

NEXT LEVEL SOLUTIONS

PUMPS & FILTRATION SYSTEMS ›

PELLETIZING SYSTEMS ›

PULVERIZING SYSTEMS ›

RECYCLING SYSTEMS ›

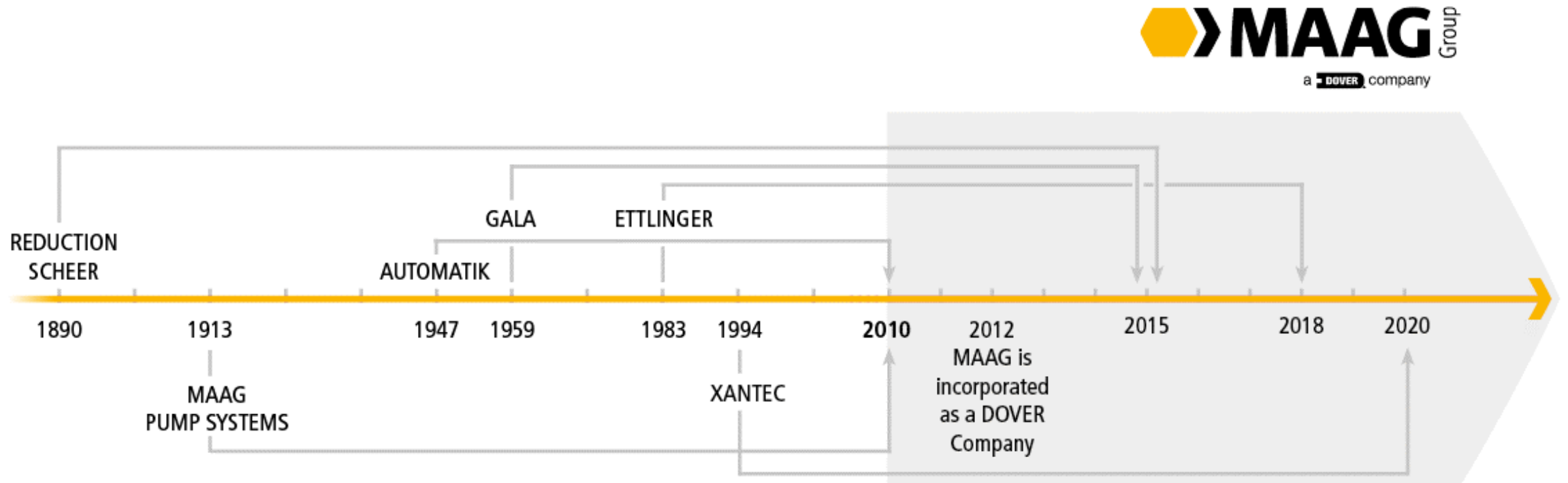


a **DOVER** company

Historical Timeline



MAAG Group today is formed by six successful and well experienced companies with an impressive heritage. Each of them brings a wealth of knowledge and years of experience. All six have achieved much in the past and will achieve even more together in the future.

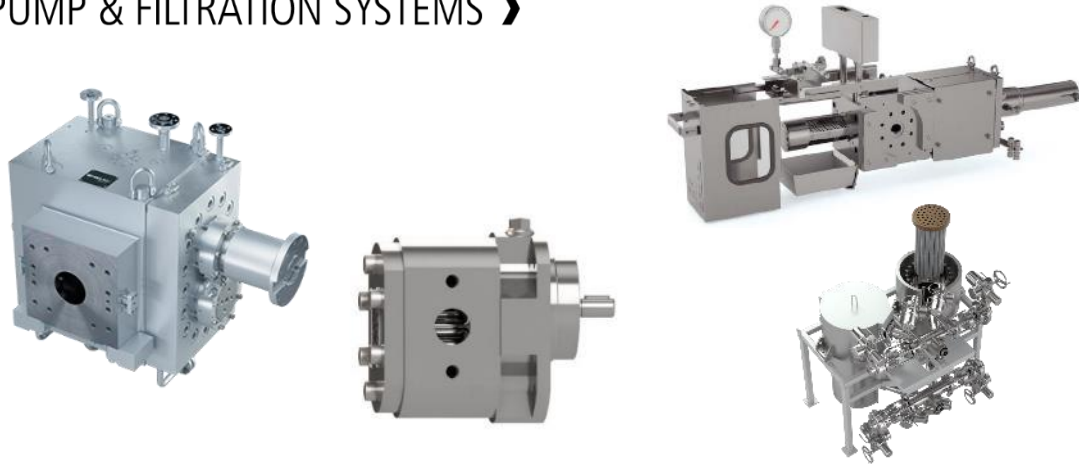


Wherever you are ...



Integrated Systems for Polymer Processing

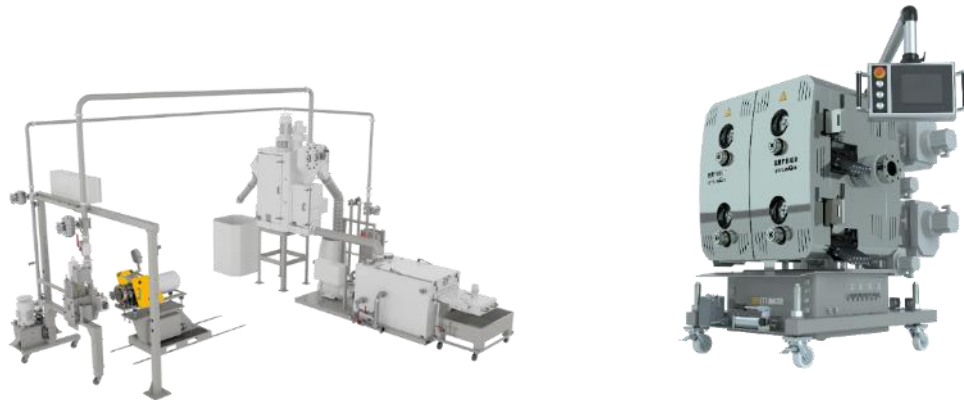
PUMP & FILTRATION SYSTEMS >



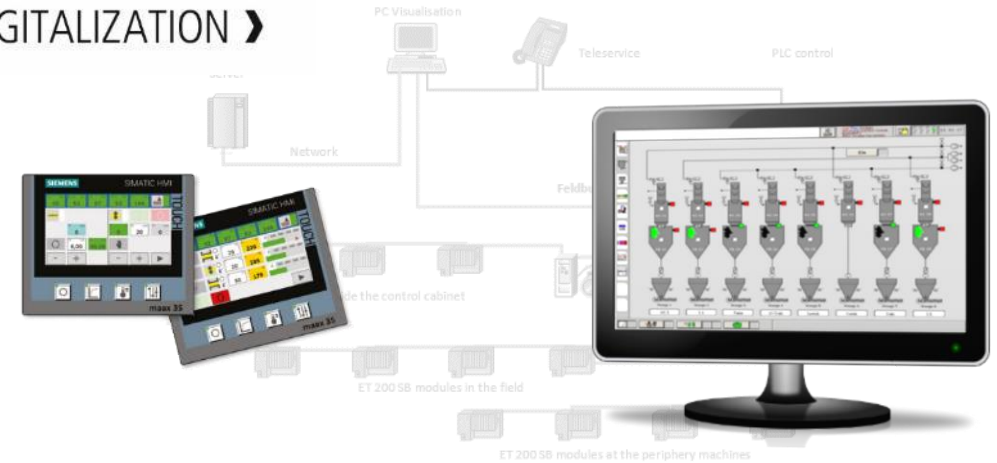
PELLETIZING & PULVERIZING SYSTEMS >



RECYCLING SYSTEMS >



DIGITALIZATION >





ERF – Melt Filter

For products with up to 16% contamination
Designed for Recycling Lines
In production since 2004



ECO – Melt Filter

For products with up to 1.5% contamination
Designed for Production Lines to improve quality
Introduced to the US in 2015

