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Roll condition and the impact on the mill performance

Impacts on roll wear and on product flow in the mill

Bill Ritchie

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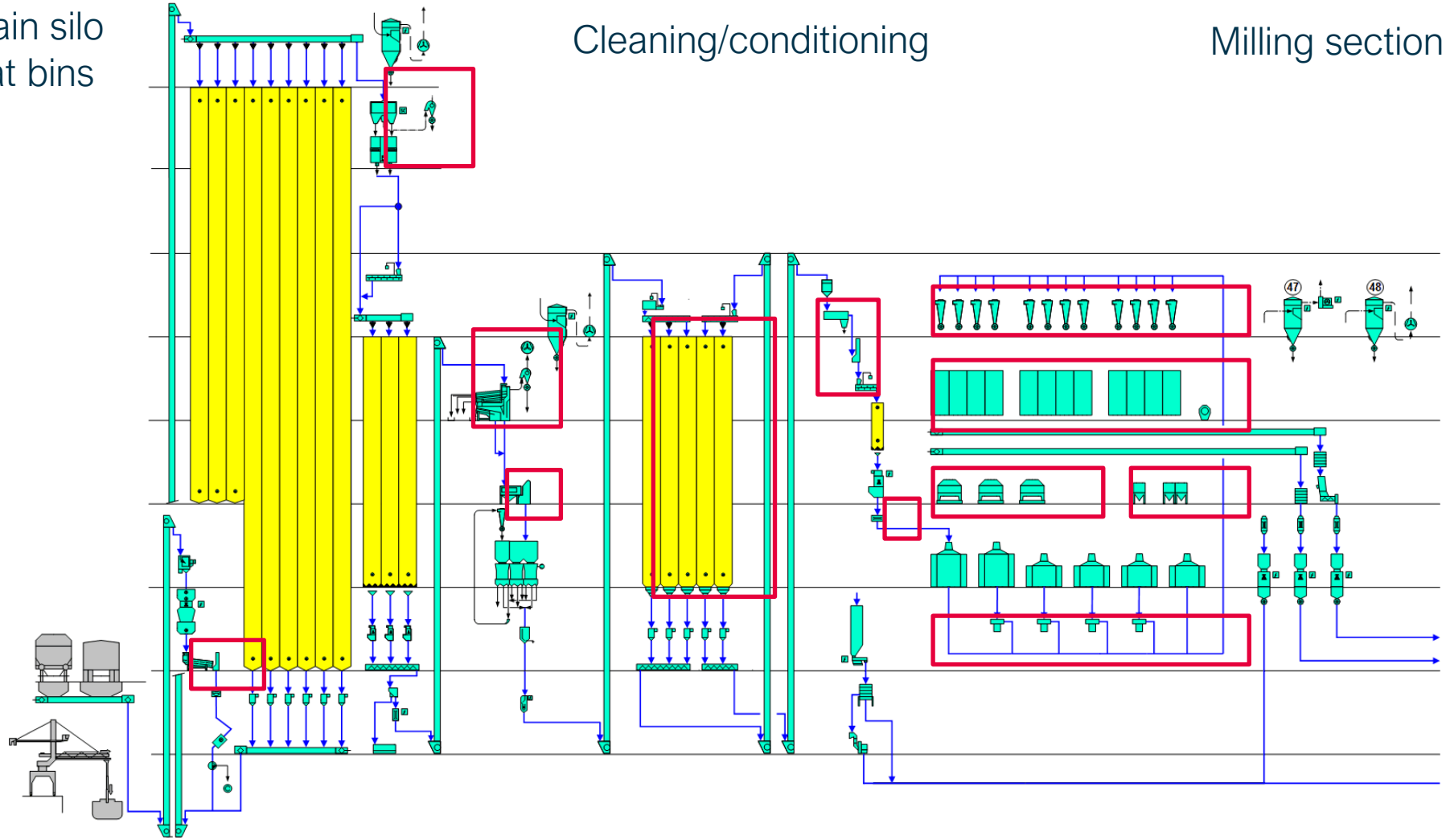
Impact points for the mill performance
Based on roll surface condition

Intake/Grain silo
raw wheat bins

Cleaning/conditioning

Milling section



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01

Corrugation technology to produce clean sizings

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Development of current flute technology

They did a comparison between the current/old flute and a new flute on the B1, B2 and B3 passage, whereby half of it with the current/old flute and the other half had the new flute.

They set the pressure (Druckfall) to 20 for both passages (in parallel), which was difficult because of the supply for the pumps. Afterwards, they defined granulation and ash content. On passages B1 and B2 were pressure measurement performed. B1 was measured under half and full pressure, B2 and B3 were measured at full pressure on one side of the roller-mill.

The new flute resulted in roughly 25% less energy consumption on B1 passage, and 7% less energy consumption on B2 passage.

The new flute showed a strong breakage of the grist (Schrot), more head-grist and darker finer wheat/product. One exemption showed B1 at double pressure: the new flute was on the finest product a little better than F21 at double pressure

22:57	B1 Riffel 21,D°				B2 Riffel 1B,D°		B3 Riffel 1B,C°		22:57	B1 neuer Riffel				B2 neuer R.		B3 neuer R.	
	½ Belast'g	Asche %	ganze Belast'g	Asche %	ganze Belast.	Asche %	ganze Belast.	Asche %		½ Belast.	Asche %	ganze Belast.	Asche %	ganze Belast.	Asche %	ganze Belast'g	Asche %
Abst. 14	68,0-67,8	–	68,1		39,8		25,7			60.4		59,0		25,7		18,8	
" 20	11 -11,3	–	11.3		18,0		14,0			19.0		19.1		29.8		23	
" 32	8 -8	1.12	8,0	1.25	16,7	1.78	12,6	3.73		8.4	1.46	8.8	1.47	22.6	1.62	18,8	3.27
" 45	4 -4,1	0.77	4,0	0.72	9,7	0.60	10,0	1.56		3.8	0.85	3.9	0.94	8,5	0.77	12,9	1.15
" 60	2,5-2,3	0.72	2,4	0.70	4.7	0.55	8,9	0.78		2.3	0.78	2.3	0.73	4.4	0.66	8.9	0.78
" 6xx	1,8 -1,8	0.70	1,8	0.67	3,3	0.54	7.3	0.62		1.7	0.72	1.9	0.67	3.0	0.62	6.0	0.67
" 10xx	2 -2	0.65	2.0	0.68	3,3	0.51	7.5	0.53		1.9	0.64	2,0	0.63	2,6	0.61	5,2	0.63
Durchf 10xx	2,7 -2,7	0.71	2.4	0.73	4.5	0.54	14.0	0.50		2.5	0.73	3,0	0.69	3,4	0.66	6.4	0.67
Durchf. 20	21,0		20,6		42,2		60,3			20,6		21,9		44.5		58,2	
Belast'g	920	kg/Std	1880		1440		615			920		1820		1500		575	
Kraftbedarf																	
leer	0,53	PS			0,48	PS				0.42	PS.			0,537	PS.		
belastet	5,0	PS	9,5	PS	4.35	PS				3.46	PS.	7,2	PS	4.05	PS		
n =	410		390		400		345			405		400		400		370	
B1 H20	16,8-16,9	35%	Manit.														
Mischung		8 5 5 40 7	Hardw. Rosafe Necochea Inland Roggen														

