Water management at a malted barley brewery

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Abstract

In order to manage and reduce water usage at brewery sites, it is essential that comprehensive water balances be available on which to base informed decisions. During 2001 a water management investigation was completed at a South African brewery to develop a suitable water balance for the plant. Literature studies, plant trials, analysis of historic and current plant data and consultations with brewery personnel were among the diagnostics used in the investigation.

Based on the overall water balance, it was found that 5 m^3 of water was used to produce 1 m^3 of beer at the brewery. Although the brewery uses lower volumes of water than other sites, numerous opportunities exist to further reduce these volumes. The breakdown of volumes of water consumed and effluent produced per department through the use of a comprehensive water balance, provides an effective tool to manage effluents at brewery sites.

Introduction

The production of beer involves the blending of the extracts of malt, hops and sugar with water, followed by its subsequent fermentation with yeast (Wainwright, 1998). The brewing industry employs a number of batch-type operations in processing raw materials to the final beer product. In the process, large quantities of water are used for the production of beer itself, as well as for washing, cleaning and sterilising of various units after each batch is completed. A large amount of this water is discharged to the drains.

For many years the brewing industry has recorded high ratios of water used to beer produced. This can be as high as 10:1 in sites with a large proportion of smallpack production, and as low as 5:1 on some traditional brewing sites (Crispin, 1996). The main water use areas of a typical brewery are brewhouse, cellars, packaging and general water use. Water use attributed to these areas includes all water used in the product, vessel washing, general washing and cleaning in place (CIP); which are of considerable importance both in terms of water intake and effluent produced.

With rising water prices and ever-increasing competitiveness within the market place, the importance of raw material costs, including water, in determining product costs and profitability should not be ignored. The minimisation of water costs should be given a high priority since it is an area where the consumption (and generation in the case of effluent) is directly under the control of the brewery site (Barnard and Alexander, 1996).

Over the last three decades many papers dealing with all aspects of malt, hops, sugar and yeast can be sourced (Van der Merwe, 2002). However, a review of technical literature related to the brewing industry indicates that little is available on water use and minimisation, in particular the breakdown of water use and effluent generated within relevant departments. The objectives of this investigation were to assess water management at a South African brewery and to determine possible steps that can be introduced to minimise waste volumes and strengths, and hence effluent treatment requirements.

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The water balance over each unit process on the brewery site (excluding those associated with malting, which takes place off site) was compiled and the results consolidated into the overall brewery water balance. Information regarding the assessment of water management in the various brewing sections is sourced from literature, plant trials, personal communication and analysis of actual plant data.

Water management at breweries

There are many unit operations involved in a brewery, all consuming water. A simplified water balance of the water used within a brewery is shown in Fig. 1, whereby the water either becomes part of the beer, part of the effluent or is evaporated. A water ratio is used to describe the total volume of water entering the brewery (A) to the total volume of beer leaving the brewery (B). Ideally the volume of effluent (Stream C) should be minimised which would reduce the costs associated with effluent treatment and purchasing of water (since Stream A would also decrease).

One of the major sources of effluent in a brewing environment emanates from cleaning operations. All vessels and pipelines frequently undergo CIP to ensure that the product is free of undesirable smells and tastes, and fit for human consumption. According to Binnie and Partners (1986), between 65 and 70% of incoming water forms part of the effluent leaving a brewery. In the past, effluent charges associated with this water, were not very high. However, with the drive towards water conservation in South Africa, higher levies for the discharge and treatment of effluent, as

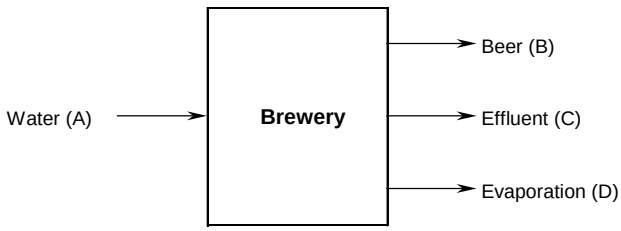

Figure 1
Simplified water balance of a brewery