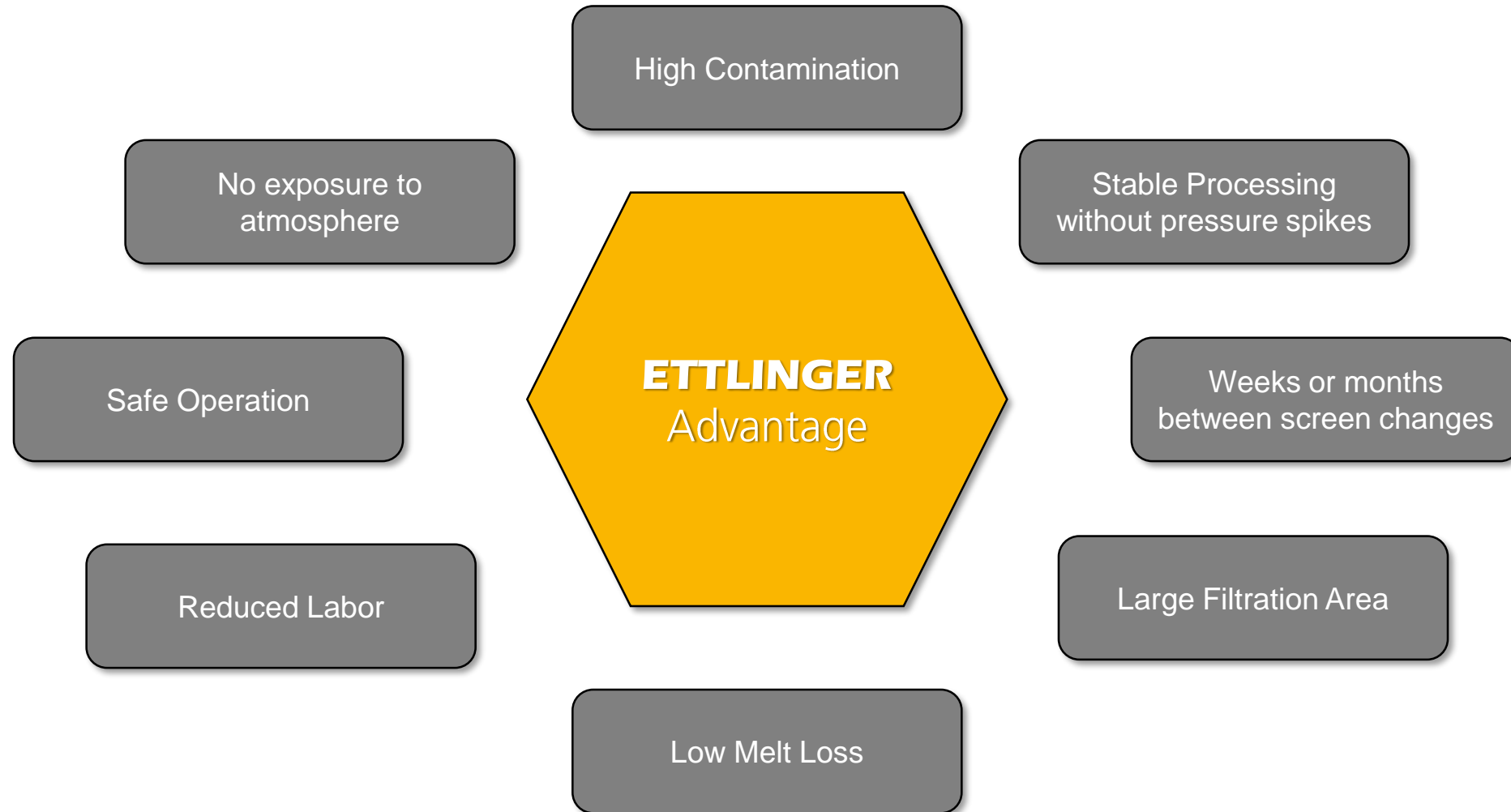
ERF – Principle of operation



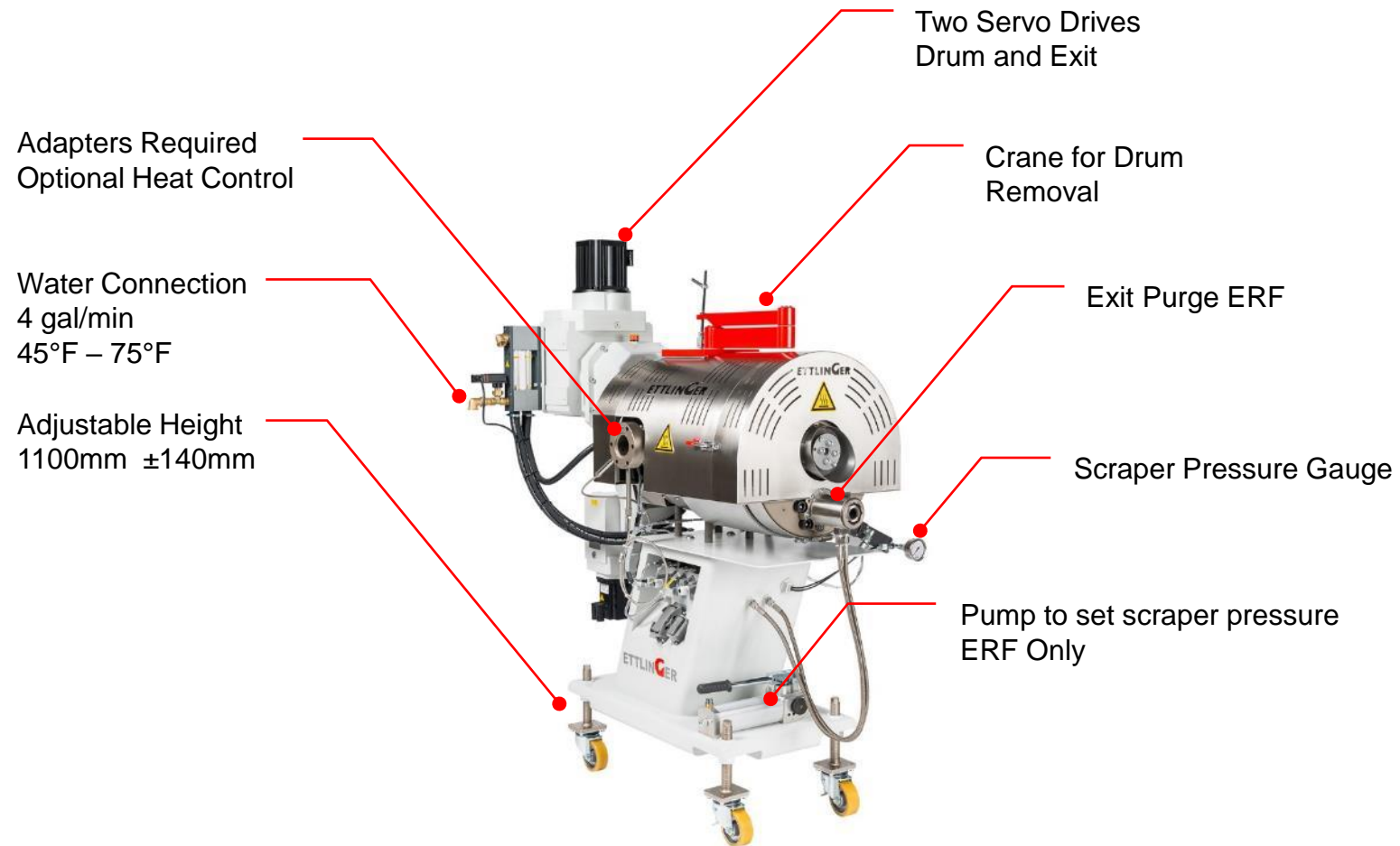
ECO – Principle of operation



Ettlinger Key Advantages – Rapid Payback



ERF Key Features



Screen Options



PET Thermoform
Melt Blown PP
PET Strapping

HDPE /LDPE for film

Injection Grade

Micron	mm	Mesh
60	.06mm	230
80	.08mm	190
120	.12mm	120
150	.15mm	100
200	.20mm	70
250	.25mm	60
300	.30mm	50
400	.40mm	40
500	.50mm	35
1000	1.0mm	18

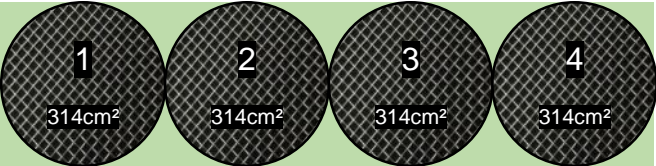
Screen Hardness = 64 Rockwell

Scraper Hardness = 59 Rockwell

Total Filtration Area



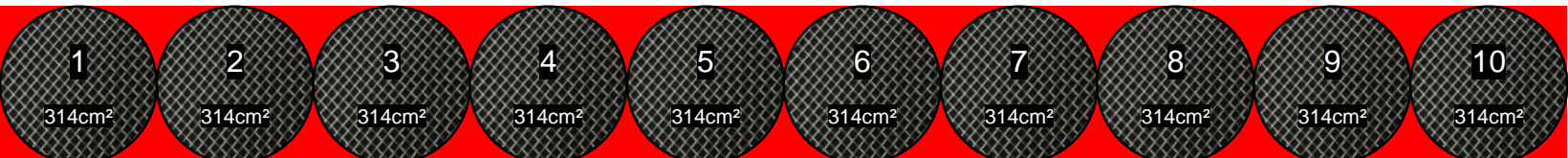
ECO/ERF 200 (1,250cm²)



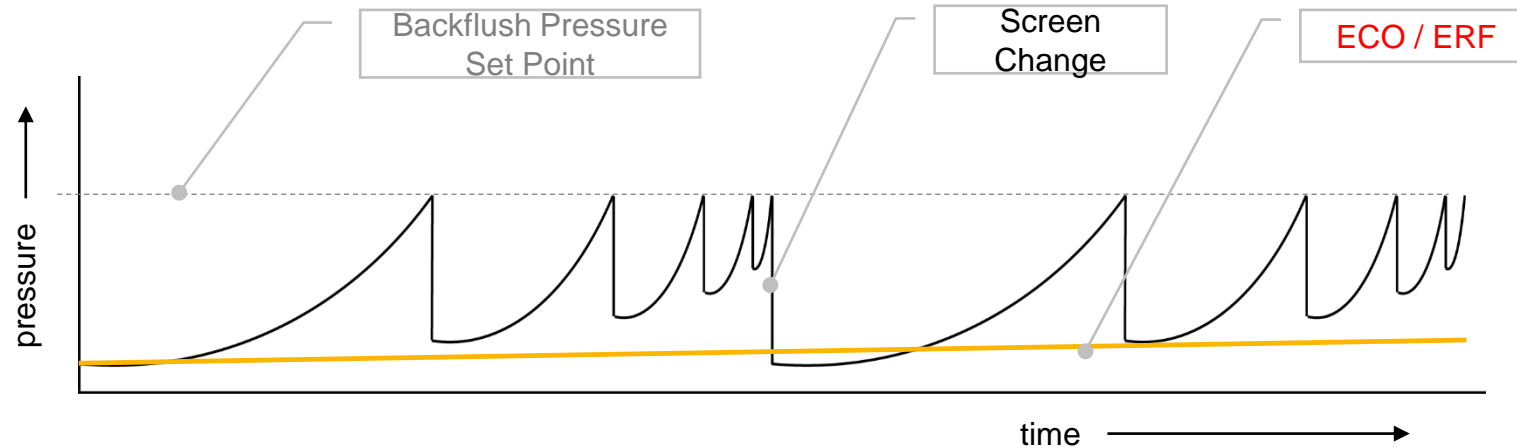
ECO/ERF 350 (1,570cm²)



ECO/ERF 500 (3,140 cm²)