Flute Technology – Flute Geometry

The flute depth is a result given by

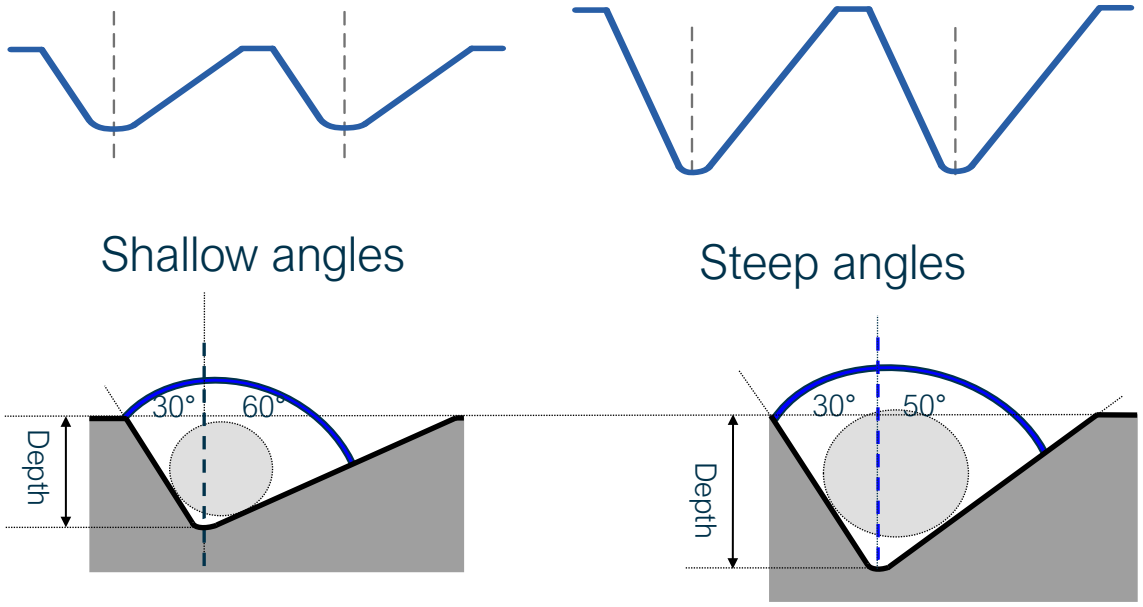
1. the number of flutes per inch or cm
2. the fluting-angles
3. the size of the land

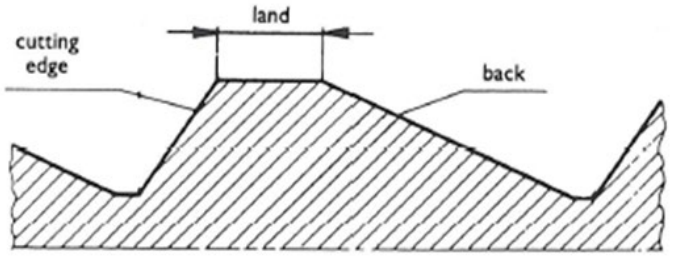
Flat flutes → smaller particles

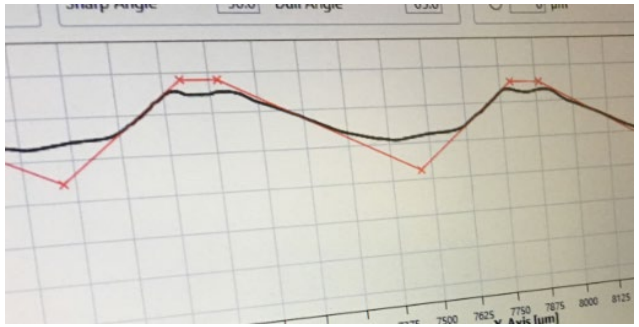
- Producing fine finished products like flour
- Flatter back angles are preferable

Deep flutes → bigger endosperm particles

- To produce coarse finished products like semolina
- Recommended to apply steep back angles







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Flow Sheet Technology

Structure and Product flow Information in a Mill Flow Sheet

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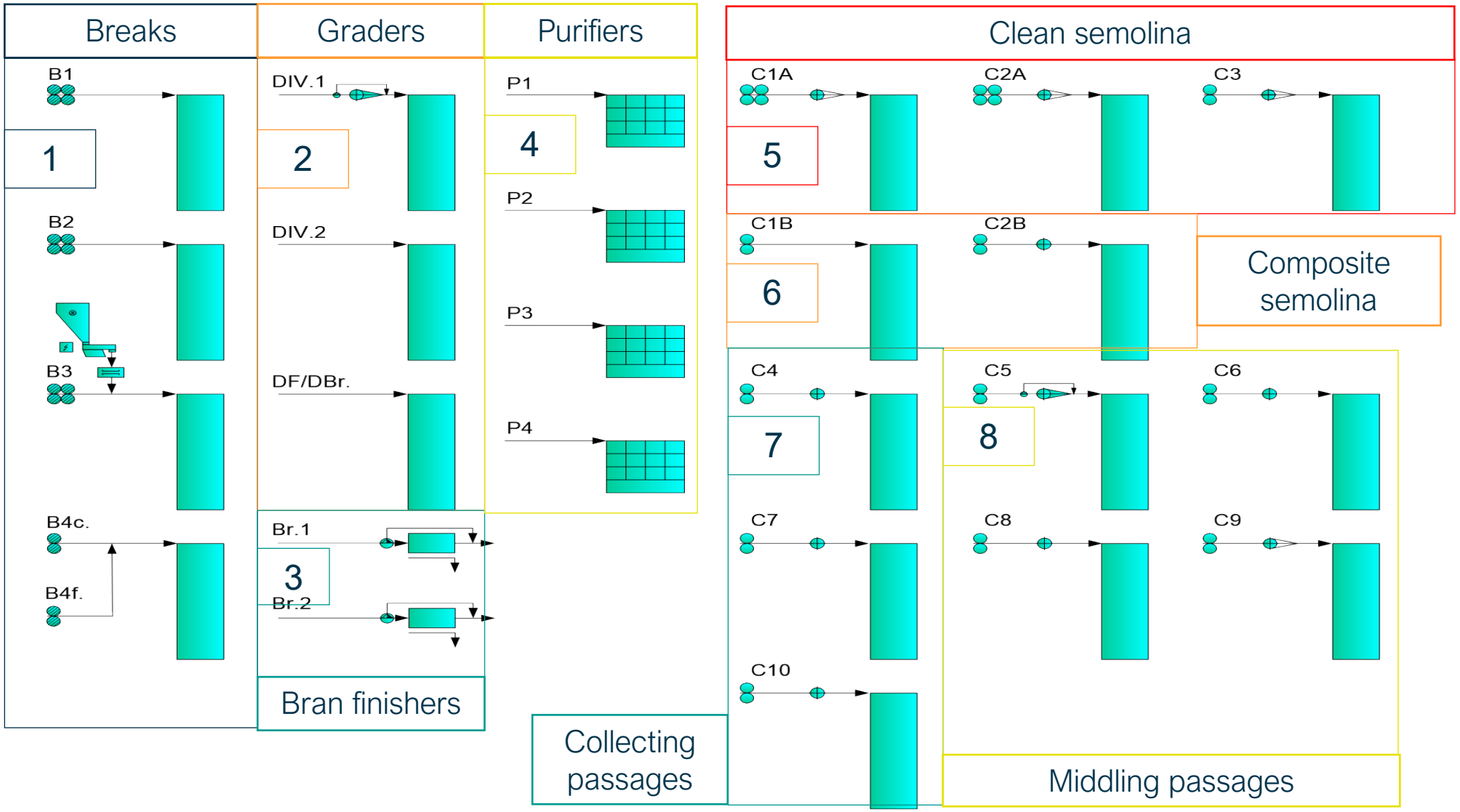
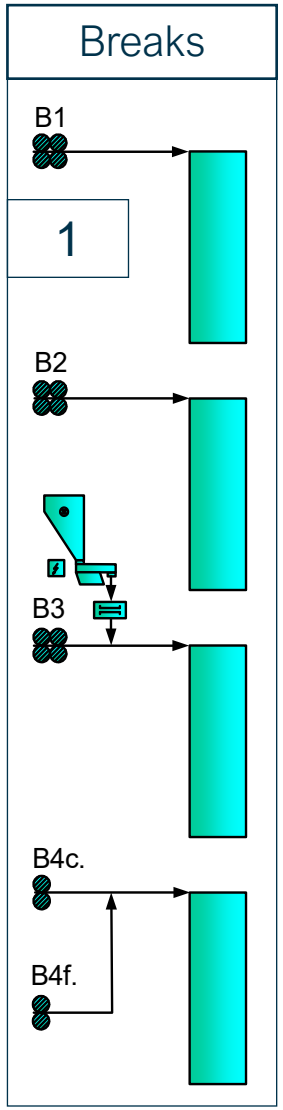
General design guidelines



