REDUCTION OF PROCESSING AIDS – APPARATUS TO REDUCE LIME, ANTIFOAM AND ALKALISING MEDIUM

Gerhard Rösner[1], Walter Hein[1], Günter Pollach[1], Paul Dodd[2] and Jason Grech[2]*
[1]Zuckerforschung Tulln GmbH, Reitherstraße 21-23, A-3430 Tulln, Austria and [2]BetaTec Hop Products GmbH, Freiligrathstr. 7/9, 90482 Nürnberg, Germany

Introduction

The production of sugar from sugar beet is increasingly under pressure to minimize costs. A significant share of these production costs comes from processing aids. This work reports on developments at Zuckerforschung Tulln G.m.b.H (ZFT) / AGRANA for savings of processing aids in three different areas. The first part deals with a computer program called LIMOS (Lime Optimization System). It calculates the necessary minimum amount of milk of lime and performs its dosage on the basis of operational characteristics, such as amount of raw juice and filter pressure. The second part deals with a so-called Anti Foam Optimiser (AFO), which is installed within a bypass; this calculates the optimal demand and dosage of antifoaming agents for various juices. The third apparatus a Lime Salts Analyser (LISA) determines the residual calcium content in juices and enables optimal dosages of alkalising medium as well as scale inhibitors.

Results and Discussion

Lime Optimisation System

For juice purification an established theory is that about 100 % CaO calculated on non-sugars in raw juice is necessary for processing. This amount corresponds with a limestone consumption of 3.0 - 3.5 % on beet and normally an amount of 7 - 8 % of coke is needed. These figures indicate that the consumption of limestone and coke are highly cost intensive factors in sugar production and present great potential for financial savings. Juice quality is the limiting factor in the reduction of limestone consumption especially with respect to the thermo stability, residual hardness, colour and filterability properties.
Research at ZFT /Agrana, Austria found a clear connection between the measured pressure in the filter station and the consumption of milk of lime. With this connection they created a command variable that is simply referred to as "specific filter performance".

$$\text{"Specific filter Performance"} = \frac{\text{Amount of raw juice}}{\text{Pressure of thickening filters}}$$

Based on this command variable a computer program was designed which was named LIMOS (Lime Optimisation System). This program operates by taking data for the filter pressure and filter juice volume from the process control system, calculating the "specific filter performance" and comparing this with the set value. The program can then make a dosage suggestion depending on the outcome of the comparison or more conveniently send a direct signal to trigger the suggested dosage

Figure 1 illustrates the mode of operation of the program. It displays the two parameters "specific filter performance" and "dosed amount of milk of lime" over the period of 2 days .In the case that the filter performance displays values above a defined range (e.g. 9.6 – 10.2)

Anti-Foam Optimiser

Within sugar production, problems with foam formation have an impact on almost every processing step, especially within the extraction area, juice purification and sometimes during the evaporation and crystallisation steps. The so-called Anti-Foam Optimiser (AFO) is an apparatus for optimised application of anti-foam agents. It removes the "psychology" involved when operating personnel are deciding the correct amount and time of dosing and works on a more objective basis. The system, shown in Fig. 5, works in bypass and consists of an overflow tank, which is flushed and then filled up with juice (tower juice, press water etc). Air is then injected into the juice and the foam formation observed. If the foam formation reaches an electrode after a certain time span (4 min) the system raises the dose of anti- foam. For the inverse case the dosage amount is reduced. Fig. 6 displays the progression of anti-foam consumption for the Tulln, factory and AGRANA as a whole. Compared to very high consumption figures in 1992 and 1993 a reduction of more then 75 % was achieved. Moreover the average consumption of the early nineties was reduced by 50 %.