Advantages vs. Backflush Screen Changers

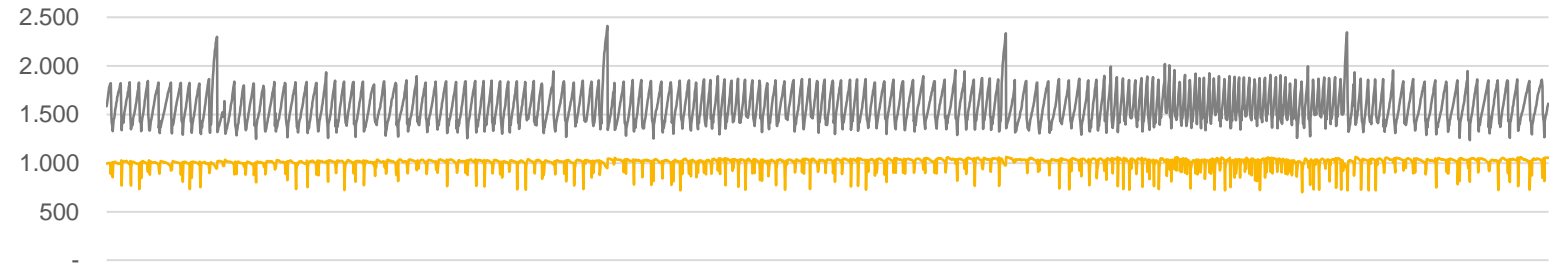
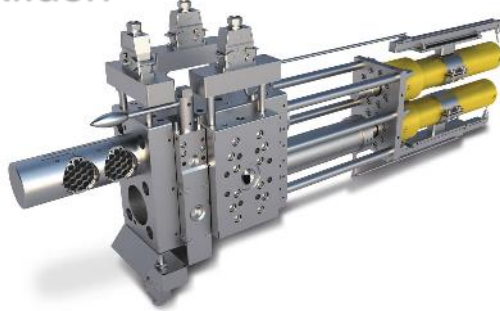


Challenges with backflush systems for highly contamination material

- Constant pressure changes which worsen over time as screens block
- As much as 5x the level of purge
- Limited to a contamination range between 0.5% to 1%

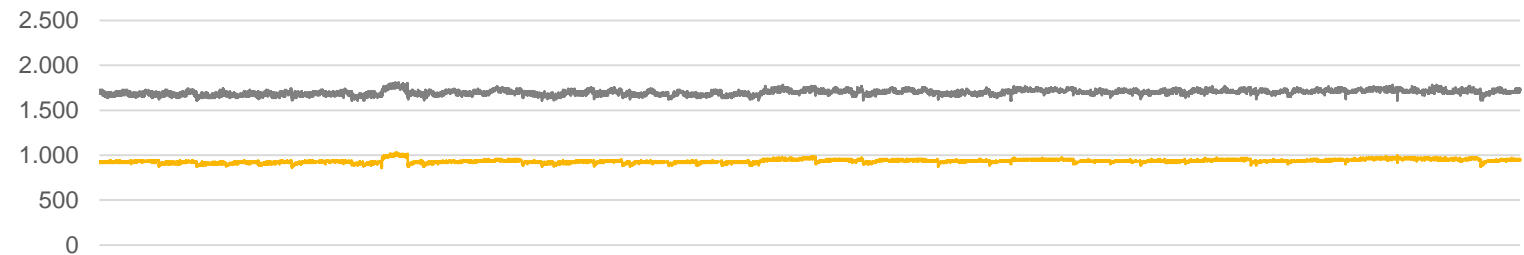
Performance Comparison

Backflush



Extreme pressure instability

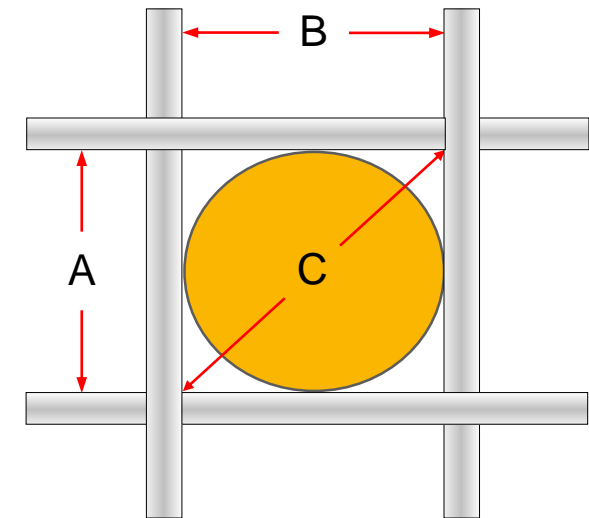
ERF

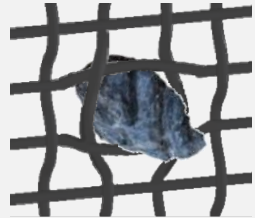


Stable pressure environment

Screen Comparison

Micron	A	B	C
50	50	50	70
60	60	60	85
80	80	80	113
120	120	120	170
150	150	150	212
200	200	200	283
250	250	250	354
300	300	300	424
400	400	400	566
500	500	500	707
750	750	750	1061
1000	1000	1000	1414





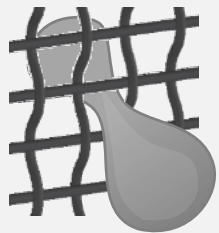
Mesh Expansion

As pressure increases over time, wires will eventually expand and let smaller objects pass



Metal Contamination

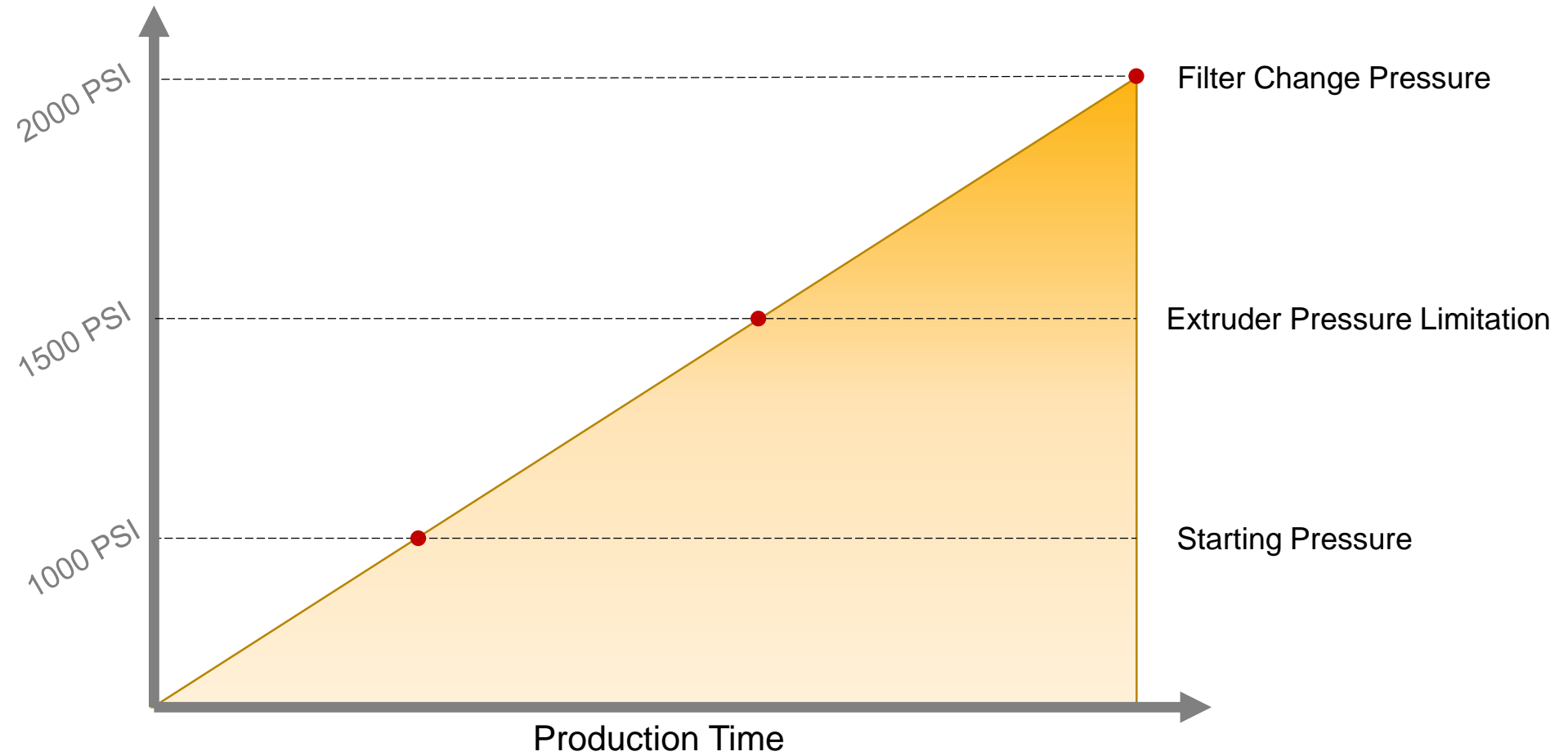
As pressure increases, screens often blow-out resulting in metal contamination in pellets



