BRAZILIAN EXPERIENCE WITH NEW GENERATION SRI JUICE CLARIFIERS

By

M. FERNANDES¹, G. DE LA RIVA¹ and R. STEINDL²

¹Fourteam Engenheiros Associados Ltda
²Sugar Research Institute
marcelo@fourteam.com.br

KEYWORDS: Trayless Clarifier, SRI Clarifier, CFD, Residence Time, Sucrose Loss, Colour Formation.

Abstract

This paper reports experience with New Generation SRI juice clarifiers in Brazilian mills during the 2003 grinding season. For the first time, three different sized clarifiers were modified or installed in Brazil using SRI clarification technology. In one case, a New Generation SRI clarifier was installed: in a second case, an existing trayless clarifier providing poor performance was modified and, in the third case, a multitray clarifier was replaced with a new SRI clarifier onto the existing support structure. All three units have performed very well, with a small period of adaptation by mill personnel for its full comprehension. During this first crop, all SRI units were operated alone with excellent results. Previously, these sugar mills were running with two and even three units for juice clarification. There is a great interest by Brazilian sugar mills to treat juice with trayless clarifiers, but all the designs tried previously were not able to perform alone satisfactorily, requiring always the operation of more than one clarifier. The benefits of having installed the SRI clarification technology include significantly higher throughput rates, improved standards of clarification, reduced sugar losses, and reduced operating costs. The results represent a significant gain to the Brazilian sugar industry, not only in clarification performance but also in reducing the cost for mill throughput expansions.

Introduction

Since the first installation of an SRI clarifier in 1969, it has been upgraded continuously. More recently, computational fluid dynamics has been used to improve the design, resulting in increased juice flow capacity of more than 100% for the same cross-sectional area. In Brazil, during the 1980s, short retention time clarifiers were installed by a large number of sugar mills under SRI consultation, but without adequate supervision and commissioning. The operation of these clarifiers could only be classified as ordinary. As soon as this group of mills tried to increase the grind rate, the clarifiers were not able to process the extra flow. In an effort to solve this problem, lots of designs have appeared, but they have proved to be inadequate.

To update and improve the clarification station, major Brazilian sugar mills have been converting their multitray clarifiers into trayless clarifiers. Several designs were tested, but poor performances were observed. Three sugar factories decided to adopt the SRI new generation clarifier technology by either installing a new clarifier or converting existing ones. In each case, the adoption of the SRI clarification technology involved an on-site pre-design audit, provision of a design specification from SRI and on-site commissioning by an SRI engineer.

During the pre-design audit phase, mill personnel noticed a big difference in how SRI conducts its audit program compared with previous experiences. Besides undertaking sedimentation tests, a full comprehensive questionnaire was presented to the mill and all relevant points were discussed very deeply, giving special emphasis to all juice processing sectors from the milling train to the clarification station. It was observed by one mill manager that never before was such importance given to several issues, even the smallest ones. In another sugar mill, the manager observed that a lot of factors were never considered before the SRI clarifier installation. It is now realised that even the best clarifier design will not perform...
satisfactorily if all the variables associated with the juice pre-treatment are not evaluated. Another
distinguished issue mentioned by mill personnel was the intensive on-site commissioning phase undertaken
by experts to ensure a successful installation. Table 1 summarises the three installations.

<table>
<thead>
<tr>
<th>Mill</th>
<th>Clarifier volume (m³)</th>
<th>Number of units in operation</th>
<th>Juice flow capacity (m³/h)</th>
<th>Residence time* (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Before</td>
<td>After</td>
<td>Before</td>
<td>After</td>
</tr>
<tr>
<td>Estivas</td>
<td>1 470</td>
<td>388</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Guaxuma</td>
<td>1 200</td>
<td>320</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Rocadinho</td>
<td>1 090</td>
<td>251</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>

(*) Residence time = clarifier volume divided by juice flow rate.