Setup and target of the break system



Setup/function

The 1st break opens the kernel and start the release of endosperm

The further break passages release / separate further the endosperm

The break system handles in general coarse bran material (large bran pieces approximately > 400 micron with attached endosperm). Means also from other system groups coarser bran is sent back to the break system. Purifier, grader and reduction system. Due to the reason that the fluted rolls can better separate endosperm from the bran than smooth rolls

Only fluted rolls are used

Targets

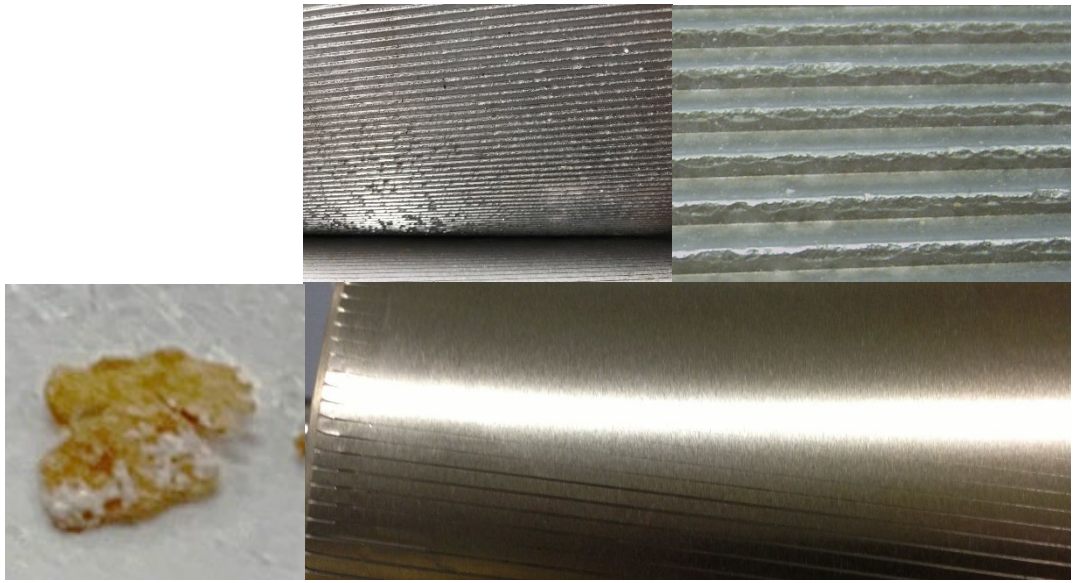
Target is to separate as much as possible endosperm with each break passage step but to cut as less as possible bran into smaller pieces

Balanced load between coarse and fine break passages

Cleaned bran at the end of the break system / last bran finisher → as less as necessary endosperm at the bran

In general no flour production only coarse endosperm parts to treat them further in the system

Roll technology & know how fluted rolls what is important?



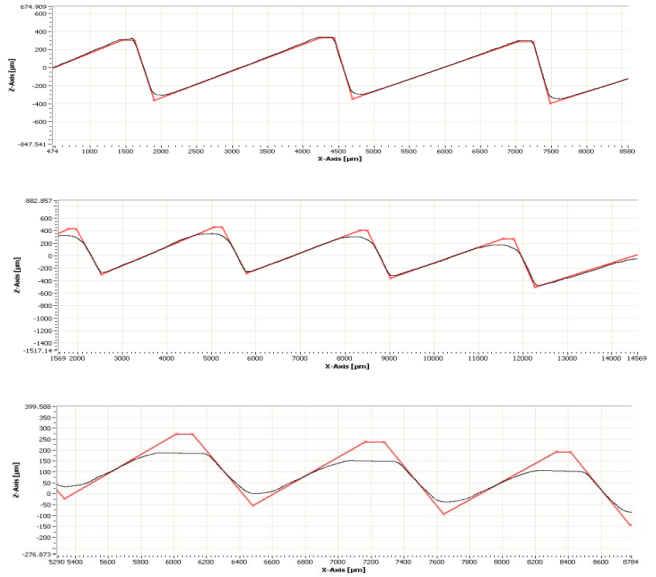
Correct flute of the rolls:

Optimal separation of endosperm from the bran means:

- Maximum separation of large endosperm parts (coarse Semolina)
- Less chopped bran

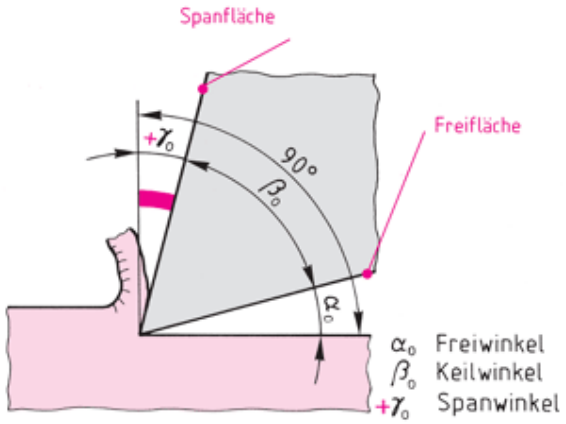
Influence factors fluted rolls

Flute condition	Flour	Granulation	Chopped bran flakes
New	Less	More coarse	More
4 % used	↓	↓	↓
8 % used			
12 % used	More	More fine	Less
15 % used			