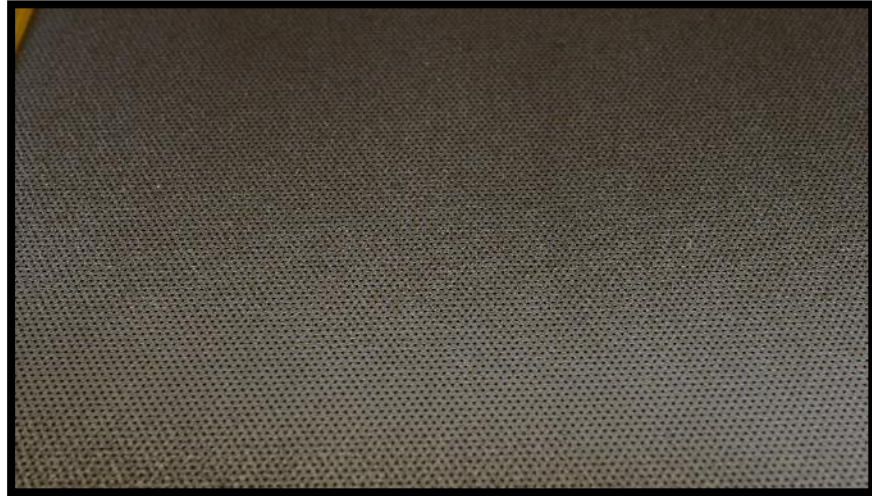
Elastic Particles

Elastic polymers will push through the screen with increased pressure

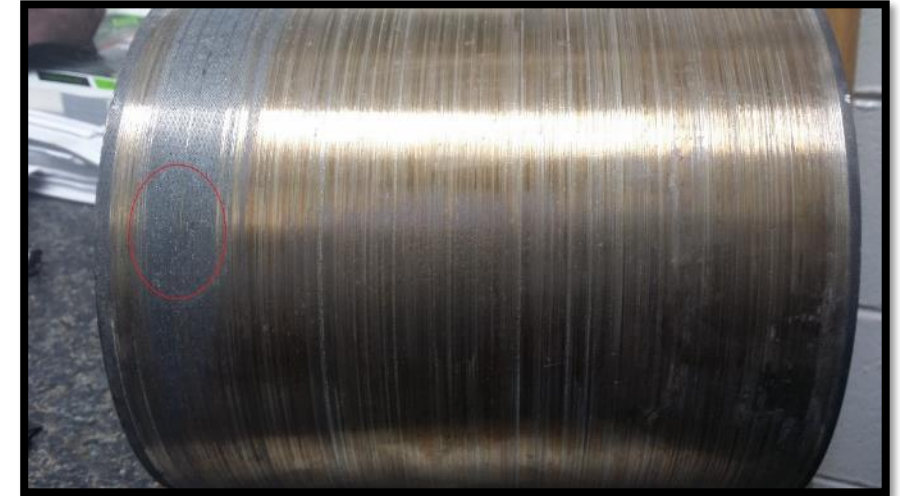
Extruder Pressure Limit



Screen Life



New Screen Surface



End of Life Screen



Average Screen Life = 1,600 hours (HDPE)
Average Screen Life = 3,000 hours (PET)

Center Shaft



Filter shaft without screen and carrier

Filter shaft with carrier (no screen)



Filter Carrier



Filter Scraper



ERF Melt Filter



PP - Battery Cases



HDPE bottles/caps



aluminium



PS
yoghurt
cups



PE
film

paper
labels

PP Flower
Pots & Trays



Irrigation Tubing



PP/EPDM
car bumpers



Available Filter Designs **ERF**



ERF-200

Area: 1250 cm²

Screen Diameter: 200mm



ERF-350

Area: 1570 cm²

Screen Diameter: 250mm



ERF-500

Area: 3140 cm²

Screen Diameter: 250mm (x2)

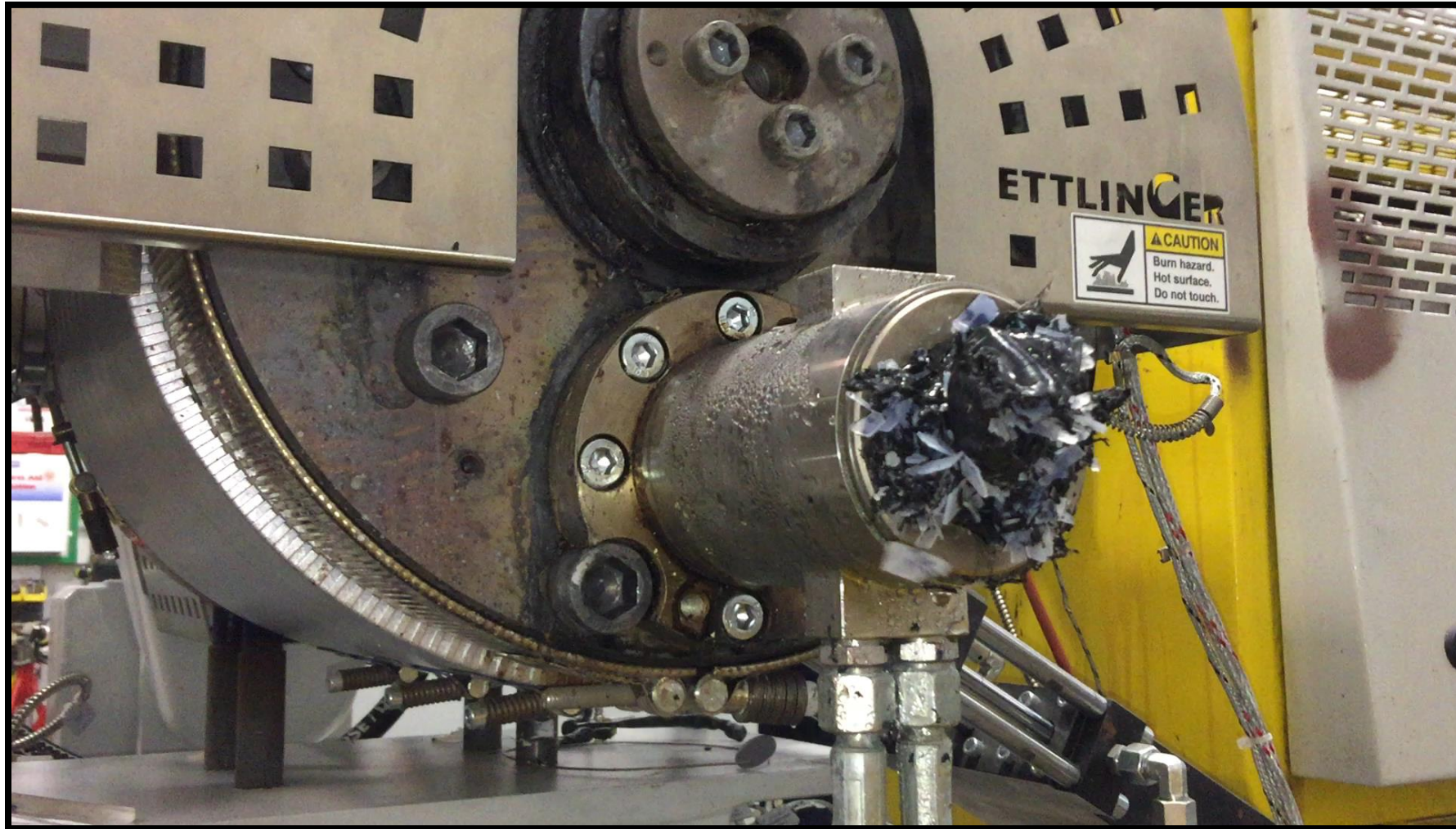


ERF-1000

Area: 6280 cm²

Screen Diameter: 250mm (x4)

ERF Exit Screw and Cooling Jacket



This would be impossible to process with screen changer

Water cooled exit screw reduces purge temperature

System sets RPM automatically based on pressure and torque

With Backflush Screen Changer

- 8 Cavity Backflush Screen Changer
- Total Screen Surface Area 1,808 cm²
- Consumes 64 screens in 12 hours
- Backflush disabled due to high purge amounts
- High temps caused PET to melt



With Ettliger Screen Changer

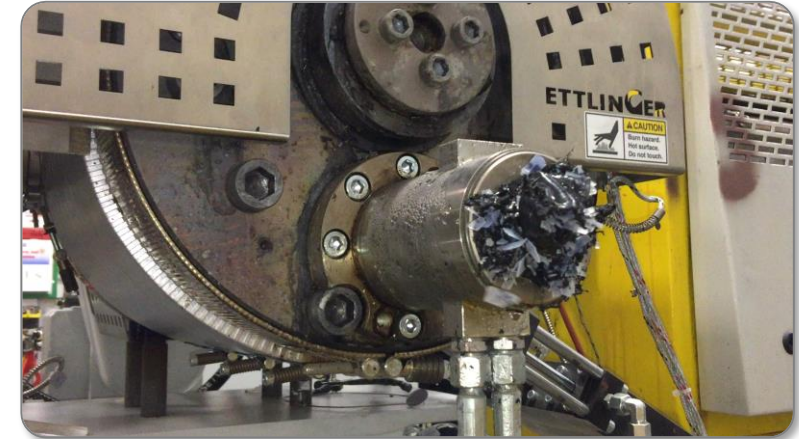
- Total Screen Surface Area 1,570 cm²
- Up to 4 weeks between screen changes / burns
- Removes PET due to lower temps
- Increased capacity by up to 26%



ERF Applications – Purge Results



PS Yogurt Cups with Aluminum Contamination



HDPE Tubing with Silicon Contamination



PP Car Bumpers with Paint Contamination



HDPE with Rubber Contamination

ERF Applications – Battery Recycling



Line Capacity: 3,000 PPH

Hours: 7,000 hours / year

Purge rate with Backflush = 6% (1.26M lbs/year)

Purge Rate with Ettliger = 0.35% (73,500 lbs/year)

