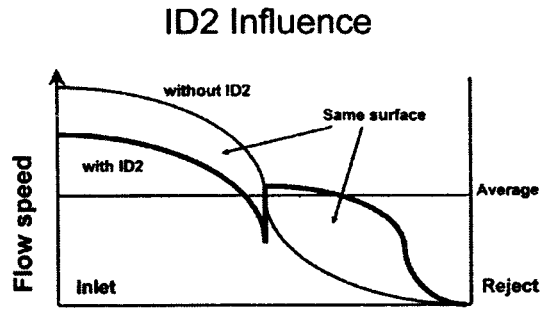


Figure 14 :

The ID2 device is composed of a cavity allowing the stock defloculation and a rotor of closed type, having a dflector located in front of the screen cylinder cavity. The used rotor is a closed type with inclined welded foils.

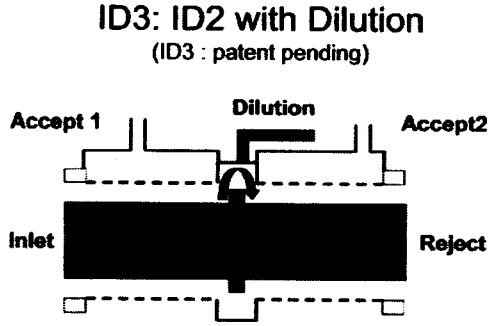


Figure 15 :

The obtained results are far over all our expectations :

- For same production and same reject rate by volume, the thickening factor is drastically reduced. It is even more reduced with same reject rate by weight.
- Maximum capacity is doubled for the same efficiency.

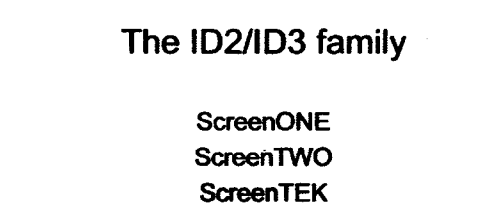


Figure 16 :

- At same rotor speed, power increases by 33% when the maximum capacity is doubled.
- For equal power rotor speed is reduced by 10% when production increases by 50%.
- For equal production, rotor speed is decreased by 20% when power is reduced by 33%.

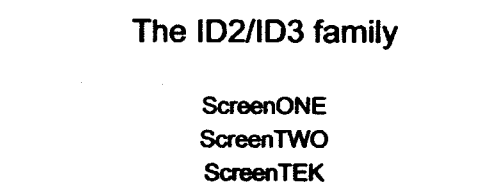


Figure 17 :

It is quite difficult to admit that for a doubled capacity, the efficiency stays stable. In fact this is du to a better use of the total screen cylinder surface, as well as a reduced screen cylinder surface in contact with a thicker highly contaminated stock. In fact on this graph, showing the production evolution compared to the screen cylinder length, we see the immediate impact of the ID2 starting a new capacity (at same efficiency) in the last part of the screen cylinder.

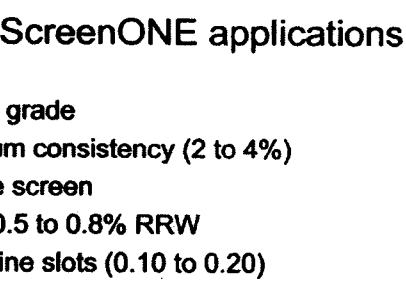


Figure 18 :

This graph shows what happens to the flow speed along the screen cylinder length. We see that the flow speed average is increased with the ID2, and also that the screen cylinder surface in contact with highly concentrated stock and with low capacity is reduced.

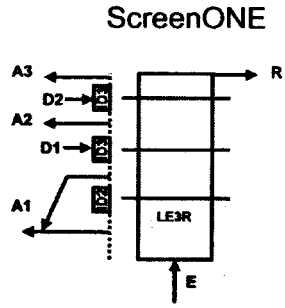


Figure 19 :

If we run at same flow speed average (or same capacity), we can see a big reduction of the flow velocity in the first screen cylinder section and always a reduced screen cylinder surface in contact with highly concentrated stock and low production. Those are the two important improvements for the efficiency.

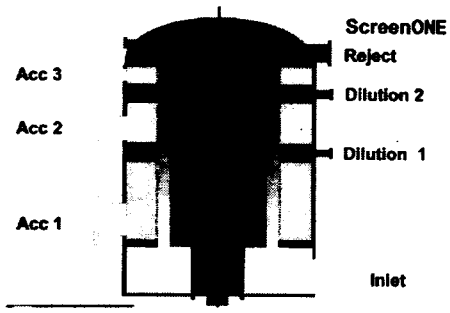


Figure 20 :

ScreenONE Files

↗Size A (500mm) available
↗Size B (630mm) available
↗Size C (780mm) priority 1

Figure 21 :

ScreenTWO applications

↗Brown grades
↗Double fractionation
↗12 to 30% RRW
↗Consistency from 2 to 3%
↗Fine slots from 0.15 to 0.25
↗Rejects to cleaners and FiberNET or ScreenTWO according the capacity, at 1 to 1.5%

Figure 22 :

ScreenTWO

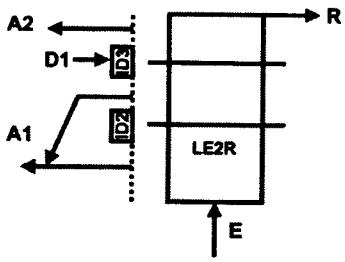


Figure 23 :

ScreenTWO Files

↗Size B (630mm) priority 3
↗Size C (780mm) priority 1
↗Size D (960mm) priority 2

Figure 24 :

3) Retrofit ID2

A retrofit operation consists into the replacement of the couple rotor-screen cylinder and to adjust the rotor speed according to the customer need. A retrofit is possible on all centrifugal screens from the Lamort or Thermo Black Clawson screens. It is also possible on centrifugal screens from other OEM's. The cost of a retrofit is low when it allows :

- Important energy savings
- Losses reduction
- Capacity increase
- Slot size or hole size reduction.

