Forschungsinstitut Futtermitteltechnik
Research Institute of Feed Technology

Influence of a liquid application in the main mixer on mixture homogeneity of feeding stuffs

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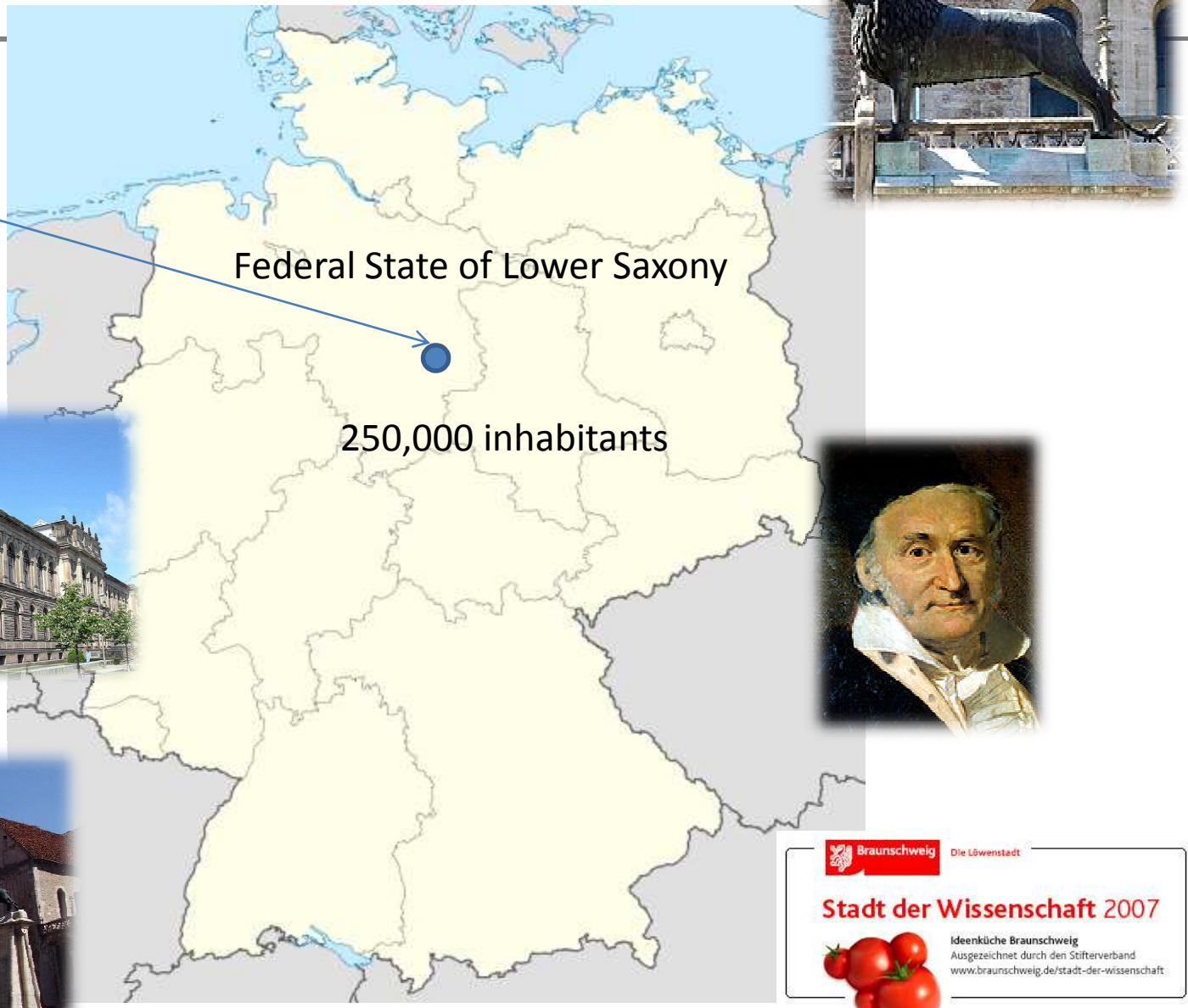
Location of IFF

BRAUNSCHWEIG

Braunschweig



International Research Association of Feed Technology

INTRODUCTION

International Research Association of Feed Technology (IFF) in head points

- founded in 1961 on the initiative of the German Association of Feed Industry

- supports German and international members in the feed processing industry by
  - results of joint research projects and
  - service activities

