Production of Micro-fibrillated Cellulose (MFC) with Valmet refiners

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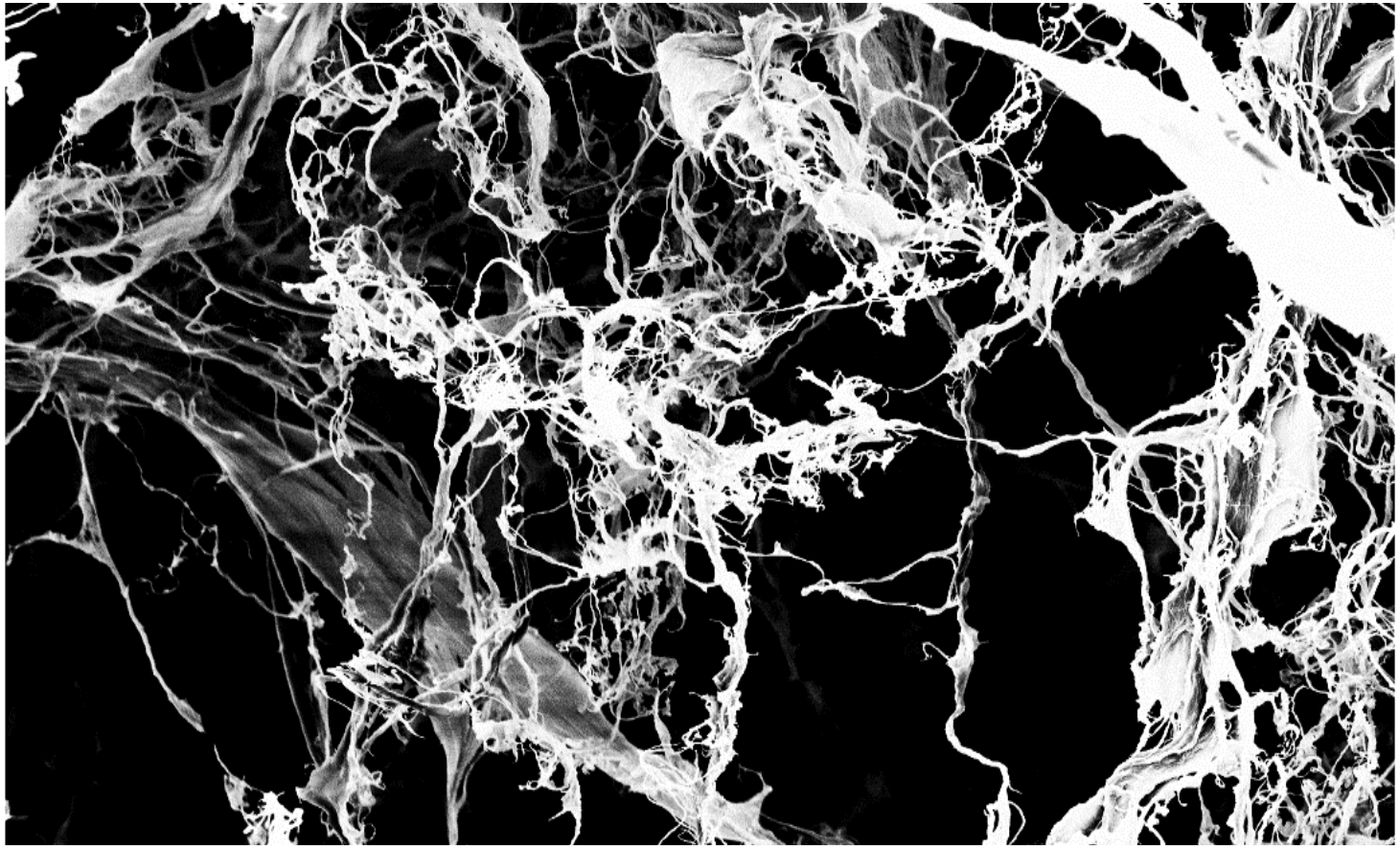
Micro-fibrillated Cellulose (MFC)

What is it and how do we define it?



- MFC has been highly refined using mechanical energy only.
- Fiber is often defined by either %fines (% less than 0.2mm) or the energy imparted upon the fiber (kWh/T).

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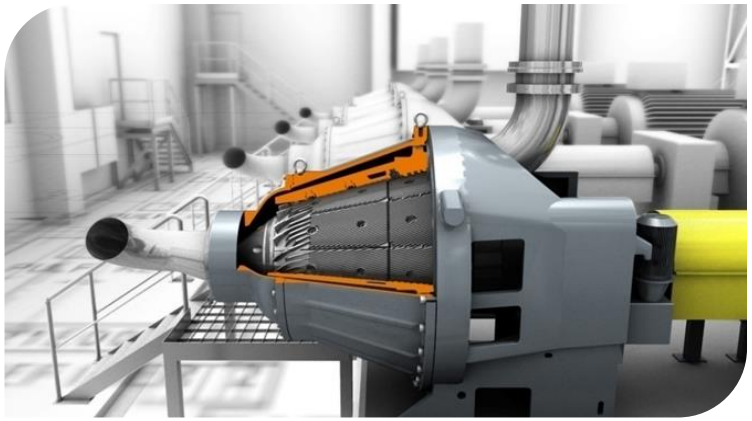
Micro-fibrillated Cellulose (MFC)

How do we produce MFC?