Such and operation allows often the cancellation of an important investment to replace a screening line with all the inherent problems :

- Installation shut down
- Civil engineering, piping, electrical connections, control
- Longer start up
- Very high costs.

4) ID3 Device

ScreenTEK applications

↗Brown or white grades
↗ID2 single stage screen
↗15 to 50% RRW
↗Consistency from 0.8 to 3%
↗Fine slots from 0.10 to 0.25
↗(CH UV SP replacement)

The agitation generated by the pulp pass into the ID2 can be utilised to add water for dilution with a very good efficiency. Thanks to this device, the two sections accept can be independently adjusted which allows us to fine-tune the reject rates of the first and the second section. This concept is the basement of our FibreNET.

ScreenTEK Files

↗Size A MC (630mm 110kW) priority 3
↗Size A LC (630mm 55kW) priority 3
↗Size B MC (780mm 160kW) priority 3
↗Size B LC (780mm 75kW) priority 3
↗Size C MC (960mm 250kW) priority 3
↗Size C LC (960mm 110kW) priority 3
↗Size D LC (1200mm 160kW) priority 3
↗Size E LC (1500mm 250kW) priority 3

5) FibreNET

The FibreNET has been developed to handle

contimuously the rejects of a screening system fitted with holes or slots. The global reject rate is strongly decreased du to the intermediate dilution; the second section is working like a fibre recovery section, The ID3 device allows an optimal use of the total screen cylinder length.

During the perfecting of the prototype, numerous trials were performed with excellent results. As an average, the losses are around 5% for white grades and 9%for brown grades. Until now the rejects were scrapped in the sewer, meaning that the FiberNet has been able to reduce the final rejects with a factor 11 to 20! The use of very fine slots allows a very high efficiency, which makes possible the forward of accepts to the stock preparation loop.

The "Everbal" mill wanted to reduce the fibre losses. A FiberNET size 5 has been installed to handle the 3rd stage rejects of the slotted screening and accepts of the vibrating screen handling rejects of the holes screening.

The results are in accordance with those of the prototype. The reject rate by weight is about 4,8%, meaning a recovery of 95% of the treated pulp. The white water consumption to clean the fibres is in a range of 22 cubic meters per tonne. The power consumption (14,7 kWh/t) is a little bit high compared to the prototype du to a constant speed (not variable) to able for the screen to handle the worse conditions of production.

6) Screen ONE

ScreenONE has been designed as a compact complete screening system with fine slots. In order to reduce the reject rate, we have inserted two ID3 with a targeted reject rate of 2% for the screen. In order to reduce the development cycle, we have decided to built it by using the mechanical base of the Thermo Black Clawson UV screens, world wide well reputed as very strong reliable screens.

The results of the trials made in our R&D facility are summarised in the previous chart.

The reject rate is very low for the white grades, it is according to the target for European OCC. (This is what we expected taking into account the characteristics of this stock).

The specific energy is low for the white grades (10,2kWh/t) and slightly higher for brown grades.

The "Papeteries de la Seine" belonging to the Smurfit - Socar Group have tested our prototype in their stock preparation line. The obtained results are in accordance with those made in our research centre. The specific energy and the reject rate are slightly higher, probably du to higher consistency, higher stickies and contaminants level.

The "Paperteries du Limousin" belonging to the Smurfit Socar Group have as well tested our prototype with equal results in the stock preparation line.

By "Cartiera Lucchese" in Italy, we have tested our prototype in even worse conditions. The consistency is very high (over 5%) and the flows are much higher compared to those reachable in our research centre. This has been achieved du to the very low specific energy used for this pulp (between 6 and 7 kWh/t) This very high production shows clearly all the potential of the ID2/ID3 devices.

We have been even more ambitious. We have fitted the 3rd stage with a 0.10mm wedge-wire screen cylinder. The production, the specific energy and the reject rate have not been affected by this change. On the other hand the last section cleanliness has been tremendously improved.

CONCLUSION

The first industrial applications for our RetroFIT ID2 are on going in Lamort and Thermo Black Clawson equipment. This process starts to be more and more popular in Europe and is difinitively the new screening process standard in North America.

After numerous very satisfying industrial trials, we have started the marketing of our FiberNET as a :

- Last stage screen
- Unique screen for small production lines.

The size 3 and 5 are available.

As well the trials with our ScreenOne have been successful and we have started the marketing. Four sizes are available :

- A : equivalent to the prototype
- B : 1,5 time the prototype
- C : 2,1 time the prototype
- D : 3,0 time the prototype

We maintain that the ID2/ID3 device will allow the paper industry to improve globally the pulp screening, to improve the recycling rate of board and paper, and in the mean time to decrease investments costs, power consumption an scrapped material.