Possibilities for Optimising Wort Preparation – Part 2

EXAMINATION OF EXISTING PROCESSES | In the article cited, wort preparation can be calculated in terms of evaporation and re-formation; this property is used here for predicting possible improvements. The second part of this five-part series of articles on improving wort preparation revisits a problem discussed previously: what is the best process for driving off DMS from wort?

EFFICIENT EVAPORATION of DMS is a known and hotly debated issue. Process knowledge about the various evaporation processes has been published by *Hertel* at that time [1]. The result was: processes in which wort is depressurised from a higher pressure to a lower pressure are less efficient compared to the classic, directly heated pot. Important sub-questions have to be answered, taking account of the particular characteristics of a boiling system (temperatures, process control, volatility etc.). These considerations are expanded on below. For the first time, account is not just taken of evaporation from the various boilers, hot holding proceeding in the boiler systems and thus DMSP breakdown are also included. Depending on process conditions, additional assessments are possible. In the following, evaporation and hot holding are considered separately in external and kettle boiling systems.

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DMS Evaporation and DMS Re-Formation

Various authors have explained and proved that DMS formation in the brewhouse can be calculated [2-5]. Their considerations are being used now in order to map processes and compare them. External boiling and kettle boiling serve as examples here. The first describes the wort flow through the heat exchanger and is found in many breweries in the form of external or internal boilers. The latter can be described using a pot as an example that is heated on a hot plate. Wort does not flow here but all wort is heated via the bottom or the walls of the container. Such directly heated systems are rare today but can still be calculated.

Evaporation of DMS from wort can be calculated for external and internal boiling and re-formation of DMS from DMSP can be predicted based on equations. Kettle boiling is an open copper having a temperature of about 100 °C throughout. In such an open process, boiling is efficient and DMS re-formation uniform under the conditions at 100 °C. External boiling continuously depressurises wort in the kettle. This is a closed process and – proven procedurally – less efficient that open boiling [1].

Re-formation of DMS is an interesting issue. The copper of the external boiler also has a temperature of 100 °C so that re-formation is the same as in kettle boiling. But what happens in the boiler as such? Temperature is more elevated (101-106 °C) so that, of necessity, re-formation of DMS rises

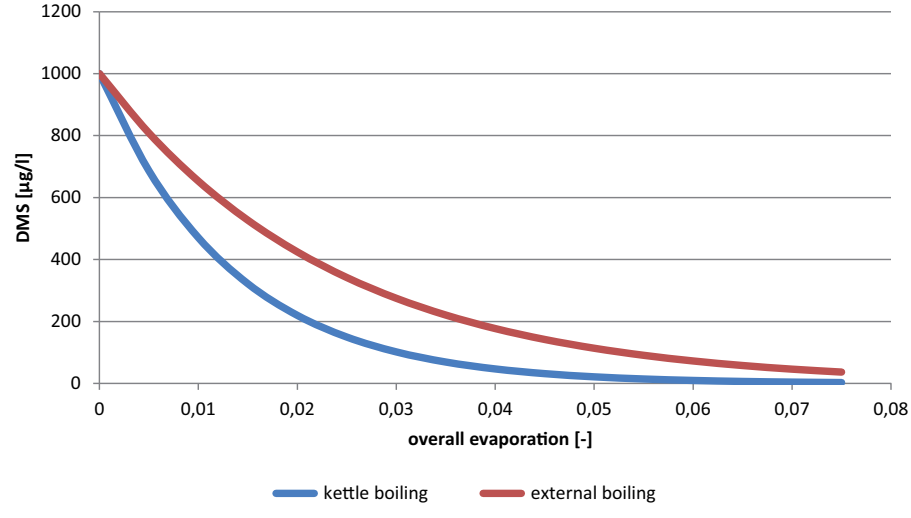

Fig. 1 DMS evaporation

exponentially. This is positive so that only re-formed and, thus, free DMS can be evaporated.

The problem is illustrated below. In Fig. 1, evaporation of free DMS in kettle (100 °C) and external boiling (106 °C) is considered at first. It can be clearly seen that in kettle boiling, less overall evaporation and, thus, less energy is required to obtain a particular target DMS concentration compared to external boiling.

