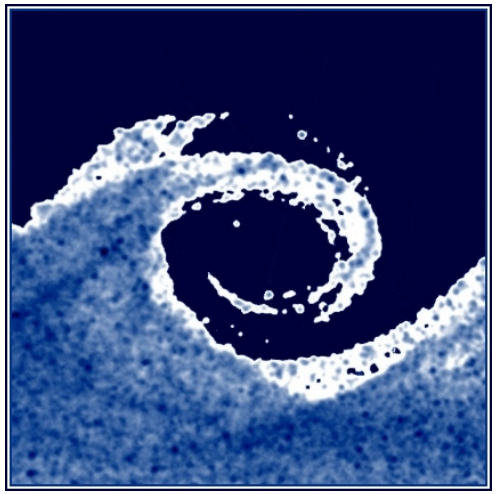


Department of Fluid Mechanics

Budapest University of Technology and Economics (BME)

Cooling System

Project Summary

Tamás Benedek

Balázs Berkó

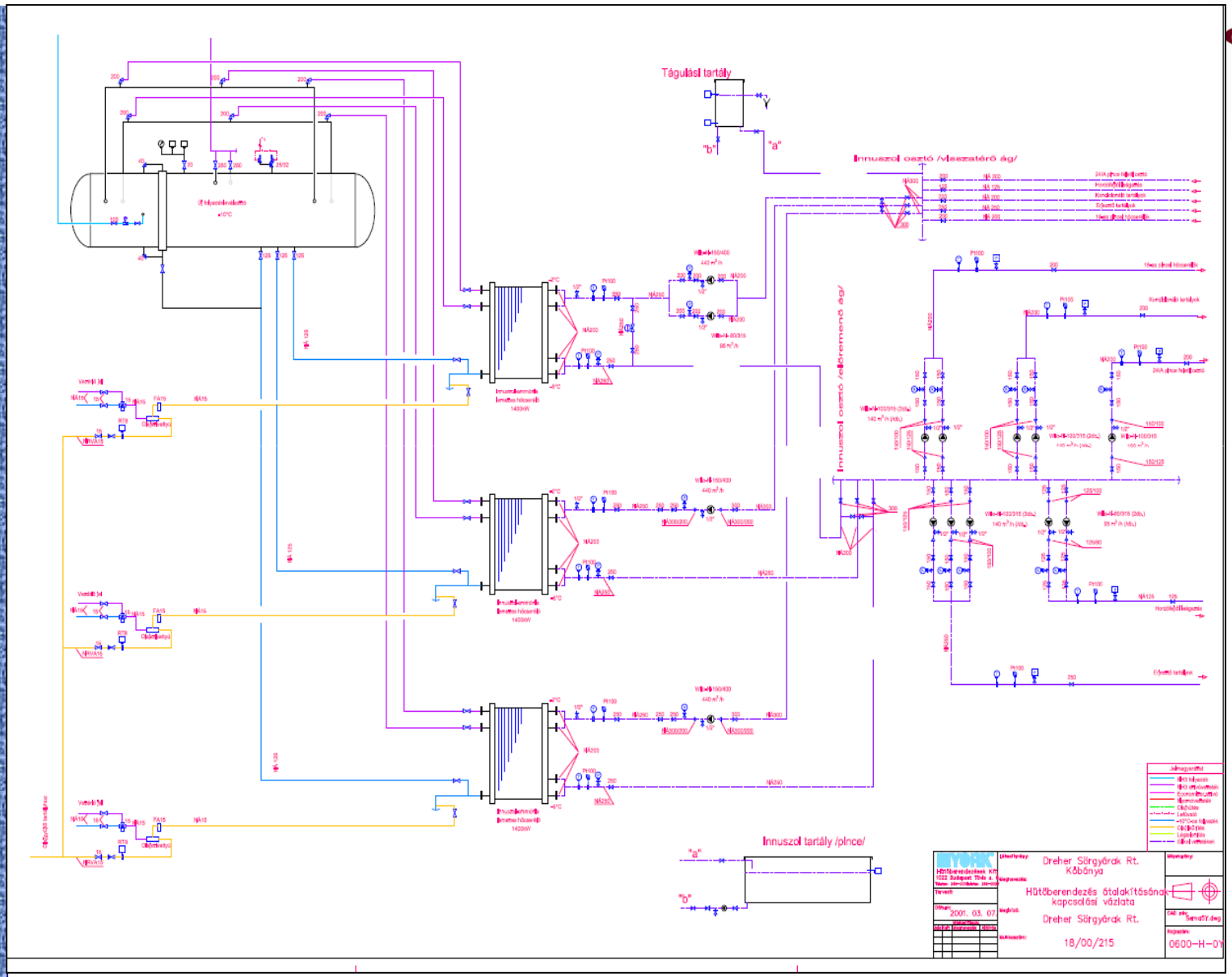
Gergely Háznagy

2012.05.18.

Introduction

- Amount of consumed beer changes seasonally
- Seasonal change in the cooling demand
- For distributing the cooling fluid, a hydraulic distribution system was installed
- Primary circuit: 3 heat exchangers, 4 pumps
  - Can be controlled by switching on / off
- Secondary circuit : each branch has an own pump
  - Can be speed-controlled, by using frequency converters
- Consequence
  - Flow rate of cooling fluid on the primary side can be higher than necessary

The system


Tágulási tartály
Innuszol oszló /visszatérő ág/
Innuszol oszló /előremenő ág/
Innuszol tartály /plnce/
Dreher Sörgyárak Rt.
Kőbánya
Hűtőberendezés átalakításának
kapcsolási vázlata
Dreher Sörgyárak Rt.
18/00/215
2001. 03. 07
0600-H-0Y

Tasks set by the local supervisor

- Survey on the operational state: estimate the flow rate on the primary and secondary sides of the hydraulic distribution system
- Recommendations for a more economical pumping operation, for reduction of consumption of electric energy
- Feasibility study: the consumers are supplied directly from the primary side

Flow rates: principles

- Importance of knowledge on system hydraulics
  - Pipe friction, diameter, lengths, number of elbows, the pressure drop of heat exchanger, …
- The characteristic curves of branches (loading curves) can be calculated as function of the flow rate:

$$H = H_{St} + C \cdot Q^2$$

$$C = \left(1 + \lambda \frac{l}{d} + \sum \xi\right) \frac{8}{d^4 \pi^2 g}$$

$$P = \frac{Q \cdot \rho \cdot g \cdot H}{\eta}$$

