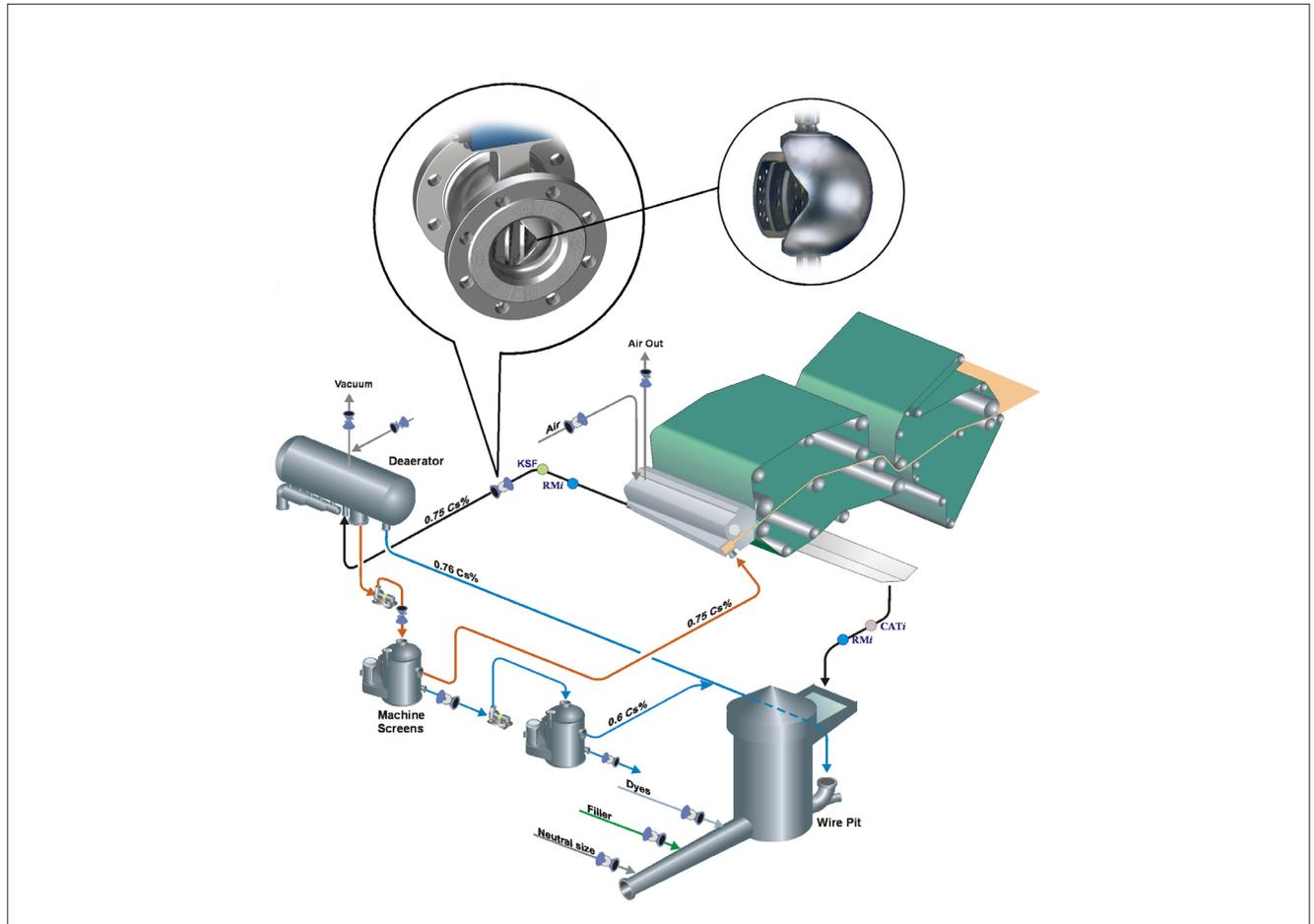


Q-Trim™ in paper machine headbox loops



Overview of the process

To meet the current demand for producing greater amounts of quality grade paper in the shortest possible time, modern paper machines run at even higher speeds (1500 m/min...4900 ft/min) than in the past. Because this requires higher pressures within the headbox, it is important that pulsations or vibration caused by cavitation resulting from high pressure drops across control valves be eliminated.

The process

The part of the process where the stock is blended with

white water and pumped through the approach flow piping to the headbox is called short circulation. White water, which falls through the wire into the wire pit contains fibers and additives. Fast running machines require higher headbox pressure, therefore, cavitation may occur in the recirculation control valve.

Results

Normally some 10 % of the total flow is recirculated through the bypass line after the inlet header. Control of the headbox is critical and seeks to eliminate any pulsations or flow velocity differences across the full width of the wire.

Recirculation control valve

Fast running machines require high pressure, 4 bar (60 psi), in the inlet header and in the headbox. To maintain the same pressure conditions in the front end and in the rear end of the tapered inlet header a recirculation valve is used.

As the differential over the recirculation valve remains high, cavitation can occur. Vibration can be carried to the headbox and cause disturbances to the paper quality.

To avoid the cavitation in ball and ball segment type valves we have developed the Q-Trim. It has been used successfully in headbox recirculation systems on many paper machines.

The combination of holes and plates produces the multi-stage pressure drop needed to prevent cavitation. A few installations are listed below.