Secondly, re-formation is considered in both systems. It should be noted here that re-formation is a function of time and time is plotted on the x-axis and not overall evaporation (see Fig. 2). The result is unequivocal. Re-formation in external boiling is superior to that in kettle boiling. This relates to the higher temperatures in external boiling, i.e. 106 °C in our sample calculation. Wort in the boiler is thus exposed to higher temperatures than wort in the kettle. The rise in temperature causes more pronounced DMSP breakdown, and DMS reduction was higher in the returning wort compared to wort in the kettle.

It would be an interesting thought to find out how temperature can be controlled in the boiler. Assuming constant heating steam temperature and supply, temperature will vary as a function of wort flow. When this is very high, temperature is lower compared to a situation when little wort flows through the boiler.

Evaluation and Summary

A separate consideration of evaporation and re-formation in kettle and external boiling yields first interesting results. Both systems are superior to the other one in terms of a unit operation. The question is now: what would be the result when evaporation is considered in combination with re-formation? It can be anticipated that a possible superiority depends on the particular process conditions and that there is potential for optimisation in practically every brewery operating with external or internal boilers. This answer will be examined in more detail in subsequent parts of this series of articles. ■

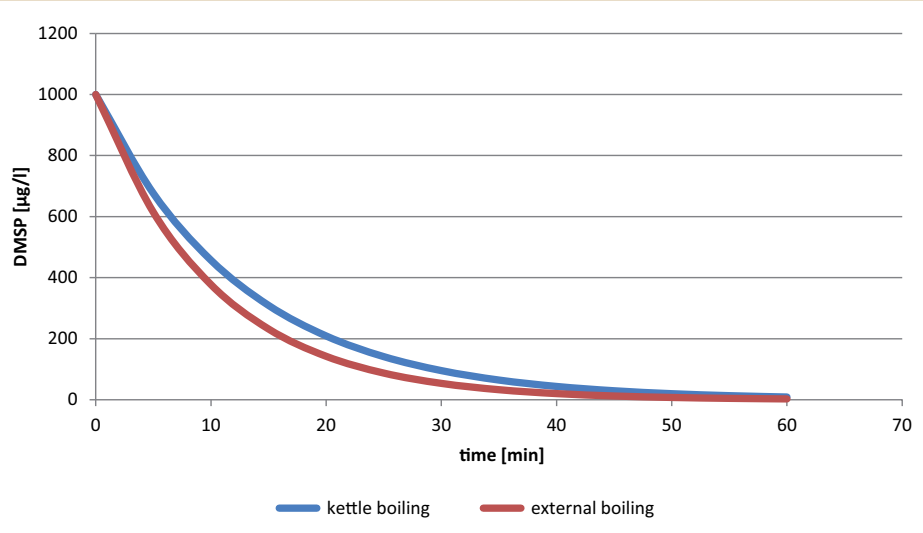

Fig. 2 DMSP re-formation

Literature

1. Hertel, M.: "Das Ausdampfverhalten von Aromastoffen während der Würzekochung", Dissertation TU München, 2007.
2. Scheuren, H.: "Modellierung gekoppelter Austreibungs- und Nachbildungsprozesse aromatischer Komponenten in der Lebensmittelindustrie am Beispiel der Würzebereitung", Dissertation TU München, 2011.
3. Scheuren, H. et al.: "Stripping DMS in the brewhouse, Part 1", BRAUWELT International No. 4, 2014, pp. 217-219.
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5. Scheuren, H. et al.: "Stripping DMS in the brewhouse, Part 3", BRAUWELT International No. 6, 2014, pp. 354-357.

Read the complete series of articles "Possibilities for optimising wort preparation" in the following Brauwelt issues:

- Part 1: Implementation in breweries in BRAUWELT International No. 1, 2017, pp. 27-28
- **Part 2: Examination of existing processes in BRAUWELT International No. 2, 2017**
- Part 3: Using calculations on existing processes in BRAUWELT International No. 3, 2017
- Part 4: Optimisation of existing processes in BRAUWELT International No. 4, 2017
- Part 5: Formulation of equipment improvements in BRAUWELT International No. 5, 2017