



## Testing of Rapidojet for starch hydration / gelatinization

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By Dr. Bernhard Noll, Rapidojet GmbH

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### *Abstract:*

*Pregel corn starch could instantly be hydrated at 6 % s.m. and showed higher viscosity than control.*

*Native starch could be hydrated and gelatinized at the same time using hot water at 64 °C. Viscosity was again higher than control using a pan for heating.*

*Gelatinized starch showed higher viscosity than pregel starch*

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## 1. Pregel corn starch

Recipe	"Coldswel"			
Flour	6 %			
Calibration "Coldswel"	2 Hz	60 s	0,255 kg	15,3 kg/h
	10 Hz	30 s	0,642 kg	77 kg/h
Water	94 %			
	Water temperature 5 °C			
Nozzle	20 ° spraying angle, size 0.030			
Capacity	450 kg/h			
Liquid flow	423 l/h			
Flour feeder	27 kg/h; 3,52 Hz			
Dough pump				
Quantity	5 kg			
Pressure	75 bar			
Time				
Remarks	Setup mixing chamber: Hydrocolloid-setup (nozzle centered with 3 screws right above smallest diameter of 1,5 cm;			
Result	A homogenous gel without lumps was formed instantly			

## 2. Pregel corn starch not mixed with high pressure for comparison

The same setting was run again, but water and starch collected separately.

Then the starch was manually mixed using a fork / whisk.

For there were still many lumps, a part of the mix was processed in a high speed kitchen mixer to achieve a lump free gel.

This gel was more opaque than the Rapidojet gel.

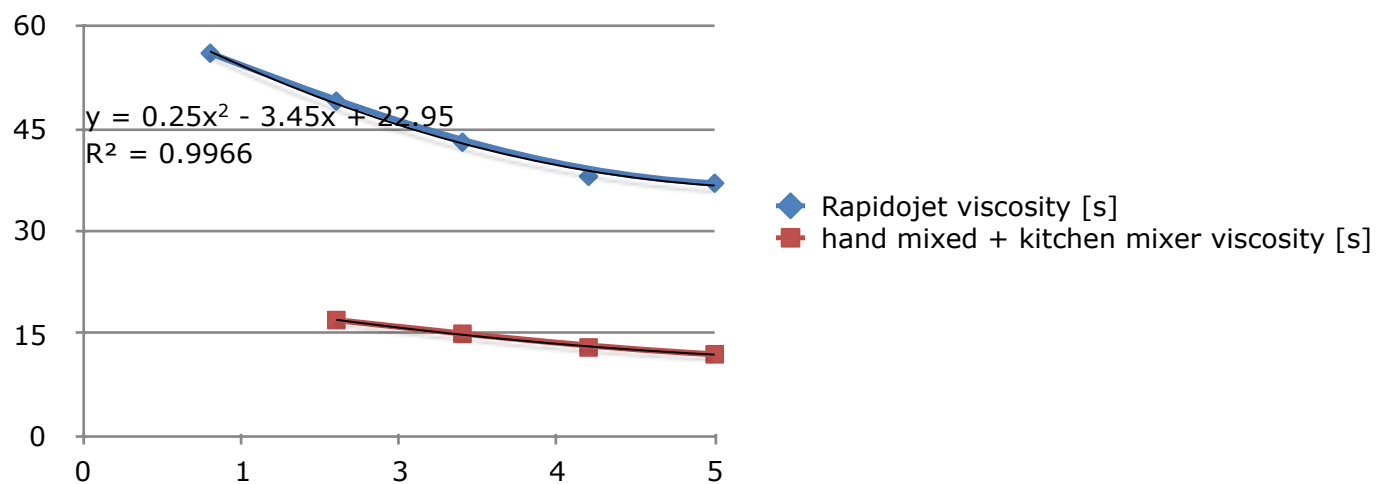
Viscosity (reported below) was tested using a Höppler ball fall viscosimeter at 27 °C.

run	Rapidojet viscosity [s]	hand mixed + kitchen mixer viscosity [s]
1	56	-
2	49	17
3	43	15
4	38	13
5	37	12

This shows that the Rapidojet sample showed a significantly higher viscosity, providing an opportunity to reduce it's usage level.

