

THE AMALGAMATED SUGAR CO.  
IMPROVED FACTORY OPERATION  
THROUGH OPTIMIZED

JUICE  
PURIFICATION  
NYSSA, OREGON



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## EXPANDED FACTORY

The Nyssa Factory was expanded in 1987 from a 7,000 tons/day capacity to a new design capacity of 8,000 tons/day. This installation included a tower diffuser and new pulp pressing capacity, as well as improved juice purification. The change in juice purification equipment was comprised of a pre-limer, cold limer and hot limer. The Steffen's operation was discontinued and the excess factory capacity was used for increased beet slice.

## 1st YEAR OPERATION

The diffusion system is designed to produce cold raw juice in the 25-30°C range and the juice purification system as purchased was to accept the cold raw juice in the pre-limer. The juice would then continue on thru the cold limer and the limed juice from the cold limer would be heated to 85-90°C before entering the hot limer. The 1st carb, clarifier and 2nd carb would be operated as they have been in the past. With factory start-up, very slow mud settling was experienced in the tray type clarifier. Filtration was very difficult for the clarifier mud in the vacuum drum filters, as well as the juice in the 2nd carb filters. To counteract this problem, large quantities of settling aid were used at various application points. The raw juice sand trap and raw juice screens were bypassed and removed from service for bacteriological reasons. A plate heater was added to the system and the hot limer operating temperature adjusted. Raw juice temperature in the range of 40-45°C were tried following a recommendation by our supplier's process engineer. The clarifier which was originally installed for a 6,000 ton slice capacity was heavily loaded with mud prior to these alterations and it was perceived to be too small to allow for any sludge recirculation to the pre-limer. However, since none of the above mentioned changes had any noticeable impact on the poor settling characteristics of the mud, equipment was installed midway thru the 1987 campaign to recycle clarifier sludge to the third cell of the pre-limer. This change resulted in an acceptable settling rate in the clarifier. Late in the 1987 campaign, tower juice was piped into the cossette mixer inlet chute to raise the temperature to 50°C. The combination of sludge recycling to the pre-limer and a raw juice temperature

of 50°C, provided a significantly improved operation.

#### 1990 OPERATION (See Flow Diagram)

The evolution of the juice purification from 1987 to 1990 resulted in the operation as shown on the attached flow diagram. The flow diagram represents actual values for the 1990 Campaign as the system is operated. Heaters which have been used for limed juice, were reallocated for raw juice service and provide a 60-65°C temperature entering the prelimer. The sludge recycle has increased to 350-370 gallons per minute which represents a 50-55% recycle. The cold limer acts as a beet end surge tank and accepts not only the juice flow from the pre-limer, but excess sweet water, tank overflows and sump pump discharge. A very important function of the cold limer is to maintain a very uniform juice flow to the following steps of the process.

The hot limer typically operates at 90°C with the major portion of the milk of lime added when operating with good quality beets. As the beets deteriorate, milk of lime is reduced to the hot limer and increased in the 1st carb. Mud from the clarifier overflow is recirculated back to the pre-limer to enhance the juice quality and provide for improved settling in the clarifier. The flow diagram should be reviewed for details of the operation. However, two critical points for juice purification are:

1. Raw juice temperature to the pre-limer of at least 50°C, preferably 60-65°C.
2. Sludge recirculation with a minimum of 30%, preferably 50-55%.

#### OPERATING RESULTS

##### Non-Sugar Elimination (See Table 1)

The available CaO to the carb has improved from 175 tons/day to 236 tons/day, which has been crucial to the expanded capacity and was accomplished by work in 4 areas:

1. Clean, properly sized coke and rock.
2. Increased CO<sub>2</sub> compressor capacity.
3. Computer based lime kiln control system.
4. Use of sodium chloride.

Non-sugars entering the factory increased from 170 tons/day to 235 tons/day with the increased slice rate. Non-sugars leaving the factory in the molasses increased from 122 tons/day to 147 tons/day with greater thru-put. The most significant change however is in the non-sugars eliminated in the carb which was 48 tons/day in 1986 and increased to 63 tons/day in 1987 in spite of difficulties in the new juice purification system. In 1990 carb elimination increased to 88 tons of non-sugars a day. The percent non-sugar elimination in carb went from 28.2% a day in the old system to 37.4% during the 1990 campaign, which represents excellent results.

#### Purity Improvement (Table 2)

The factory operated at an average slice rate of 7,022 tons/day in 1986 which was the last campaign with the old juice purification system and the first without Steffen's operation. During the first year of expanded operations, the design capacity of 8,000 tons/day was exceeded by 93 tons/day. During the 1990 campaign, the average slice rate had increased to 9,165 tons/day without any major changes in process equipment. The diffusion juice apparent purities are shown and are influenced primarily by beet quality. The purity increased across the juice purification system has shown significant improvement from 2.8 in 1986 to 4.3 in 1990. The juice purification non-sugar elimination expressed as a percent in beets increase by 44% (1986-1990).

