High Performance Foil Rotor Improves De-Ink Pulp Screening

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Our Goal

To help our customers by:
- enhancing pulp quality (efficiency / fractionation)
- increasing capacity
- reducing power consumption
- reducing the overall cost of pulp screening
Pulp Screening Basics

- Pressure screens are essential for contaminant removal and fibre fractionation
- Cylinders and rotors are the key performance parameters
Nomenclature

Positive Peak, $P_{\text{max}}$

Negative Peak, $P_{\text{min}}$

Pulse Width

Pressure Coefficient: \[ C_P = \frac{P}{\frac{1}{2} \rho V_t^2} \]

Power Consumption: \[ C_{\text{Power}} = \frac{P}{\rho V_t^3 D^2} \]
Previous Work

Wall Cp vs. foil camber (numerical, Feng et al. 2005).

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CFD Single foil
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Wall Cp vs. angle-of-attack for a NACA 0012 foil (numerical, Feng et al. 2005).

\[ C_P = \frac{P}{\frac{1}{2} \rho V_t^2} \]
New Developments

Foil Parameters Studied:
- Angle-of-attack (α)
- Flap Angle (δ)
- Flap positioning

Canadian Forces C-130

Anderson, 1991
Results

Flap angle was varied at a constant $\alpha$:

$\delta = 7^\circ$:
Results

Flap angle was varied at a constant $\alpha$ :

$\delta = 15^\circ$:
Results

Flap angle was varied at a constant $\alpha$:

$\delta = 22^\circ$: 

[Image of a diagram showing flow characteristics with a legend indicating pressure values.]
Results

Flap angle was varied at a constant $\alpha$:

$\delta = 29^\circ$:
Results

Flap angle was varied at a constant $\alpha$:

$\delta = 36^\circ$: 
Results

The $\alpha$- and $\delta$- sweep data was combined to create surfaces of max. and min. wall $C_P$.

Min. $C_P$ vs. $\alpha$ and $\delta$. The ‘x’ marks the optimum of $C_P = -0.82$ at $\alpha = 1.2$ deg. and $\delta = 16$ deg.
Results

Surfaces were constructed of min. and max. wall $C_P$ vs. x- and y- position of the flap LE:

Min. $C_P$ vs. x and y positions of the flap LE. The optimum of $C_P = -0.82$ is at $x = -0.05*c$ and $y = -0052*c$. 
Mill Trial – De-Ink Fine Screen
Mill Trial – De-Ink Fine Screen

Catalyst Paper, Paper Recycling Division Flowsheet
Mill Trial – De-Ink Fine Screen

![Graph showing power (kW) vs. tip speed (m/s) with data points for DEF Rotor and OEM Rotor. The graph indicates a 42% increase in power at a certain tip speed.](image-url)

- Power (kW)
- Tip Speed (m/s)

**DEF Rotor**

**OEM Rotor**
Mill Trial – De-Ink Fine Screen

![Graph showing Stickies Removal Efficiency vs Tip Speed (m/s)]

- DEF Rotor
- OEM Rotor
Mill Trial – De-Ink Fine Screen

![Bar Chart]

**Stickies Removal Efficiency**

- **OEM Rotor**
- **DEF Rotor**

Comparison between OEM Rotor and DEF Rotor for Stickies Removal Efficiency in Count and Area.
Mill Trial – De-Ink Fine Screen

![Graph showing stickies distribution](image)

Accept Stickies Concentration (number per gram)

- OEM Rotor
- DEF Rotor

Stickies Distribution (mm²)
Conclusions

- Multi-element foil technology allows for greater control of pressure pulse.
  - Wider, stronger pulse can be obtained
- Reducing Rotor Speed Increases Stickies Removal Efficiency
- Power savings of 42% have been shown thus far with equivalent OEM rotor capacity
- Preliminary mill trials extremely promising.
Thank you!

Questions?