- The intersection between the loading curve of a branch and the characteristic curve of the related pump gives the operational point (the fluid is innusol)
- **DETAILED FURTHER INVESTIGATION NEEDED**

Recommendations for reducing energy consumption

POSSIBILITIES:

- The primary side pump control
  - Valve control (throttling)
    - Inadequate due to losses
  - Bypass con trol
  - Frequency converter
    - Flow rate as a function of motor speed
    - Lower losses
    - Measur ement date are required for fitting to the system
    - Motor speed control by measuring temperature

DETAILED FURTHER INVESTIGATION NEEDED

Direct supply from the primary side

- Eliminate the hydraulic distribution, directly supply the branches on the secondary side
  - Pumps are controlled by frequency converter
  - Continuous measurement is necessary for control purposes
  - Build new pipe into the system

DETAILED FURTHER INVESTIGATION NEEDED

SUMMARY

The first steps were done in the following topics:

Future improvement offered by the University (BME):

- Elaboration of a reliable, detailed hydraulic model
  - On-site survey → data on system elements
  - Technical documentation → data on system elements
  - Elaboration of a mathematical model for system hydraulics
  - Local non-invasive measurements (ultrasonic flow rate measurements), for validating and adjusting the model
- Using the model: recommendations for a more economical pumping operation, for reduction of electric energy consumption
  - Feasibility studies on various control solutions
  - Feasibility study: consumers supplied directly from the primary side
  - Economical calculations for the various solutions
  - Technical proposal(s) for modification

Thank you for your attention!