Master Brewers Association of the Americas

Dedicated to the technology of brewing.

MBAA Annual Conference

WORKSHOP BREWING ENGINEERING

Mash Kettle - layout and characteristics

Brewing Summit 2014 (June 4-7), Chicago
MBAA Annual Conference, June 5-7

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Objectives of Mashing

- Enzymatic conversion of insoluble extract in the grist into soluble components
- Insoluble: Starch, Celluloses, High molecular Proteins
- Soluble: Sugar, Dextrins,
higher and lower molecular proteins up to Amino Acids
- High Brewhouse Yield
- Basis for the following process (lautering and boiling)
- Basis for the wort composition
- Require small amount of energy

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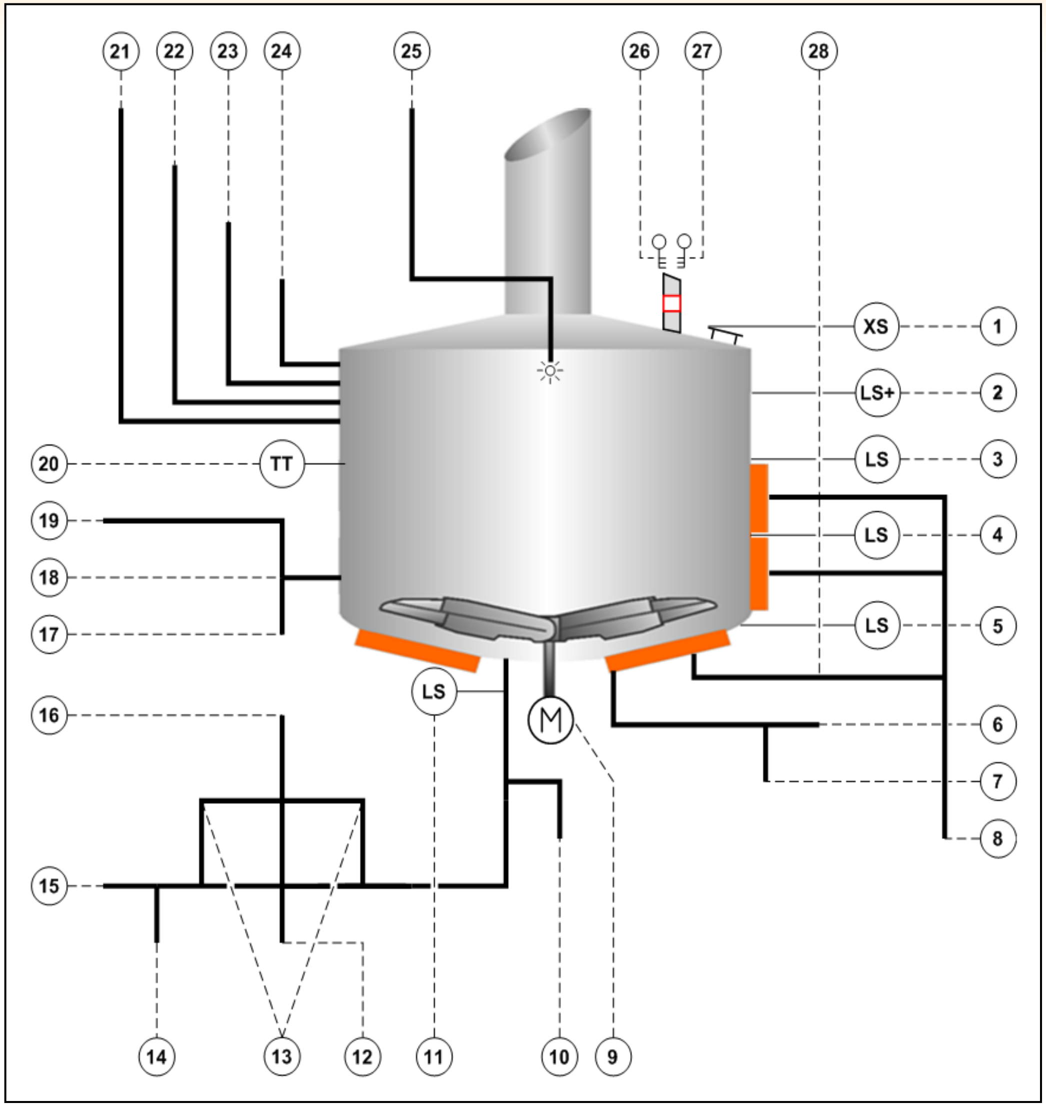
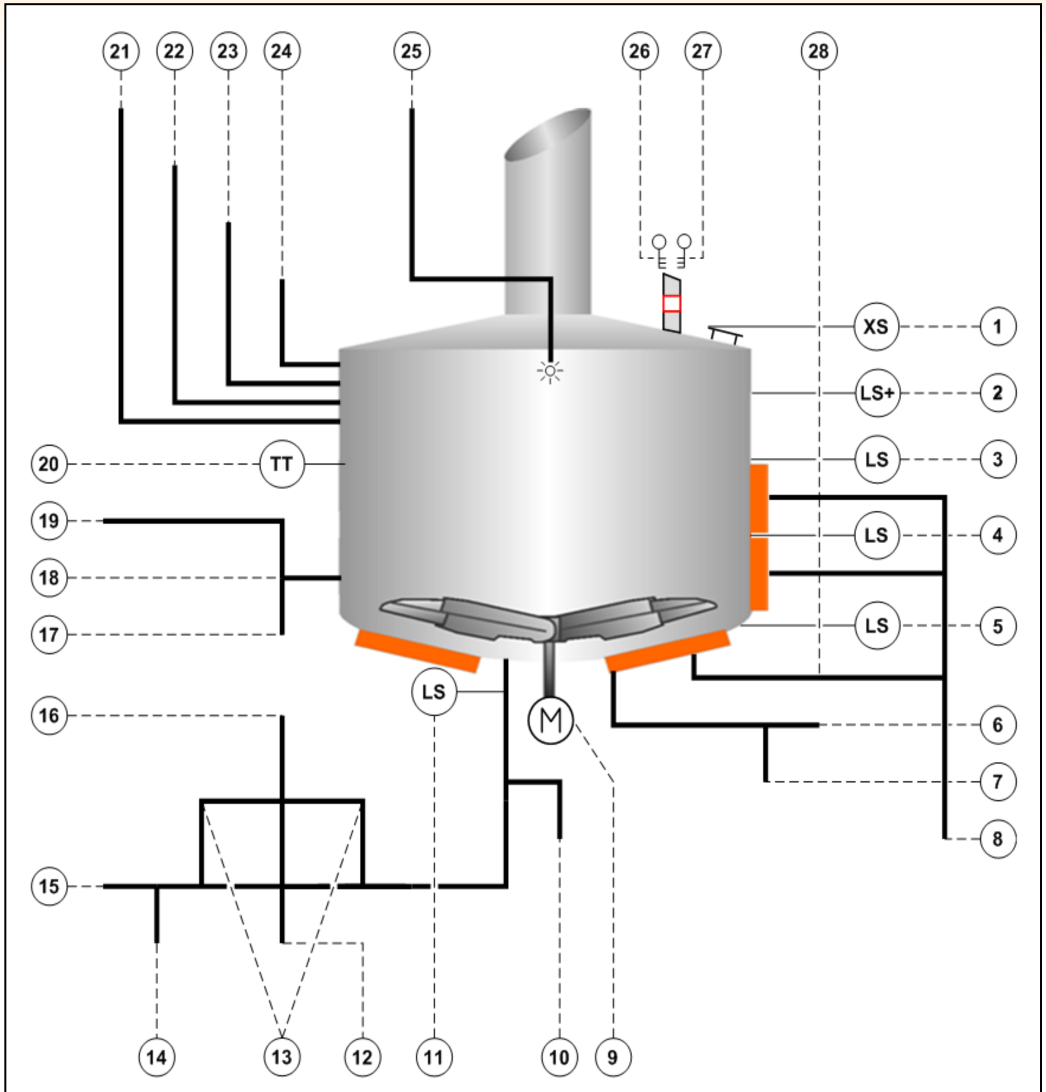
Mash kettel and mash cooker