$$y = 0.9286x^2 - 10.471x + 65.8$$

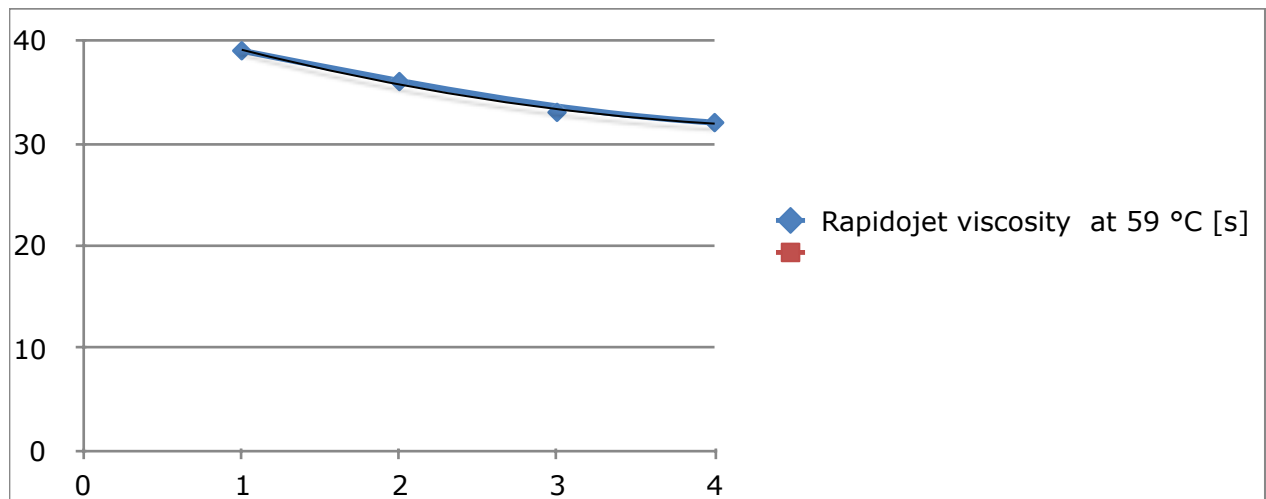
$$R^2 = 0.9959$$



The final time for Rapidojet sample was 37 seconds compared to 12 second for the control. This means, that the viscosity with Rapidojet at same starch level was significantly higher.

### 3. Native corn starch

Recipe	“Cornstar”			
Flour	6 %			
Calibration “Cornstar”	2 Hz	60 s	2,18 kg	13,1 kg/h
	10 Hz	30 s	0,732 kg	87,8 kg/h
Water	94 %			
	59 °C final temperature (water temp. 88 °C)			
Nozzle	20 ° spraying angle, size 0.030			
Capacity	450 kg/h			
Liquid flow	423 l/h			
Flour feeder	27 kg/h; 3,49 Hz			
Dough pump				
Quantity	5 kg			
Pressure	75 bar			
Time				
Remarks	Water was heated up using an electrical heater with 20 l capacity; water was pumped in a loop to heat up the pipes, high pressure pump and mixing chamber; for the room temperature was 5 °C, the resulting temperature was 59 °C; the starch was just about starting gelatinization			



#### 4. Native corn starch at higher temperature

20 l of water was brought to a rolling boil and then used with Rapidojet; first 10 kg were rejected; then a sample was taken at 64 °C; the starch seems to be completely gelatinized.

Viscosity was highest of all samples. The ball of the viscosimeter did not move within 15 minutes. Appearance was like vaseline, more like a paste.

#### 5. Native corn starch control heated in a pan

30 g starch + 470 ml water were mixed in a pan and then heated up to 97 °C on a stove.

Viscosity was very high; a ball fall time of 160 minutes was estimated.

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#### Conclusions:

**Rapidojet can be used to hydrate pregel corn starch and to hydrate and gelatinize native corn starch in a single step using hot water.**

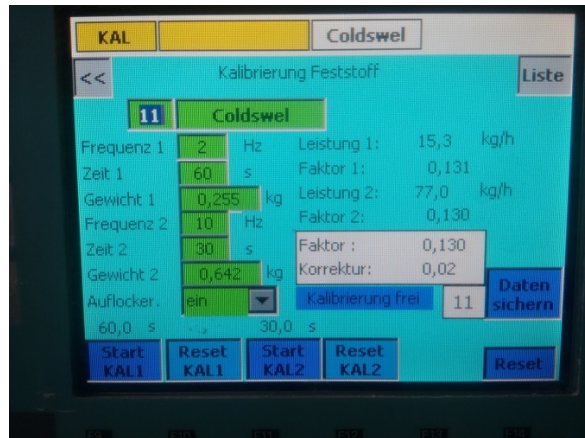
**Viscosities of Rapidojet produced samples were significantly higher than control. This provides a cost cutting opportunity.**