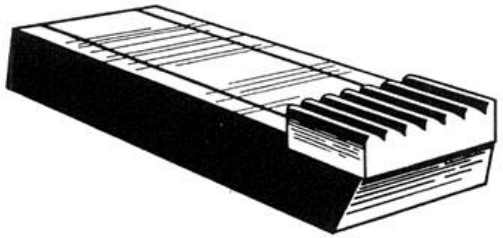


Different types of roll cutting tools to achieve the correct geometry

Micro grinding of multipoint with high powered magnifying glasses

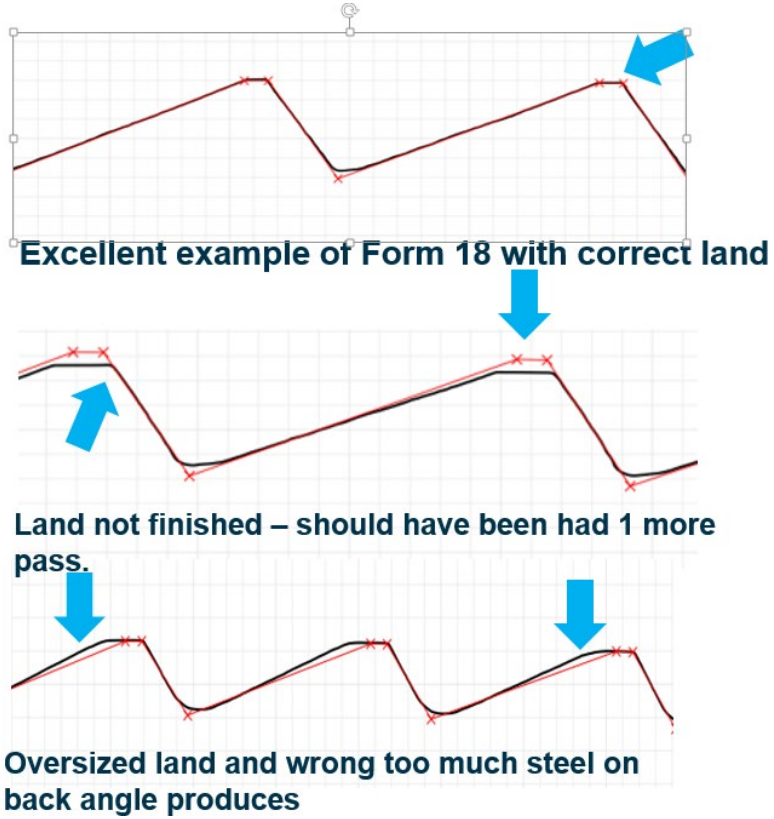


Single Point

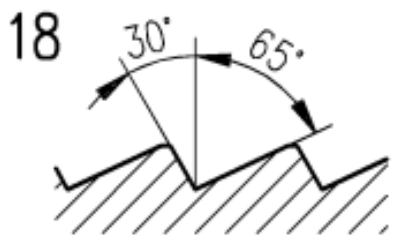


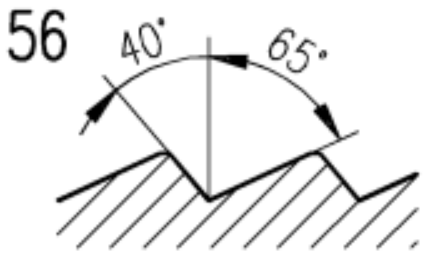
Multi-point cutting

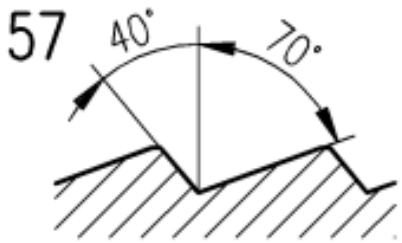
Controlling hand ground cutting tools

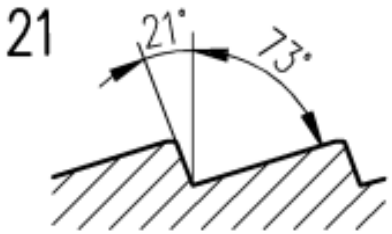


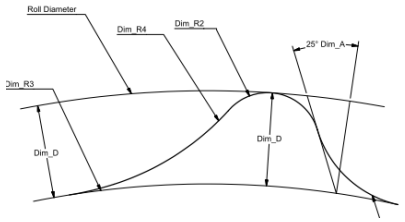
Evaluating cutting angles for the correct effect – note the dull side angles

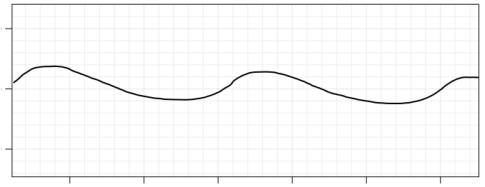








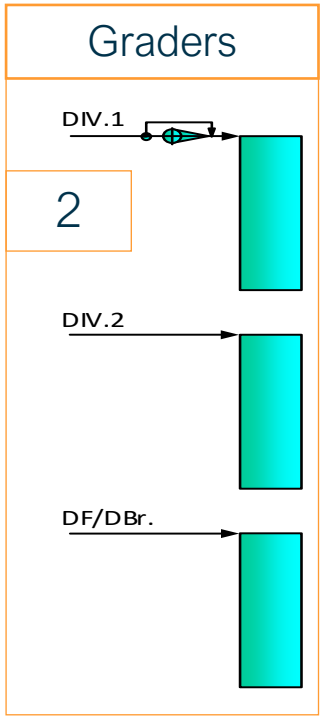




Radius cuts become flat and heat up

Optimal break release
Clean released endosperm and clean bran at the end of the break.

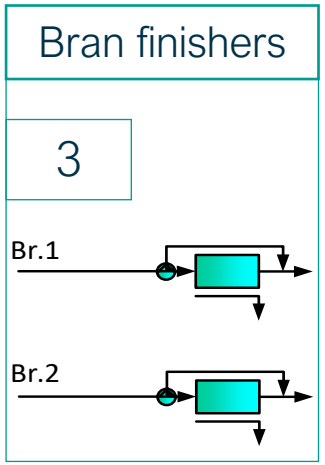
Setup and target of the break system



Setup/function
Extension of sieve area for the break system
More product quantity or to many granulation requires more sieve area based on the requirements
Simple sieving function only to separate particles by size
Typically used for the through of the bran finisher and filter flour

Targets
Optimal load to the sieve area
Maximum load to the pneumatic relift to the grader from the break system sifter
No under- or oversifting

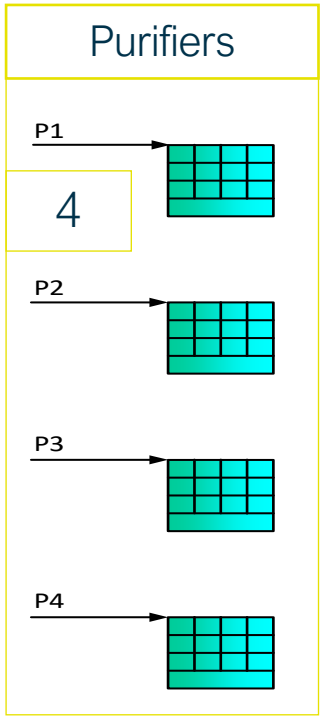
Setup and target of the break system



Setup/function
Extension of break roll length
Supporting the separation of endosperm from the bran
Separation by friction

Targets
Optimal load to the bran finisher
Cleaned bran as an over from the bran finisher → as less as necessary endosperm at the bran