Sell price for PP Pellet = \$0.45 cents/lb

Total savings with purge alone = \$533,925 / year



ECO Melt Filter



Available Filter Designs **ECO**



ECO-350

Area: 1570 cm²

Screen Diameter: 250mm



ECO-500

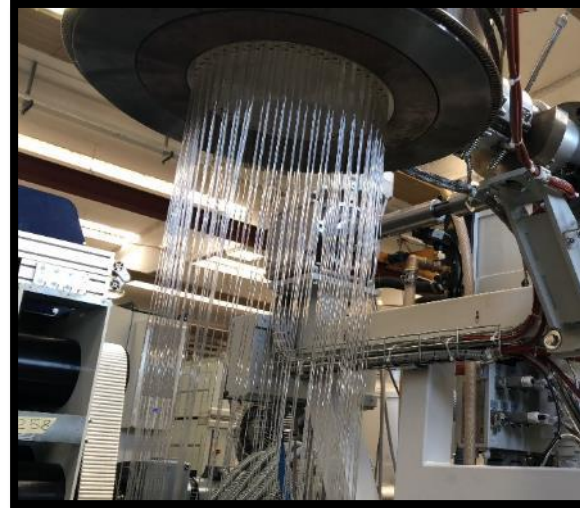
Area: 3140 cm²

Screen Diameter: 250mm (x2)



Strapping

Nearly eliminate line breaks
Stable pressure for months
Consistent quality



Monofilament

Create quality Monofilament
from low value PET Fines



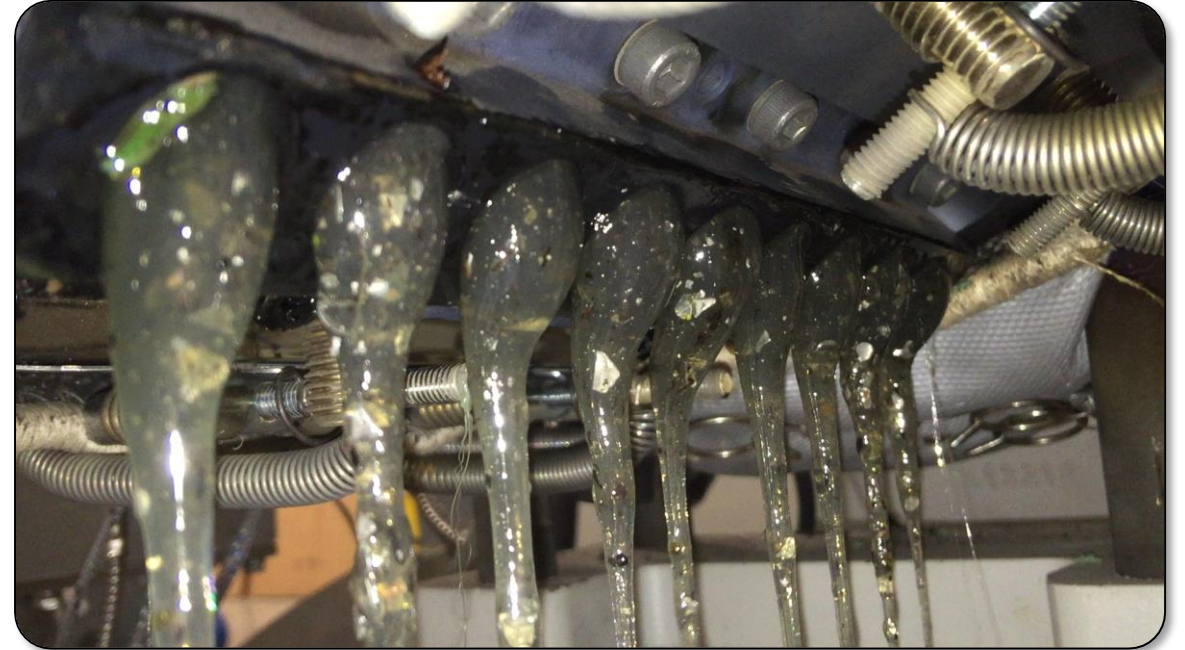
Thermoforming

Use of 100% Recycled Flake
50% reduction of black
specks
Reduced scrap rates

ECO Purge Examples



RPET Flake with Aluminum Contamination



PET Fines with Aluminum and Other



PET Sheet Extrusion

150mm Single Screw Extruder

Capacity: 1,400 kg/hour

MAAG Pre-filter (12 mesh screens)

MAAG Gear Pump

ECO-250 Filtration (80 Micron)



