Test Report

September 27-28, 2016

Testing of Rapidojet for different applications such as flour pre-hydration and complete continuous dough mixing for bakery applications, pectin, sprouted grains and tea

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Abstract:

Rapidojet high pressure RJ1000 used to evaluate possible benefits in a wide and disruptive range of applications.

All tests were successfully completed with the first run after setup (selection of the proper feeding screw, calibration).

Rapidojet setup:

RJ1000 with exchangeable screw; all tests were performed with a spinning nozzle size 0.030. Flow rate was kept constant at 450 l/h at a pressure about 135 bar for most application. The standard mixing chamber was used for all tests including hydrocolloids (pectin).

Tuesday, September 27,.2016

1. 100% Flour pre-hydration using white bread flour

Powder	White flour			
Calibration	20 Hz	30 s	4,370 kg	525 kg/h
	40 Hz	30 s	7,882 kg	945,8 kg/h
Hydration	Increasing, starting with 55 %			
Nozzle	20 °, size 0.030			
Capacity	1100 - 1260 kg/h			
Liquid flow	450 l/h			
Flour feeder	25,79– 33,68 Hz			
Quantity	8 kg			
Pressure	135 bar			

Remarks	The 55 % hydration dough was very stiff; the best dough was found to be 63 % hydration; 70 % hydration was sticky

Variations:

Hydration [%]	Hydration increase compared to standard [%]	Production rate [kg/h]	Speed of feeding screw [Hz]	remarks
55	0	1260	33,68	Very stiff
60	9,09	1200	30,68	Still quite stiff
63	14,55	1160	28,85	Positive window test
70	27,27	1100	25,79	Very sticky, to soft

2. Complete formulation dough (except yeast)

10 % whole wheat flour was premixed with 100 % white flour by running the product through the feeder + agitator of Rapidojet. Flour was collected in buckets and returned to the Rapidojet dry ingredient hopper.

All Minors and Micros were added to the Ingredient Water in the premix vessel under Rapidojet. The feeding pump was activated and the liquid mixed by running liquids in a loop.
Then the valve controlling backflow was partially opened, so that the pressure reading above the feeding pump showed half the pressure compared to pressure against closed valve.

Powder	"10Wholewh"			
Calibration	20 Hz	30 s	3,931 kg	471,7 kg/h
	40 Hz	30 s	7,374 kg	884,5 kg/h
Hydration	Includes 12 % minors (based on flour mix)			
Nozzle	20 °, size 0.030			
Capacity	see below			
Liquid flow	450 l/h			
Flour feeder	25,79– 33,68 Hz			
Quantity	8 kg			
Pressure	135 bar			
Remarks	Original calculation of minors was based on 55 % hydration, so for the 65 % hydration, the ratio of minors to flour was higher			

Hydration [%]	Hydration increase compared to standard [%]	Production rate [kg/h]	Speed feeding screw [Hz]	remarks
55	0	1260	33,68	Very stiff
65	18,18	1200	30,68	Fully developed dough as shown with window test

Wednesday, 28.9.2016

3. Pectin

For the test with pectin, two changes were made to the RJ1000:

1. Exchange of feedings screw (low volume) including distribution star
2. Flow rate was increased to 500 l/h, resulting in 147 bar
3. Filling of premix vessel with hot water for a second test

Powder	Pectin			
Calibration	8 Hz	60 s	0,384 kg	23 kg/h
	40 Hz	60 s	1,529 kg	91,7 kg/h
Solid content	5 %			
Nozzle	20 °, size 0.030			
Capacity	525 k/h			
Liquid flow	500 l/h			
Flour feeder	9,5 Hz			
Quantity	8 kg			
Pressure	147 bar			
Remarks	Both tests dissolved pectin immediately and resulted in a very smooth gel; no lumps were found in the mix			

a) Cold water: no residue in mixing chamber
b) Hot water: some residue in mixing chamber, but no lumps either; temperature of mix was 128,1 °F.

4. Sprouted grains

Quinoa was used for this test (mix of white and brown varieties). Standard feeding screw with distribution star was used.

Dry ingredient	Quinoa			
Calibration	8 Hz	15 s	1,368 kg	328,3 kg/h
	20 Hz	10 s	1,557 kg	560,5 kg/h
Hydration	100 %			
Nozzle	20 °, size 0.030			
Capacity	900 kg/h			
Liquid flow	450 l/h			
Flour feeder	15,24 Hz			
Quantity	8 kg			
Pressure	135 bar			
Remarks	Water was used in excess to clean the surface and to initiate steeping; the whole mix was rested in a bucket. After 75 minutes there was no free water above the grains anymore. All			

	water had been absorbed. Control did not have the cleaning effect (clear water was visible above the grains after stirring), also swelling was less. After 4 hours, the first sprouting occurred.

5. Black tea

Low volume feeding screw was used without distribution star to avoid compaction.

Powder	Tea			
Calibration	10 Hz	30 s	0,103 kg	12,4 kg/h
	50 Hz	10 s	0,157 kg	56,5 kg/h
Solids	10 %			
Nozzle	20 °, size 0.030			
Capacity				
Liquid flow	450 l/h			
Quantity	8 kg			
Pressure	135 bar			
Remarks	After hydration, the bucket showed three distinct regions: on the lower side, large swollen tea particles settled, then there was a middle region basically free of solids but with high amounts of dark dissolved components; a thin layer of small tea particles was skimming on the surface. By end of the run, the feedings screw started to compact the tea, so the screw was replaced by the standard screw for the next test.			