- This mechanical energy is supplied using one of three traditional refiner types specifically adapted to produce MFC.
  - Next Generation Conical Design
  - Double Disk Refiner
  - Traditional Conical Refiner



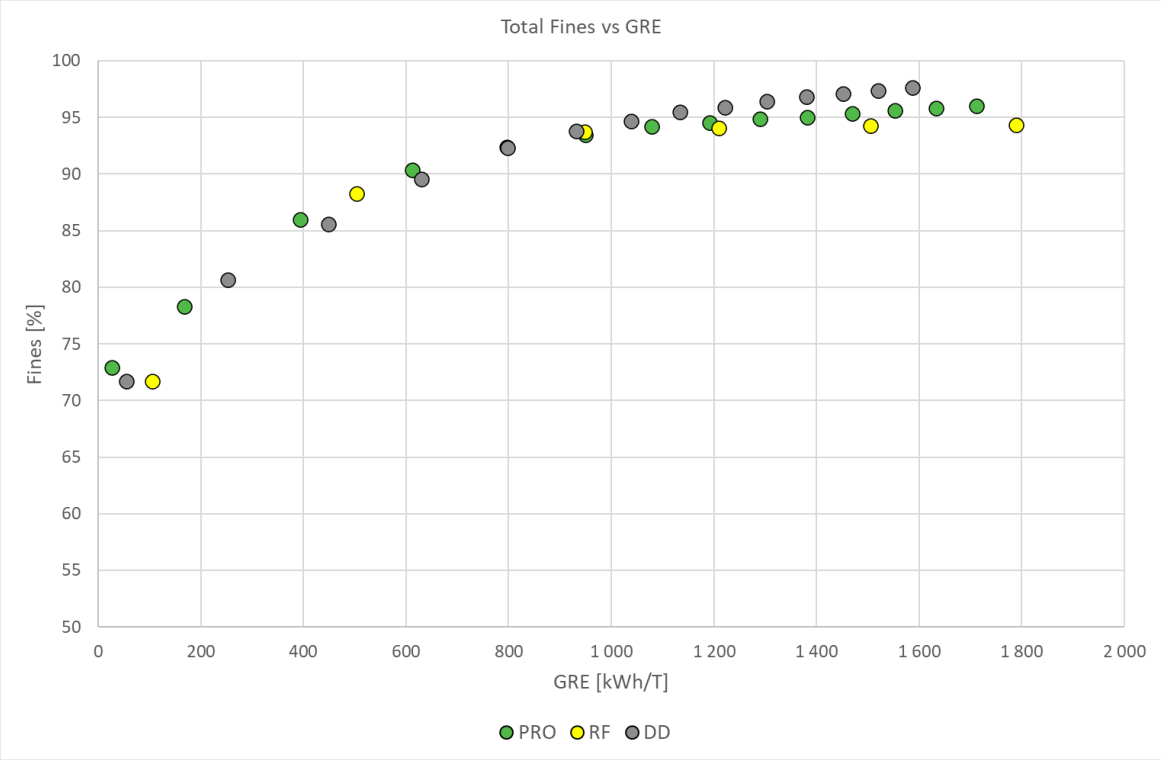
Refining results

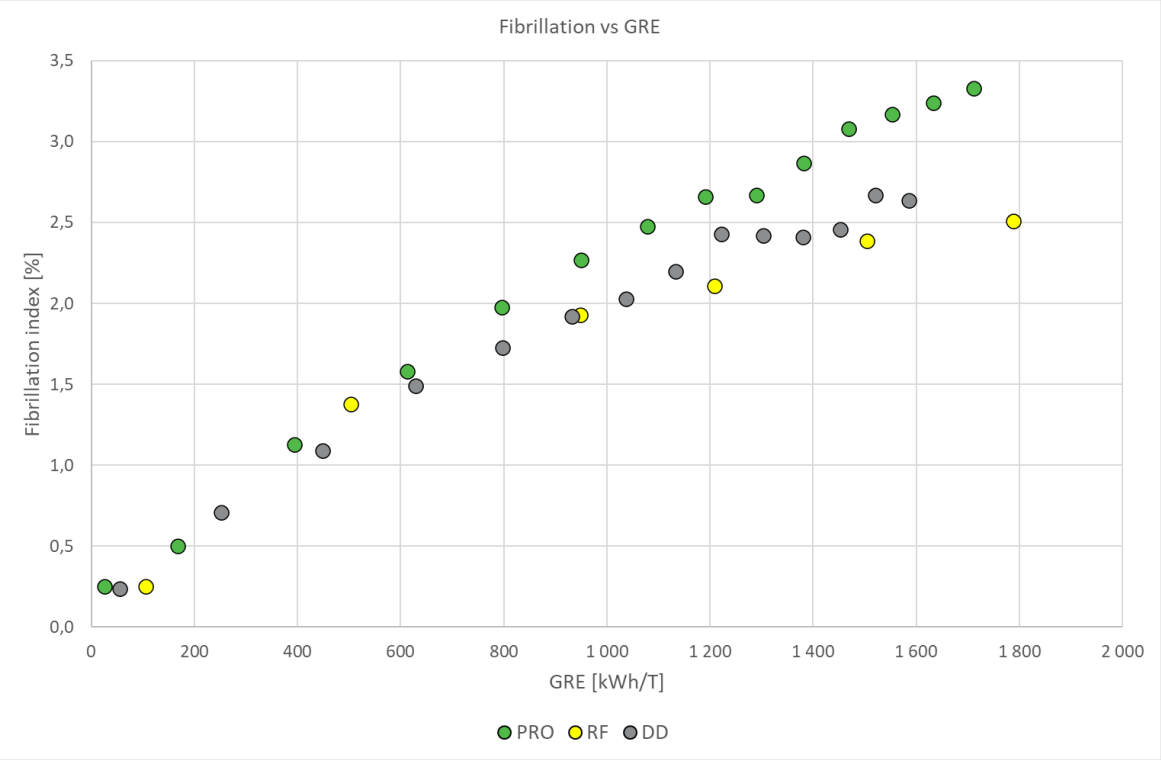
Evaluation Parameters

- Pulp used was UPM Uruguay market bleached eucalyptus pulp
- Consistency range 4.0 – 4.5 %
- Fillings Used: Proprietary
- Batch Process - up to 40 Rounds of

