EXPERTIP

Category	FORMING
Keywords	Forming fabric, Drive Load, Drag Load, Vacuum Schedule, Fabric Life

Tips for Reducing Forming Fabric Drive Load

Big savings can be obtained by reducing forming fabric drive load. Case studies included below highlight:

- Forming fabric life increased 2.5x
- Drive load energy savings of 5 to 9%
- Off-couch solid increase of 1%

In this ExperTip, we show you a method for determining drag load on a Fourdrinier table. Drag load or power consumption is defined as the change in tension of the forming fabric as it passes over a drainage component. Any steps taken to reduce this drag will help decrease energy consumption on the machine and also potentially increase fabric life and reduce drainage issues related to excessive forming fabric wear late in life.

Drag Load

In order to calculate the drag load, the total horsepower contribution must be determined. Standard horsepower can be calculated as (Amps x Volts)/746 = Horsepower. This calculation should be done for all contributing drives. Add all contributing drive horsepower together. Couch drive + Wire turning roll drive + Return roll drive = Total Horsepower. Calculate the drag load in pli using ((Total Horsepower x 33,000) / (Fabric Speed x Fabric Width)) x 0.08 = 80% of the drag load (pli). (Note that 1 pli equals 0.175 kN/m). 80% efficiency is used as an assumption for mechanical losses in the transmission of the drive horsepower.

The calculated drag load (pli) can be checked against standards listed below for Fourdrinier machines. *TABLE 1* is a list for fine paper grades and *TABLE 2* is a list for packaging grade drag-load guidelines. There are no firm guidelines for gap formers, but diagnosing an excessive increase in drag load or excessive fabric wear could point toward similar issues in contributing elements on a gap former as noted below for Fourdrinier table elements.

If a reduction in drag load is needed to meet the optimal standards, the vacuum schedule, vacuum slot standards, and vacuum box cover design should be reviewed. Recommend at least a 2"(5cm)Hg vacuum increase in consecutive high vacuum zones units moving toward couch. Vacuum should not exceed the recommendations in *TABLE 3* for the slot width of the structure. Excessive vacuum over slots that are too wide for the vacuum level can cause the fabric to be pulled too far into the slot creating the extra drag.

Additionally it is recommended no more than 6 vacuum slots are utilized after reaching 16% to 18% sheet consistency. More than 6 slots in this consistency range will have inadequate water available for lubrication later in the vacuum zone and cause increased drag load and fabric wear.

TABLE 1. Power Consumption or Drag Load Guidelines - Fine Paper

Machine Speed	
< 600 m/min (~2000 ft/min)	≥ 600 m/min (~2000 ft/min)
< 3.5 kN/m (20 pli) is a very well managed machine	< 4.4 kN/m (25 pli) is a very well managed machine
4.4 to 6.1 kN/m (25 to 35 pli) is normal	5.2 to 7.0 kN/m (30 to 40 pli) is normal
> 6.1 kN/m (35 pli) is a problem	> 7.0 kN/m (40 pli) is a problem

TABLE 2. Power Consumption or Drag Load Guidelines - Packaging Grades

Machine Speed	
< 550 m/min (~1800 ft/min)	≥ 550 m/min (~1800 ft/min)
< 5.2 kN/m (30 pli) is a very well managed machine	< 6.1 kN/m (35 pli) is a very well managed machine
6.1 to 7.9 kN/m (35 to 45 pli) is normal	7.0 to 8.8 kN/m (40 to 50 pli) is normal
> 7.9 kN/m (45 pli) is a problem	> 8.8 kN/m (50 pli) is a problem

TABLE 3. Slot Width versus Operating Vacuum

Slot Width	**Operating Vacuum Range**
1.0'' (2.5 cm)	Up to 5.0'' (12 cm) Hg
0.75'' (1.7 cm)	5.0 to 9.0'' (12-23 cm)
0.625'' (1.6 cm)	9.0 to 18.0'' (23-46 cm)
0.50'' (1.2 cm)	Above 18.0'' (46 cm)

If it is determined that drag load is normally in range but has recently elevated, the following checklist can be used to determine potential issues:

1. Pulp or thick stock freeness has dropped lower than it normally runs
2. Poor guiding systems can contribute to high drag load as a fabric is laterally stressed
3. High air pressure in suction roll's load tubes (normal: 0.4 to 1.0 bar or 5 to 14 psi)
4. Insufficient lubrication water delivered inside suction roll in internal shower
5. Excess vacuum application in LoVac structures causing high dewatering rates and associated added drive load
6. Excessive vacuum settings or improper vacuum graduation in high vac boxes
7. Too many HiVac boxes that consume drive horsepower without additional dewatering benefits
8. Deep position of loadable blades
9. Wrong power distribution (drive split between driven rolls)
10. High load pressure of doctor blades
11. Too high fabric tension
12. Too rapid early table drainage causing sheet sealing conditions that create the need for excessive vacuum application to remove water
13. Too high vacuum application in the HiVac boxes made necessary by poor dewatering earlier in the table (sheet sealing)
14. If forming fabric has monofillament fibrillation damage or fiber entrapment in fabric structure
15. A different forming fabric design may require less vacuum application. Applying the same vacuum as prior design will create excess drive load
16. Dirty forming fabric

