

prevent this caramelization.

Direct firing requires a greater total bottom surface coverage than any other heating media.

For paler beers, lagers in

particular, direct fire may also produce too many melanoidins, which increase the wort color. But brewers who intend to brew darker beers may even appreciate this. In spite of its drawbacks,

the ease and low cost of direct-fire heating make it the most probable option for small brewpubs.

### Live Steam — the Professional Standard

The most common heating system is live steam. Saturated steam at a pressure usually between 12.5 and 42 psi is injected into a dimple-plate or a semi-coil heating surface. Over time copper has been replaced by stainless steel in the construction of these devices. But because mild steel provides a better heat transfer than stainless steel, the heating surface is often made of mild steel, jacketed with stainless steel. Compared with direct heating, the efficiency of steam is better and averages 100 MJ per barrel.

Steam heating allows precise control of the product temperature as well as of steam condition and consumption. It is more flexible in terms of making adjustments to the process. For example lower steam pressure results in a decline of color and hop utilization and slightly higher DMS values. These higher DMS values are more than compensated for by a better convection in the vessel.

Lower surface temperature results in a smoother heat transfer and fewer Maillard products, important especially for paler beers. It also allows a lower mixing speed for the mash, which equals less sheer force. Due to less exposure to critical temperature, a steam-heated brewhouse will also last longer than one that is direct fired.

The biggest advantage of



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CIRCLE 45 ON READER SERVICE CARD