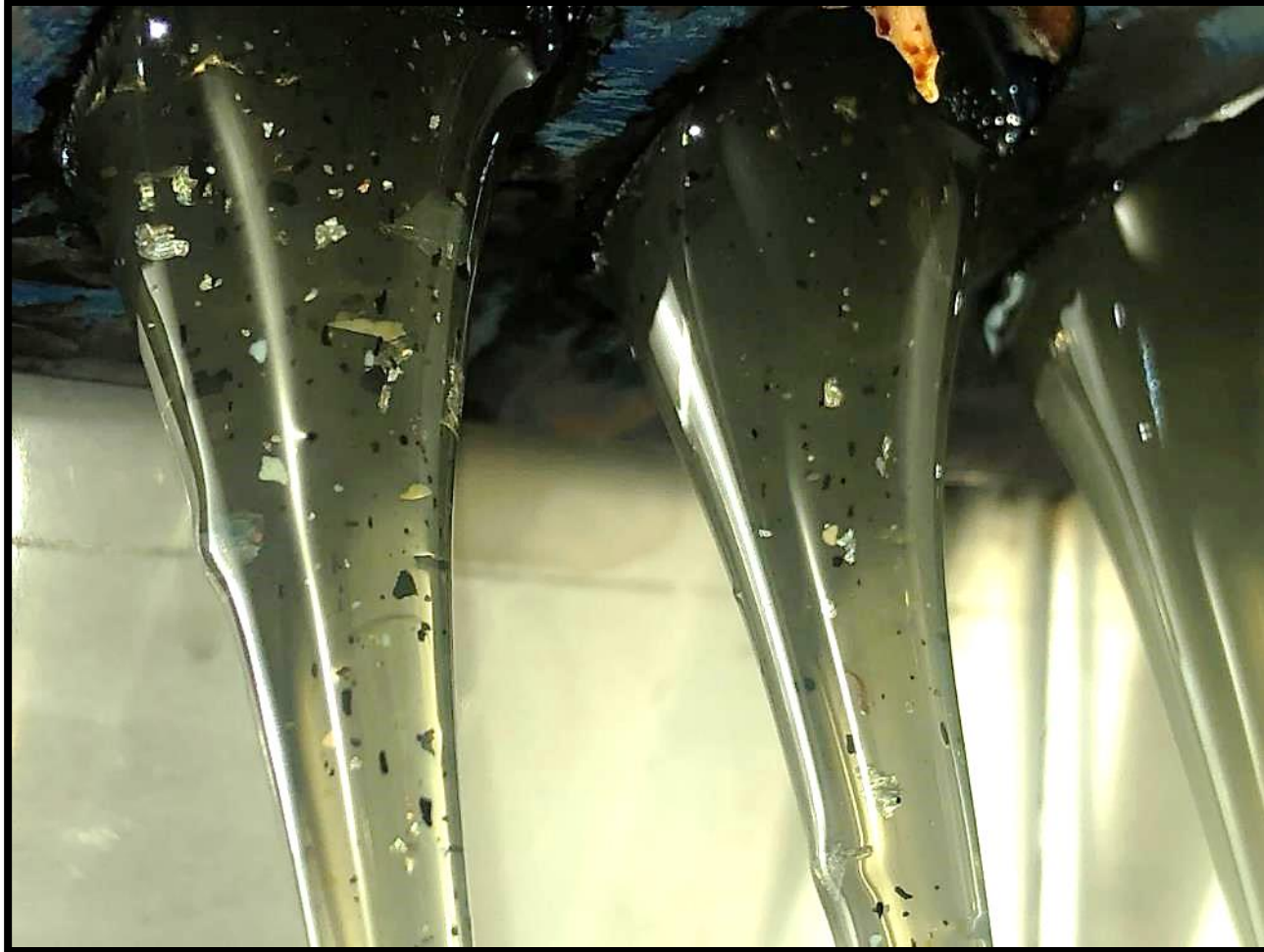
MAAG Pre-Filter

Dual piston 2-cavity screen changer

Protection of Gear Pump

Prolongs life of ECO Screens

12 mesh screens



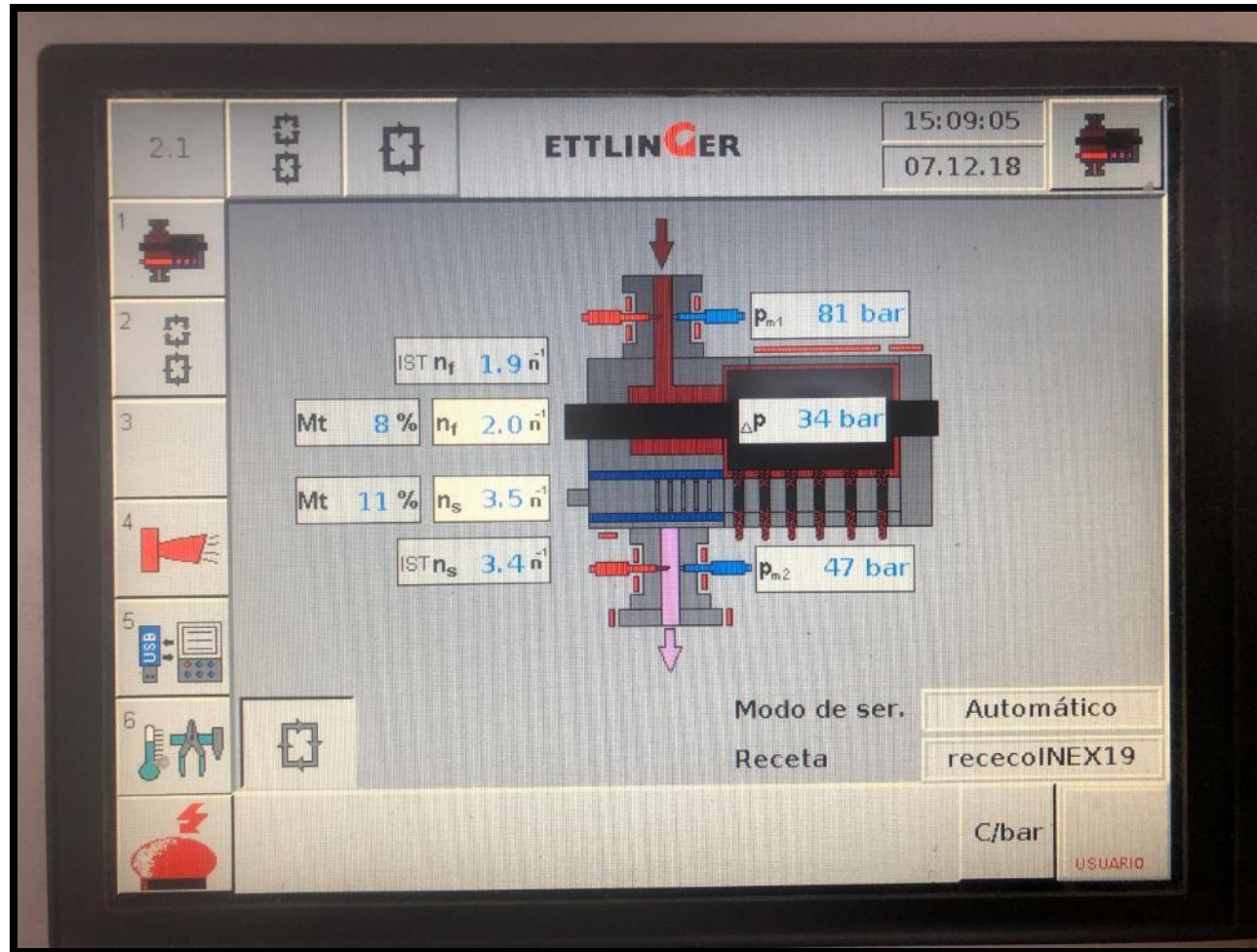
ETTLINGER ECO-250

Discharge from ECO Filter

6 months between screen changes

Purge Rate between 0.2% to 0.5%

80 Micron Screen



Process Conditions

1,400 kg/hr using

80 micron screen

Delta pressure of 34 Bar

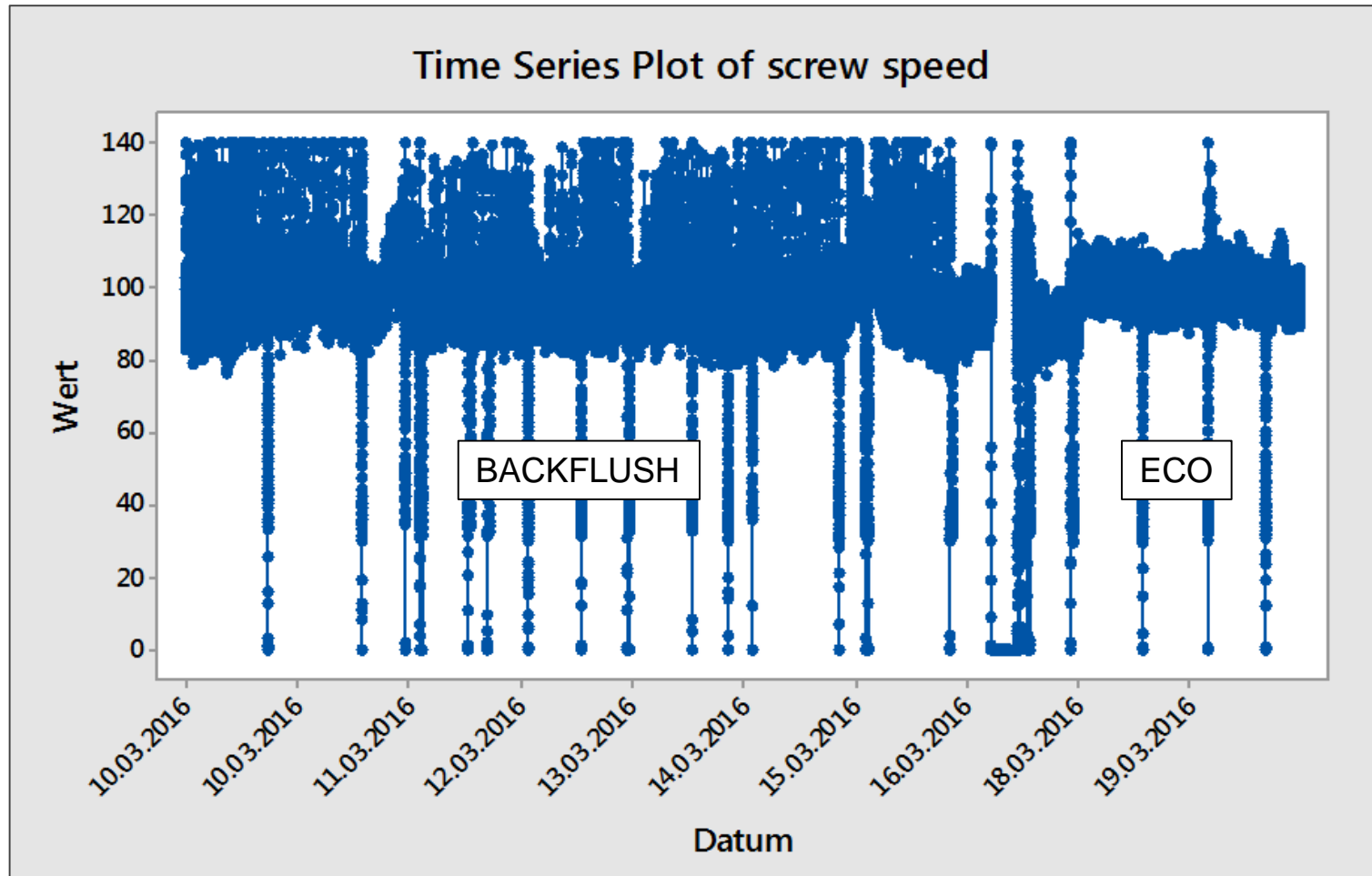
Change screen at 130 Bar

Months in operation

Case Study PET Thermoform Sheet

- Avoidance of back-flush resulting in reduction of black specks
- Reduction of material usage, e.g. by reduction of thickness variation and running at lower tolerances (1% → **53k€/a**)
- Reduction of scrap (0,8% → **42k€/a**)
- Reduction of orange peel (**4k€/a**)
- Downtime reduction due to screen changing (availability: +75h/a → **33k€** PET sheet)

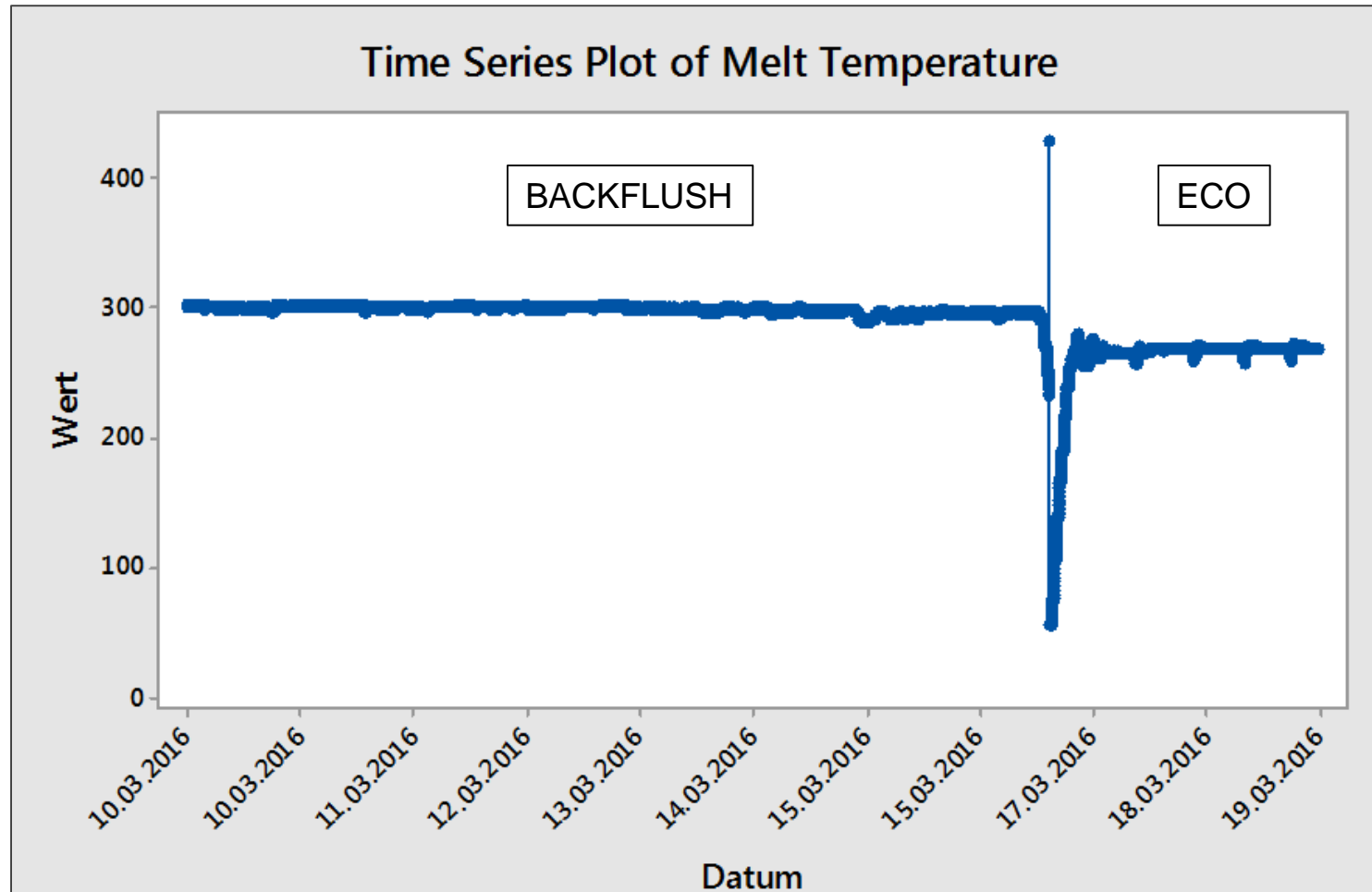
ECO Case Study



Screw Speed

Screw speed must continuously change to maintain a consistent work pressure to the inlet of the melt pump. This inconsistency results in higher energy costs and higher temps resulting in material degradation.