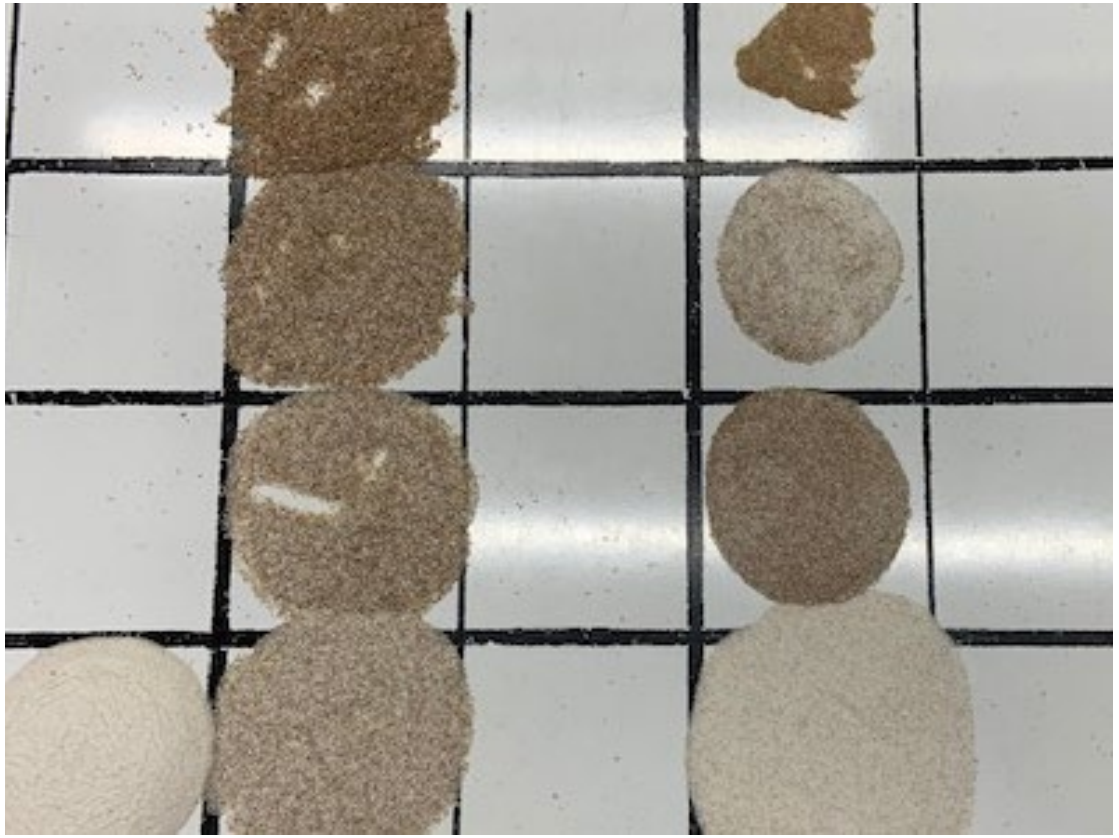
Setup and target of the break system



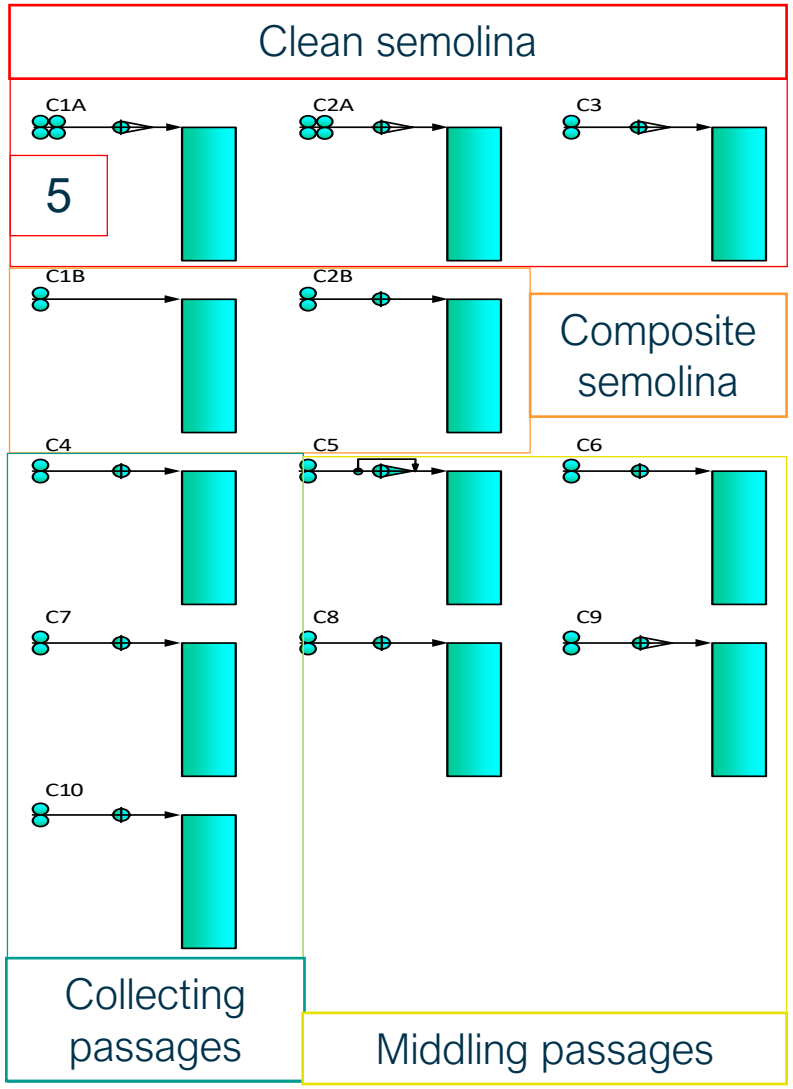
Setup/function
Separation of endosperm parts (Semolina / Middlings) from semolina with attached bran or only bran parts
Reduced bran content in the intermediate stock to increase total extraction of low ash content flour
Reduced specks in the flour

Targets
Optimal load to the sieve area
No under-or overload
No product is removed by the air stream to the aspiration system

Purifier
Load and incoming bran quantity



Setup and target of the break system



Setup/function

The reduction system handles also small bran material (small bran pieces approximately < 400 micron with attached endosperm). This means other system groups send small bran is sent to the reduction system. Purifier, grader and reduction system. Due to the reason that the smooth / fine fluted rolls can better separate endosperm from the bran than coarser fluted rolls in the break system

Mainly smooth rolls but also fine fluted rolls are used

Targets

Flour production! Reduction of Semolina and middling down to flour

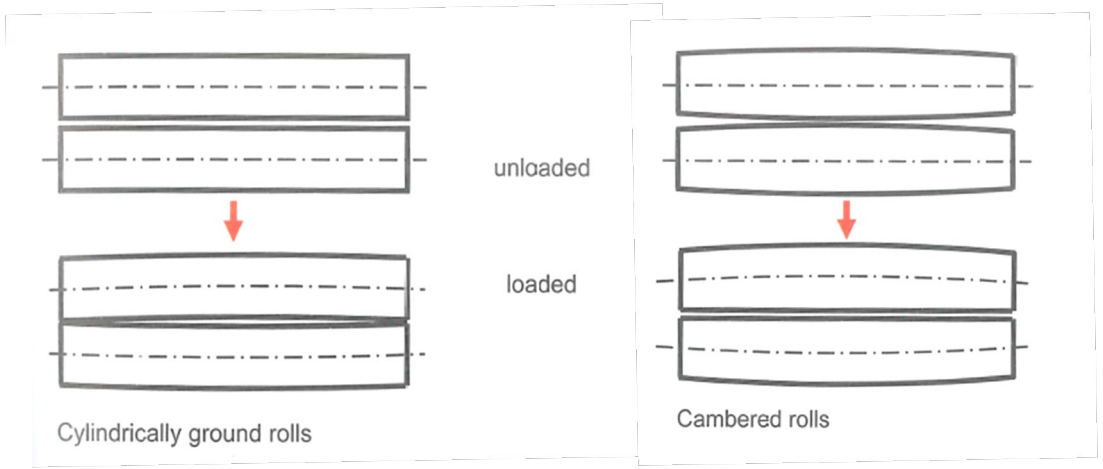
Balanced load between reduction passages

Optimal flour / fines stock production for an optimal load of the flour sieve area

Cleaned fine bran at the end of the reduction system → as less as necessary endosperm at the small bran.

