Int. J. New. Chem., 2019, Vol. 6, Issue 3, pp. 151-155.

International Journal of New Chemistry
Published online 2019 in http://www.ijnc.ir/.

Online ISSN 2383-188X
Open Access

Original Research Article

The Lime and Flocculant Dose Optimization in the Clarification Process of a Sugar Factory

Ehsan Darouneh[1*], Tahereh Pirhooshyaran[1] and Hashem Shalagheh[2]

[1]*Chemical Engineering Faculty, Dezful Brach, Islamic Azad University, Dezful, Iran*

[2]*Agro-Industry Company of Karoon, Khuzestan, Iran*

*Corresponding author Fax number: Tel.: +98 9100215026

*E-mail: Darouneh@gmail.com

ABSTRACT

The objective of this research was the economic analysis of two different methods for the clarification of sugarcane juice. The first method was the method of using 700 ppm of CaO (final pH=7.9) and 1 ppm of Separan flocculant which previouly was being used. The other method was using 500 ppm of CaO (final pH=7.4) and 3 ppm of Separan flocculant. This study was carried out on an industrial scale in the Karoon sugar industry in south west of Iran. The results showed that increasing the amount of Separan and reducing the amount of lime directly increases the purification and the brix of the juice besides reducing the amount of lime precipitation in the evaporators. Economic analysis of the total process showed that the second method of clarification was 5 % more economical.

Keywords: Clarification, Separan, lime, Economic analysis, Sugarcane

Introduction

The sugarcane industry is one of the major food industries in Iran and produces around one million tonnes of sugar each year. Clarification is one of the important processes in sugar factories. Sugarcane juice produced after course filtration of extracted juice contains small particles of bagasse and soluble substances such as salts, acids, proteins and polysaccharides. Other impurities such as flavonoids, polyphenols and organic acids present in juice contribute to the color of juice. The clarification process is required to remove or reduce these impurities to produce clear and light juice [1]. The clarification is not a simple decanting process since the product consists of a complex colloidal system in which the colloids present different isoelectric points [2]. The clarification of sugar juice occurs by coagulation, flocculation, and precipitation processes. Flocculation can be carried out by changing the pH using lime and Separan reagents [3]. Such reagents modify the precipitation condition which removes impurities. Application of lime, up to a pH between 7.5 and 8.5 can produce satisfactory clarification [4]. It is difficult to establish an optimum condition for clarification of sugarcane juice. In general, the Separan dose for treating the juice is varied from 1 up to 5 ppm [5]. In this study we investigate the economic benefits of adding different amount of lime and Separan into the sugarcane juice by using a full factor pattern of experiment design. The objective of this research was to establish the optimum economic required dose of lime and Separan in sugarcane juice at the clarification section of Karoon Sugar Company.

Experimental

To achieve the maximum productivity at minimum costs, two dose levels of lime of 5000 ppm and 700 ppm based on CaO content and three dose levels of 1ppm, 2ppm and 3ppm Separan were investigated in six experiments which were designed based on full factor experiment design method. Each experiment condition was tested for one month before changing to the next set of conditions. Lime and Separan addition was done by injection of lime slurry to the juice line after the preheaters and the Separan liquor to the stabilization tank located after juice heaters. mean juice property was monitored during production period to consider variation in juice properties. The measurements collected during each experiment included the raw sugar colour by RM40

refractometer, turbidity of clear juice by 2100Q turbidity meter, the monthly white sugar production and the production costs. All materials used in this study were industrial grade prepared by the Agro-industry company of Karoon. The instruments which were used in this study were a RM40 refractometer, 2100Q turbidity meter, UV5 spectrophotometer, S400 pH meter and XP205 analytical balance.

Results and discussion

The results of optimizing the clarification process are shown in Table 1. As can be seen the minimum turbidity and raw sugar color occurred at a lime dose of 500 ppm and Separan flocculant dose of 3 ppm. Field observations showed that increasing the amount of Separan and reducing the amount of lime directly reduces the lime sedimentation in evaporators. This directly reduces dead time for repairment and increases the production rate. Economic analysis of monthly total white sugar production in each month of experimental production period is shown in Table 2. The calculation of benefit, income and costs was based on monthly production rate and production costs. The results determine the optimum economic conditions of using lime and Separan flocculant reagent for clarification process of sugarcane juice. As can be seen in Table 2 the maximum productivity and the minimum costs occurred at a lime concentration of 500 ppm and a Separan addition rate of 3 ppm. Comparing the monthly total production costs in these optimum conditions with the production costs of using lime dose of 700 ppm and Separan flocculant reagent dose of 1 ppm which was used during the last two years, the monthly net profit increases around 5 % more than the average last two year's monthly net profit.

Table 1. The results of the experiments at different dose rates of lime and Separan

lime dose (ppm)	Separan dose (ppm)	Turbidity	Raw sugar colour ICU
500	1	13	1807
	3	10	1612
	5	14	1917
700	1	17	2314
	3	15	2155
	5	19	2443

Table 2. Monthly production data for the different experimental conditions

lime dose (ppm)	Separan dose (ppm)	Monthly production (ton)	production costs($/ton)
500	1	22895	260
	3	27317	220
	5	23450	260
700	1	26267	240
	3	27115	230
	5	22842	270

Conclusion

This study shows that using lime and Separan flocculant at optimum conditions of 500 ppm and 3 ppm respectively, reduces the sugar juice turbidity and raw sugar colour to some extent. Comparing the monthly total production costs in this optimum conditions with the production costs of using lime at 700 ppm and Separan flocculant at 1 ppm which was used during the last two years shows that the monthly net profit increases around 5 % more than the average of the last two years of monthly net profit.

Acknowledgments

I am highly grateful to Agro-industry Company of Karoon and Islamic Azad University for their help and support.

References

[1] J. C. Chen, C. C. Chou, Cane sugar handbook: a manual for cane sugar manufacturers and their chemists. 12th Ed. John Wiley and Sons, New York (1993).

[2] R. B. L. Mathur, Handbook of Cane Sugar Technology. 2nd Ed, Oxford and IBH New Delhi, (1999).

[3] P. W. Rein, L. S. M. Bento, R. Cortes, 2007. *Int. Sugar. J.* 109, 286 (2007).

[4] G. L. Spencer, G. P. Meade, Cane suger hand book, John Willey &Sons, Landon (1955).

[5] P. W. Vander Poel, H. Schiweck, T. Schwart, Sugar technology: beet and cane sugar manufacture. Berlin: Bartens (1998).