DALHOUSIE UNIVERSITY
Faculty of Engineering
Department of Chemical Engineering

Beer Filtration and Filter Aid Recovery at Oland Brewery

Kaitlin McMillan
Björk Eyvindson
Tareq Amasheh
Amir Seidshazileh

OLAND BREWERY
Generations of Great Maritime Brewing.

Introduction

Project Objective:

Optimize the filtration and downstream processing system at Oland's brewery in order to meet current operating targets.

Process:

1. Filtration until maximum cake space or pressure reached.
2. Washout to remove cake from filter screens.
3. Cake and water (DE slurry) enters series of holding tanks.
4. Rotary Vacuum Drum Filter (RVDF) separated water content from slurry.
5. Dry DE can be removed and disposed of off site.

Issues:

- RVDF unable to process slurry at a sufficient rate.
- PLF using higher water volumes than required to clean screens creating excess slurry.
- Pump trucks required during peak seasons to remove slurry due to RVDF rate.

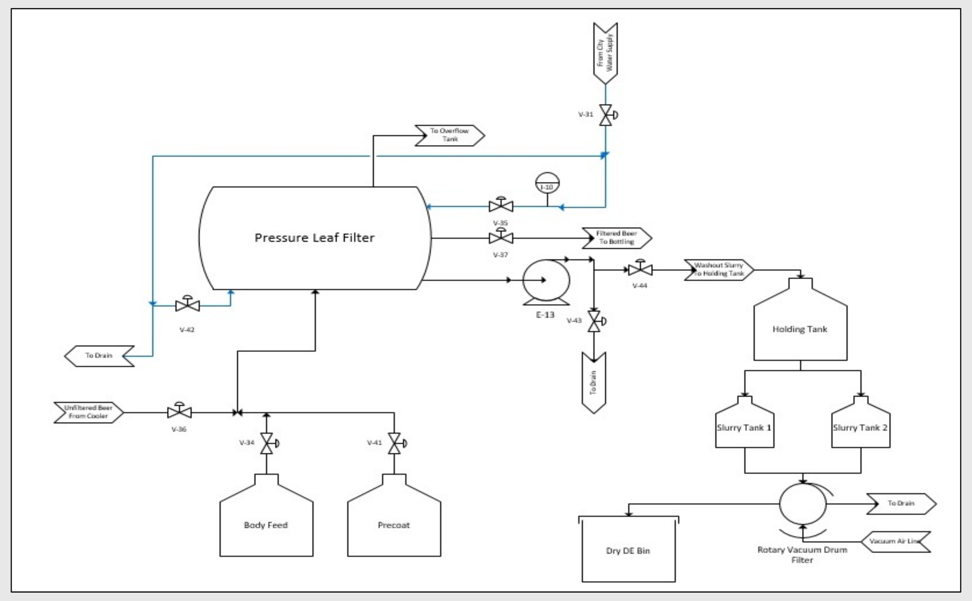

Figure 1: Oland's filtration and downstream processing process

Optimization Objectives

Pressure Leaf Filter	
Objectives	Optimize operation of the PLF to obtain more efficient washouts through altering pulse and pause sequencing.
Requirements	Reduce the volume of water used in a washout in order to optimize weight percent solids exiting the PLF.
Specific Requirements	1) Reduce water volume by 32%. 2) Increase weight percent solids from 7% w/w to 10% w/w. 3) Maintain or decrease washout time from 62 minutes.
Rotary Drum Vacuum Filter	
Objectives	Optimize operation of RDVF to increase the rate of processing to match the rate of DE slurry exiting the PLF.
Requirements	Improve the rate of processing DE by improving the slurry coagulation.
Specific Requirements	1) Improve removal of cake from RDVF cloth. 2) Improve solids content in RDVF tank. 3) Improve distribution of cake on RDVF cloth.

Pressure Leaf Filter Optimization

Theory:

- Oland's currently uses pulse and pause sequencing, which can be used to optimize cleaning with pause time having the largest effect on cleaning grade.
- Testing aimed optimizing pulse and pause times to minimize water used.