Rollers
Roller cambering

Cylindrically ground rollers grind inefficiently in the middle area of the rollers. Thus, cambering of the rollers is crucial. The cambering can vary between 10 and 50 mm



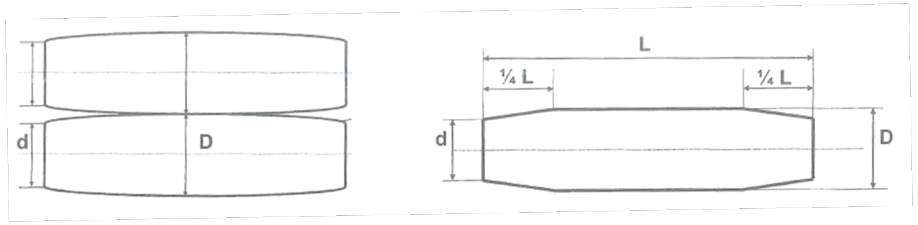
Roll deflection without and with cambering

Circular arc cambering

- This requires a special grinding machine

Roof-shaped cambering

- The typical cambering is 15 – 75 µm depending on the roll length and roll pressure



Circular arc cambering Roof-shaped cambering

- Corrugated rolls are only cambered in the range of 15 – 20 µm as a lower roll pressure are applied

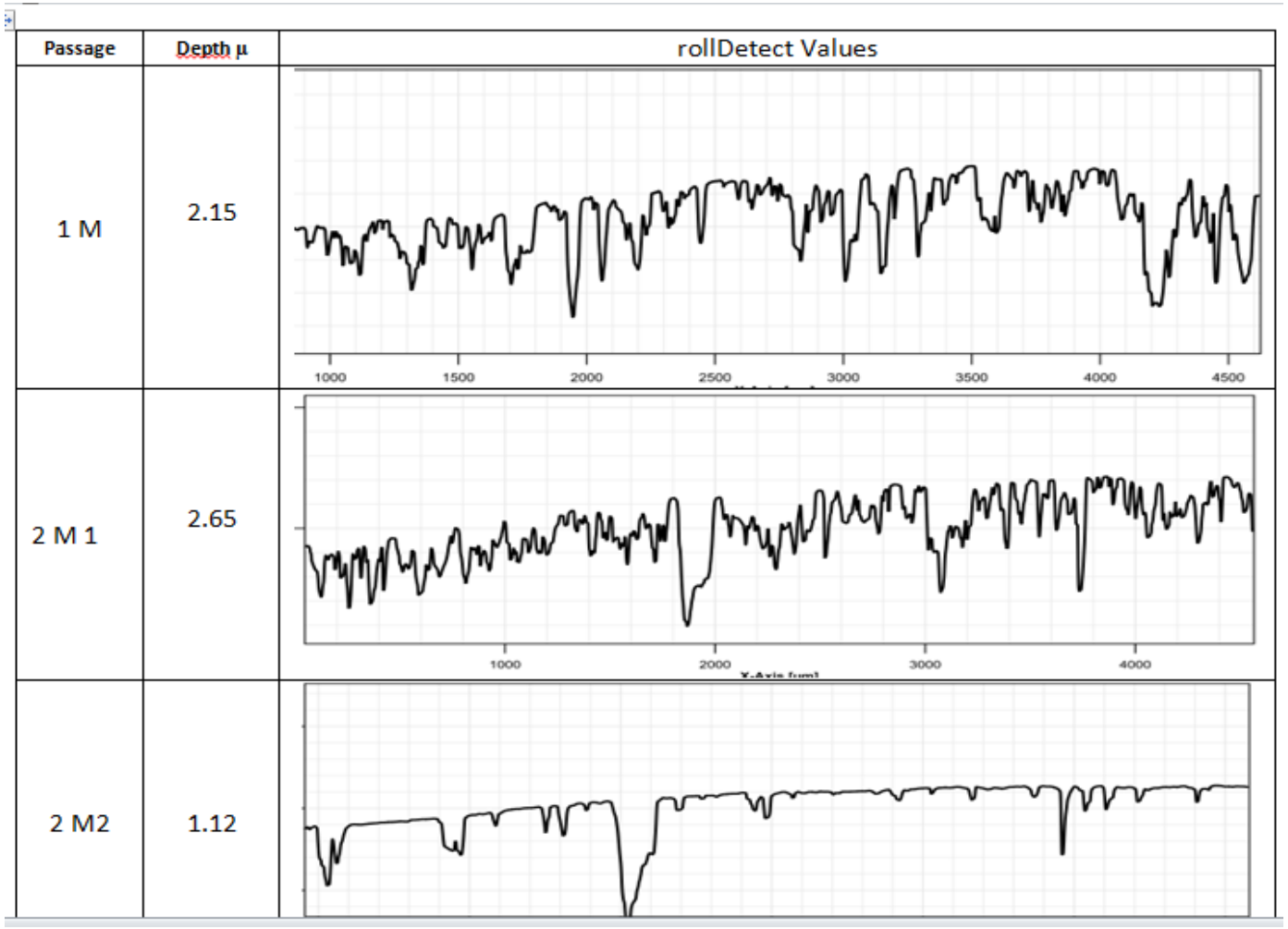
As a result of the strong pressure between the rollers, the rollers slightly deflect during the grinding process. Therefore, the rollers will do less work in the central area than at the two roller ends. Therefore, an uniform work across the entire roller length can be achieved by cambering (crowning) the rollers. The degree of cambering depends on the roller pressure, roller length and the roller diameter. For a given roller length, roller deflection will be greater with a high roller pressure than with a low one. The roller pressure depends on the specific roller loading, degree of hardness of the product and the fineness of the end product

Evaluating smooth rolls - We can see something happening

Traditionally – no one really has optimized the smooth rolls

Now we can!

Below a reading of 1.0 millers should change the roll



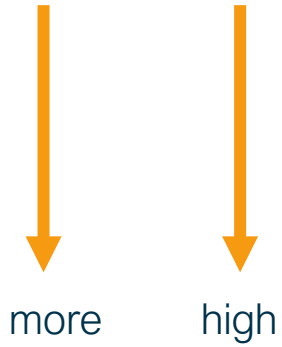
Roll technology & know how smooth rolls what is important?