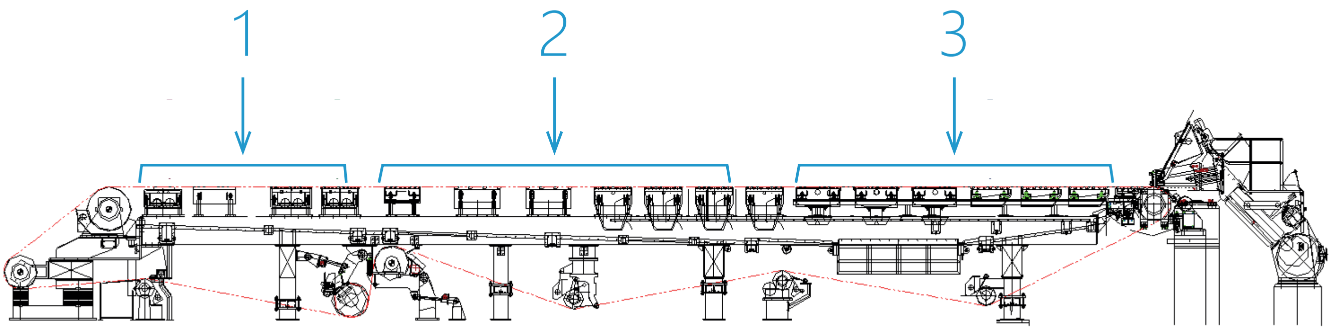


Figure 1. Power Consumption or Dragload - Influencing Factors.

1. Hivac Area	2. Lovac Area	3. Forming Section	4. Misc.
Cover Design Number of Units Vacuum Schedules Cover Material	Proper Application Number of Units Vacuum Schedules	Sealed Sheet Blade Design	Bearings, Doctors, etc.

Case Study No. 1 - Corrugating Medium

Goal: Reducing fabric wear was the primary objective. Reduction of total drive load energy was the secondary objective.

Method: Drag load was determined to be high contributing to excessive fabric wear. The 1st Duovac (chamber 1&2) had 16 slots at 1" width with doctoring type blades. This made this box an obvious choice for elimination in this optimization trial. The 1st Duovac was shutoff reducing drive loads with minimal effect on solids off the couch. Additional load reduction was achieved with proper vacuum redistribution and proper graduation over the high vacuum boxes. The last DuoVac unit needed internal repair (seal between two chambers was leaking) to allow for addition optimization, which would allow another reduction in total drive load. Couch solids and steam usage were monitored during the trial to ensure no loss of off-couch solids.

TABLE 4.

Unit	Initial Vacuum	Initial Consistency	Initial Drive Load	Final Vacuum	Final Consistency	Final Drive Load
Duovac 1	4.8	15.6%	#1 Couch - 22%	0	10.1%	#1 Couch - 19%
Duovac 2	7.0	15.6%	#2 Couch - 19%	0	10.1%	#2 Couch - 19%
Duovac 3	7.8	18.9%	#1 WTR - 70%	7.5	18.9%	#1 WTR - 63%
Duovac 4	10.3	18.9%	#2 WTR - 74%	12	18.9%	#2 WTR - 64%
Duovac 5	14.8	21.7%		14.8	22.4%	
Duovac 6	14.3	21.7%		14.3	22.4%	
Couch	16.2	24.3%		16.2	23.7%	

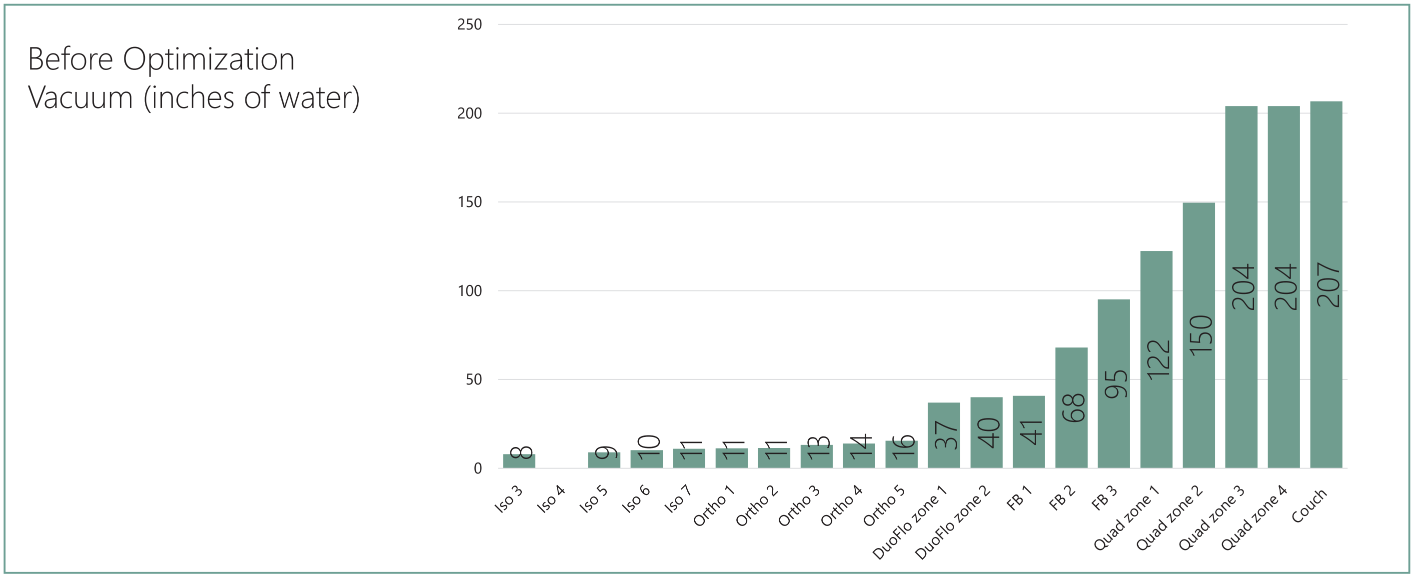
Benefits:

- Drive load levels indicated there was a 9% decrease in the wire turning roll drive load. This was equivalent to 90 HP on two motors for a total 180 HP drive load reduction. This produced $70,384 in electric savings.
- The reduced drag load that minimized the excessive fabric wear improved forming fabric life from an average of 60 days to 160 days.

Case Study No. 2 - Linerboard

Goal: Optimize couch solids

Method: Improving the vacuum graduation was achieved by shutting off two of the seven high vacuum zones. Then the total vacuum was optimized over five zones.



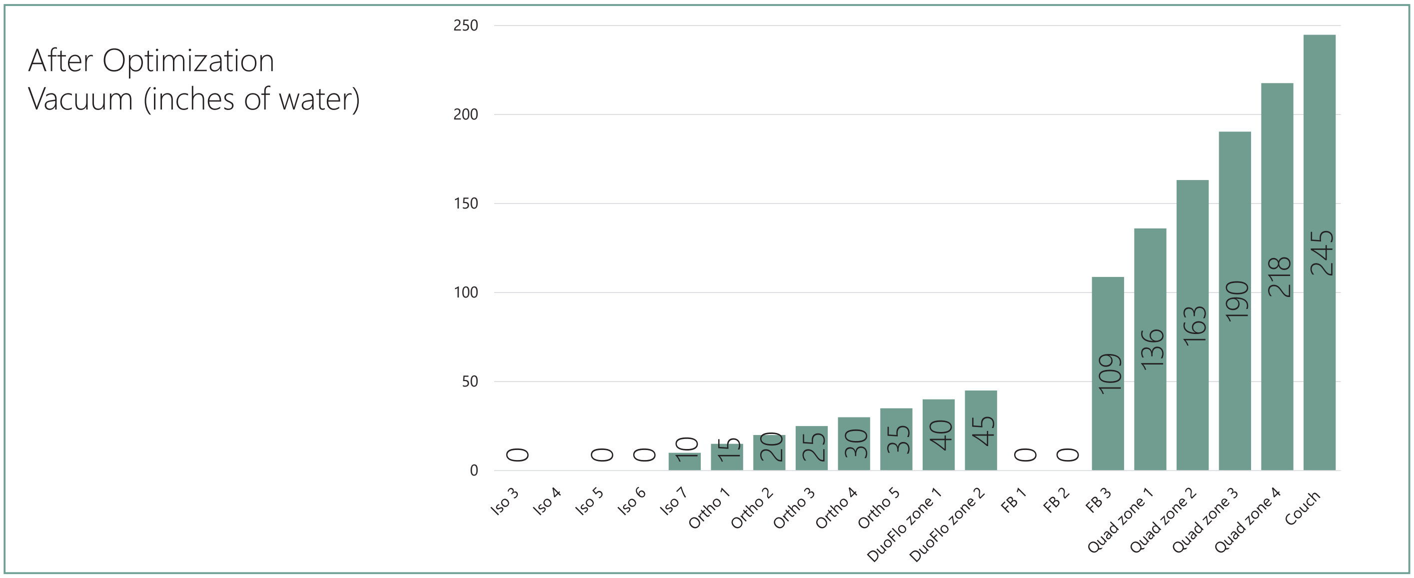


Figure 2.

Benefits:

- The changes produced a 1% Increase in couch solids.
- Additional benefit of proper vacuum graduation was the 5% drive load reduction on two 1500 HP motors.

Got Questions?

We are here to help. We distribute **ExperTips** to help you improve the performance of your paper machine. Not just fabric performance, but the overall efficiency, reliability, and productivity of your mill.

If you have questions about anything you see here, please contact us by emailing **expertip@astenjohnson.com** or visiting our website **www.astenjohnson.com/expertips**.

And, if you have suggestions about other topics you would like to receive an ExperTip on, we would love to hear from you!