Mash kettel – technical equipment



(1) Manhole/ Manway Switch
(2) High Level Switch
(3) Level Switch Steam 3
(4) Level Switch Steam 2
(5) Level Switch Steam 1
(6) Outlet Condensate
(7) Drainage Condensate
(8) Inlet Steam
(9) Motor Agitator
(10) CIP Return Mash Tun
(11) Low Level Switch
(12) Drainage Mash Tun
(13) Mash Distribution
(14) Mashing-In Line

Mash kettel – technical equipment



(15) Pipe from/ to Adjunct Cooker
(16) Outlet Mash
(17) Drainage/ Sample Point
(18) Sample Line
(19) Hot Water
(20) Temperature Transmitter
(21) Inlet Enzymes
(22) Inlet Salts
(23) Inlet Lactic Acid
(24) Inlet Phosphoric Acid
(25) CIP Supply
(26) Vessel Release Switch
(27) CIP Release Switch
(28) Steam Lines

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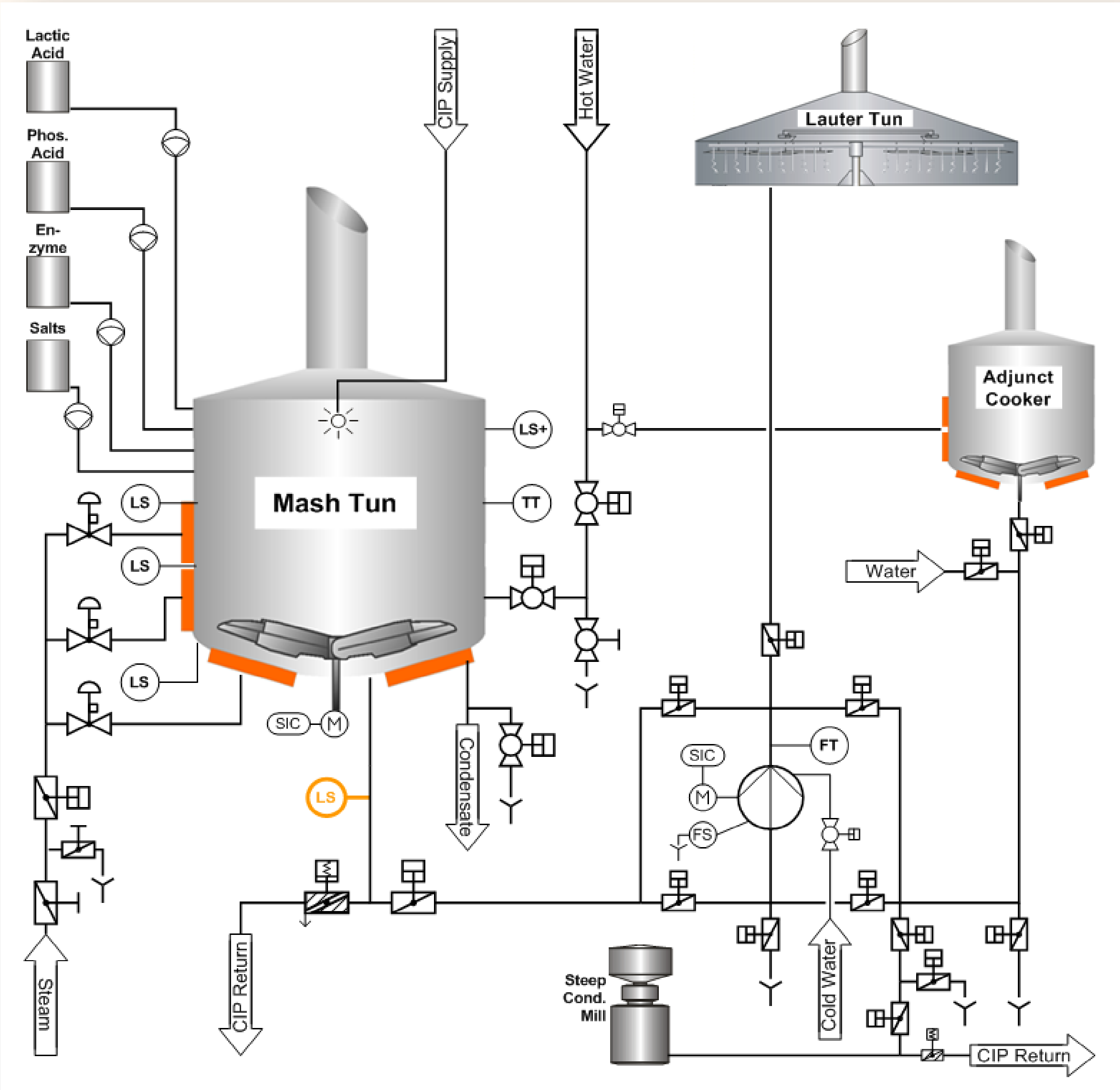
Kettel design – process



