78

WORLD BREWING CONGRESS 2016

Depletion of water as a source for beer brewery through freeze crystallization

Lars Erlbeck[1], Matthias Rädle[1], Thomas Kunz[2], Frank-Jürgen Methner[2]

World Brewing Congress
August 13-17, 2016
Sheraton Downtown Denver
Denver, CO 80202, U.S.A.

INTRODUCTION

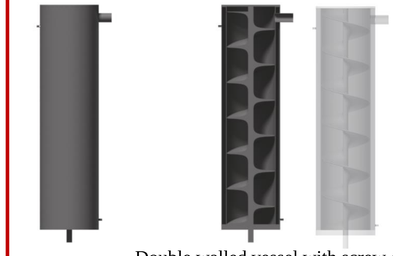
- Water one of the most eminently important educts in brewery industry
- Necessary decalcification and reduction of concentration of Manganese and Iron
  - Residual alkalinity effects the pH-value during brewing process
  - High iron concentration → negative influence on yeast and taste of the beer
  - Manganese concentration responsible for taste and color of the beer
- Nowadays ion exchanger are used mostly
  - Disadvantage of chemical usage and therefore production of chemical waste
  - Risk of overdosage and so discoloration (precipitation of Manganese)
  - Batch process → duplicate design → high investment
  - Not combinable with renewable energies

Alternative:

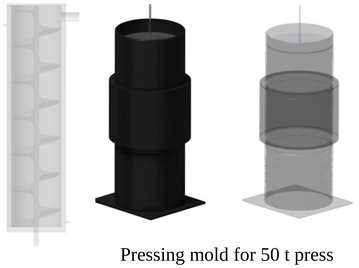
- Crystallization of solvent, separation of crystals and posttreatment through pressing
- Development of freeze crystallization plant to purify natural water for brewing processes
  - Low energy, no chemicals, no corrosion or scaling effects and operable by renewable energies

MATERIAL & METHODS / SCRAPE CHILLER 1

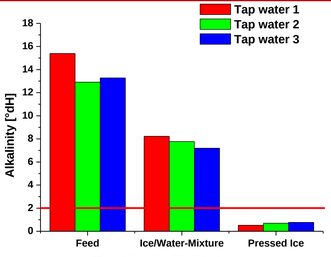
Scrape chiller



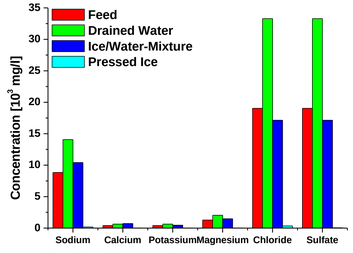
Double walled vessel with screw conveyor



Pressing mold for 50 t press



Residual alkalinity

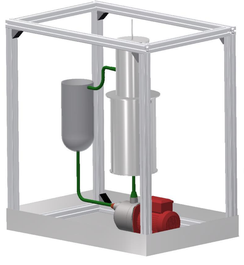


Purification of high concentrations

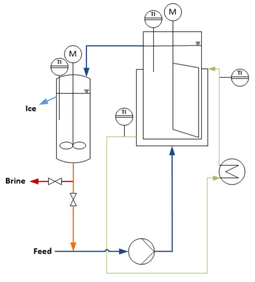
- Improvement of the ice movement through forced conveyance
- Heat exchange area of 0.023 m², a rotating speed of 10 1/min and a production rate of 100 kg/d
- Investigating the drainage effect and the yield for a bigger ice volume → cooled press mold (F = 46 kN)
- Reduction of residual alkalinity
- Desalination of water with high concentrations (sea water) → potable water
- Improvement of the yield through cooling of the press

MATERIAL & METHODS / SUSPENSION

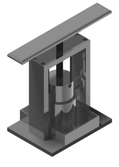
Suspension Crystallization



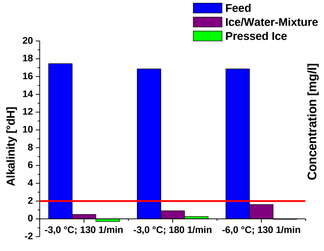
Plant Design



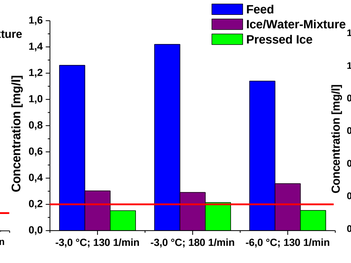
Process flow chart



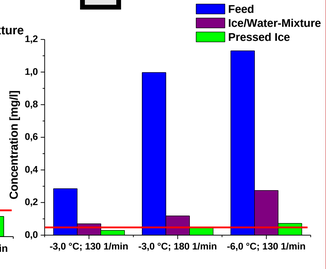
Screw press



Residual alkalinity



Iron

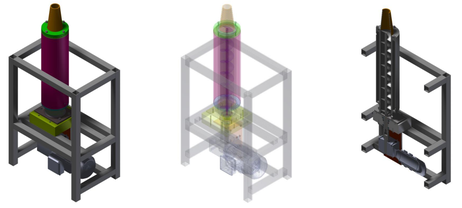


Manganese

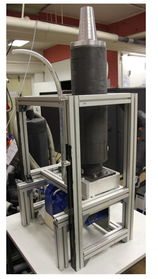
- Common crystallization process for pharmaceutical products (high yield)
- Volume of 7.1 l in the main vessel with a heat exchange area of 0.165 m²
- Second vessel for separating small from big crystals
- Usage of a s screw press for posttreatment
- Possible reduction of Iron, Manganese and the residual alkalinity by freezing only
- Further reduction below the limit values through pressing
- Problems with adhering ice on the vessel surface → abortion of the experiments (yield 2.9 – 13.5 %)
- No influence of rotating speed or supply temperature → Forced scraping

Conclusion

- Possible reduction of different ions through freeze crystallization and pressing
- Steady improvement of each crystallization plant
- Until now only semi-batch process control
- Expectable desalination of all other ions and molecules
- Unknown influence on microorganism
- Development of a continuous process (e.g. figure below)



Plant design of a scrape chiller with pressing section



[1] Institute for Process Control and Innovative Energy Conversion, University of Applied Sciences Mannheim
[2] Chair of Brewing Science, Department of Food Technology and Food Chemistry, Technical University of Berlin

Contact:
Lars Erlbeck
l.erlbeck@hs-mannheim.de