Control of Evaporator Scaling Through Application of Sodium Alginate Protection

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During the 1948 49 campaign the Nyssa factory conducted a campaign trial on sodium alginate scale inhibitor for its evaporators. That trial appears to have been blessed with some success so that this year the use of this protection was extended to the Nampa factory as well.

Two materials are purchased for the scale control from the Drew company, namely, evaporator concentrate and Amoroid APA-M. For addition to the juice the two items are combined together with water to give a single solution. The original recommendation was to add to the juice 3.5 parts per million, based on juice weight of each of these two materials. The addition of this solution to the juice during the 1948-49 campaign was at two points, half of it ahead of the first effect and the other half between the second and third effect.

The 1948-49 results indicated the protection was much more pronounced in the first three effects. In an attempt to carry this protection on down to the fourth and fifth effect an additional two parts per million of the straight evaporator concentrate is being added this year ahead of the fourth effect.

In setting up an evaluation of the benefits derived from this protection the comparison will be divided into two parts:

(a) The comparison covering the 1948-49 trial at Nyssa.
(b) The comparison covering the 1949-50 trial at Nampa.

Each of these trials will be seen to have its limitations. The Nyssa trial involved other simultaneous changes which had to be compensated for to arrive at a conclusion. The Nampa run is incomplete at the date of this writing.

(A) Comparison of results covering the 1948-49 trial at the Nyssa factory.

In setting up this comparison there exists the complication that Nyssa had a substantially lower lime salt content in juice during 1948-49 than for the 1947-48 campaign. This was the result of the introduction of the "Effective Alkalinity Control" for lime salts. Fortunately through the work on second carbonation studies being conducted at Nampa there was a similar condition of reduced lime salts there without the addition of sodium alginate, and through this data a correction for the reduction in boiling out attributable to lower lime salts can be made and the residue of boiling out reduction at Nyssa can then be credited to sodium alginate protection.

At Nampa during the 1948-49 campaign through close effective alkalinity control the average lime salts were 31.77% lower than for the 1947-48 campaign. As a result of this lower lime salt, the tons of beets sliced per evaporator body boiled was increased from 7,220 tons to 10,582 tons, an

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increase of 46.6%. From this it was established that a one percent decrease in lime salts would increase the beets sliced per evaporator boiled by 1.47%.

At Nyssa the lime salts for the 1948-49 campaign were reduced 24.6%, as compared to the 1947-48 campaign. Using the Nampa factor it would have been expected that the boiling out would have been reduced at Nyssa by 24.6 x 1.47 = 36.2% if no sodium alginate had been employed. Actually the tons of beets sliced per evaporator body boiled at Nyssa were increased from 9,069 tons in 1947-48 to 15,535 tons in 1948-49, an increase of 71.3%. We can, therefore, credit to sodium alginate an increased tonnage per body boiled of 35.1% or 3,183 tons per body boiled.

The detailed comparison of boiling out on the two campaigns is as follows:

Table 1.

	1948-49 Campaign	1947-48 Campaign
Tons beets sliced	512,651	544,164
Total bodies actually boiled	33	60
Bodies boiled corrected to 1948-49 tonnage		56.53

The following table shows the comparison of the number of bodies boiled for each effect for the two campaigns.

Table 2-

Effect	1947-48 Campaign (corrected to 1948-49 tonnage)	1948-49 Campaign
1	6.59	**2**
2	**11.31**	**3**
3	13.19	**7**
4	11.31	**10**
5	14.31	**11**

It was apparent from the above figures that the reduction in boiling was greater in the first bodies. To better illustrate this, the table below calculates the tons of beets sliced for each individual body for the two campaigns and the percentage of increase.

Table 3.

	Tons Beets Per Body Boiled		
Effect	1948-49	1947-48	% Increase
1	256,326	77,738	229.7
2	170,884	45,347	276.8
3	73,236	38,869	88.4
4	51,266	45,347	13.1
5	46,605	36,278	28.5

(B) Comparison of Results covering the 1949-50 trial at the Nampa Factory to January 18, 1950.

While the campaign has not been completed at the Nampa factory at the time of this writing, the figures there for last year and this year, to **the** date of January 18, can be compared directly without the complication of correcting for lime salt variation. The lime salts for the two campaigns were nearly identical as shown below:

Table 4.