**Viscosity of Rapidojet mixed native starch at 64 °C was higher than fully cooked control sample.**

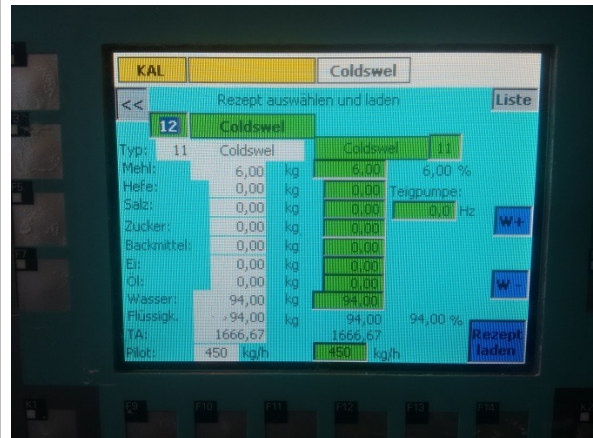
**Viscosity of pregel corn starch was lower than heated native corn starch.**

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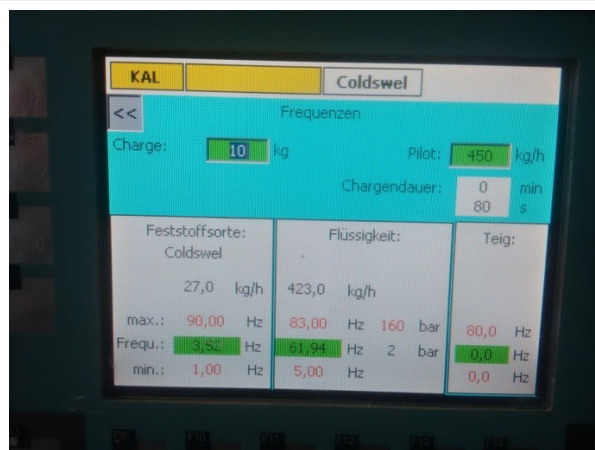
## Pictures