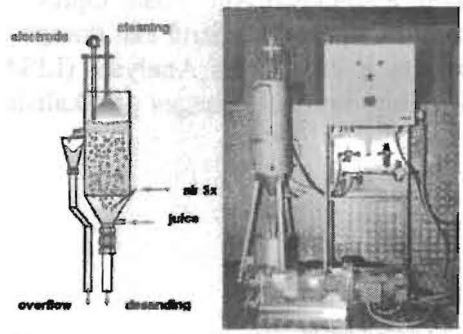


Fig. 5 AFO System

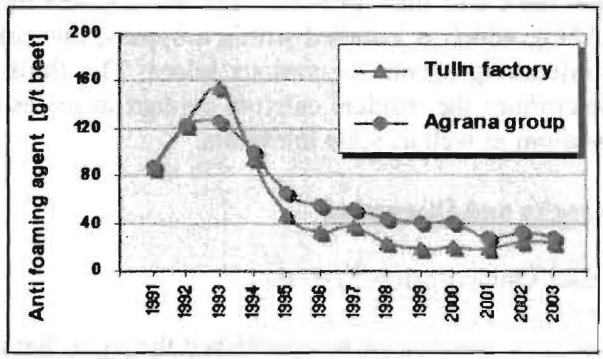


Fig. 6 Antifoam consumption

Lime Salts Analyser

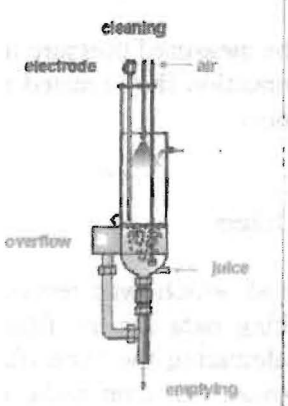


Fig. 7 LISA

Alkalising medium is usually added during juice purification in order to keep the residual content of calcium in the juices low. Under dosing leads to high content of calcium ions in thin juice leading to scaling problems in the following steps of the process. Overdosing results in high pH-values in thin and thick juice and causes troubles during crystallisation. A Lime Salts Analyser (LISA) was developed as a method for the determination of calcium in thin juice based on the *Clarke's* soap method. Again the system works in by-pass.Small doses of soap solution are added to a known amount of juice in which air is injected. The soap forms insoluble salts with Ca and Mg ions so that no foam formation occurs in the solution. The slightest surplus of soap solution causes foam formation which is detected by electrodes.The known amount of soap solution can be used to calculate the concentration of Ca and Mg in the juice. There are several potential fields of application such as the optimal dosing of alkalizing medium (NaOH, Soda) in juice purification, the measurement/ control of residual Ca^{2+} in ion exchangers for de-sweetening and the optimal dosing of scale inhibitors in evaporation stations.

the dosed amount of milk of lime is lowered. In the case that the filter performance displays values below the defined range the dosed amount of milk of lime is increased.

Fig 1: LIMOS mode of operation

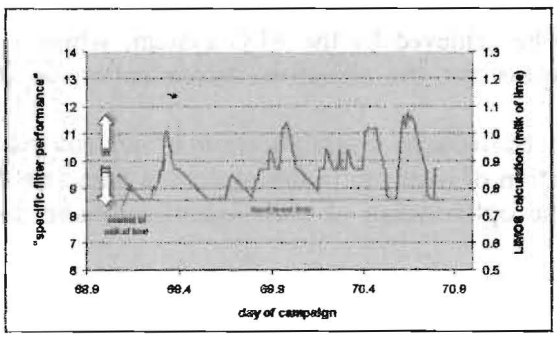
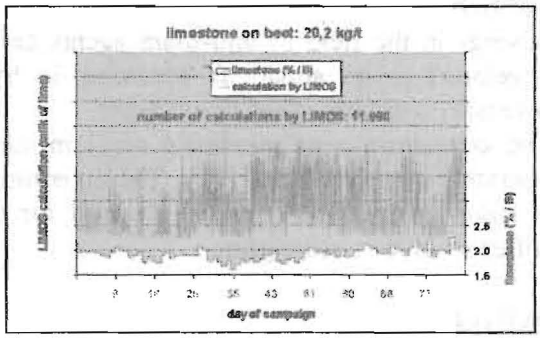


Fig 2. Limestone consumption at Tulln in 2002



The effect over the 2002 campaign at the Tulln factory, Austria is displayed in Fig 2. The program performed 11990 calculations over the whole campaign and resulted in a total limestone consumption of 2.02 % on beet (this figure covers the gross limestone consumption including splitter and unburned and those amounts which were needed for alkalisation of flume water, I.e. it does not just simply refer to juice purification).
Fig. 3 displays results of the last 11 campaigns. The downward tendency in limestone consumption continued, mainly due to optimisation of the LIMOS system. There were also no adverse changes to the thick juice colours. In 2005 the factory in Tulln had a gross consumption of limestone of 1.59 % on beet, with the AGRANA average for three factories at 1.78%.