Testing:

- Four parameter sets developed.
- Eight tests performed during washouts at Oland's.
- Metrics collected:
  - Pressure upon start up
  - Water usage
  - Time of washout
  - Cake Space on filter prior to washout

Testing Parameters:

Step	Description	Parameter Set				
		Original Parameters	1	2	3	4
Step 1	Bottom Pulse(s)	40	40	40	38	35
	Bottom Pause(s)	20	10	2	10	20
Step 1 Time (min)		**5**	**4.2**	**3.75**	**4**	**4.6**
Step 2	Top Pulse(s)	40	40	40	38	38
	Top Pause (s)	20	10	2	10	10
	Bottom Pulse(s)	40	40	40	38	38
	Bottom Pause(s)	20	10	2	10	10
Step 2 Time (min)		**22**	**18.3**	**16.5**	**17.6**	**17.6**
Step 3	Top Pulse(s)	20	20	20	19	19
	Top Pause (s)	15	10	2	10	10
	Bottom Pulse(s)	20	20	20	19	19
	Bottom Pause(s)	15	10	2	10	10
Step 3 Time (min)		**28**	**24**	**20**	**23.2**	**23.2**
Total (min)		**55**	**46.5**	**40.25**	**44.8**	**45.4**

Tests Performed:

Test	Parameter Set	Cake Space	Volume Filtered (hls)	Start Up Pressure (psig)	Water Usage (m^3)
1	1	89%	2465	18	18.15
2	2	88%	2575	17	19.63
3	3	67%	1534	18	17.25
4	3	87%	2201	18	17.25
5	4	92%	3062	18	17.15
6	4	45%	905	18	17.15
7	4	63%	1510	18	17.15
8	4	61%	1722	18	17.15

Results:

1. Pause times showed little to no effect on washout quality.
2. Up to 5.5% reduction possible by reducing pulse times.
3. Potential to target washout length based on cake space.

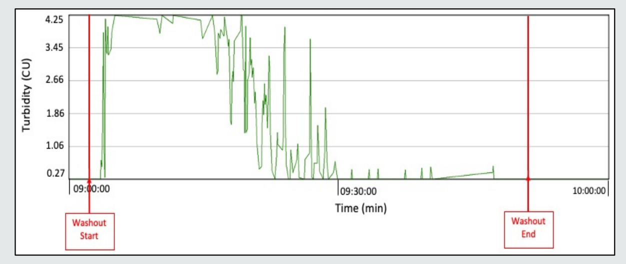

Figure 2: Turbidity during washout for Test 5

61% Cake space

- ➢ Washout completed after only ~ 30 mins

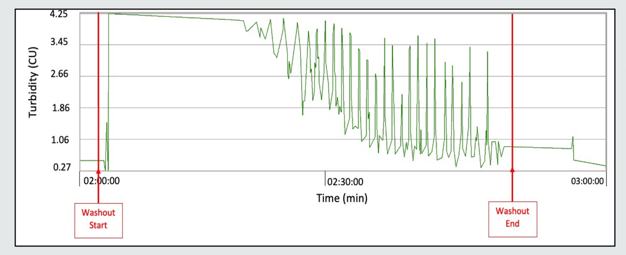

Figure 3: Turbidity during washout for Test 8

92% Cake space

- ➢ Washout completed after full 55 mins

Economics:

1. Up to 8% (1100 m^3) annual washout water reduction possible from successful testing to date.
2. Up to 3% increase in production time from reduced washout time possible from successful testing to date.

