CHROMATOGRAPHIC SEPARATOR EXTRACT PROCESSING

OR

WHAT THE HECK IS EXTRACT AND
WHAT AM I SUPPOSED TO DO WITH IT?

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THE AMALGAMATED SUGAR COMPANY
TWIN FALLS, IDAHO

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Section F

396
Chromatographic Separator Extract Processing

Or

What the Heck is Extract and What Am I Supposed to Do With It?

In spite of the fact that at the time, the term extract could not even be found in the working vocabulary of most Sugar Bums, we at the Twin Falls Factory of the Amalgamated Sugar Company found ourselves having to deal with this "phantom" material. Now as any operator here can attest, we all take great pride in somehow being able to produce pure, white, granulated sugar from so called beets disguised as black, ugly masses of protoplasm and protein. So... how tough could it be to make sugar out of.....extract? We were all very confident until the word came down from research...that is from Mike, and Kathy and Tom and Dennis... and the word was "No Problem - Trust Me!" Now I don't know what that does to you, but those words reminded me of a blind date I once had when my good buddy said "No Problem - Trust Me!" With that being said, let's look at the processing of extract in comparison to thick juice - a juice stream with which all of us are intimately familiar.

On December 23, 1988, the Amalgamated Sugar Company commenced the operation of a TASCO Molasses Chroma Separator. This was the culmination of a tremendous effort on the part of TASCO Research, Engineering, Construction, and Operations personnel to develop, design, build and commission a molasses desugarization process. In less time than it took to say "Sugar", we were back at it again,
designing and building a second separator which was placed on line in April of 1990. With two separators on line, we went from a factory with no extract to one producing and having to deal with approximately 200 TPD.

What is Extract?

The purpose of a separator is to separate the sugar in molasses from the nonsugars, which is done utilizing an ion exchange resin.

The molasses to be treated by the separator contains sucrose, glucose, fructose, sodium and potassium salts, amino acids, raffinose and a large assortment of other organic materials. As the molasses moves through the resin, the sucrose is more easily absorbed by the resin than other components and therefore moves along at a slow rate. The sodium-potassium salts and many other components are rejected by the resin and move along at a faster rate. Therefore, the non-sucrose moves ahead and leaves the sucrose behind. By removing material from the resin at appropriate points a sucrose rich fraction and a non-sucrose rich fraction can be obtained. Extract is the sucrose rich fraction that results from the chromatographic separation of molasses into its sucrose and non-sucrose components.

"What do I do with it?"

During the 1988 and 1989 beet and juice campaigns, extract, which in its dilute form directly from the separator is approximately 35 brix, was concentrated in a two effect evaporator system to 70 brix and then entered the process on the sugar end at
the high melter. Extract sugar made up approximately 10% of total sugar entering the sugar end, so thick juice flow was balanced between the sugar end and outside thick juice storage to fully optimize sugar end capacities. The replacement of thick juice with concentrated extract on the sugar end did not noticeably alter sugar end operations during those operating periods.

Since the separator was utilized during 330 operating days per year, extract produced during the 3 1/2 - 4 months that the sugar end was not operational was concentrated to 68 - 69 brix and stored as thick extract in outside storage tanks. No filtration or pH adjustment was necessary, and other than cooling to 20°C no special handling of the extract was required for storage. The factory lab monitored stored extract purity, pH and invert every two weeks to determine storage quality. Observations indicated that extract was a pH stable material that stored very well with only a slight increase in color over time (approximately 500 ICUMSA units). The stability of stored thick juice appeared be equal to or slightly better than thick juice when compared under similar storage conditions.

Thick extract was stored throughout the summer until mid August when the extract juice was brought into the factory to be processed during an extract juice campaign. The process of producing granulated sugar from thick juice and extract was the same and utilized normal sugar end equipment and procedures.

The most significant difference observed between extract and thick juice was color. Thick juice color averaged 1800 ICUMSA
units the last two juice runs, with extract being 4800 and 7100 for the extract runs of 1988 and 1989 respectively. Molasses feed syrup to the separator, from which the extract was generated, ranged in color from 32,200 to 46,800 ICUMSA units which indicated there was an 85% to 90% color elimination across the separator. The higher extract color profile extended through the sugar end to the final molasses and resulted in higher centrifugal wash water requirements, slightly higher standard liquor purities, lower daily white sugar production, higher white sugar color, and increased energy requirements on a therms per CWT basis. On the plus side, extract sugar produced was extremely low ash, .003 vs. .009 for thick juice sugar, and molasses purities approached those possible with a quentin ion exchange system because of the separator elimination of sodium and potassium salts and other melassigenic materials. Molasses produced during the extract juice campaign was discarded as a purge mechanism to rid the system of nonseparable nonsugars. Sugar boilers noted a slight reduction in pan boiling time when using extract standard liquor, and a reduction in fondant was required to maintain MA specifications.

Comparative information for the 1988 and 1989 thick juice and extract campaigns is listed in Table 1. This details the most significant variations observed between the processing of thick juice and extract.

There was some skepticism as to the processability of extract due to the words from research "No Problem - Trust Me!"
But what we found was that extract from the **Tasco Chromatographic Separator**:

1. Processed very comparably to thick juice.

2. Required no additional pre-treatment which maintained the environmental advantage of the separator through the final processing of its sugar rich extract stream.