*Calibration of pregel starch at 2 speeds*



*Recipe for pregel starch*



*Working conditions for pregel starch*



*Rapidojet setup with "hydrocolloid" mixing chamber*



*Manually mixed pregel starch*



*Lumps even after stirring*



*High speed mixing to destroy lumps*



*From left to right: Rapidojet mixed – handmixed with lumps – high speed mixed*

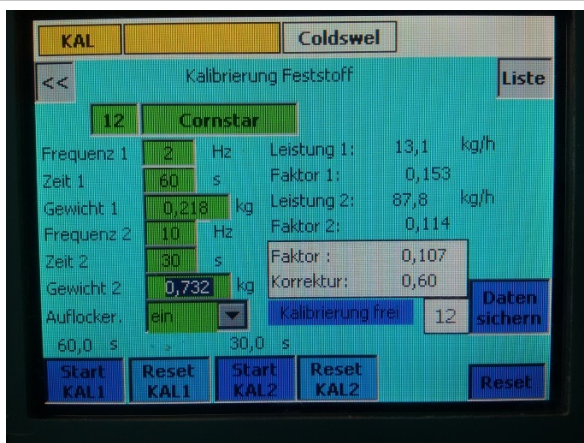




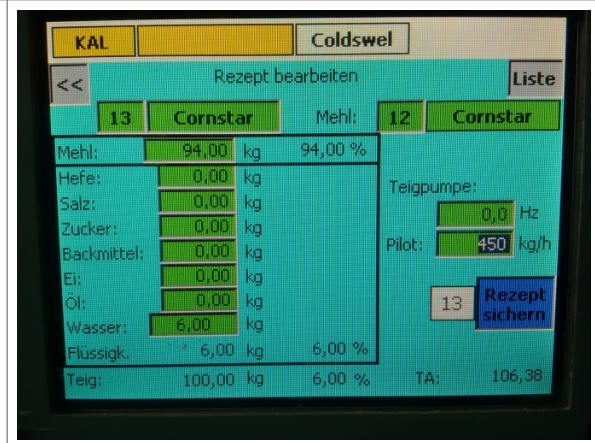
*Höppler ball fall viscosimeter*



*Water bath controlled setup at 27 °C*

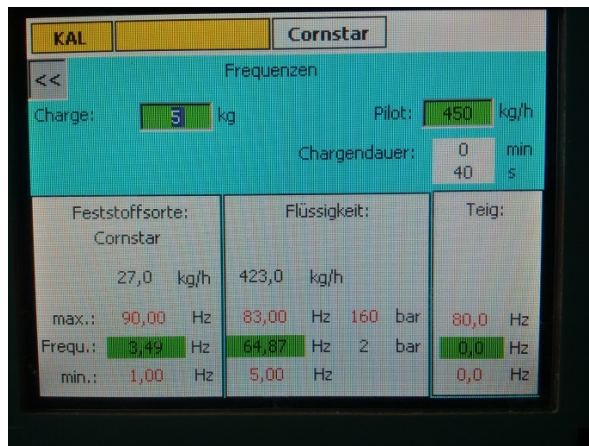


*Calibration native starch*



*Recipe native starch*





*Working conditions for native starch*



*Heating up of equipment by pumping hot water in a loop*



*Production of gelatinized starch at 64 °C*



*Control native starch heated in a pan*



*Left: heated up to 59 °C; right: heated up to 64 °C*



*Starting gelatinization at 59 °C*

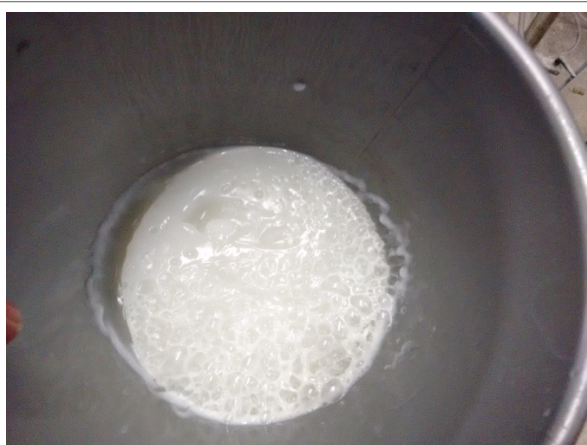




*At 59 °C - opaque*



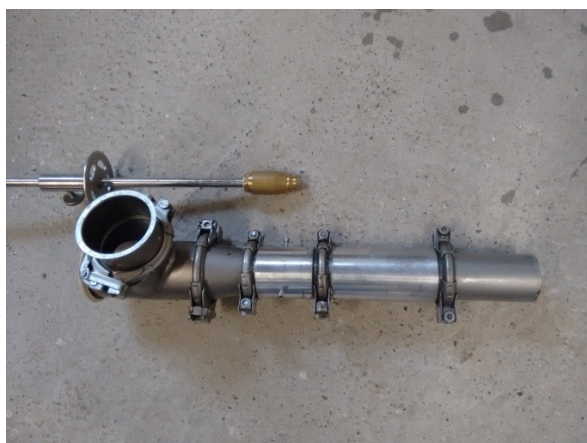
*At 64 °C – clear gel*



*At 64 °C*



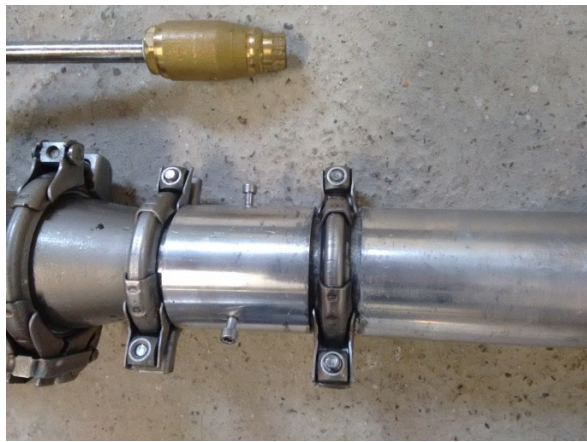
*Control heated in pan – 59 °C Rapidojet – 64 °C Rapidojet*



*Mixing chamber disassembled*



*Mixing chamber disassembled*



*Hydrocolloid mixing chamber with screws to center and fix high pressure nozzle*



*Look through mixing chamber with 1,5 cm diameter right under nozzle position*



*Rapidojet gelatinized native starch at 64 °C*