Fig. 3 Limestone consumption over the years

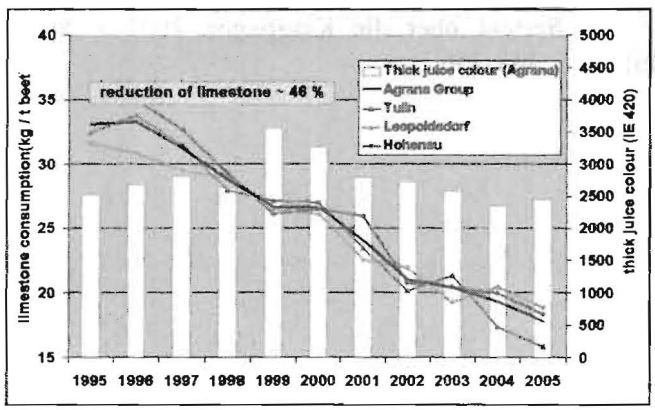
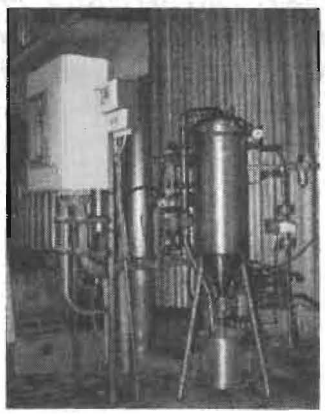


Fig.4 Mini - Filter



Some factories have clarifiers instead of filter stations. In which case there is no filter pressure to measure. A mini-filter was designed, that takes a side stream of the juice to be clarified and passes it through a shortened candle filter and the pressure across this filter is then used by LIMOS. This system has passable operating expenses and provides a quick and robust signal. In 2003 the Tulln factory installed clarifiers. The mini-filter was tested in 2004 and used for the entire 2005 campaign the system was found to be very effective and the reduction in limestone consumption continued.

Summary

LIMOS, a program that controls the optimal dosage of milk of lime within juice purification has a high potential for economic savings in sugar factories. Variants of this system are available for both, factories operating with filter stations as well as ones operating with clarifiers.
Savings in the field of anti-foam agents can be achieved by the AFO system, which was developed as an apparatus operating in bypass for the objective determination of the necessary amounts of anti-foam agent.
The consumption of alkalising medium can be reduced by application of an automatic operating system named LISA. The determination of hardness in this system is based on the "Clarke Method". It can also be used for the optimisation of scale inhibitor dosage and softeners in ion exchangers.

References

1. *Rösner, G.; Pollach, G.:* Erfahrungen mit Entschäumeranwenung in österreichischen Zuckerfabriken, Sugar Industry 122 (1997), No. 10, 787-793
2. *Rösner, G.; Pollach, G.:* Verfahren zur automatischen Bestimmung der Härte von Dünnsäften. Sugar Industry 126 (2001) No 11, 890-897
3. *Pollach, G.; Hein W.; Rösner, G.:* Bericht aus der Kampagne 2001 – Agrana Österreich, Agrana Ungarn. Sugar Industry 127 (2002) No 5, 362-366
4. *Pollach, G.; Hein W.; Rösner, G.:* Kurzbericht über die Kampagne 2002 – Agrana Österreich / The 2002 campaign – Agrana Austria. Sugar Industry 128 (2003) No 5, 358-363
5. *Hein W.; Pollach, G.; Rösner, G:* Kurzbericht über die Kampagne 2003 - Agrana Österreich Sugar Industry 129 (2004) No 7, 498-504
6. *Hein W.; Rösner, G:* Kurzbericht über die Kampagne 2004 - Agrana Österreich. Sugar Industry 130 (2005) No 4, 299-304
7. *Hein W.; Rösner, G; Emerstorfer, F.: B*ericht über die Kampagne 2005 - Agrana Österreich. Sugar Industry 131 (2006) No.5. 349-356.