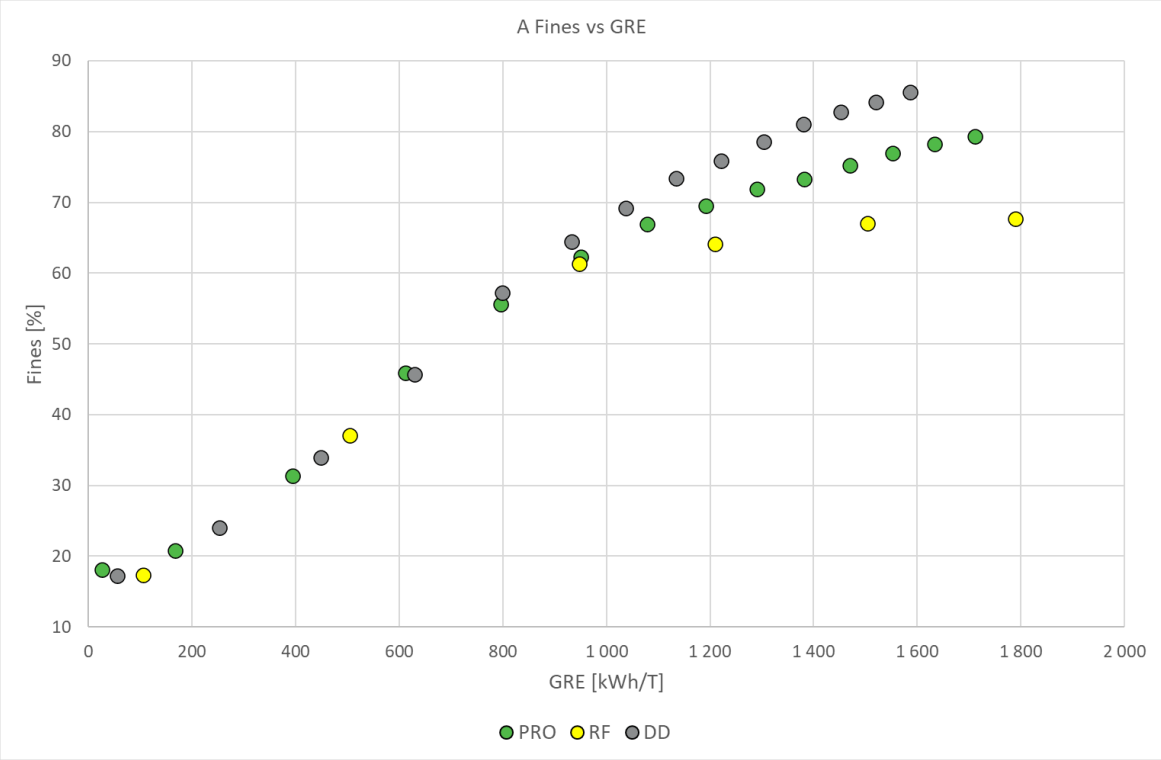
  pulp turnover
- Evalaluated power used, fiber morphology (Total, A & B fines) and handsheet results