- maintains a Research Institute of its own

International Research Association of Feed Technology (IFF) in head points

- 100 members (national and international companies as well as associations and organisations)

- SME oriented industrial cooperative research in the fields of
  - feed quality and safety as well as
  - process optimization

- member of the Working Pool of Industrial Research Associations (Arbeitsgemeinschaft industrieller Forschungsvereinigungen “Otto von Guericke” e.V.) at Cologne, Germany, since 1964

Impressions

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International Research Association of Feed Technology

RESEARCH INSTITUTE OF FEED TECHNOLOGY

Research Institute of Feed Technology in numbers

- Head of the Institute: Dr.-Ing. Alexander Feil
- 4 scientists
- 3 technicians
- 2 laboratory technicians
- 1 assistant

Research Institute of Feed Technology in facts

Pilot plant/test facilities (capacities from 10 kg/h up to 1 t/h)

Milling: hammer and roller mill

Mixing (capacities from 10 up to 1,000 l):
single-shaft slanted vane mixer, ribbon mixer, double-shaft paddle mixer, vacuum twin-shaft paddle mixer, ...

Pelleting and agglomerating:
2 ring-die presses, laboratory flat-die press,
expander/extruder, belt cooler, vertical cooler

Conveying:
mechanical and pneumatical conveying devices

Research Institute of Feed Technology in facts

Physical analyses

density, bulk density, tap density, flowability

pellet & agglomerate abrasion/durability

dusting behaviour (rotation drum, single drop devices)

particle-size distribution (sieving analysis, laser-diffraction)

Chemical analyses

Weender analysis

wet-chemical analysis according to the VDLUFA method manual

fat indicators

photometry

element analysis (AAS), additive analysis (HPLC)

starch gelatinisation

protein dispersibility index

Examples of terminated research projects

Investigation and evaluation of alternative technological processes for the production of medicated feeding stuffs

Comparing investigations for improving the product safety of mash compound feed by low energetic irradiation and hydrothermal treatment

Investigations on the applicability of the vacuum-coating process for the production of compound feed rich in energy and for the application of liquid formulated additives after pelleting

Production of structurised and mixing-stable mineral feeds with high product safety and quality by using selected compaction processes

Research project on optimized liquid application

STARTING POINT AND SELECTED RESULTS

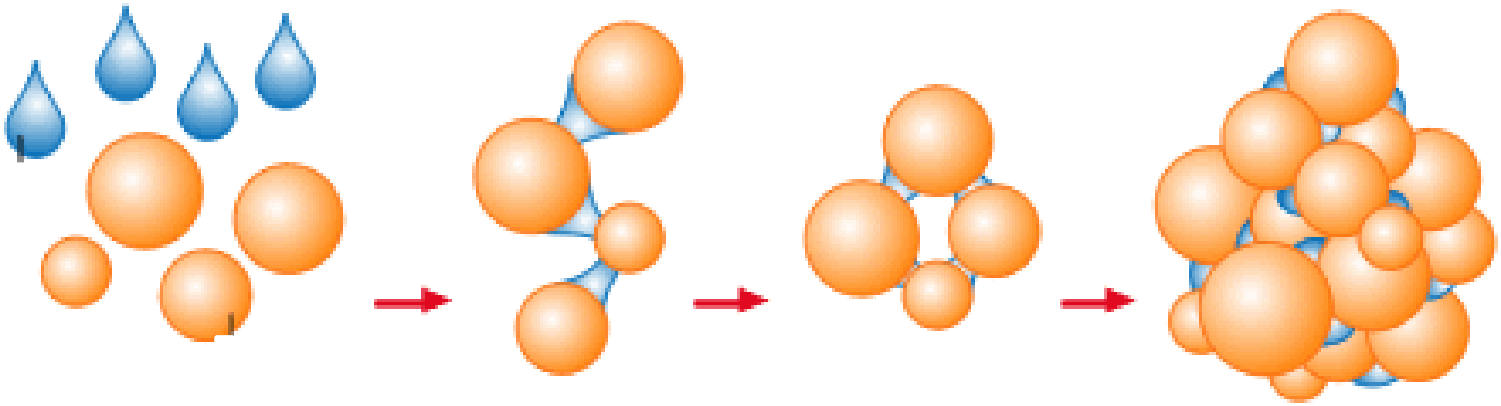
Liquid addition to feeding stuff powders as an aspect of feed quality and safety

Liquids are added to feeding stuffs to

- decrease dusting behaviour,
- increase taste and nutritional value,
- avoid segregation.