Results

Prior to start-up, mills were expecting a lighter mud, because this was found in all other trayless
clarifier designs installed in Brazil. For this reason, mill managers had insisted on installing a mud density
meter, in order to use density to control mud withdrawal. Exactly the opposite was found, as mud
withdrawn from the SRI clarifier was very heavy, facilitating filter station operation, and resulting in a
better filtration and lower sucrose content in mud cake. Typical mud densities from the SRI clarifiers

Another overwhelming experience was the new control procedures implemented for the
clarification station, done now by computerised logic software with no manual interference. All variables
are now automatically controlled, except mud level inside the clarifier, which is monitored visually and
controlled by mud withdrawal valve or pump, depending on the site installation. It was also noticed that a
clarification station based on a single clarifier was also far simpler to manage than a station based on
multiple small units of earlier designs.

The actual retention time of the clarified juice is lower than the values given in Table I, varying
from 20 to 30 minutes as the calculation oversimplifies the flow situation. The juice residence time has
enormous influence, both in sucrose loss due to inversion and colour formation. These interdependent
factors are better related in Figure 1, showing linear relationships between sucrose loss and colour increase
with increasing residence time in the clarifier.

![Graph showing the relationship between juice residence time and the formation of colour and loss of sucrose through inversion.](image)
Besides the simple operation of the SRI clarifier, excellent results were achieved in all three mills for clarified juice quality as measured by juice purity and turbidity. Table 2 shows purity values and variation when comparing before and after the installation of the new clarifiers.

**Table 2**—Purity data for the clarified juice from the three SRI clarifier installations.

<table>
<thead>
<tr>
<th>Mill</th>
<th>Clarified juice purity (%)</th>
<th>Variation(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Before (3 crops avg.)</td>
<td>After</td>
</tr>
<tr>
<td>Estivas</td>
<td>81.88</td>
<td>82.73</td>
</tr>
<tr>
<td>Guaxuma</td>
<td>82.55</td>
<td>83.64</td>
</tr>
<tr>
<td>Rocadinho</td>
<td>83.02</td>
<td>83.95</td>
</tr>
</tbody>
</table>

Guaxuma Mill, which converted a poor performance trayless clarifier into an SRI clarifier, increased the juice throughput from 250 m³/h to 520 m³/h, an increase of more than 100%. It is interesting to note that the existing clarifier body was retained, but all the internals were completely replaced, including the mud scrappers.

All the juice pre-treatment stages were upgraded at the same time. Before the modifications there were two operators at the clarification station. This has now been reduced to one operator.

Rocadinho Mill, by installing an SRI New Generation Clarifier onto an existing support structure, increased the juice flow from 250 m³/h, using two and sometimes three clarifiers during wet weather periods, to 330 m³/h, achieving excellent results with only the one SRI clarifier.

Juice clarity improved significantly and, although turbidity was not measured, raw sugar penalties have reduced by more than 70%, improving productivity and profitability.

Estivas Mill, which installed a new clarifier, replaced three old multitray clarifiers, simplifying dramatically the clarifier operations, mainly because these three units were installed well away from each other, making it difficult to monitor performance of each one, not to mention the difficulty in splitting the juice and distributing flocculant between the three clarifiers.

It was found by all mills that, although all controlled variables were important, it was necessary to pay special attention to juice temperature, as trayless clarifiers were very susceptible to temperature variations, when bagacillo carryover is most likely to happen.

This issue was more pinpointed at Rocadinho mill, where there was no clarified juice screening. As a result, the control loop was programmed to alarm at the computer screen anytime the juice temperature went out of control limits, informing the field operator to check the heaters and vapor valves.

**Conclusions**

In Brazil, ‘SRI’ clarifier is a common nickname for short retention clarifier, although the true New Generation SRI Clarifier was only installed in three mills during 2003 crop and another three for the 2004 crop.

Simple in operation and simple to operate by mill staff, this high performance equipment is considered approved by all three mills.

