

# What happens during mashing – a closer look on the behavior of the particles during the mashing process

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## Abstract

Technological impacts on the mashing process are well investigated and the influences of the raw material quality, fineness of the ground malt and temperature programs explored. New aspects on the mashing process from the procedural point of view show, that alternative ways can give a lot of new opportunities for a faster and better lautering.

Concerning this, a lot of research is done at the institute. Especially the behavior of the fine particles were investigated very intensive during the last months.

First test were done with laser diffraction. A method, developed at the institute, gave the possibility to follow the behavior of the particle size distribution during the mashing process. Subsequent, trials were done in a microscopic mash tun. This gave the chance to see in reality what happens on the particles in dependence of temperature, enzyme input and others.

This knowledge is important for a better procedural understanding of the mashing process and gives the basis for modeling the mashing process.

Finally, it can give the solution to develop a control system with which it will be possible to manage the mashing process against the particle size of the mash. This optimization will save time of mashing, and as a consequence to that, energy and money.

## Experimental

### Measuring of the particle size distribution of mash by laser diffraction



Fig. 1: Laboratory mashing kettle

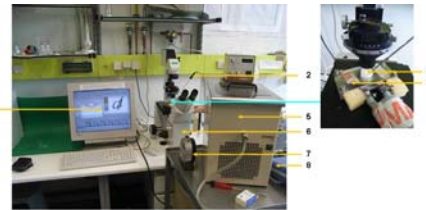
Tab. 1: Analysis procedure for particle size measurement

- Taking a sample of 15 ml
- Stop degradation processes and fixing the composition with the temperature of -20°C
- Defrosting in 1 litre of cold (0°C), degassed and demineralised water
- Giving 2 ml into another 50ml degassed water (15-18°C)
- Identification of the particle sizes with an HELOS (laser diffraction spectroscopie)



Fig. 2: Laser diffraction spectroscopie „HELOS“

### Mashing under the microscope



1 picture analysis software, 2 temperature sensor, 3 mash tun, 4 heater, 5 thermostat, 6 inverted microscope, 7 timer, 8 thermometer

Fig. 3: Microscope with micro mash tun

## Results

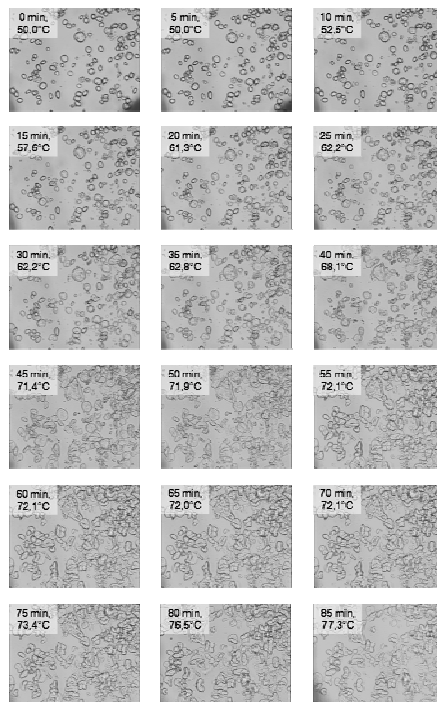


Fig. 4: Journal of a mashing process, starch particles in the microscope mash tun

## Conclusions and Discussion

The development of the measuring system for the particle size distribution was the first step to get a deeper knowledge about the specific behavior of the particles during the mashing process.

To validate the results of the laser measurements, particles has been observed under a microscope. The pictures has been analyzed by picture analysis and compared with the laser results. This showed, that the change of the particle size distribution is analogue to the change of the laser measured distribution.

Most of the mashing methods are "safety procedures" to guarantee the complete conversion of the worth giving ingredients. With the new procedural knowledge about the coherence between the particle size distribution and the status of the mashing process, it can be possible to control the mashing process in a better way.

Usually it is not possible to integrate a microscope in to the mash tun. Also the laser diffraction spectroscopie is not suitable to be installed for inline measurement.

Therefore a new way to analyze the particle size distribution had to be found. By patent law it is unfortunately impossible to tell the name of the new system, but figure 6 shows the test signal of test mashing. The transfer for the inline use is investigated at the moment in Weihenstephan.

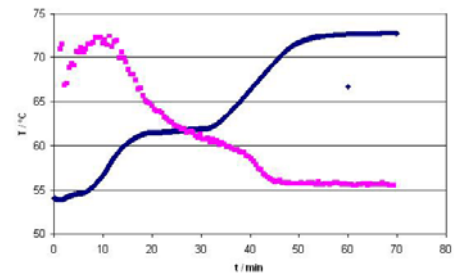


Fig. 6: First results of a new inline control system (blue line: mashing temperature)

Microscope mashing video clips to be seen on youtube!

Without enzyme:  
<http://www.youtube.com/watch?v=yKVeU4MC29s>

With enzyme:  
<http://www.youtube.com/watch?v=xXXJaVaX3yE>

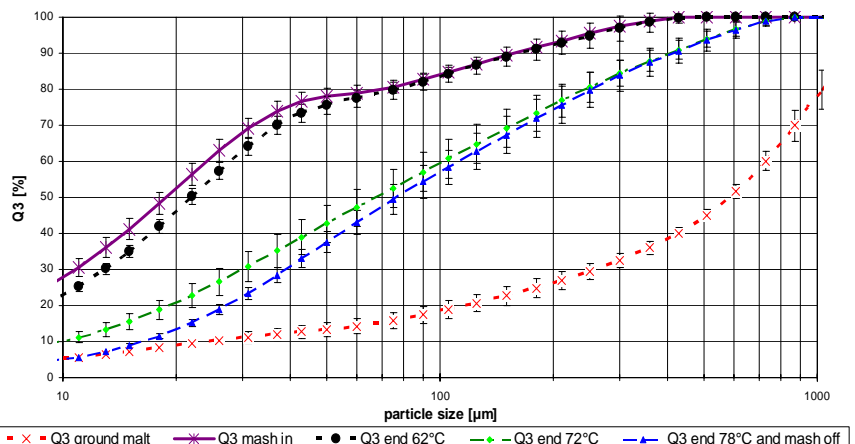


Fig. 5: Development of the particle size distribution during the mashing process