Liquid application in the main mixer – Problems

Liquid addition for avoidance of segregation

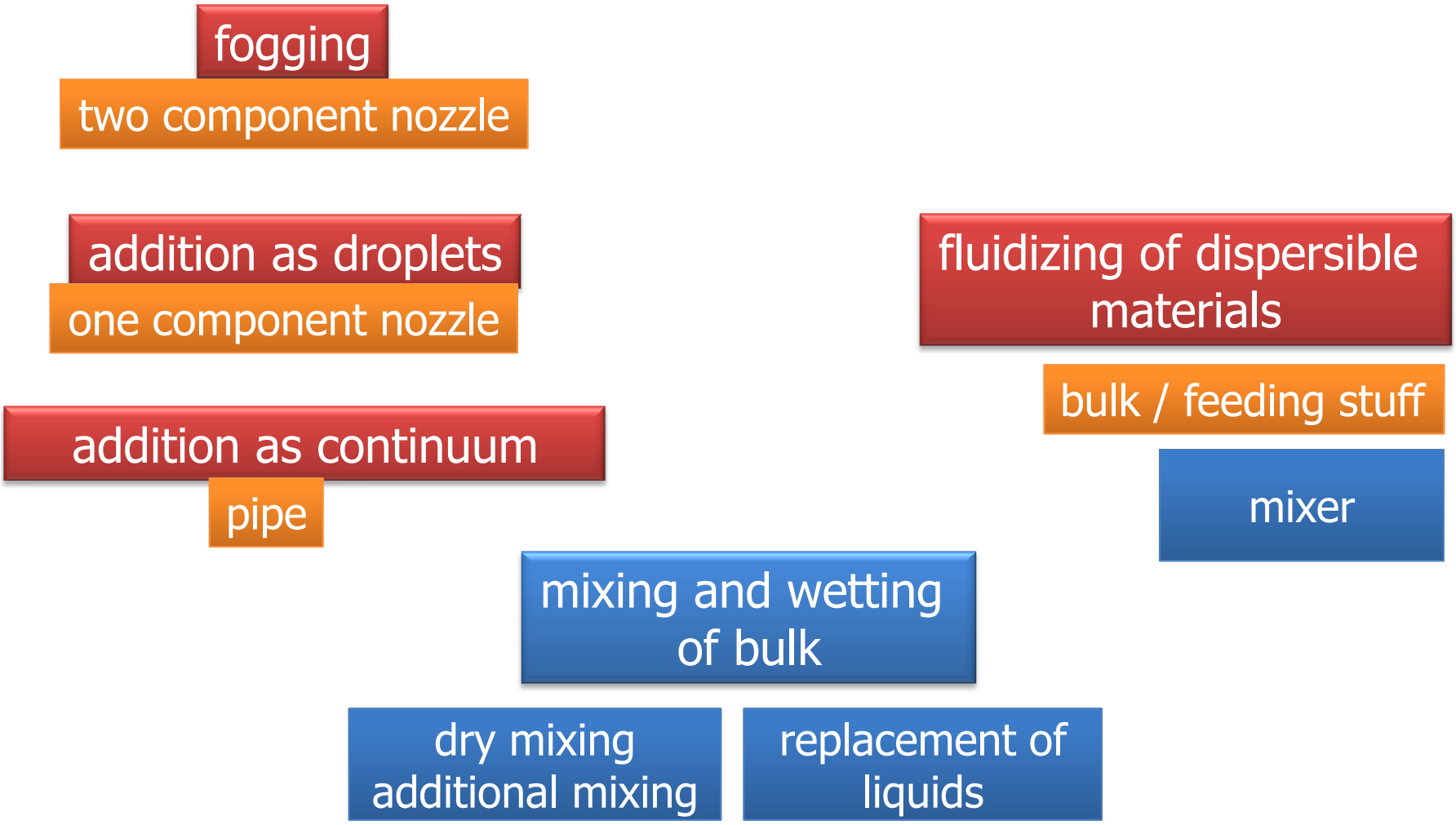


formation of liquid bridges – agglomeration