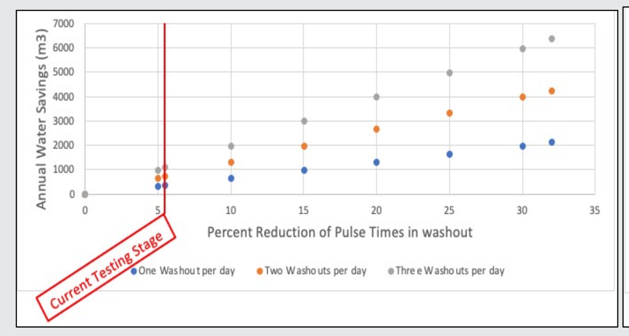

Figure 4: Potential decrease in annual water usage

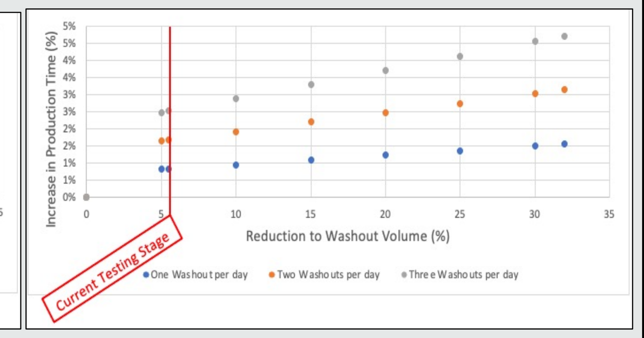

Figure 5: Potential increase in production time

Rotary Vacuum Drum Filter Optimization

Flocculent Addition to RVDF Slurry

Theory:

- Flocculent addition to the DE slurry forms larger clusters of particles, which enhances cake formation.
- Newly formed particle clusters have different settling times, and the newly formed cake has new characteristics.

Testing:

Flocculent doses:

1. 0 ppm
2. 50 ppm
3. 100 ppm
4. 200ppm

Metrics:

1) Settling time
2) Stickiness
3) Firmness
4) Dryness

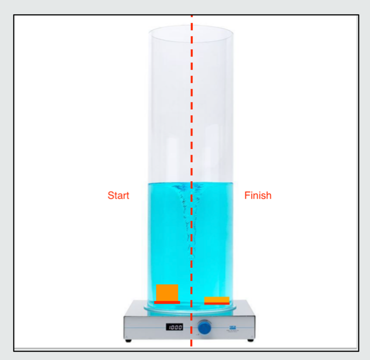

Figure 6: Stickiness testing process

Results:

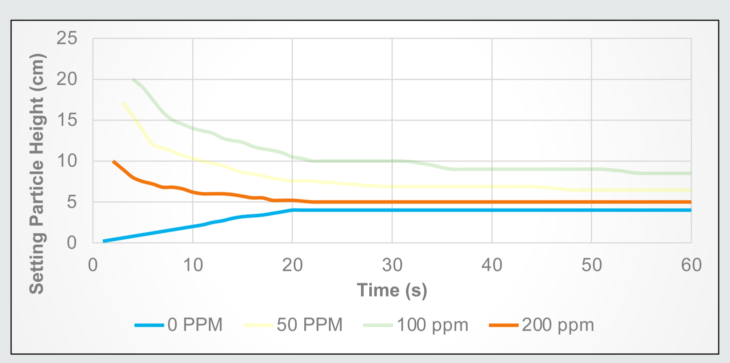

Figure 7: Sedimentation over time for various flocculant doses

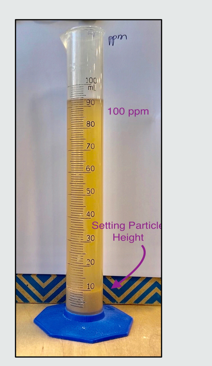

Figure 8: 100 ppm settled slurry

- Clear drain water
- Economic benefits: Decrease operational cost from $6,300 to $20

PAC Dose	Relative Stickiness Changes %	Relative Firmness Changes %	Dryness
100 ppm	3.1	-15	Negligible

RDVF Discharge System Modification

Theory:

- Changing the current knife design will allow better extraction of DE when paired with the flocculent addition part of this project.
- The pressure applied to the knife when approaching the DE cake would also affect the extraction efficiency.

Design:

- The new knife designs involve knives that have differently shaped edges, shown in Figure 9.