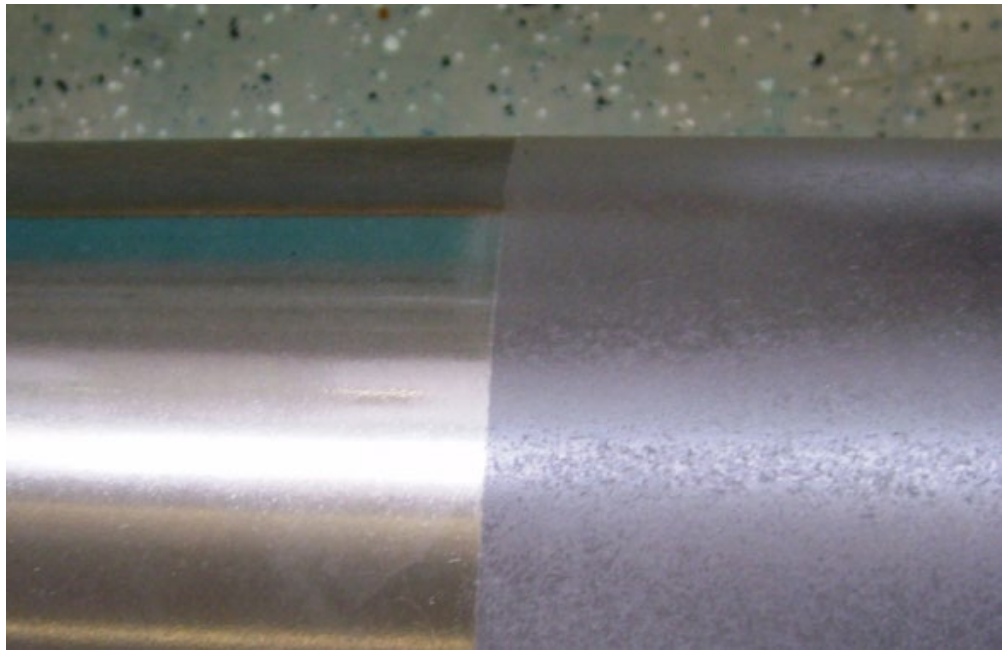
Correct matting of the rolls:

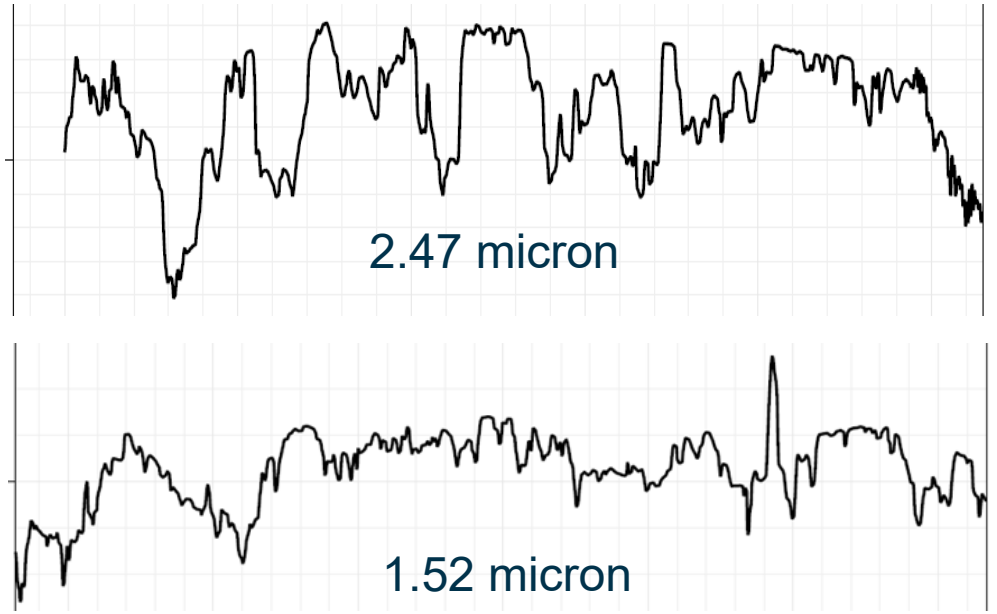
Reduction set-up, smooth rolls need a correct roll surface roughness of Ra 2.5 (micron) micron to Ra 3.5 (micron).
Completely blank rolls will not grind but only press semolina particles resulting in poor flour yield.

Influence factors smooth vs. fluted rolls

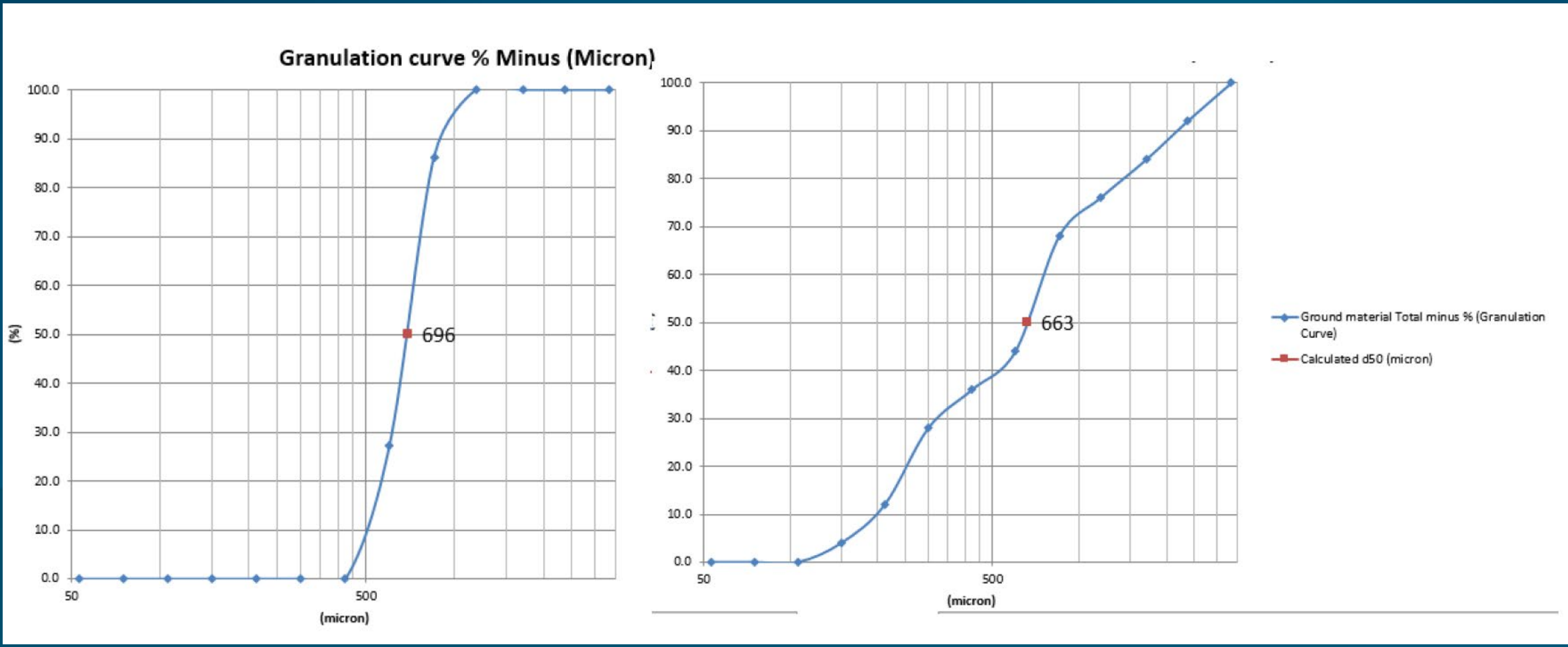
- Polished roll (shiny) < 1.0 Ra
- Light matting roll > 1.0 – 2.5 Ra
- Strong matting roll > 2.5 – 3.5 Ra
- Fine fluted > 14 flutes / cm