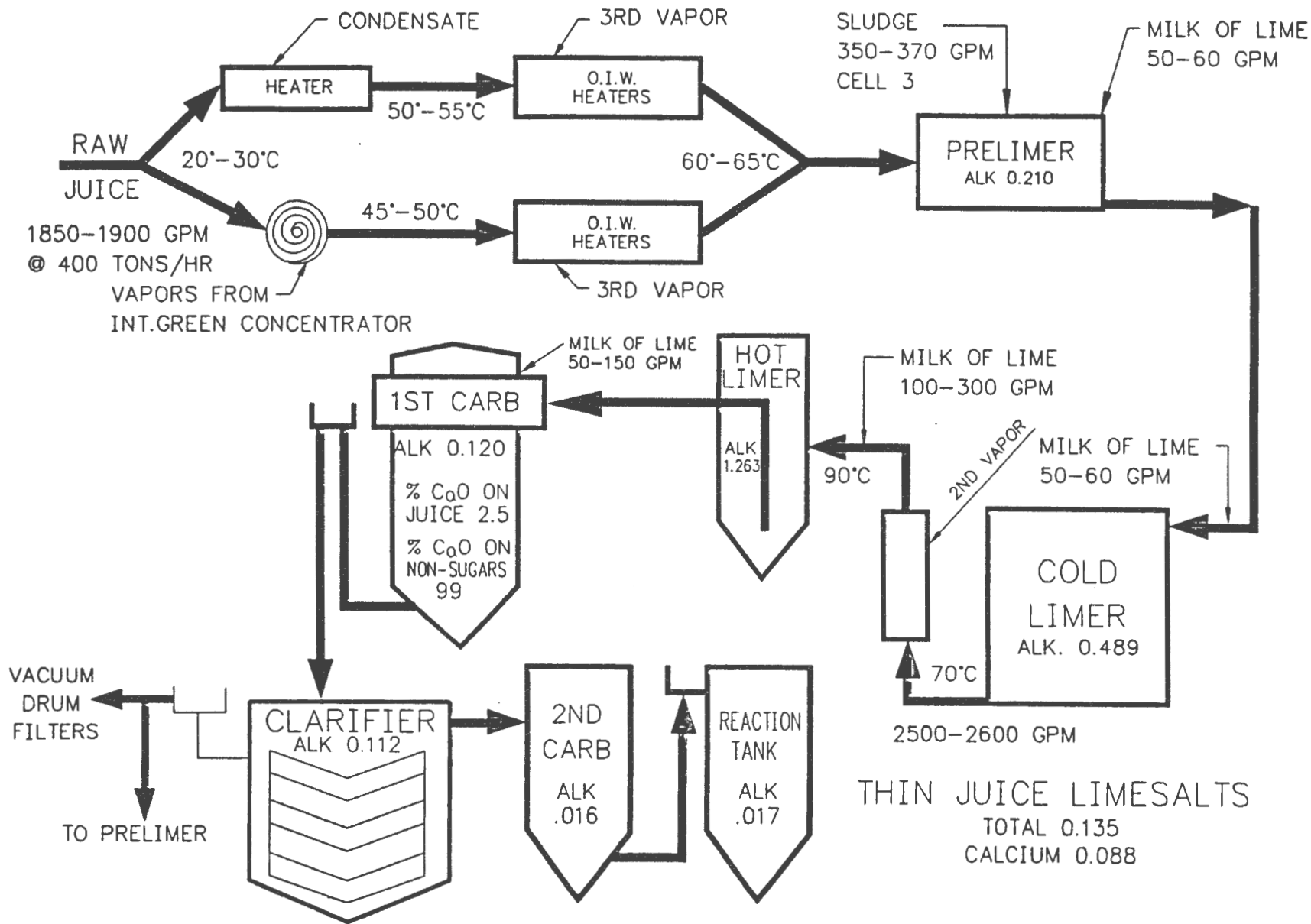
#### SUMMARY

We had thought prior to the installation of the pre-limer, cold limer and hot limer that our juice clarifier was too small and would require replacement filters. The first half of the 1987 campaign certainly supported that contention. However, with our current operation, the replacement of the clarifier is not necessary and could not be financially justified.

As the system is now operated, the juice clarifier is so stable that it is very difficult to cloud the trays. The 1st carb was operated for several days without a circulator, due to a broken shaft and acceptable settling was obtained.

We have found that the very consistent operation through the 1st carb is more important to low lime salts than 2nd carb alkalinity.

The juice purification improvements have been a key factor in Nyssa Factory's improved operation and slicing performance. A 27% increase in beet slicing performance has been achieved without significant process equipment changes downstream of the juice purification.



FLOW DIAGRAM

## NONSUGAR ELIMINATION

	1986	1987	1988	1989	1990 1/28/91
TONS AVAILABLE CaO TO CARB/DAY	175	190	215	234	236
TONS NONSUGARS ENTERING FACTORY/DAY	170	201	215	226	235
TONS NONSUGARS LEAVING FACTORY/DAY	122	138	143	144	147
TONS NONSUGARS ELIMINATED IN CARB/DAY	48	63	72	82	88
PERCENT NONSUGAR ELIMINATION IN CARB	28.2	31.2	33.5	36.3	37.4

TABLE 1

## PURITY IMPROVEMENT

	1986	1987	1988	1989	1990 1/28/91
TONS BEET SLICED (AVERAGE PER DAY)	7,222	8,093	8,677	9,044	9,165
DIFFUSION JUICE (APPARENT PURITY)	86.5	86.6	86.5	85.9	84.8
THIN JUICE (APPARENT PURITY)	89.3	89.6	90.0	90.3	89.1
PURITY INCREASE	2.8	3.0	3.5	4.4	4.3
(NEW DIFFUSER & JUICE PURIFICATION INSTALLED 1987)					

TABLE 2