Engineering:

- Type of milling
- Mashing in device
- Weak wort recovery
- Mash kettel design
- Additive dosing
- Adjunct material
- Decoction process
- Heating medium
- Mash filtration system
- Brand variety

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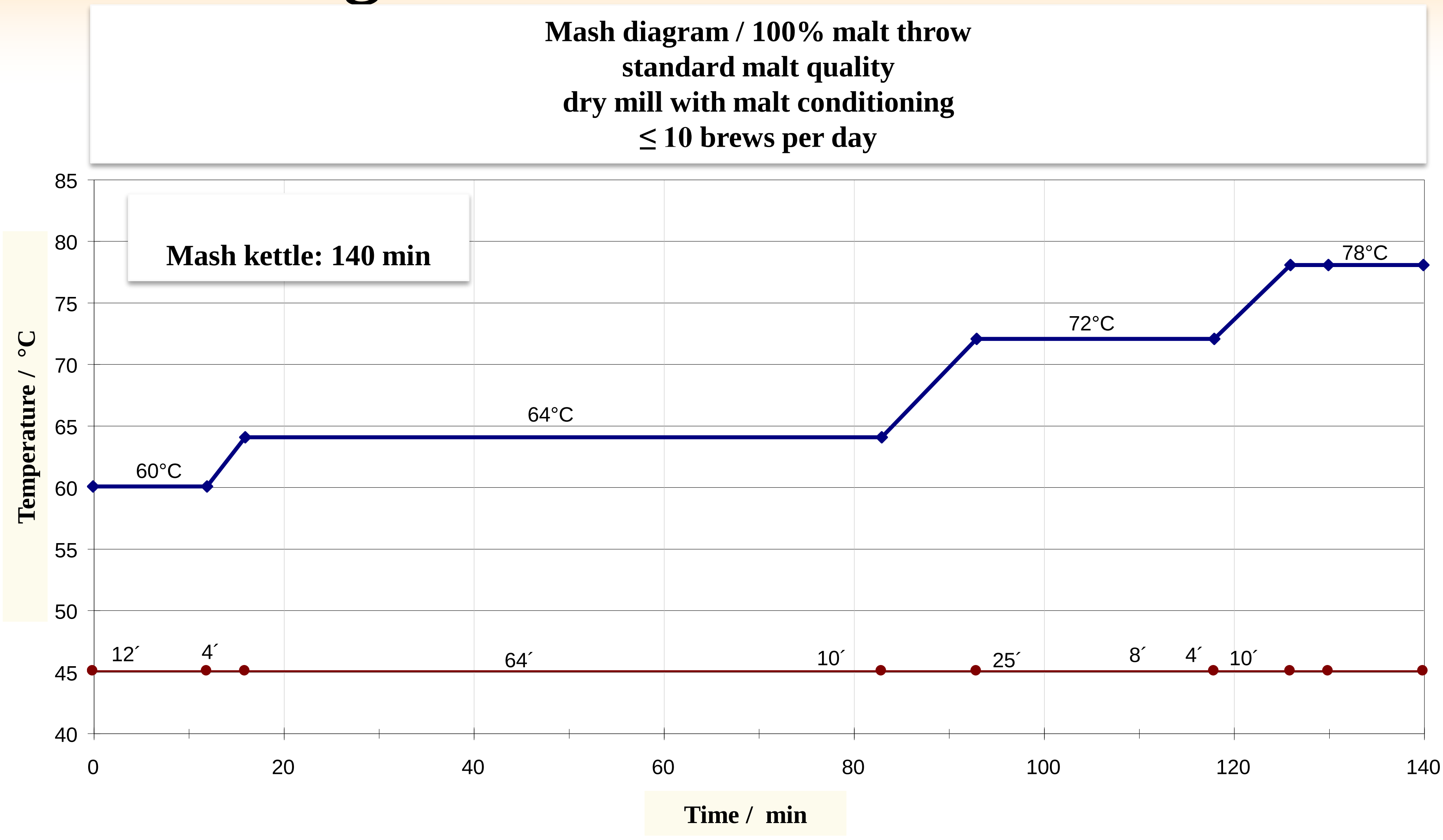
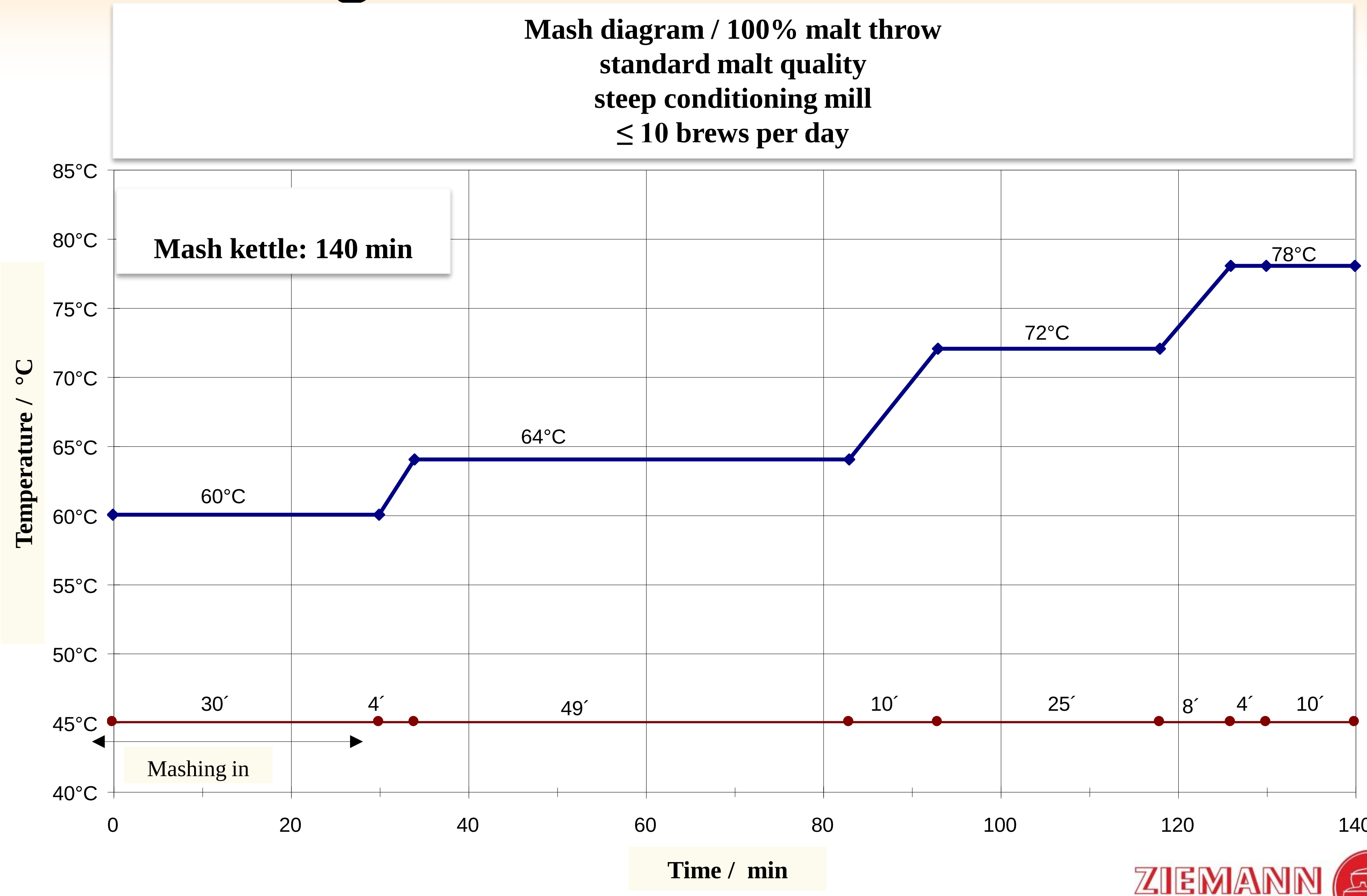
Mash diagram – infusion method