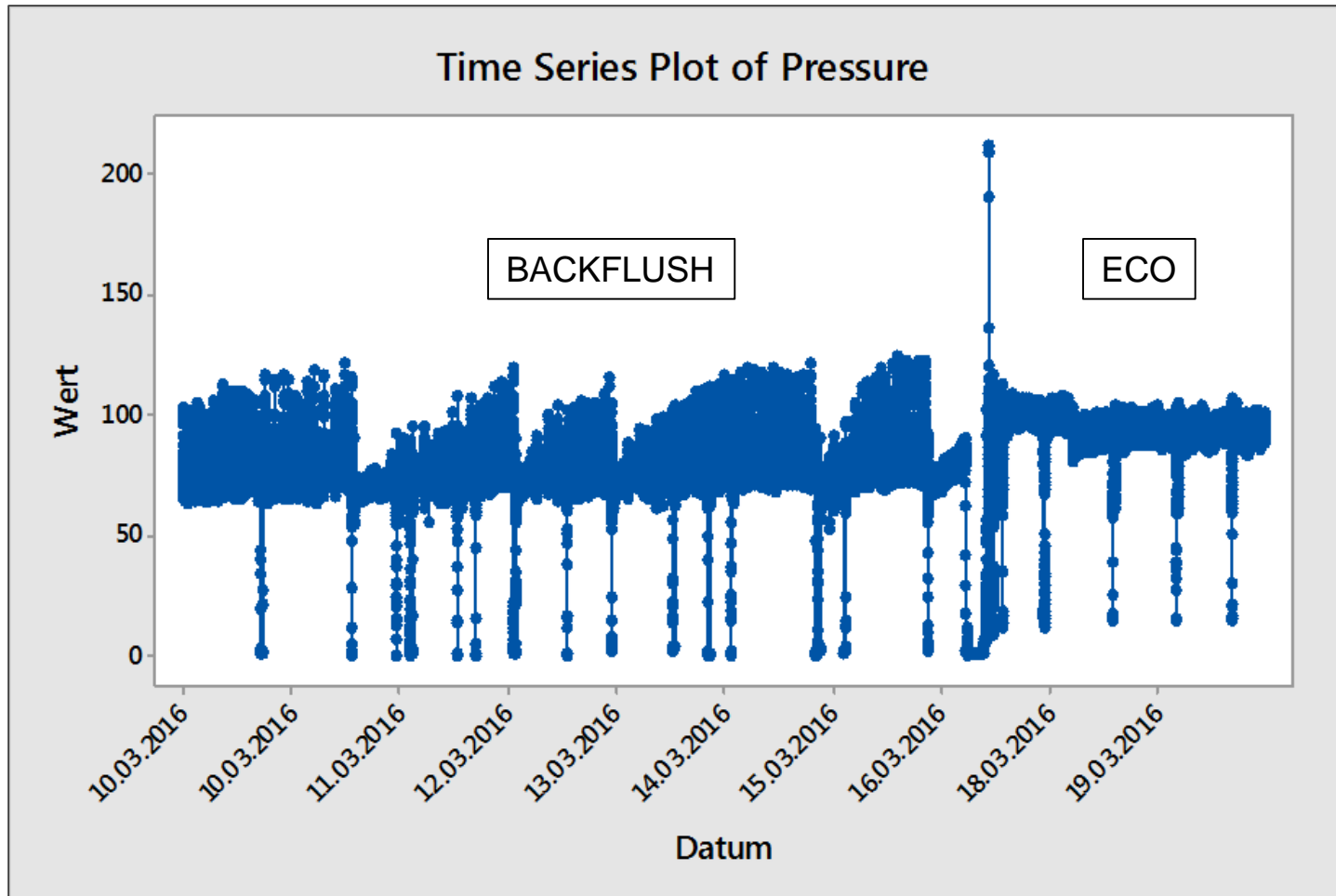
ECO Case Study



Melt Temperature

Consistent extruder speed results in lower overall temperatures which produces higher die-lip pressures. This helps to reduce orange peeling on sheet surface.

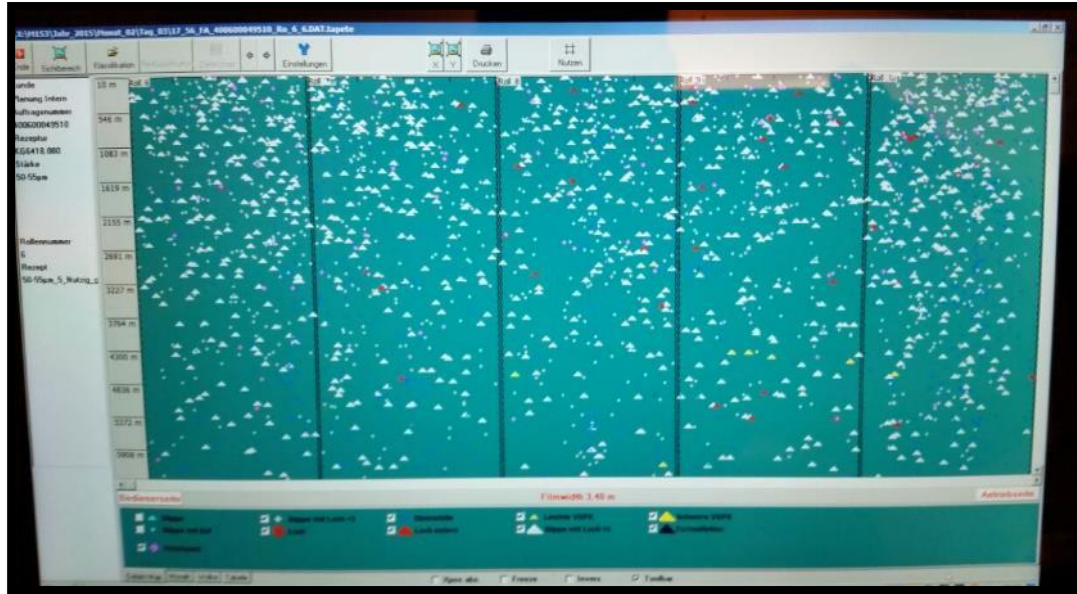
ECO Case Study



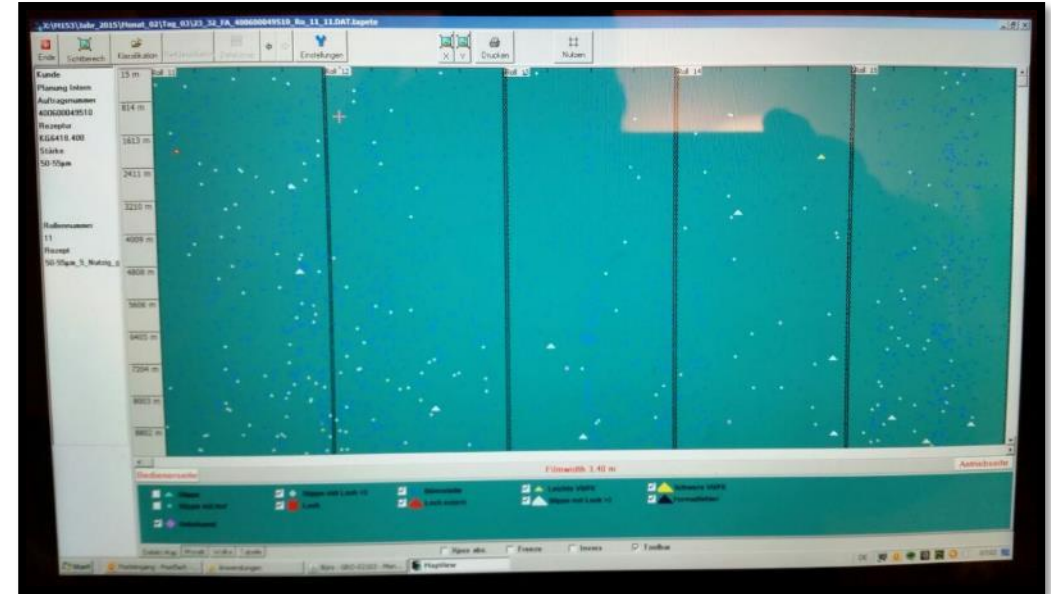
Melt Pressure

The key to successful production is consistency. The Ettlinger filters offer reliable pressures for up to 6 months in many PET sheet applications.

ECO Case Study



Backflush screen Changer
with 120 micron



ECO-250
With 80micron

THANK YOU!

 **ETTLINGER**

High Contamination

RETURN

Ability to run a more highly contaminated material. Many customers speak about getting material for free or pennies / lb. PP, PS, HDPE, LDPE can be sold for .30-.45 per lb.

Value calculation:

- 2000 lbs/hr
- 7200 hrs/yr
- 15/cents per lb. material savings
- \$2.16M in raw material savings!