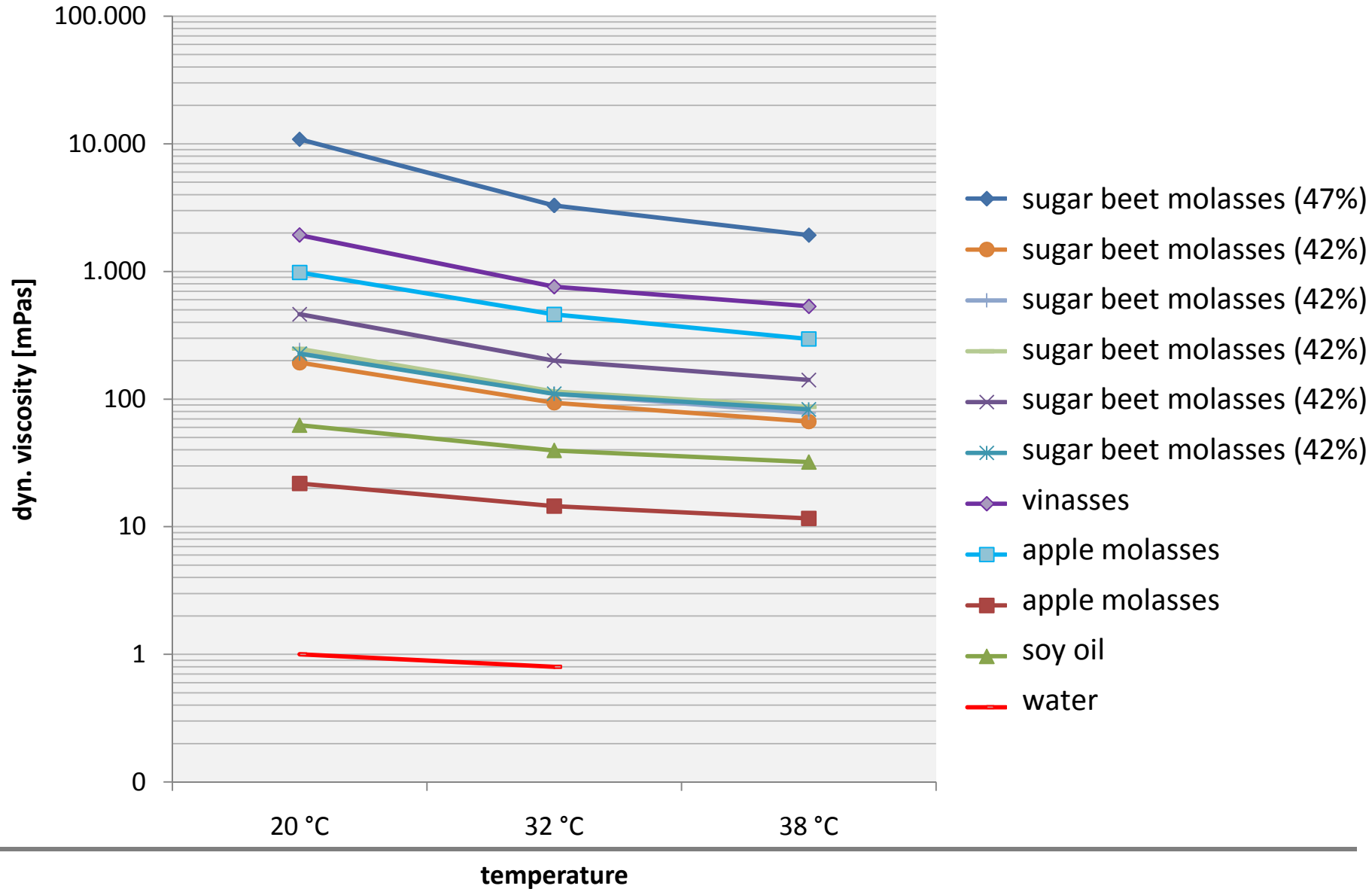
definition of the project must be to find an optimum between desired and undesired effects when adding liquids to feeding stuffs regarding