Mash diagram – infusion method



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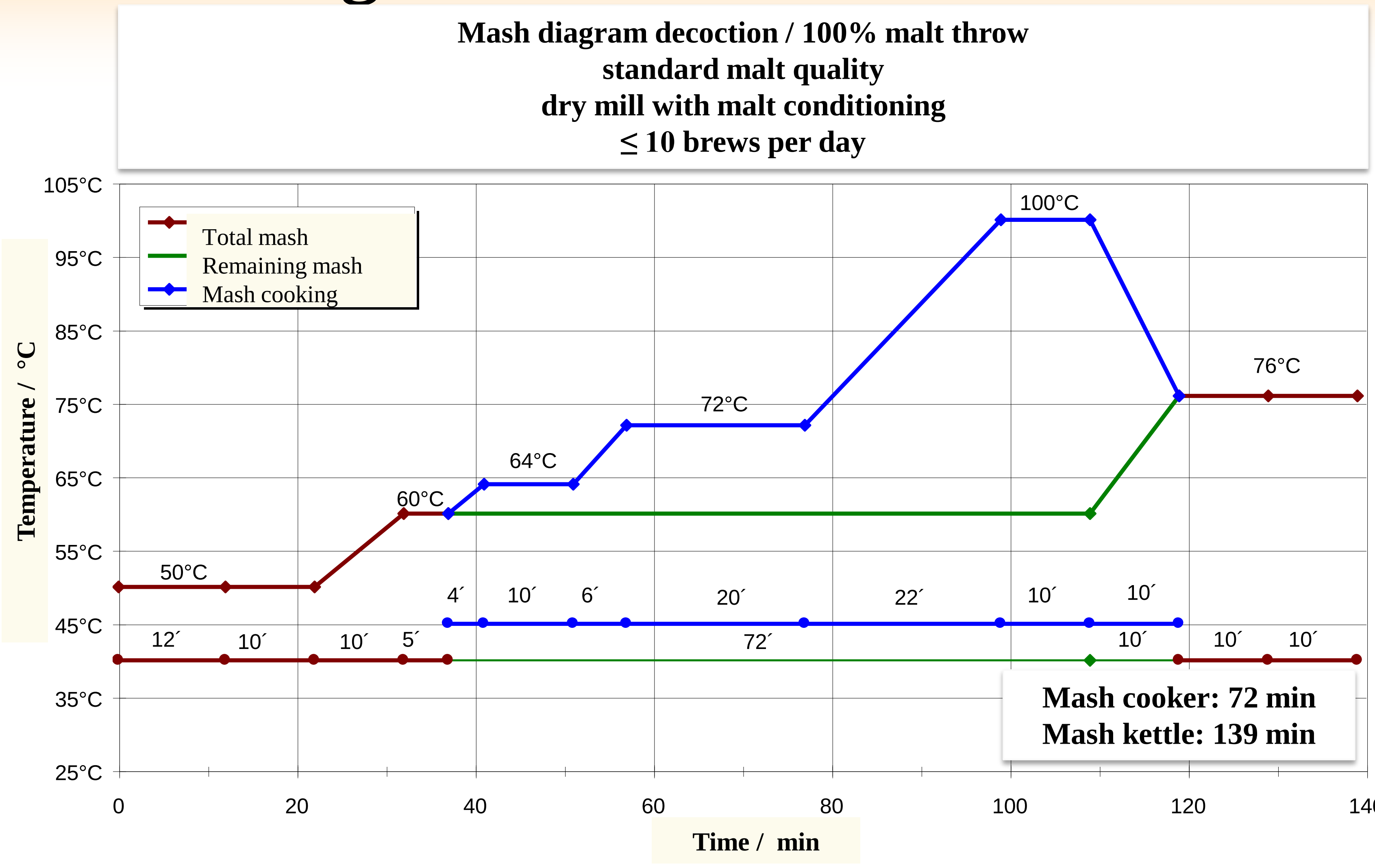
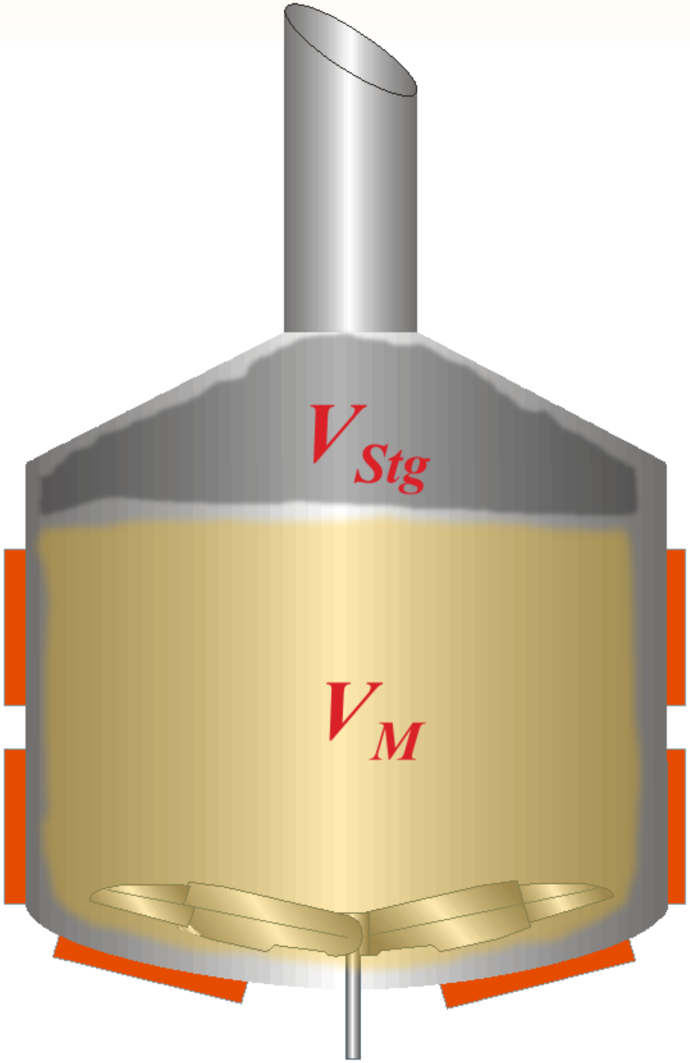
Mash diagram – decoction method