Value calculation:

- 700 lbs/hr of duct-tape end cut-offs
- Removing 7% PET fiber from LDPE
- Eliminate \$300k/yr in landfill costs
- Use filtered material back into line 5% rate
- Fulfills Marketing needs as well

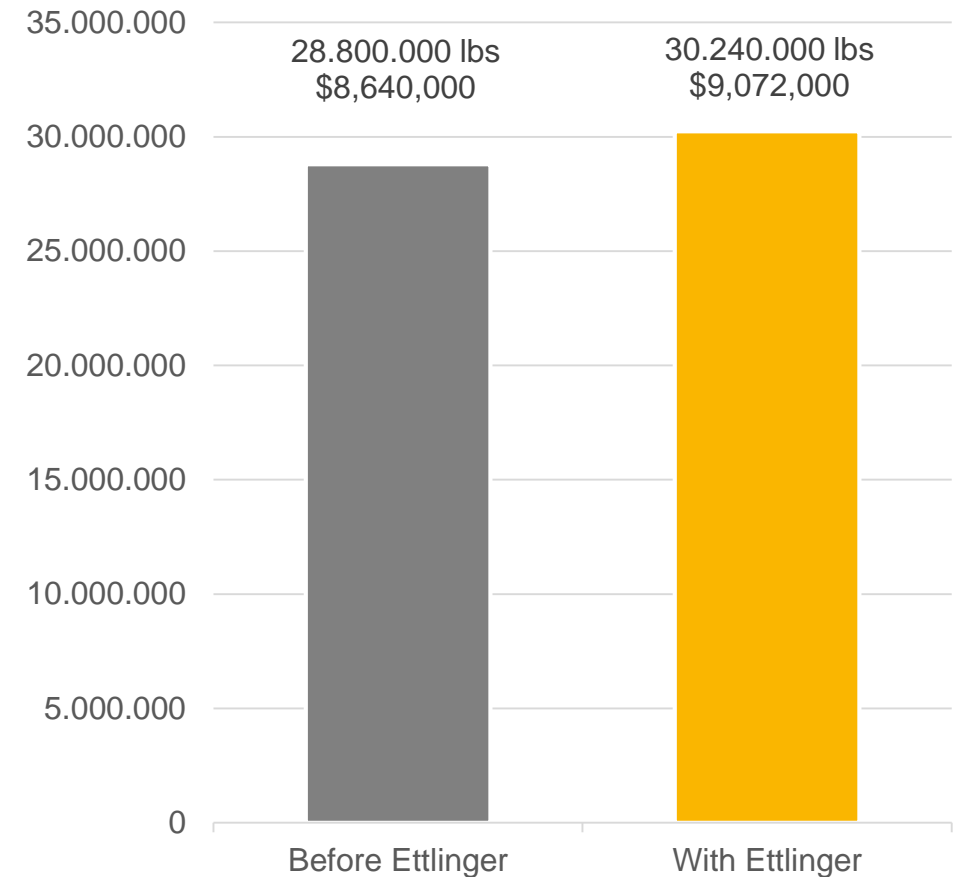
Stable processing without pressure spikes

RETURN

5% uptime increase reported

- 4,000 PPH x 7,200 Hours
- 360 extra hours per year per line
- 1.44M additional pounds per line/yr
- \$432,000 increase @ 30 cents/lb
- 84% to 89% increase in uptime

Increased Output = Increased Revenue



Weeks or months between screen changes

RETURN

- Less operator involvement
- Lower purge loss
- Less downtime
- Better quality pellets
- Eliminate folded, frayed or missing screen packs
- Stability reduces energy, reduces line maintenance



Large filtration area – Higher Throughput

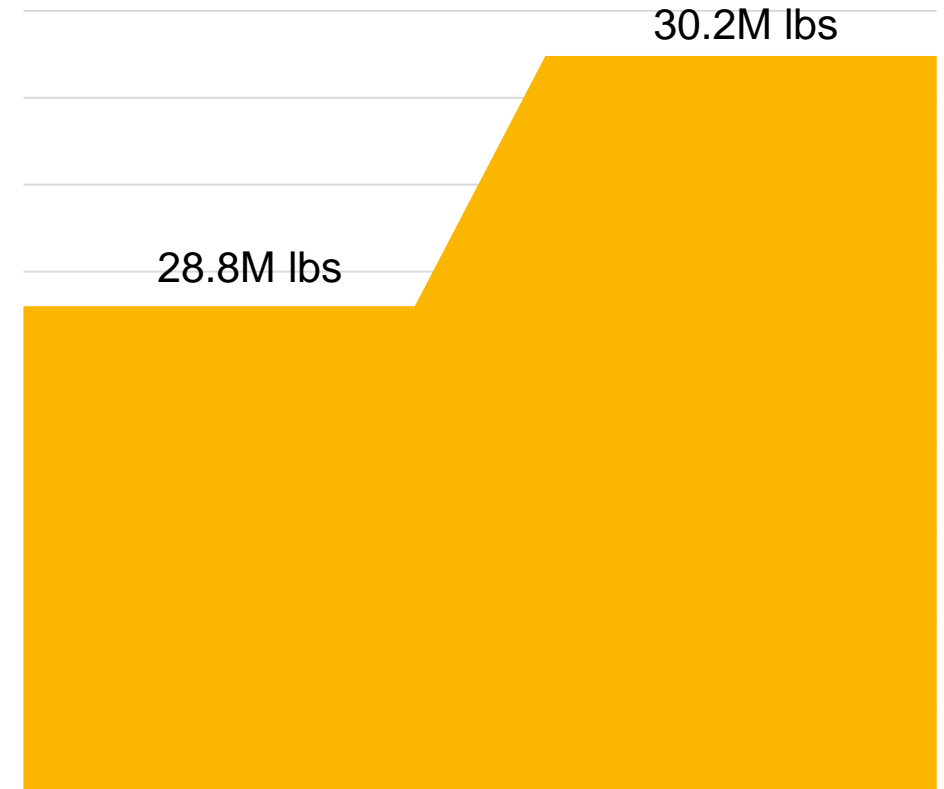
RETURN

- Large surface area in small footprint
- Low cost to retrofit in existing line
- Increase productivity in existing line
- Lower pressures vs flat-screen
- Lower temps due to higher surface area
- Lower micron size often possible

5% throughput increase

- 4,000 PPH x 7,200 Hours
- 360 extra hours per year per line
- 1.44M lbs/yr extra per line
- \$432k extra per year @ 30 cents/lb

Larger Filtration Area / Higher Throughput



Low melt loss

RETURN

Line Capacity: 3,000 PPH

Hours: 7,000 hours / year

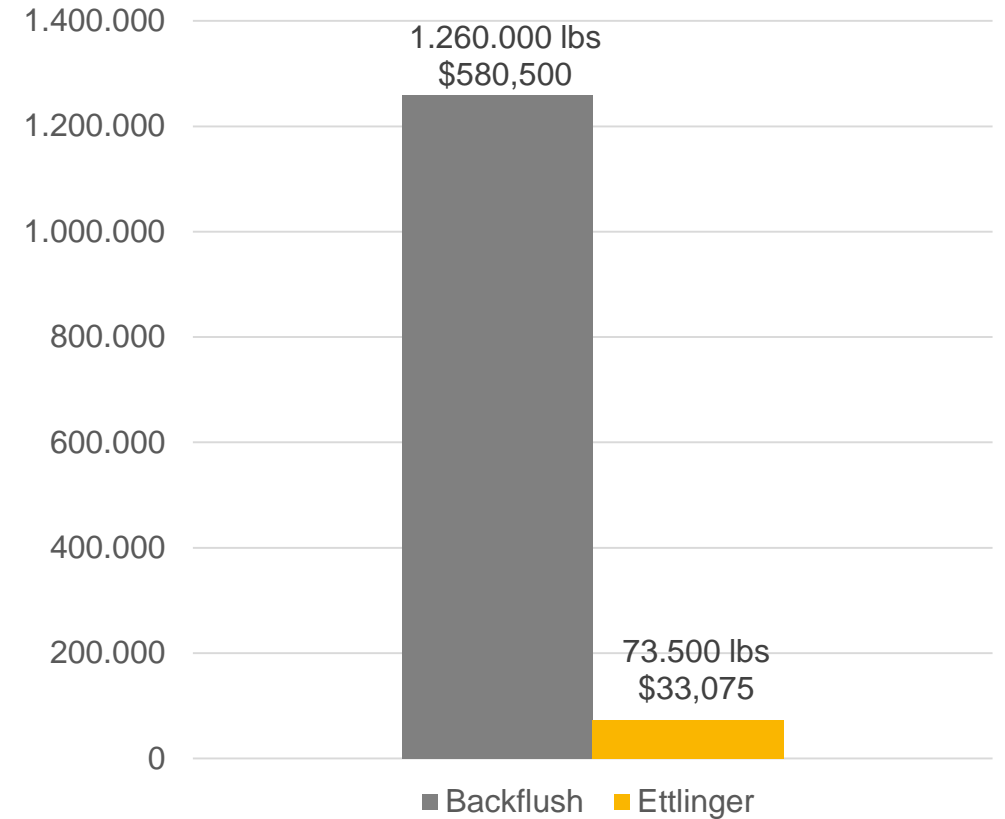
Purge rate with Backflush = 6% (1.26M lbs/year)

Purge Rate with Ettlinger = 0.35% (73,500 lbs/year)

Sell price for PP Pellet = \$0.45 cents/lb

Total savings with purge alone = \$533,925 / year

Purge Savings



Reduced Labor

RETURN

Example of 7-lines in one building
Needed 13 people using slide-plates (24x7!)
Reduced to 3 people using ERF melt filters
Eliminate line-down due to “no-shows”
Reduced Maintenance visits as well
Estimated savings of min. \$900K in Labor costs/Yr



Safe operation

RETURN

- No pinch points on filter
- No heavy purge patties to remove
- No exposure to hot purge
- No high pressure hydraulics
- Standard Lock-Out Tag-Out



No exposure to atmosphere

RETURN

- Tear reduction in film and sheet lines
- No screen cavity venting required
- No degraded material brought into melt flow
- Reduction of black specks in pellet or sheet