- technological parameters
- material characteristics

Technological parameters



Liquids


100.000
10.000
1.000
100
10
1
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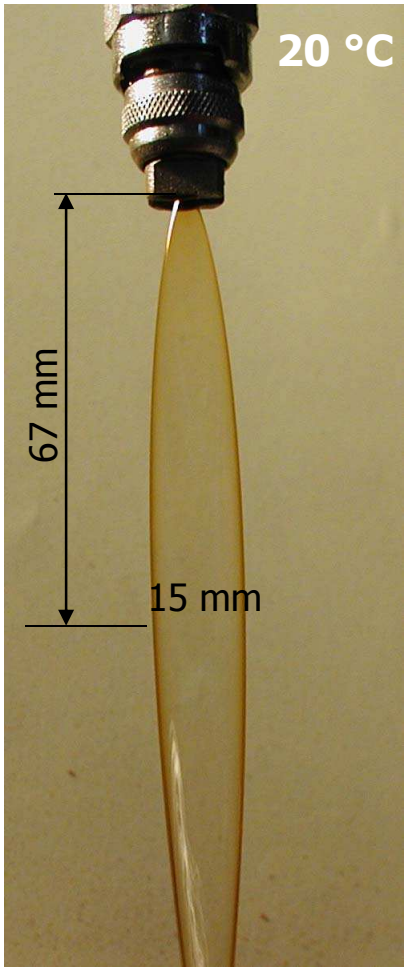
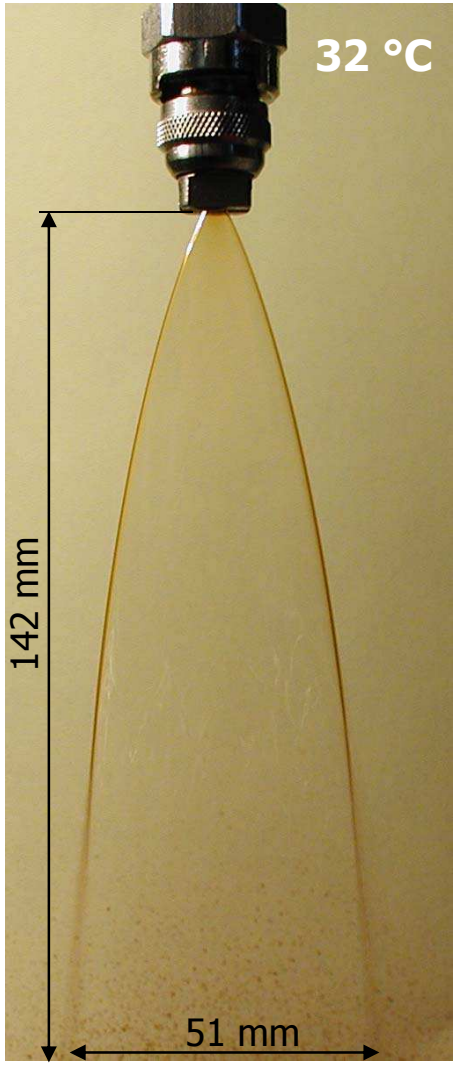
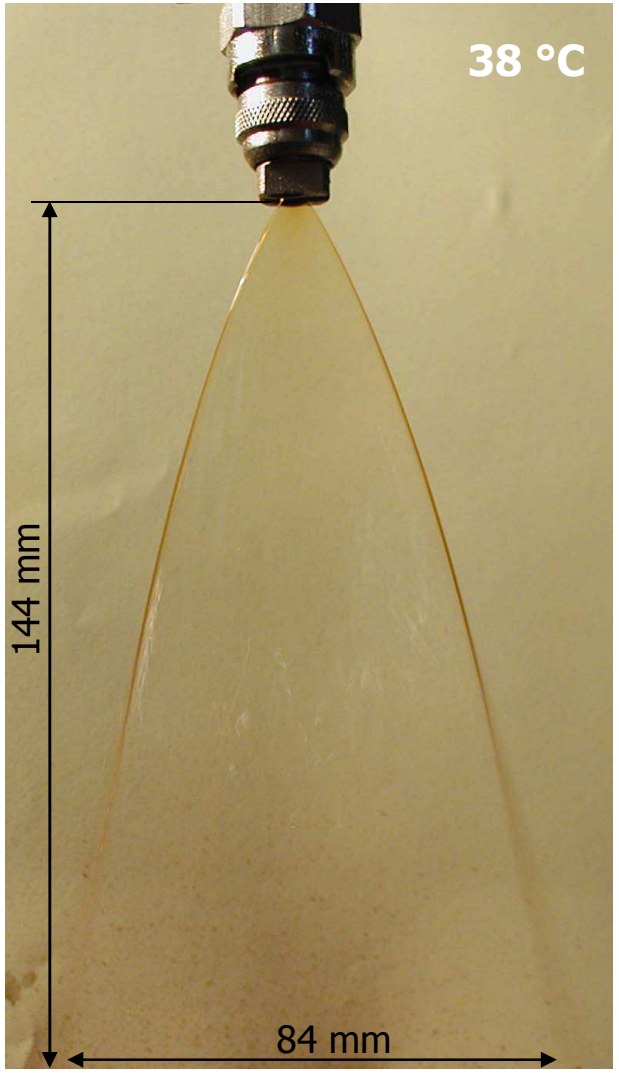
dyn. viscosity [mPas]
20 °C
32 °C
38 °C
temperature
sugar beet molasses (47%)
sugar beet molasses (42%)
sugar beet molasses (42%)
sugar beet molasses (42%)
sugar beet molasses (42%)
sugar beet molasses (42%)
vinasses
apple molasses
apple molasses
soy oil
water