Kettel design – volume

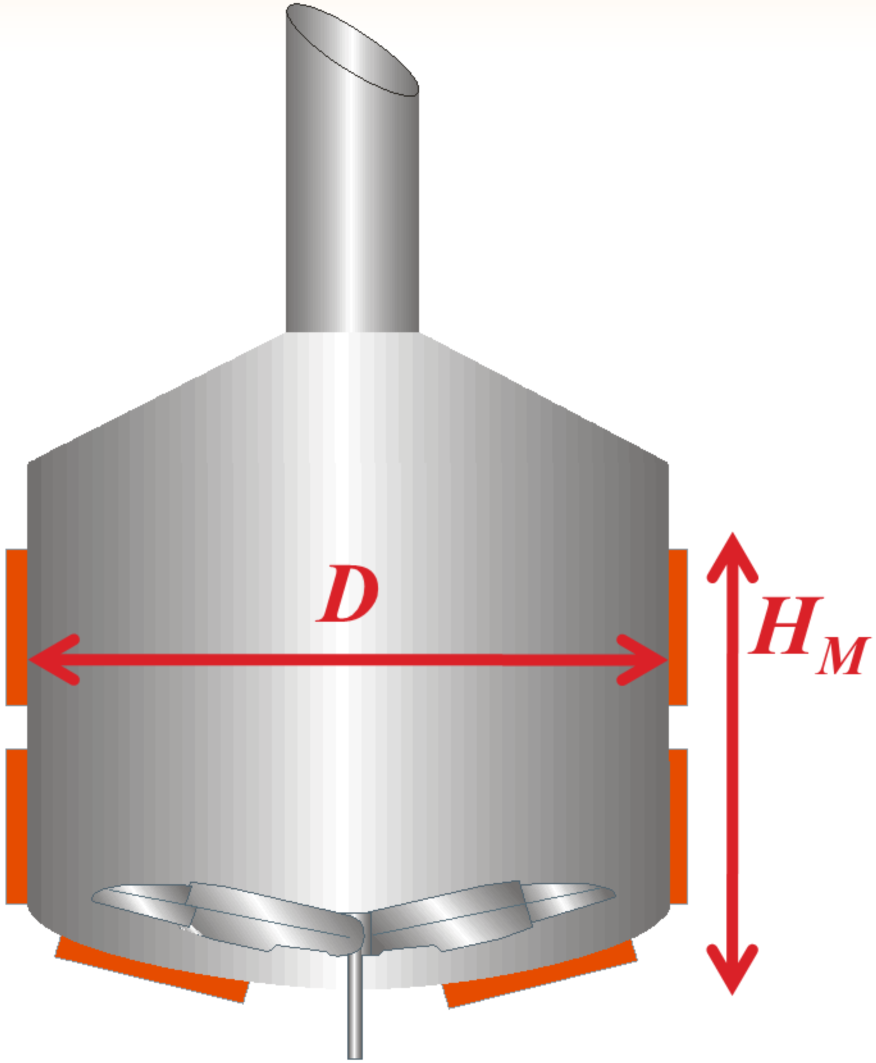


V_M = Mash volume
dependent from:

- Grist load
- Malt yield
- Displacement by grist
- First wort concentration / cast out wort concentration
- Underlet water volume of lauter tun

V_{Stg} = Head space

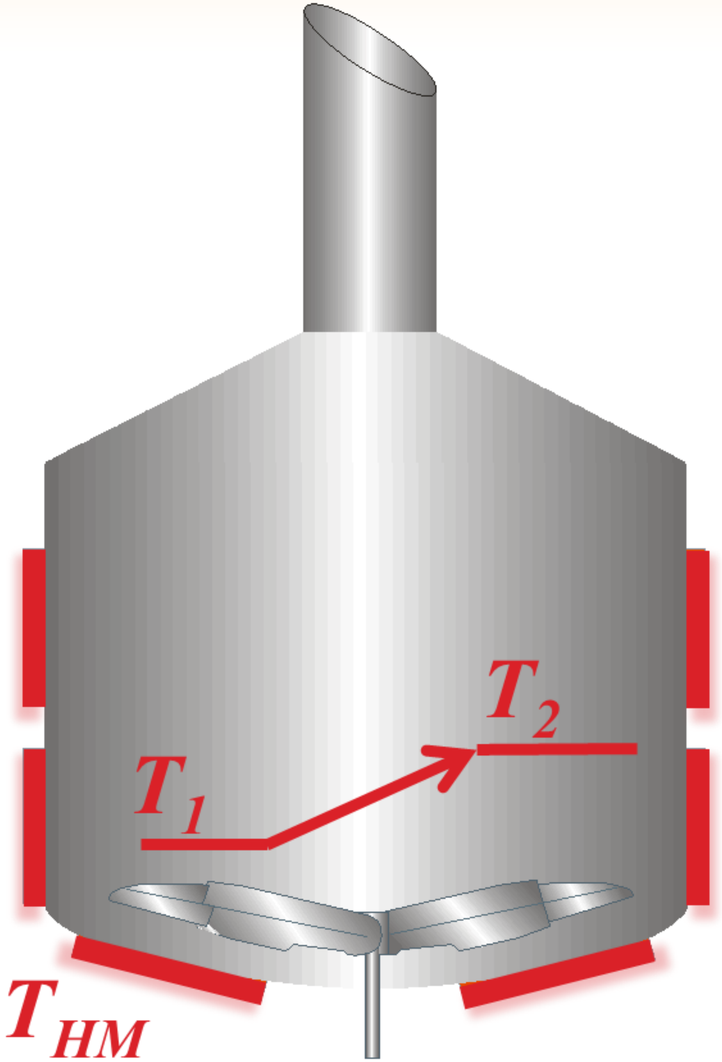
Kettel design – height / diameter



$$H_M / D = 0{,}6 \quad \text{(e.g.)}$$