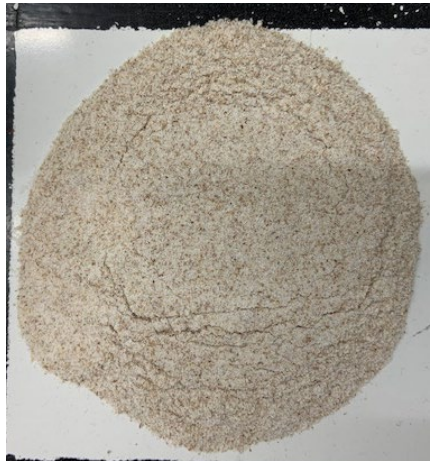


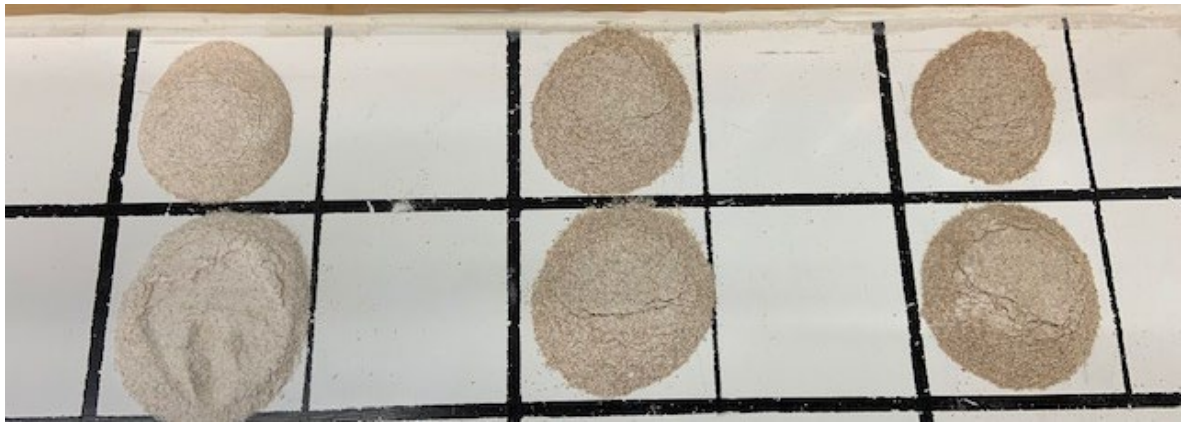


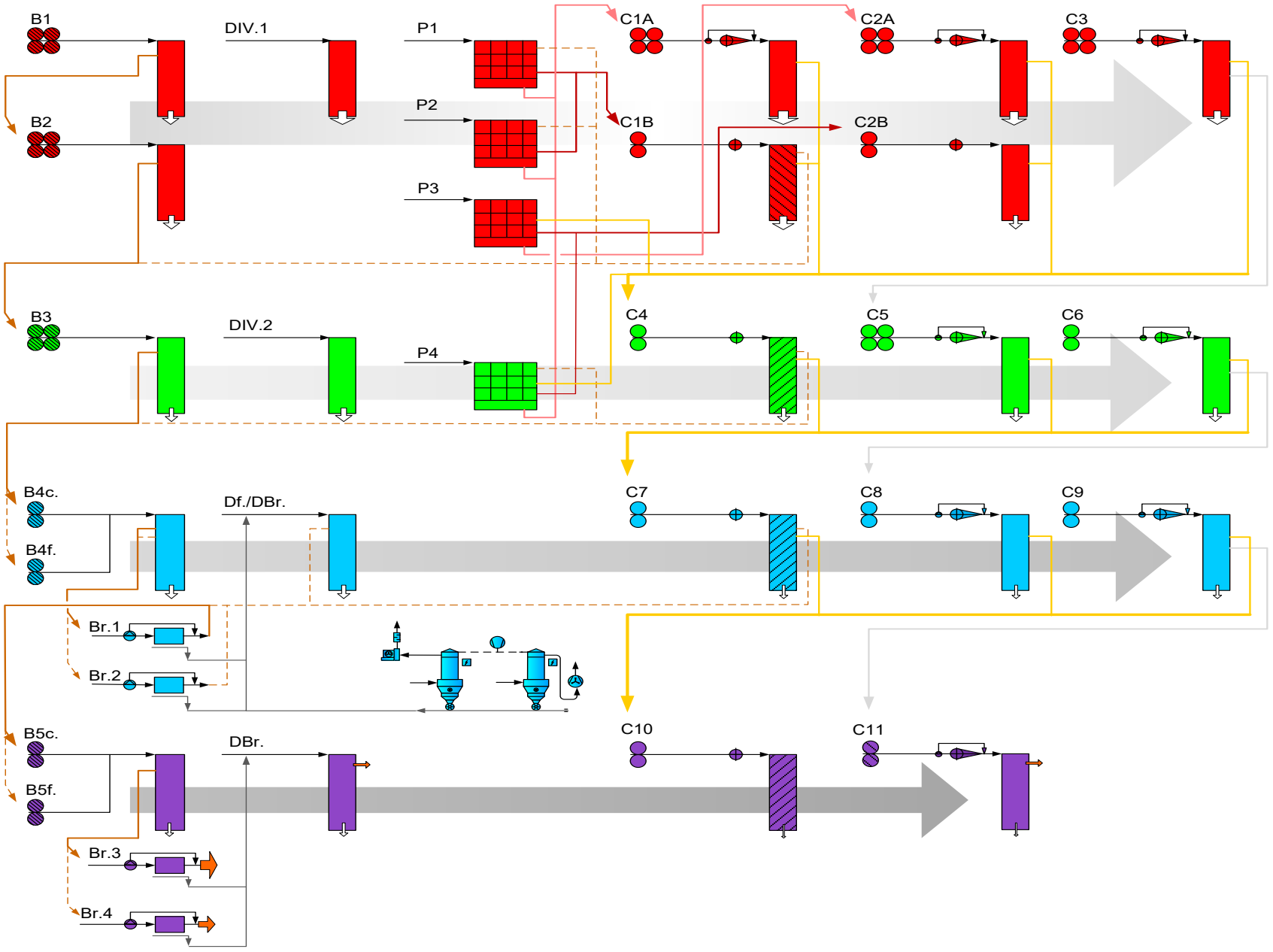
Look at how the granulation has shifted on the quality of the cut



Optimal reduction release
Clean small bran at the end of the reduction system







Legend to Symbols

- I Quality
- II Quality
- III Quality
- IV Quality
- Collecting Passages

Product flow & quantities

- Intermediate products and ash distribution
- Break – coarse overs
- Break - fine overs
- Product mix - coarse/ medium overs
- Semola - low ash
- Semola – high ash
- Semolina – fine overs
- Flour
- Bran

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