Viscosity – Dispersibility of liquids in nozzles







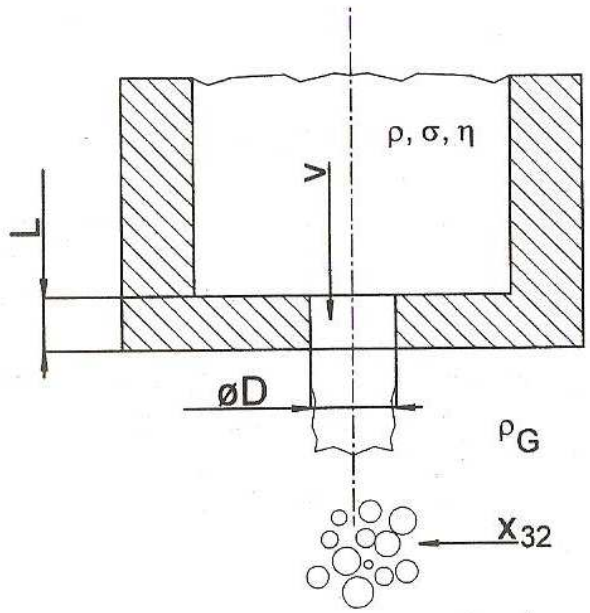
One comp. nozzle 80 °
sugar beet molasses F-909

Feil, Kirchner (2007), Final Report of the IGF-project “Melasse” No. 14210 N

Droplet size and droplet size distribution

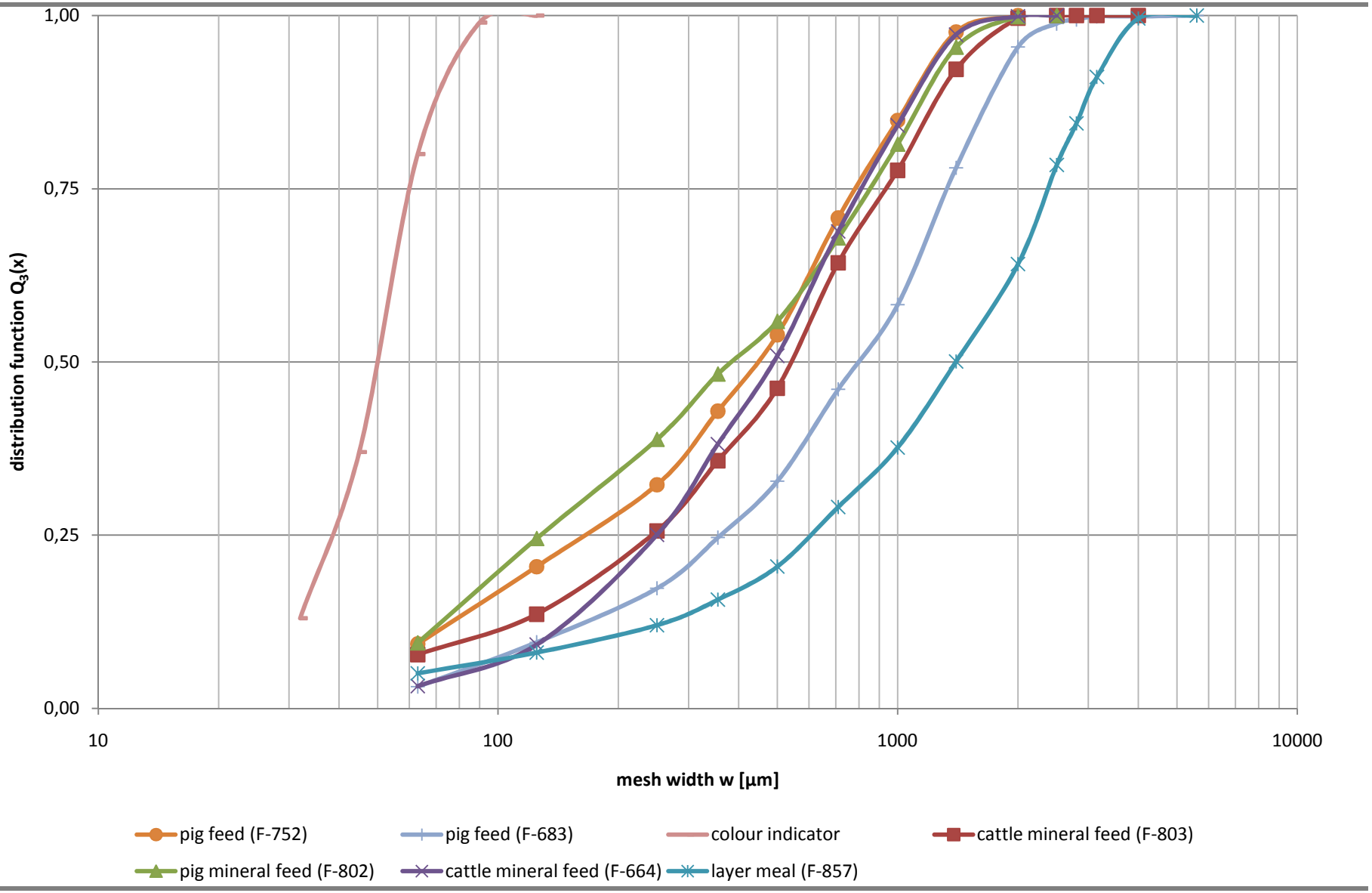
Calculation of characteristic droplet diameters