$$D = \sqrt[3]{\frac{20 * V_M}{3 \cdot \pi}}$$

Kettel design – heating zones I



$$\Delta T_h = T_{HM} - T_1$$

$$\Delta T_s = T_{HM} - T_2$$

$$\Delta \vartheta_m = \frac{\Delta T_h - \Delta T_s}{\ln \frac{\Delta T_h}{\Delta T_s}}$$

$$\Delta T = T_1 - T_2$$

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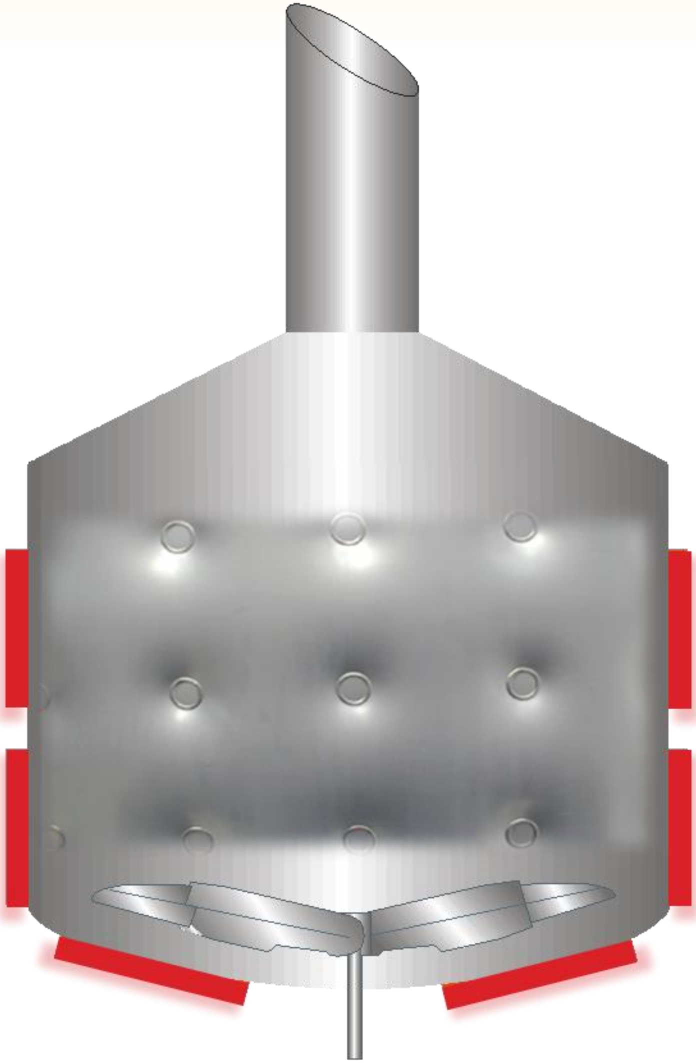
Kettel design – heating zones II