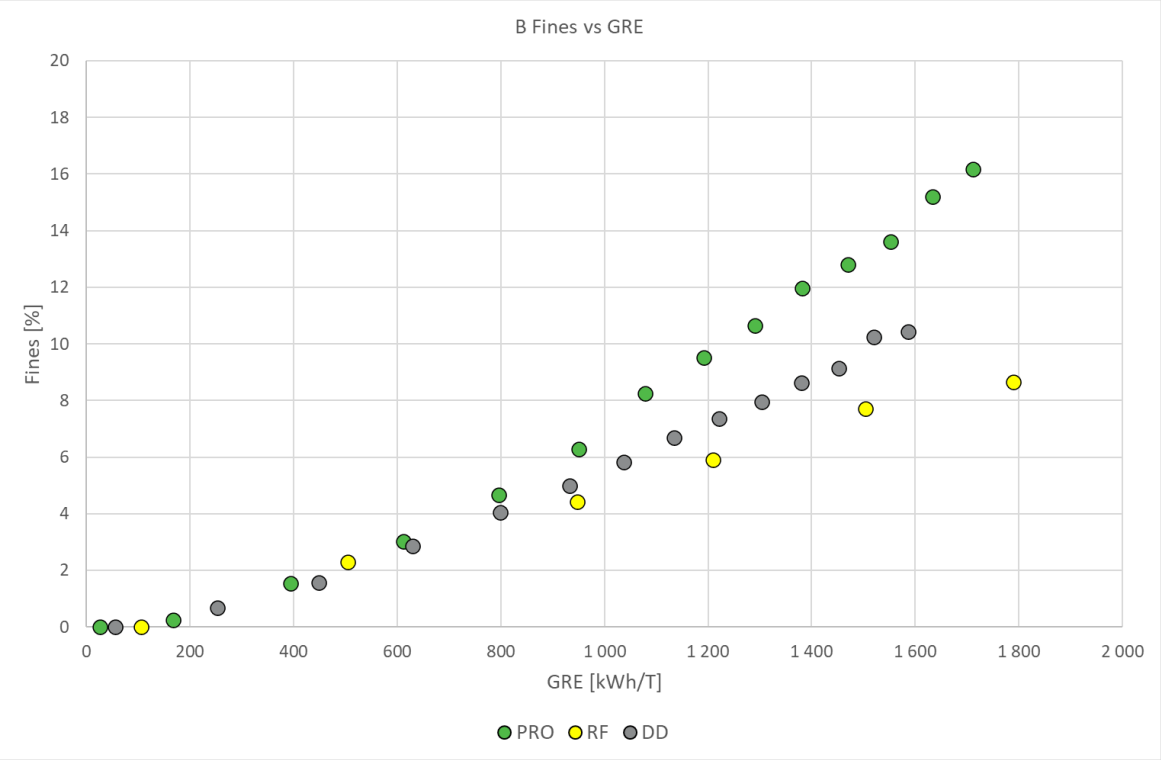
Total fines and Fibrillation



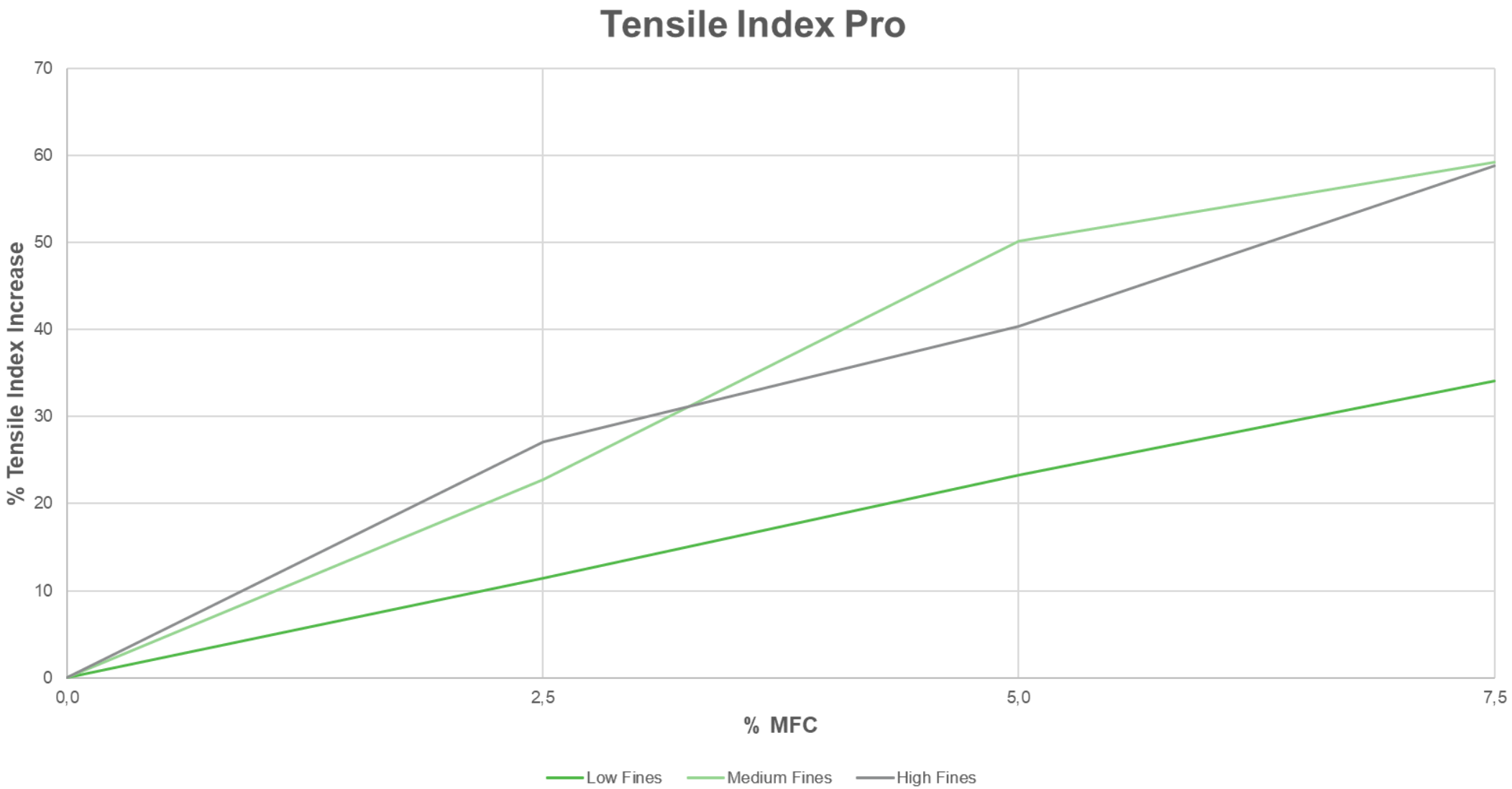


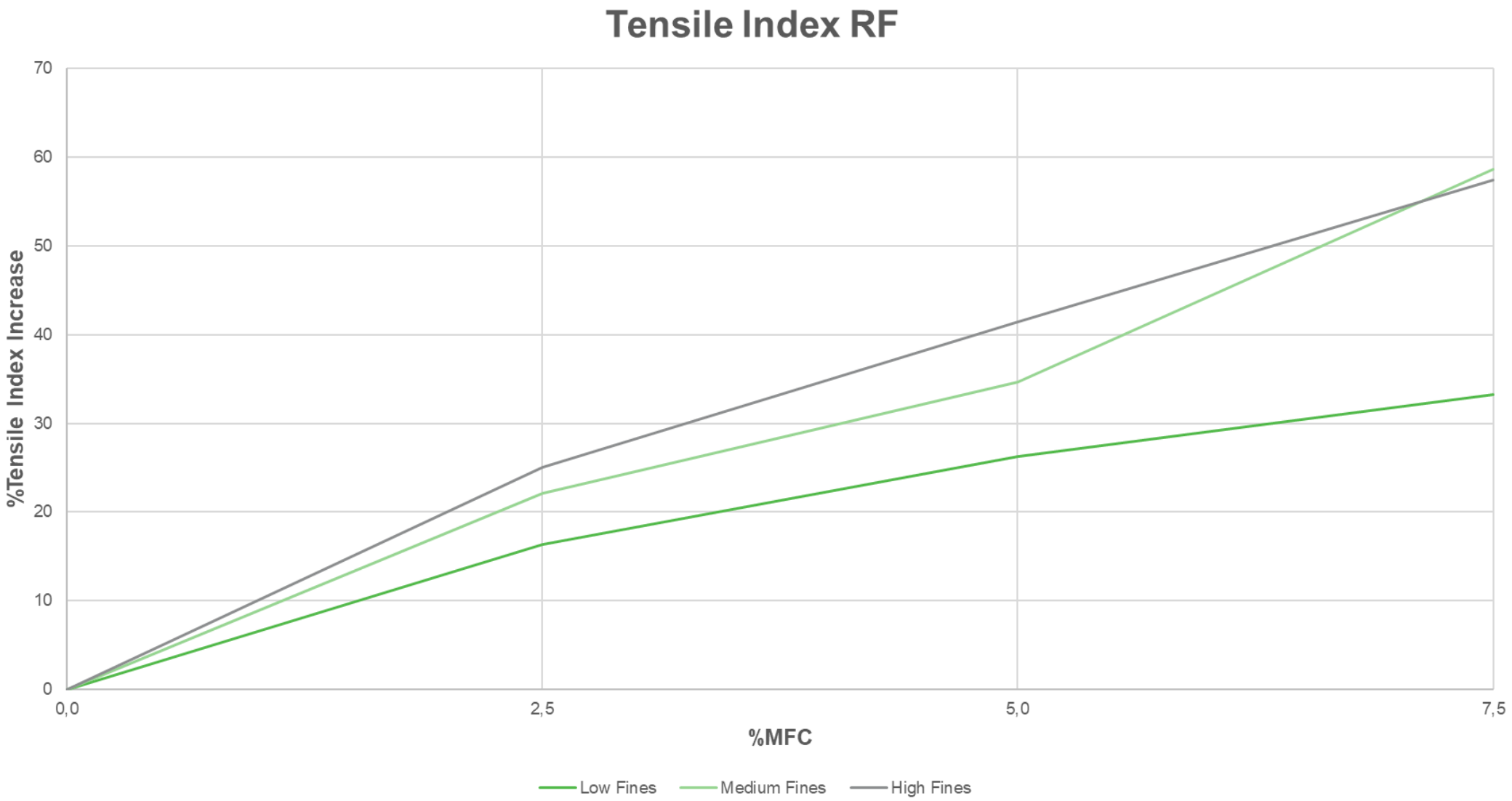
A and B Fines