equation	author
$x_{50}/D \approx 6*Re^{-0,15}$	Panasenkov
$x_{0,999}/D = We^{-0,333}(23,5+395*10^{-6}*Re)$	Miesse
$x_{32}/D = 47/v\ (\sigma/\rho_G)^{0,25}\ (1+331*Oh)$	Tanasawa



Re - Reynolds number
We - Weber number
Oh - Ohnesorg number
x_{50} - average droplet diameter
x_{32} - Sauter diameter
D - diameter of nozzle outlet
ρ_G - density of gas atmosphere
σ - surface tension

Particle-size distribution



State-of-the-art

The binding of particles is caused by liquid bridges and therefore a reduction in the number of particles occurs

- negative influence on ***optimal*** mixture homogeneity but
- avoidance of segregation

Free flowability of particles is limited

- negative influence on mixture homogeneity

A dry mixing cycle is necessary because liquids may cause a "freezing" of the state of the mixture

The liquid must be evenly distributed in the mash to avoid the occurrence of rough agglomerates

Experimental study

An experimental study was carried out to mark up

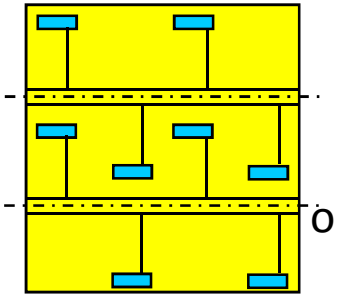
technological parameters and material properties for optimized discontinuous liquid application in the main mixer regarding feed quality in the cases of

- mixture homogeneity
- avoidance of segregation and
- dusting behaviour

and to minimise cross-contamination – caused by unbound fines on the one and caking on the other hand

The project is funded by the German Ministry of Economics via AiF (AiF-Code 16016 N, 2009-2011)

Experiment



twin shaft paddle mixer

one component nozzle

20 l

intensive mixer

pipe

45 l

mineral concentrate rough and fine

compound feed rough and fine

1-3%

molasses

vinasses

soy oil

dry mixing

additional mixing

colourant as indicator (micro component)