$$Q = V_M \cdot \rho_M \cdot c_p \cdot \Delta T$$

$$A_{HS} = \frac{1000 \cdot Q \cdot \eta_{HS}}{k \cdot \Delta \vartheta_m \cdot \Delta t}$$

A_{HS}	= Total heating surface (m^2)
Δt	= Heating time (s)
c_p	= spec.heat capacity of mash (kJ/kg_*K)
k	= Coefficient of heat transfer ($W/m^2{}_*K$)
η_{HS}	= Heat surface factor (e.g. 1,05)

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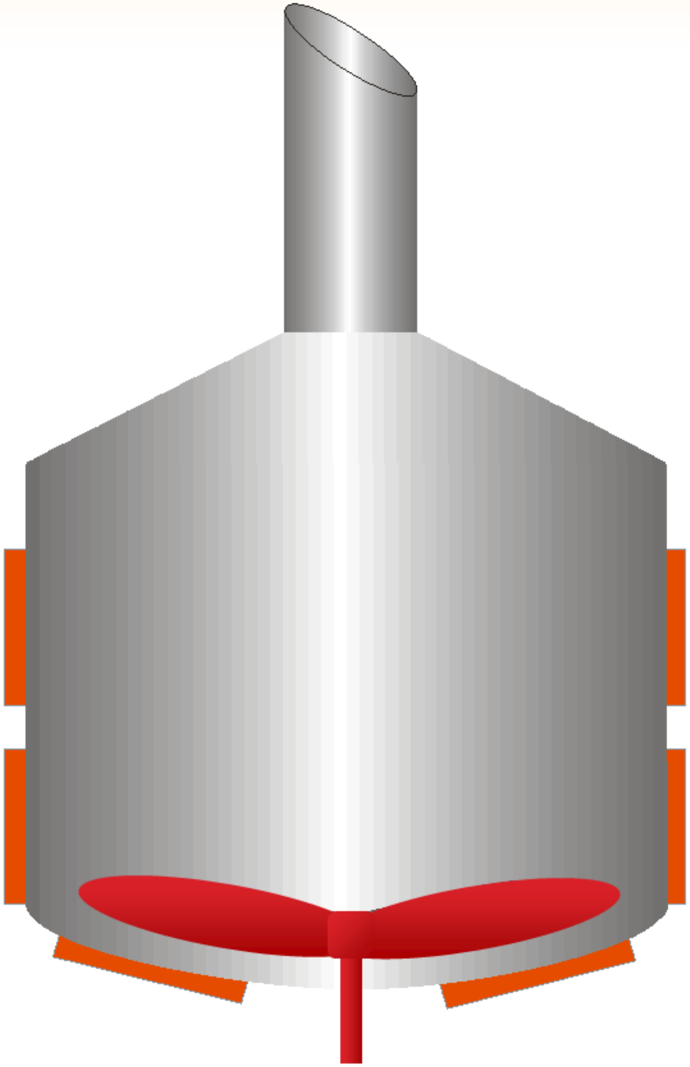
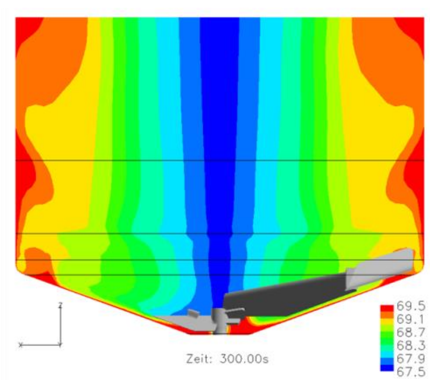
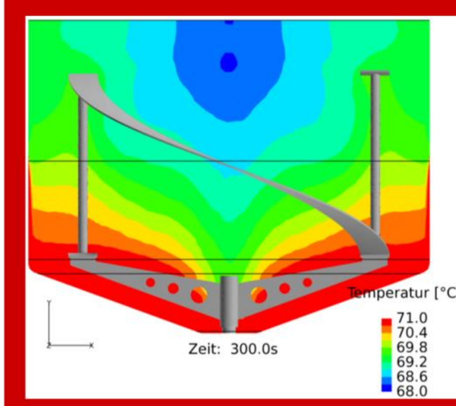
Kettel design – agitator