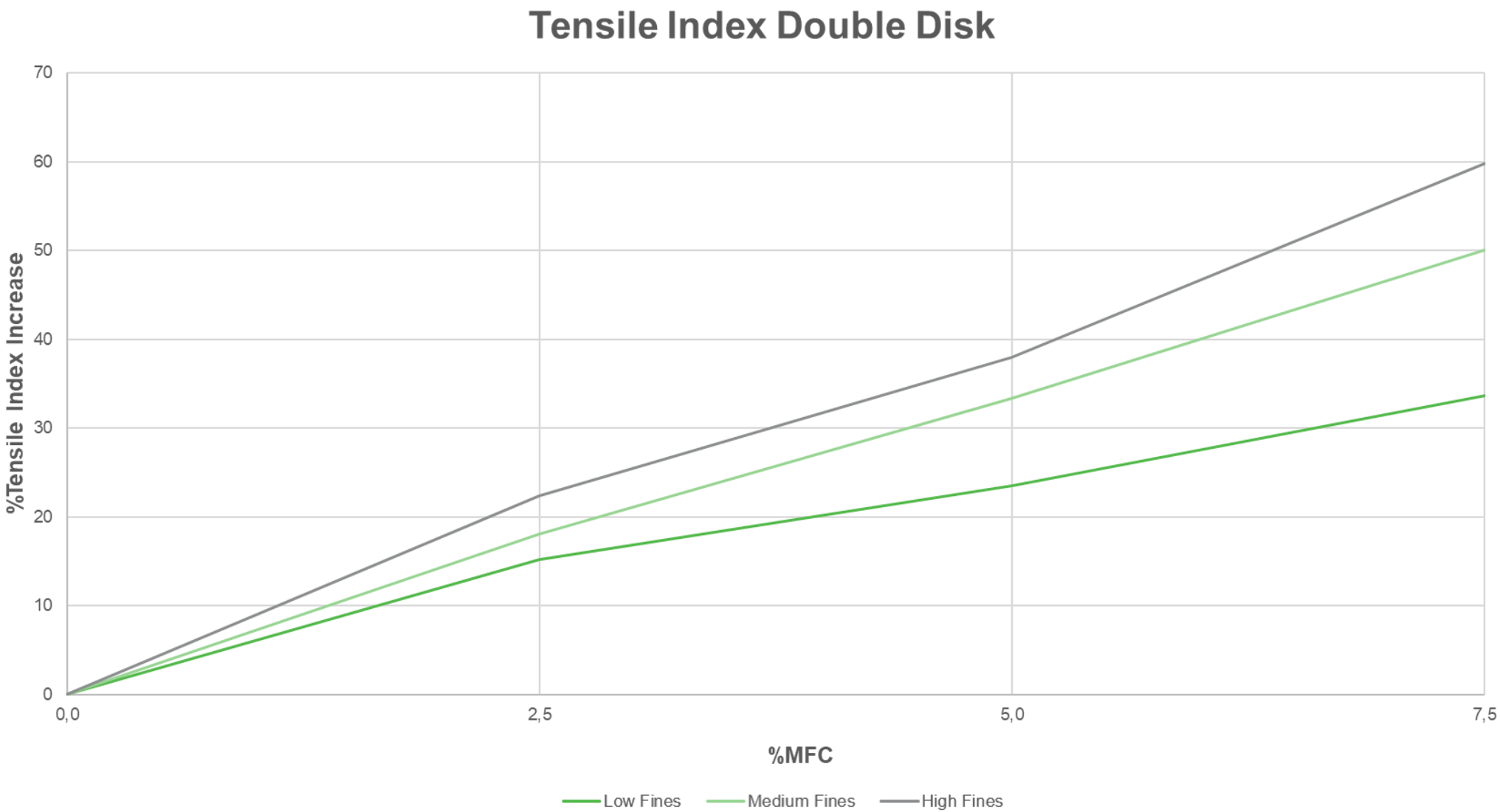

A Fines vs GRE
Fines [%]
90
80
70
60
50
40
30
20
10
0
200
400
600
800
1 000
1 200
1 400
1 600
1 800
2 000
GRE [kWh/T]
PRO
RF
DD