Its low operational volume allows mills to start up and liquidate very quickly with only 30% of previous times being expended with these operations. Also, it was noticed that there was less sucrose loss and colour formation, due to the short residence time.

All mills achieved a better quality of clarified juice, increased sugar recovery and lower raw sugar penalties, along with reductions in maintenance and production costs.
LA NOUVELLE GENERATION DE DECANTEURS SRI:
EXPERIENCES BRESILIENNES

M. FERNANDES¹, G. DE LA RIVA¹ and R. STEINDEL²
¹Fourteam Engenheiros Associados Ltda
²Sugar Research Institute
marcelo@fourteam.com.br

MOTS CLEFS: Decanteurs, SRI, Trayless, CFD, Temps de Séjour,
Pertes de Saccharose, Couleur.

Résume
ON DONNE des résultats obtenus avec des décanteurs SRI dans des sucreries brésiliennes, en 2003. Trois décanteurs, de grandeurs différentes, ont été utilisés: dans le premier cas on a installé un décanteur SRI Nouvelle Génération; dans le second on a modifié un décanteur déjà en opération, et finalement on a installé un SRI sur des structures existantes. Les trois installations ont donné de bons résultats, après une période de formation pour le personnel. Avant l’installation des SRI ces sucreries se servaient de deux ou même trois décanteurs, remplaces maintenant par un seul SRI. L’industrie brésilienne est très intéressée par les décanteurs du type « trayless », mais avec tous les models essayés avant le SRI il fallait plus d’une unité pour traiter le jus. Les avantages du SRI comprennent de plus forts débits, une clarification, des pertes faibles et un coût d’opération plus faible. Ces résultats sont avantageux pour l’industrie brésilienne, non seulement en termes de performance mais aussi en termes des coûts d’expansion.

LA EXPERIENCI BRAZILEÑA CON LA NUEVA GENERACIÓN
DE CLARIFICADORES DE JUGO SRI

M. FERNANDES¹, G. DE LA RIVA¹ y R. STEINDEL²
¹Fourteam Engenheiros Associados Ltda
²Sugar Research Institute
marcelo@fourteam.com.br

PALABRAS CLAVE: Clarificador sin Bateas, Clarificador SRI,
CFD, Tiempo de Residencia, Pérdida de Sacarosa, Formación de Color.

Resumén
Esta ponencia reporta la experiencia con los clarificadores de jugo SRI de Nueva Generación en los molinos brasileños durante la temporada de molienda del 2003. Por primera vez, tres clarificadores de distintos tamaños se modificaron o instalaron en Brasil usando tecnología de clarificación SRI. En un primer caso, se instaló un clarificador SRI de Nueva Generación: en un segundo caso, se modificó un clarificador sin bateas ya existente y que tenía un pobre desempeño y en el tercer caso, un clarificador de bateas múltiples se reemplazó por un clarificador SRI nuevo sobre la estructura de soporte existente. Las tres unidades se han desempeñado muy bien, con un pequeño periodo de adaptación por parte del personal del molino para su completa comprensión. Durante esta primera cosecha, todas las unidades SRI se operaron solas con excelentes resultados. Con anterioridad, estos molinos de azúcar operaban con dos e incluso tres unidades para la clarificación del jugo. Existe un gran interés por parte de los molinos de azúcar brasileños por tratar el jugo con clarificadores sin bateas, pero todos los diseños probados con anterioridad no habían sido capaces de operar solos en forma satisfactoria, y requerían siempre de la operación de más de un clarificador. Los beneficios de haber instalado la tecnología de clarificación SRI incluyen tasas de producción significativamente más altas, estándares mejorados de clarificación, reducción en pérdidas de azúcar y reducción en costos de operación. Los resultados representan una ganancia significativa para la industria azucarera brasileña, no solamente en cuanto al desempeño de la clarificación sino también en la reducción de costos que permitirá la expansión de la producción de los molinos.