State of the art



New technology



ZIEMANN Colibri –

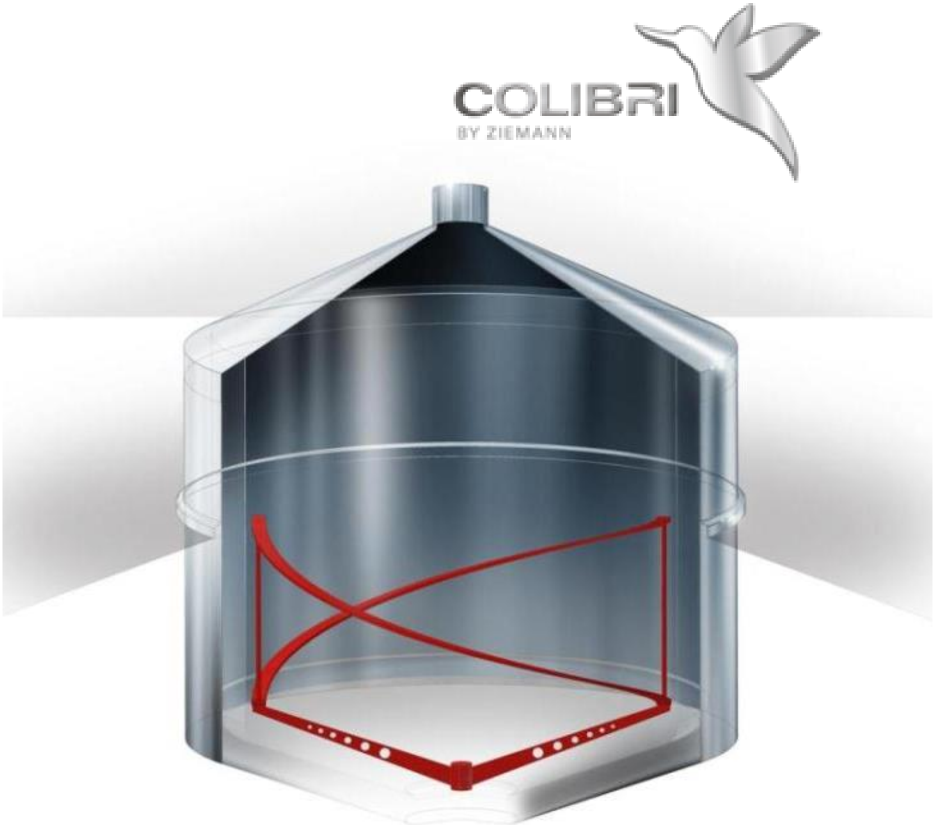
New Design Approach for Improved Mashing

Mixing instead of Stirring

- Helix agitator blades are passing the shell heating zone with their wing like profile improving both **mixing and heat transfer** rates
- Perforated agitator bars above the bottom heating zone ensure **flow and mixing**
- Alternating inclined transverse bracings intensify **homogenizing** effect

Results

- Highest enzymatic conversion rates
- Most efficient usage of raw materials
- Shorter mashing times
- Perfect heat transfer



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ZIEMANN Colibri –
New Design Approach for Improved Mashing

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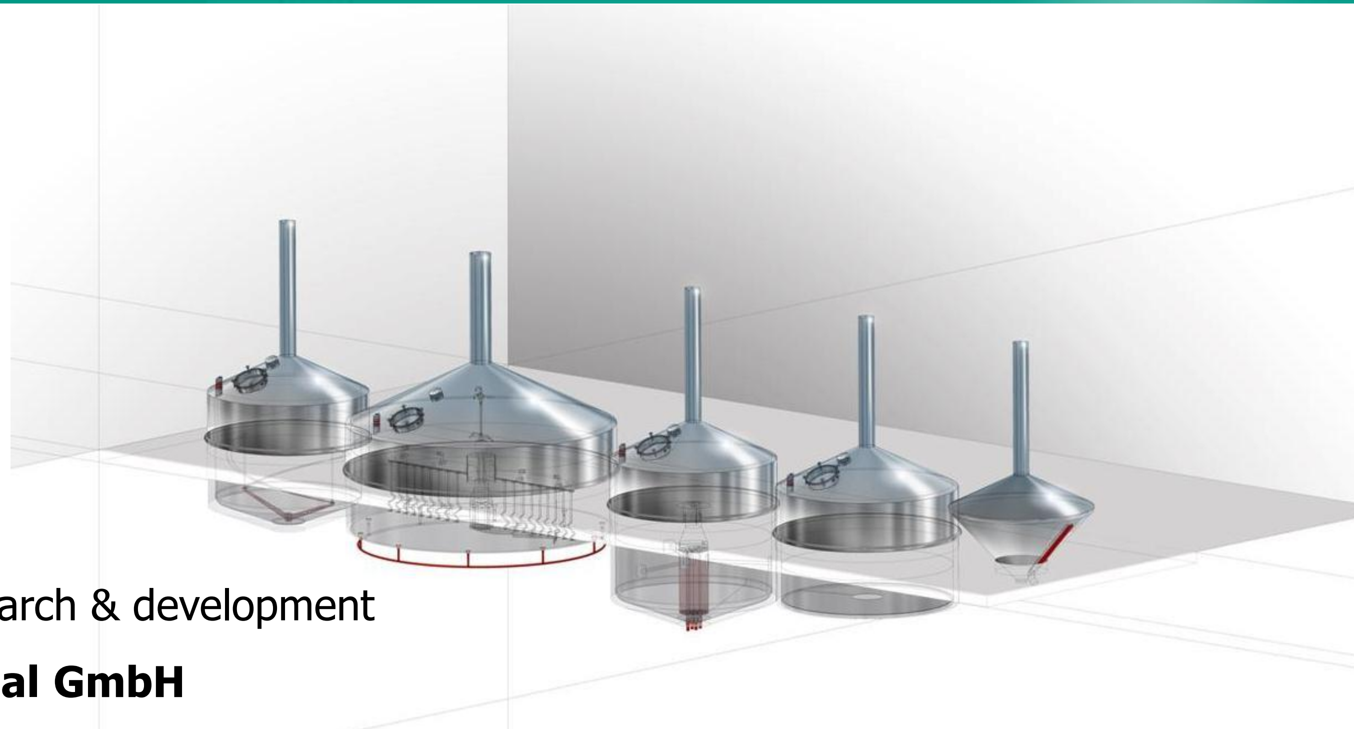

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Taking care of brewing

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