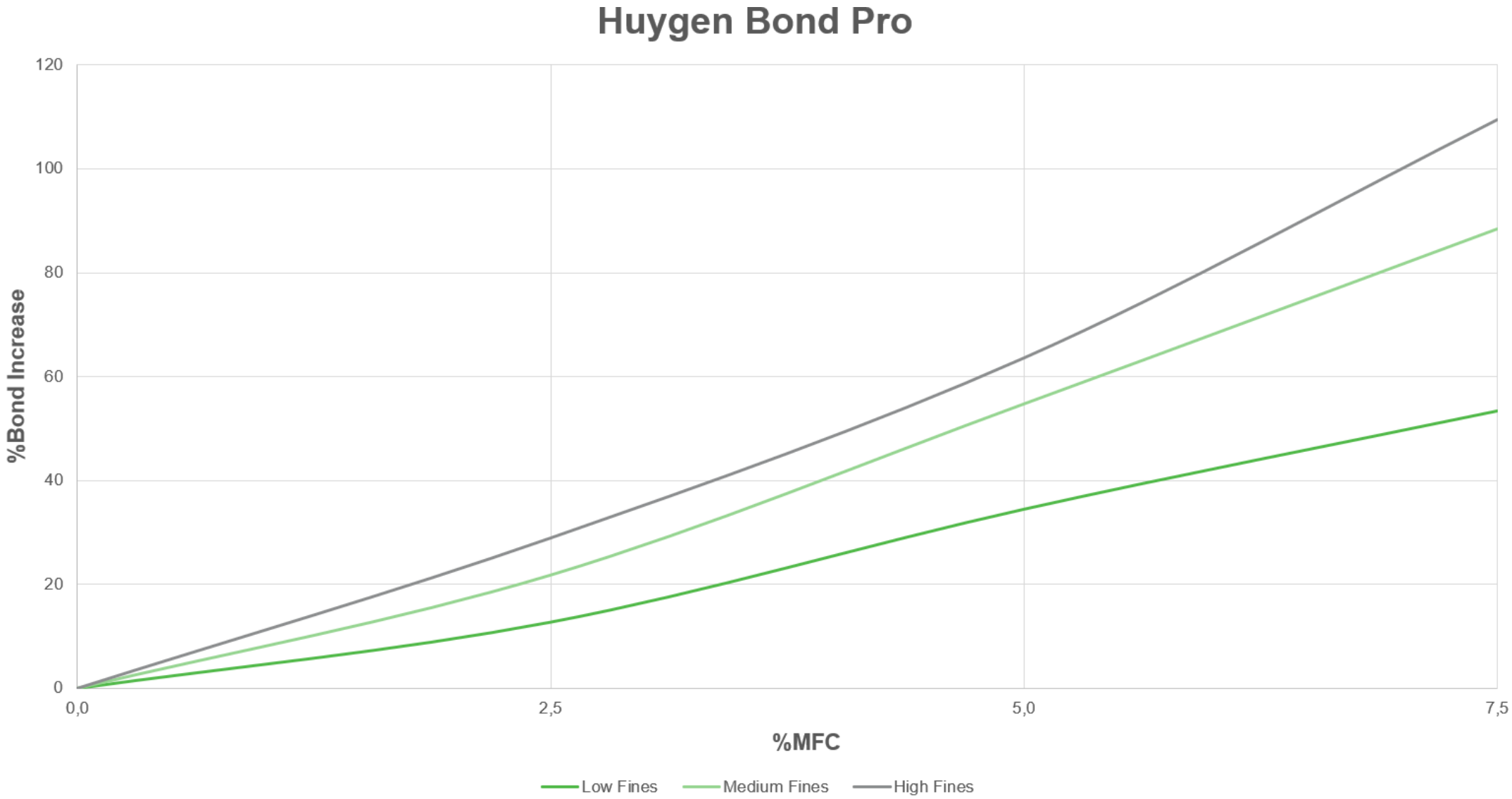

B Fines vs GRE
Fines [%]
20
18
16
14
12
10
8
6
4
2
0
0
200
400
600
800
1 000
1 200
1 400
1 600
1 800
2 000
GRE [kWh/T]
PRO
RF
DD