6. Green tea

Feeding screw was exchanged to standard screw.

Powder	Tea			
Calibration	5 Hz	30 s	0,320 kg	38,4 kg/h
	10 Hz	20 s	0,331 kg	59,6 kg/h
Solids	10 %			
Nozzle	20 °, size 0.030			
Capacity				
Liquid flow	450 l/h			
Flour feeder	7,75 Hz			
Quantity	8 kg			
Pressure	135 bar			
Remarks	The teat particles swelled very much, so after 30 minutes, the bucket with mix was almost completely filled with hydrated particles, only a very small layer of water was in between.			

7. Coffee agglomeration

This application had been discussed in detail.
Hydration level shall be between 10% and 20 %. Because the density of the powder is reported to be very low (0,25 g/ml), the feeder will not be able to feed enough material to achieve the desired hydration level.
The speed of the feeder VFD was changed, so it will accept 70 Hz as maximum speed.

So the following strategy for the tests is proposed:

1. Calibration of the powder between 50 Hz and 70 Hz
2. Test of flow rate in manual mode with the #3 nozzle in place in 5 % increments starting at 10 Hz
3. Editing a new recipe with the maximum feeding rate and the flow rate at 50 bar (recommended minimum pressure for the test);
4. Check if the resulting hydration level is close enough to the desired value to justify the test.

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Pictures

Rapidojet RJ1000 hydration device

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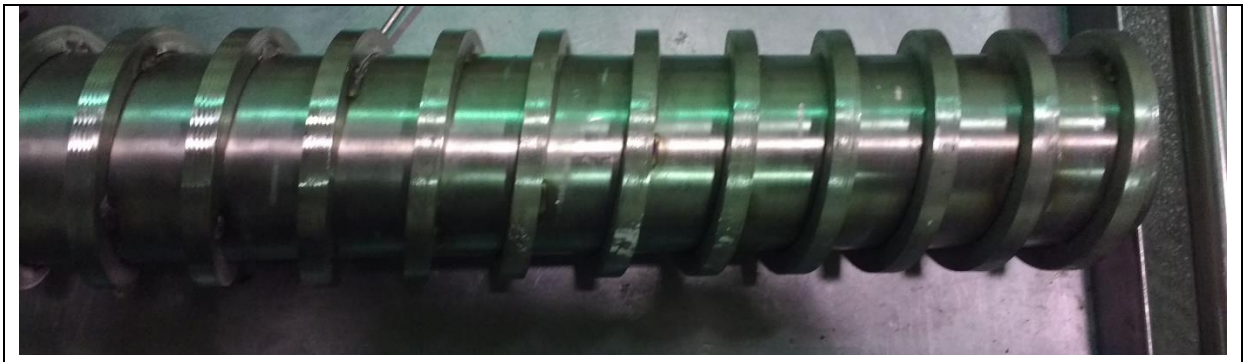

Feeding screw with reduced feeding rate

Distribution star at the end of the screw

Pectin solution of 5 % directly after hydration

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Mixing chamber: wet mixing area; no possibility for lumps to sit on the wall

Viscosity of 5 % pectin solution

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No residues on mixing chamber wall at cold hydration of pectin

Some residues on the mixing chamber at hot water hydration of pectin

Quinoa in hopper with agitation bar

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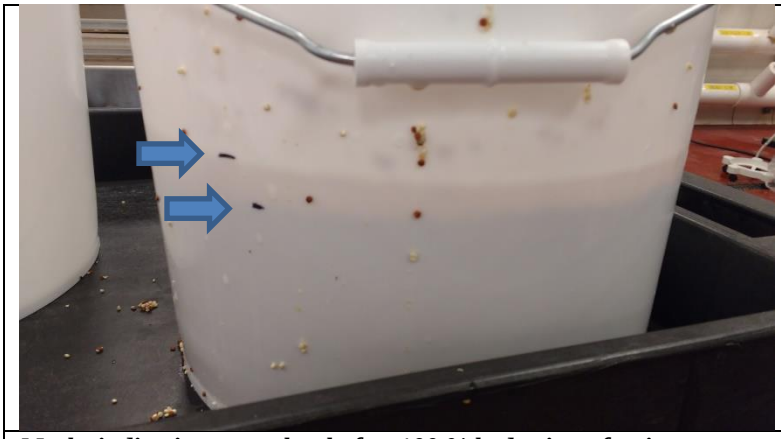
White quinoa

Blend of white and brown quinoa

Quinoa after hydration; cleaning effect good visible (water not clear)



Marks indicating water level after 100 % hydration of quinoa

Quinoa directly after hydration

Control: no cleaning effect (clear water), little swelling, some grains floating

Surface covered with water right after mixing

Much of water absorbed by quinoa after 40 minutes

All of the water absorbed by quinoa after 75 minutes

Back tea at 10 % solids; one-layer skimming on top

Green tea at 10 % solids; intense swelling, almost no phase of free water