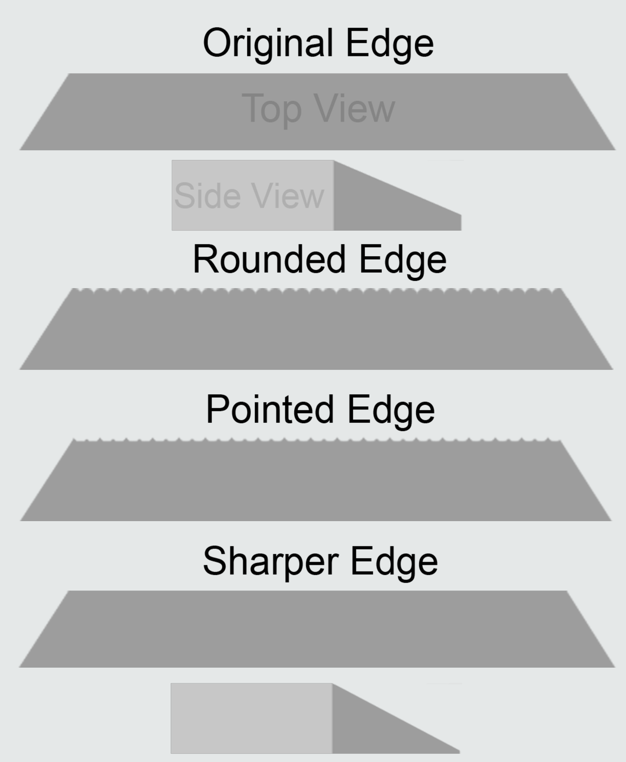

Figure 9: Knife design edge shapes

Equipment

Pressure Leaf Filter:

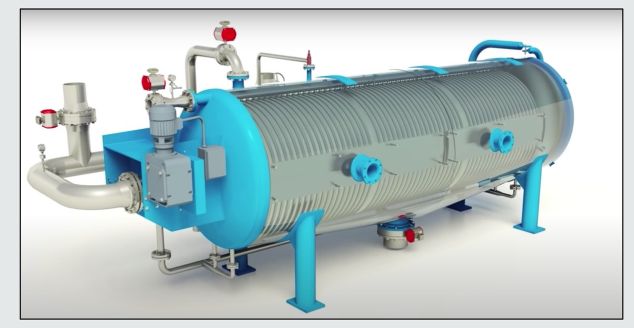

Figure 10: Pressure Leaf Filter model (Veolia Water Technologies, 2016)

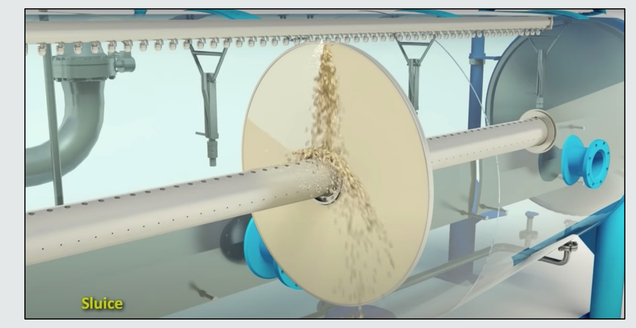

Figure 11: Sluicing DE cake from pressure leaf filter screens (Veolia Water Technologies, 2016)

Rotary Drum Vacuum Filter:

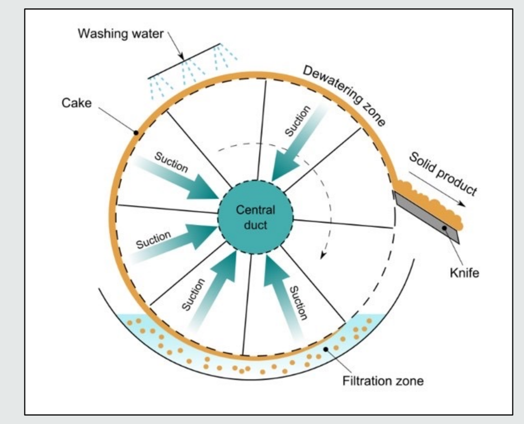

Figure 12: RVDF washout system (Pugliesi, 2009)

Recommendations

Pressure Leaf Filter:

1. Continue testing incremental reductions to water volume by reducing pulse time.
2. Document cake space and turbidity to identify opportunity for targeted washout length based on cake space.
3. Ensure maintenance is completed on screens and all screens are in place.

Rotary vacuum Drum Filter :

1. Continue tests for wider varieties of flocculant dosses to find the optimum flocculant addition.
2. The new knife designs need to have more testing done on them. This is to prove if the knives are operating the way they should be which is the improved extraction of DE and less rotary drum vacuum filter cloth tearing.
3. In addition, the pressure adjustment system on the knife should be changed into an automated system rather than the manual system that is currently in use.

References

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