XCELIS® Ethanol Solutions

A GUIDE TO HIGH TEMPERATURE FERMENTATIONS

Tips for High Temperature Fermentations

The methods presented in this document are not guaranteed to reduce or correct the impact that high temperature excursions have on fermentations. By employing one or more of these methods, there may be an increase in the probability of limiting that impact.

Before the fermentation starts

If a customer anticipates that their fermentation is going to get hot (≥95°F) and they will not be able to control the temperature there are some steps they can take to increase the probability that the fermentation will finish. All of the described options can be tried individually or in combination depending on the customer's preference.

- Add additional nitrogen (urea – recommended ≥600 ppm; ammonia – recommended 246 ppm at T=0, target 300 ppm FAN at the beginning of fermentation). Additional nitrogen increases growth and fermentation rates.
  - There is the potential to increase the protease dose also as a means of increasing the nitrogen. This would have to be optimized for each plant based on their current nitrogen addition and protease dose to see a potential benefit.
- Decrease the %DS to reduce other environmental stressors on the yeast.
- Staggering the enzyme loading (i.e. split GA dosing) can reduce the heat generation in early fermentation.

Notes: Increasing the yeast dose to prop has little effect on combating hot fermentations. Increasing the enzyme dosing (i.e. glucoamylase) in the fermentations is not recommended for both GA and non-GA producing yeast. The enzymes are positively impacted by the elevated temperatures and will continue to produce sugar even when the yeast is not utilizing it, leading to potentially higher glucose at drop.

If a high temperature spike is observed during fermentation the following actions can be taken to potentially reduce the impact of final ethanol yields:

Monitoring and additions

- Characterize the high-temperature excursion (use data from DCS if possible).
  - Was it for an extended period of time (>5 hrs.)?
  - Is the temperature still rising?
- It is recommended to cool the fermentor to below 95°F before corrective action.
- Check the cell counts and viability of the yeast (<60-70% viability indicates that stress has occurred).
- Measure the FAN and adjust to 200-300ppm through the addition of nitrogen (urea or ammonium).
  - Alternatively, adding 1–2X the initial nitrogen dose can be done
- Add 2X the initial yeast dose for non-GA producing yeast and 1.5X for GA producing yeast via one of three methods:
  - Direct-pitch
  - Adding mash from an actively fermenting fermentor to the stuck fermentor, if capacity allows
  - Adding a portion of the prop

Process changes

Cooling water is a finite resource and every fermentor has a specific heat exchange capacity. The goal is to maximize heat exchange efficiency. It is important to minimize the amount of heat that needs to be handled in the cooling tower. Some tips for doing this are:

- Maximize the beer feed temperature.
  - Cool fermentation when it will provide the most benefit. If the fermentation gets hot towards the last 10–15 hours it does not necessarily have to be cooled. Little benefit will be observed and it allows for a warmer beer feed.
- Keep heat exchangers clean and in proper working order to allow for efficient heat management.
- Consider having a heat survey performed by a water quality company to determine where the cooling tower water goes and how efficiently it is managed.

Keep in mind that after 15–24 hrs. little can be done to make any significant change in fermentation.

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