Analysis

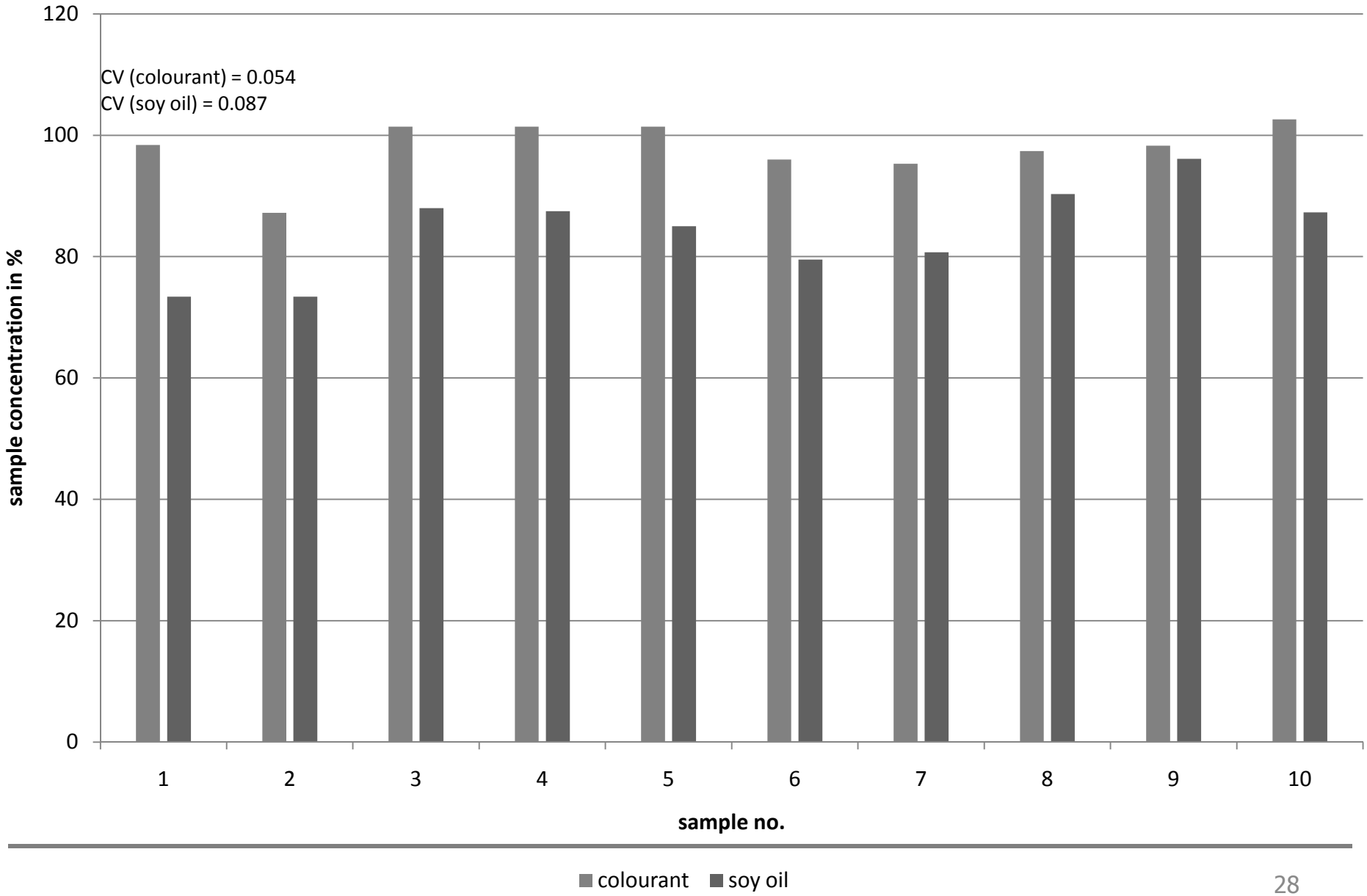
For the characterization of the mixture homogeneity a particulate organic colourant was used as additives' indicator (ratio of 1:100,000 or 1:50,000)

The colourant can be detected photometrically with a low analytical error

The concentration of the indicator in single samples was analyzed and statistically evaluated by the coefficient of variation (CV)

Mixture quality of cattle mineral feed

Sample concentration of colourant



Conclusions

- The estimation that liquids must be evenly distributed in the mash to avoid the occurrence of rough agglomerates could be validated by the experimental study
- It seems to be essential that the liquid is spread evenly on the particle surfaces of all particles to avoid undesired agglomerates and increase mixture homogeneity. Therefore a material specific amount of liquid is necessary.
- Under defined circumstances a dry mixing cycle is not necessarily needed to reach an adequate mixture homogeneity
- At the moment a general conclusion on the influence of a liquid addition on the mixture homogeneity is not possible

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