



## Production and Usage of Natural Lactic Acid

### Lactic acid bacteria *Lactobacillus amylovorus* / *amylolyticus*

Propagation of a liquid culture:

Allow 500 ml of a *Lactobacillus* culture to multiply in 50 l of diluted first wort (10 – 12 % w/w) at a constant temperature of 48 °C. Propagate in stages to the desired batch volume (e.g. in a ratio of 10 % *Sauergut*\* to 90 % wort).

\*Used in German breweries to acidify the mash and wort in the brewhouse, *Sauergut* is a lactic acid solution, which is naturally produced through fermentation on a substrate of wort extracted from 100 % barley malt. It is one of the methods allowed under the *Reinheitsgebot*.

After reaching the logarithmic growth phase and a pH below 3.5, the culture should not be left at such a high temperature. In order to prevent cell death, the temperature of the *Sauergut* should be reduced to below 30 °C and mixed with fresh wort (50 – 90 %). Generally speaking, *Sauergut* can be maintained indefinitely. It is necessary, however, that beer is brewed regularly from at least Monday to Wednesday; otherwise, removal of the *Sauergut* does not occur with sufficient frequency, and the drop in pH is too extreme. The bacteria may thus be adversely affected, causing reproduction of the microbes to decline or cease altogether. Should there be an interruption in the brewing schedule, a freshly cultivated culture can be maintained, for example, at a temperature of 5 – 8 °C for a maximum of two months.

The use of an agitator in the tank or injection with carbon dioxide gas represent two common methods for mixing the contents, the former being more favorable, since a carbon dioxide atmosphere in the tank prevents the growth of filamentous yeasts.

The volume of *Sauergut* required per batch of wort must first be known, in order to properly dimension the storage tank. The capacity of the storage tank should be two to four times the volume of *Sauergut* required per batch of wort.

After removal of the *Sauergut* and replenishing it with the same volume of diluted first wort, the pH should rise to above 4.0. This ensures that the lactic acid cultures will continue to grow.

To reduce the pH by 0.1 with lactic acid, 580 g of lactic acid per metric ton of grist is required. This comes to roughly 10 g of lactic acid per hl of mash. The lactic acid needed for wort acidification is reduced by half, thus 5 g of lactic acid per hl of wort.

Example:

Wort pH: 5.6 → 5.2, brewed using 5 t of grist

Required amount of lactic acid: 290 g/t of grist × 5 t of grist × 4 (per 0.1 pH unit) = 5800 g

Lactic acid concentration:

0.8 % w/v equals 8 g/l

*Sauergut* addition per batch:

$$\frac{5800 \text{ g}}{8 \text{ g/l}} = 725 \text{ l}$$