Year	Total Bodies Boiled	To-Date Lime Salts Thin Juice	Tons Beets Sliced	Tons Beets Sliced Per Body Boiled
1948-49	42	.034	433,846	10,330
1949-50 **to Jan. 18**	**15**	.038	333,691	22,246

*Increase in tons sliced/body boiled r= 115.4%

The table below shows the comparative tonnage of beets sliced for each effect boiled last year without sodium alginate and this year with sodium alginate treatment.

Table 5.

Effect	Tons Beets Sliced per Body Boiled		
	1949-50 to Jan. 18	1948-49	% Increase
1	333,691 +	216,923	
2	333,691 +	114,615	
3	333,691 +	108,462	
4	111,230	36,154	207.7
5	27,808	20,659	34.6

As seen above, the sodium alginate treatment this year at the Nampa factory seems to be showing greater benefit than was calculated for last year at Nyssa. It also appears this year at Nampa that the extra addition of concentrate alone into effect number four may be carrying the protection through the fourth and fifth effect to better advantage.

This sodium alginate treatment acts as a protective colloid to prevent scaling. A protective colloid can inhibit crystallization by holding the scaling salts in solution in a supersaturated state. Originally some concern was held as to whether the protective colloid would be able to hold the scaling salts in solution for a certain length of time as the juice becomes progressively more concentrated and then would let them loose at some point, say in one of the final evaporator bodies or pans, and develop excessively heavy deposits at that point. The above figures indicate that this did not occur in the evaporators. Nyssa and Nampa report no evidence of increased scaling in the pans.

As for economic justification for this treatment, it is only possible to balance the cost of the alginate treatment against the saving in boiling out chemicals. No exact evaluation can be placed on the increased life of the evaporators or the reduced loss of tonnage during boiling out or the increased tonnage or brix due to averagely cleaner evaporators.

The following reduction in boiling out chemicals is calculated at Nyssa based upon the 1948-49 tonnage and the actual boiling chemicals listed by Nyssa as being used on that body. This was the saving in boiling out chemicals due to both lower lime salts and use of sodium alginate. Half of this total was found to be attributable to sodium alginate treatment.

Table 6.

Effect	Calculated	Saving			
	Reduction in Bodies Boiled	Drums Caustic	Sacks Soda Ash	Carboys Acid	Gallons Formaldehyde
1	4.59	4.59	55.08	68.85	68.85
2	8.31	8.31	99.72	116.34	66.48
3	6.19	6.19	49.52	49.52	24.76
4	1.31	1.31	10.48	7.86	3.93
5	3.13	3.13	25.04	18.78	9.39
Total		23.53	239.84	261.35	173.41

Total savings in dollars = $2,746.70
Saving credited to Sodium Alginate = $1,373.70

The cost of the sodium alginate treatment for the 156-day campaign at Nyssa was $2,246.40. On the basis of chemical costs above the treatment shows a deficit of $872.70. There are, of course, other items of cost to consider most of which are intangible and difficult to pin down. There are the benefits of average cleaner evaporators with the resulting increased evaporator capacity, the lessened chemical attack on the evaporators during acid boiling, and lessened loss of slicing capacity during boiling out.

There is no way to figure, on the Nyssa trial, the savings from less corrosion of evaporators or less tonnage sliced during boiling out. On the effect of average cleaner evaporators, however, we do have an indication of some benefit. For the 1948-49 campaign Nyssa sliced an average of eighty tons of beets more per day than for the 1947-48 campaign, and at a two point higher draft. In addition, the sugar in the beet was 0.53% lower in 1948-49 which resulted in 1.1 brix lower juice to evaporators. Under equal conditions this would have been expected to result in a lower brix of thick juice. Contrary to this, however, the brix of thick juice in 194849 was 1.5 higher than for 1947-48 (63.3 and 64.8 brix respectively) . This difference in brix represents 3.66 pounds less water in thick juice per one hundred pounds of solids which must be evaporated single effect in the pans. At Nyssa's evaporator ratio of 2.15 to 1.0 this would represent a steam saving of 1.96 pounds of steam per one hundred pounds of dissolved solids introduced. This would have represented a saving of approximately 22,000 pounds of steam per 24 hours. This saving, if correct, would easily put the sodium alginate treatment on the profit side. It was felt that the picture was sufficiently attractive to expand the trial to both the Nyssa and Nampa factories during the current campaign.