Company, mill	Machine	Paper	Speed m/min	Valve type
Shotton Paper Co. PLC, United Kingdom	PM2	News	1500 (4921 ft/min)	Q-R V-port segment valve
Cellulose de Stracel, France	PM1	News	1500 (4921 ft/min)	Q-R V-port segment valve
United Paper Mills, Finland Kaipola Rauma	PM7 PM2	News SC	1500 (4921 ft/min) 1400 (4593 ft/min)	QL-C2C ball valve
Oji Paper Co., Japan Nishinan Yonago	PM3 PM1	Fine Fine	≈1000 (3280 ft/min) ≈1000 (3280 ft/min)	Q-R V-port segment valve
Willamette Industries, Bennettsville, S.C. USA	PM1	Uncoated Fine	1100 (3500 ft/min)	Q-R V-port segment valve
Enso Fine Papers Oy, Finland Oulu	PM6 PM7	Fine Fine	1200 (3937 ft/min) 1600 (5249 ft/min)	Q-C2C ball valve Q-R V-port segment valve
Kemi	PM2 PM5 PM7	Fine LWC Fine		Q-R V-port segment valve Q-R V-port segment valve Q-R V-port segment valve



How does the Q-Trim work?

The Q-Trim is controlling the fluid velocity: this is an effective mean avoiding cavitation. The aim of this is to get the lowest pressure in the valve trim above the vapour pressure for the liquid in question.

A Q-Trim valve utilizes a combination of the following effects:

- The pressure drop is taken in multiple stages, leading to lower valve trim velocity and higher trim minimum pressure.
- Division of the flow into multiple streams diffuses the flow and provides acoustic control.
- The trim outlet is designed in such way that the flow is spread out evenly across the downstream flow port.

The rotary motion in rotary type of valves, such as the segment valve gives additional benefits of being able to handle a very large flow range and pass pulp fibers through the valve.

The demonstration

To demonstrate how effective the Q-Trim is in this application we have made two sizing calculations with typical process data.

Case 1:

Two butterfly valves installed in series (common in many mills)

Case 1:

The screenshot shows the Nelprof 6.0 software interface. The main workspace displays the following data:

Pipeline	Unit	Inlet dia	Outlet dia	Thickness	Schedule
	mm	200	200		40

Flow data	Unit	Case 1	Case 2	Case 3	Case 4
Liq flow	m3/h	700	700		
Inlet temp	degC	40	40		
Inlet press	barG	4	2		
Press diff	bar	2	2		
Outlet press	barG	2	0		
Vap press	barA	0.085	0.085		

Valve...	Unit	Type	Press rating	Code	Size
	mm	ALL	ALL ANSI	L-ANS1150	200

Results	Unit	Case 1	Case 2	Case 3	Case 4
Max capacity	FpCv	3050			
Req capacity	FpCv	570.28	596.17		
Travel	%	47.3	48.6		
Opening	deg	44.1	45.3		
Noise	dBA [IEC]	87	92		
Flow velocity	m/s	6.19	6.19		
Terminal dp	bar	3.13	1.84*		
FI coeff.		0.8	0.79		

The 'Result:' field at the bottom of the interface shows: **L-ANS1150 200**

Case 2:

One valve in use: Q-Trim R-series

Like the attached calculation data shows the two butterfly valves (half of the pressure drop taken by each) cause cavitation and high noise/vibration.

One Q-Trim can handle these conditions without problems.

Case 2:

The screenshot displays the Nelprof 6.0 software interface. The main window is titled 'Nelprof 6.0' and contains a menu bar (File, Edit, Create, Calculation, ISA Sheet, Sort, Preferences, Help) and a toolbar. The interface is divided into several sections:

- Left Panel:** A tree view showing a project structure with folders for 'Project', 'Area', 'Tag', and 'Control'.
- Control Panel:** Includes buttons for 'Liquid', 'Water', 'Pulp', 'Gas', 'Steam', and '2-phase'. A dropdown menu is set to 'Mechanical pulp'. Below are input fields for 'Consist %' (0.9), 'Crit press' (221.2 barA), 'Special servi' (Normal), and 'Dpm-factor' (0.3). There are also fields for 'Design P', 'DesignTmax', and 'DesignTmin'. Checkboxes for 'Actuator sizing' and 'Recommended safety factor' are present. A 'Resistors' section has a 'Details' button. A large 'Calculate' button is at the bottom of this panel.
- Right Panel:** Contains several data tables.
 - Pipeline Table:**

Pipeline	Unit	Inlet dia	Outlet dia	Thickness	Schedule
	mm	200	200		40
 - Flow data Table:**

Flow data	Unit	Case 1	Case 2	Case 3	Case 4
Liq flow	m3/h	700			
Inlet temp	degC	40			
Inlet press	barG	4			
Press diff	bar	4			
Outlet press	barG	0			
Vap press	barA	0.085			
 - Valve... Table:**

Valve...	Unit	Type	Press rating	Code	Size
	mm	ALL	ALL ANSI	Q-RA	200
 - Results Table:**

Results	Unit	Case 1	Case 2	Case 3	Case 4
Max capacity	FpCv	880			
Req capacity	FpCv	403.25			
Travel	%	73.7			
Opening	deg	67.9			
Noise	dBA [IEC]	84			
Flow velocity	m/s	6.19			
Terminal dp	bar	4.11			
Fl coeff.		0.91			

At the bottom of the right panel, the 'Result:' field displays 'Q-RA 200'.

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