3. Required no sugar end equipment modifications.

4. Allowed the separator to be utilized on a year round operational basis

*So... what is extract and what am I supposed to do with it?*

Extract is the sucrose rich fraction that results from the separation of molasses into its sucrose and non-sucrose components which in its concentrated form can be handled just like thick juice in the way it is stored, handled and processed.
<table>
<thead>
<tr>
<th></th>
<th>EXTRACT RUN</th>
<th>JUICE RUN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purity - Extract/Thick Juice</td>
<td>92.6</td>
<td>92.5</td>
</tr>
<tr>
<td>Purity - Standard Liquor</td>
<td>94.6</td>
<td>94.9</td>
</tr>
<tr>
<td>Brix - Extract/Thick Juice</td>
<td>68.9</td>
<td>68.4</td>
</tr>
<tr>
<td>pH - Extract/Thick Juice</td>
<td>9.1</td>
<td>9.6</td>
</tr>
<tr>
<td>Color - Extract/Thick Juice</td>
<td>4800</td>
<td>7100</td>
</tr>
<tr>
<td>ICUMSA units</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Color - Standard Liquor</td>
<td>4700</td>
<td>6100</td>
</tr>
<tr>
<td>ICUMSA units</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Color - White Sugar - RBU</td>
<td>32</td>
<td>35</td>
</tr>
<tr>
<td>% Ash - White Sugar Extract/Thick Juice</td>
<td>.003</td>
<td>.003</td>
</tr>
<tr>
<td>*1 Net Production - CWT/day</td>
<td>13230</td>
<td>13417</td>
</tr>
<tr>
<td>Extract/Thick Juice</td>
<td></td>
<td></td>
</tr>
<tr>
<td>*2 Purity - Molasses - AP/TP</td>
<td>52.10</td>
<td>52.72</td>
</tr>
<tr>
<td>Extract/Thick Juice</td>
<td>68.55</td>
<td>59.11</td>
</tr>
<tr>
<td>Therms - CWT Sugar Extract/Thick Juice</td>
<td>5.18</td>
<td>3.83</td>
</tr>
<tr>
<td>*3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wash Water - White Centrifugals Extract/Thick Juice - Seconds</td>
<td>18</td>
<td>24</td>
</tr>
<tr>
<td>Color - Molasses Feed to Separator - ICUMSA units</td>
<td>35100</td>
<td>47700</td>
</tr>
<tr>
<td>Color - Extract From Separator ICUMSA units</td>
<td>4800</td>
<td>7100</td>
</tr>
</tbody>
</table>

*1 Maximum production capability on a daily basis appears to be approximately 16,500 CWT for extract - 18,000 CWT/day for thick juice.

*2 Apparent purities based on pol are not meaningful due to concentrations of invert, raffinose, amino acids, and others that interfere with accurate indications of sucrose.

*3 Reflects short length of campaign, additional wash and lower production rate.
Chromatographic Separator Extract Processing

Or

What the heck is extract and what am I supposed to do with it?
Extract ?
No Problem - Trust Me!

Tom  Mike  Dennis  Kathy
**General Description of Separator Process**

- **Molasses** → **Extract (high purity recovered sugar)**
- **Water** → **Raffinate (low purity eliminated non-sugars)**
Factory Process Schematic

Campaign and Juice Run

Thin Juice Evaporator -> Thick Juice -> Thick Juice Storage

Separator

Extract Concentrator

Concentrated Extract -> Hl Melter

Sugar End

Product Sugar -> Molasses

Summer Extract Run

Concentrated Extract

Extract Juice Storage
<table>
<thead>
<tr>
<th>Year</th>
<th>ICUMSA Units</th>
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<tbody>
<tr>
<td>1988</td>
<td>4800</td>
</tr>
<tr>
<td>1989</td>
<td>7100</td>
</tr>
<tr>
<td>1988</td>
<td>1800</td>
</tr>
<tr>
<td>1989</td>
<td>1700</td>
</tr>
</tbody>
</table>

**Color**

### Extract

**Thick Juice**

- 1988: 4800
- 1989: 7100
- 1988: 1800
- 1989: 1700
Centrifugal Wash Water - Seconds

Extract White Sugar

Thick Juice White Sugar


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18 24 14 15

0 10 20

SECONDS
Extract Standard Liquor

Thick Juice Standard Liquor

ICUMSA UNITS


4700 6100 2300 2500

Color

409
Daily White Sugar Production - CWT

Thick Juice Sugar

Extract Sugar

CWT Per Day

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>CWT</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>16000</td>
<td></td>
<td></td>
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<tr>
<td>14000</td>
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<tr>
<td>12000</td>
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<tr>
<td>10000</td>
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<td>6000</td>
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<tr>
<td>4000</td>
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</tr>
<tr>
<td>2000</td>
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<tr>
<td>0</td>
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</tr>
</tbody>
</table>
White Sugar Color

Extract White Sugar

Thick Juice White Sugar

RBU


32 35 20 18

1988 1989
White Sugar % Ash

Thick Juice White Sugar

% Ash

Extract White Sugar


0.003  0.003  0.009  0.01

0.01

0.009

0.008

0.007

0.006

0.005

0.004

0.003

0.002

0.001

0
Molasses Purity

Extract

Thick Juice

A.P. / T.P.


68.55 63.78 62.49
52.1 59.11 59.1 55.3
2.72

60
50
CONCLUSIONS

Extract from the TASCO separator processed very comparably to thick juice.

No additional pre-treatment was required.

No equipment modifications were required.

This has allowed the separator to be utilized on a year round operational basis.