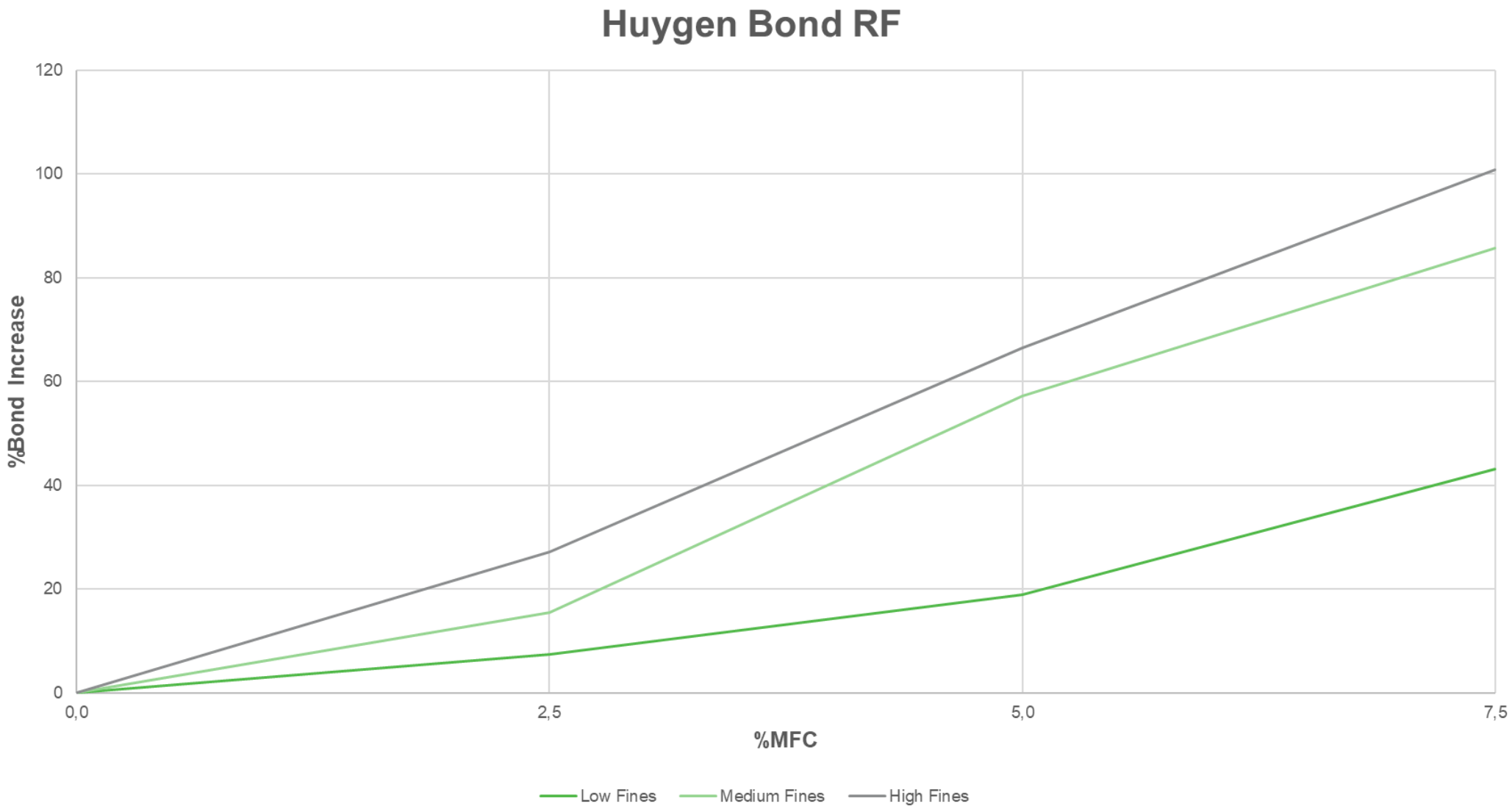
Handsheet results

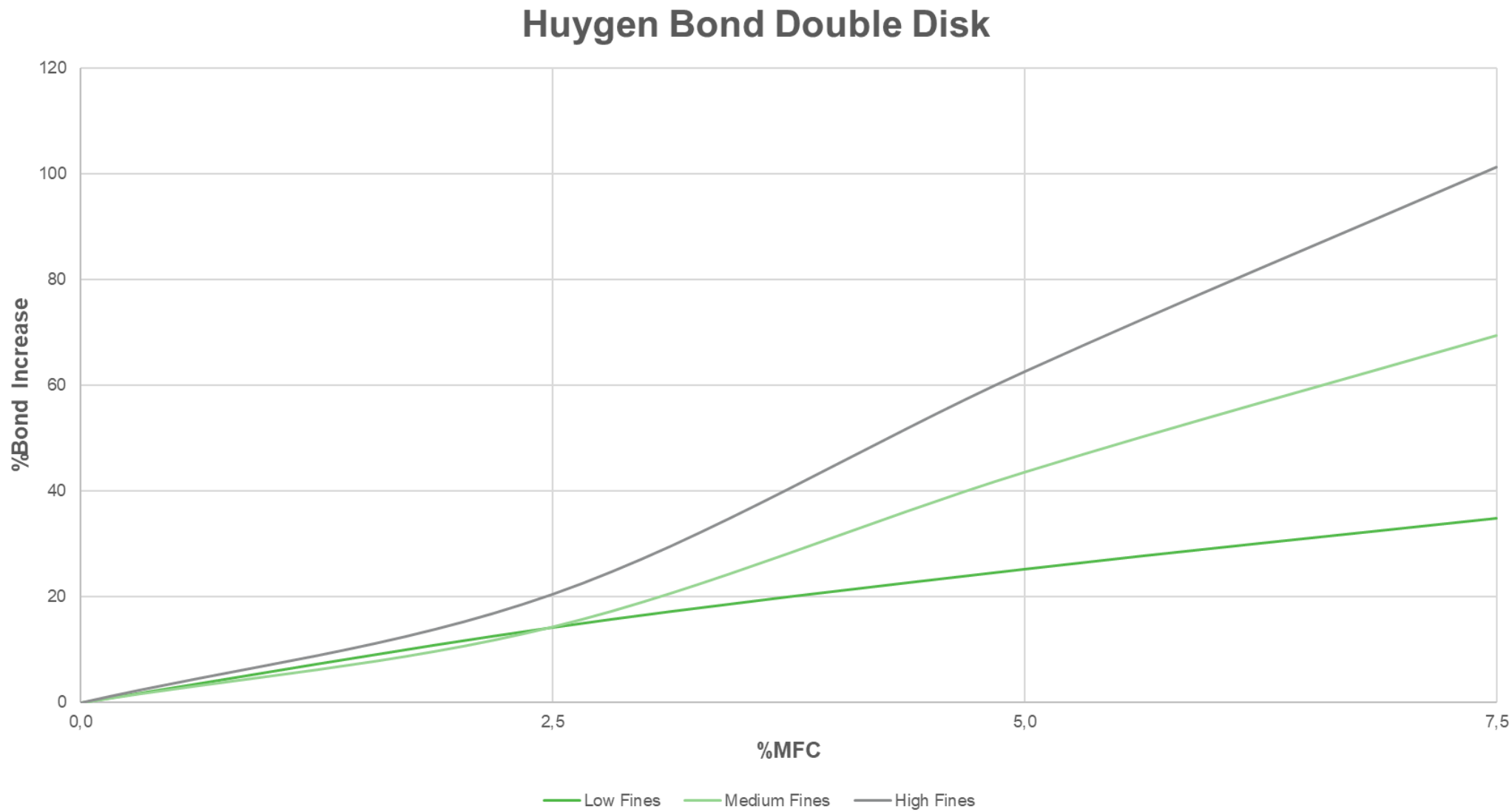

Tensile Index Pro
% Tensile Index Increase
70
60
50
40
30
20
10
0
0,0
2,5
5,0
7,5
% MFC
Low Fines
Medium Fines
High Fines


Tensile Index RF
%Tensile Index Increase
70
60
50
40
30
20
10
0
0,0
2,5
5,0
7,5
%MFC
Low Fines
Medium Fines
High Fines


Tensile Index Double Disk
%Tensile Index Increase
70
60
50
40
30
20
10
0
0,0
2,5
5,0
7,5
%MFC
Low Fines
Medium Fines
High Fines


Huygen Bond Pro
120
100
80
60
40
20
0
%Bond Increase
0,0
2,5
5,0
7,5
%MFC
Low Fines
Medium Fines
High Fines


Huygen Bond RF
120
100
80
60
40
20
0
%Bond Increase
0,0
2,5
5,0
7,5
%MFC
Low Fines
Medium Fines
High Fines


Huygen Bond Double Disk
120
100
80
60
40
20
0
%Bond Increase
0,0
2,5
5,0
7,5
%MFC
Low Fines
Medium Fines
High Fines

Additional Physical Test Results

Pro Refiner

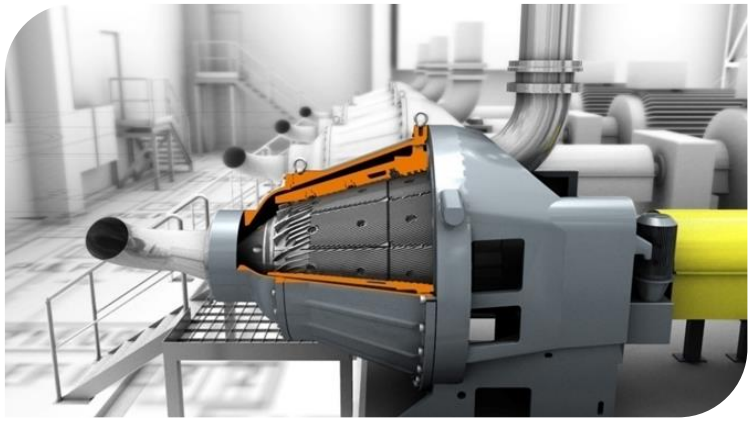
- Burst Index
  - 32% - 150% Increase
- Gurley Air Resistance
  - 30% - 88% Increase

Double Disk Refiner

- Burst Index
  - 31% - 127% Increase
- Gurley Air Resistance
  - 24% - 84% Increase

Conical Refiner

- Burst Index
  - 30% - 128% Increase
- Gurley Air Resistance
  - 26% - 84% Increase



MFC Conclusions

Flexible

MFC for many different applications can be produced from a variety of pulps using any of the three types of refiners discussed, along with the special fillings.

Energy

At high fines content, final accumulated energy usage is generally similar with all three refiner types; at lower fines content there are more differences between the technologies that depend upon control strategies.

Property Development

Similar levels of sheet property development can be obtained using MFC produced by all three refiner types; however, there are some differences in the fines morphologies produced.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