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THIN JUICE SOFTENING
USING
THE GRYLLUS PROCESS

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THIN JUICE SOFTENING USING THE GRYLLUS PROCESS

Thin juice softening was installed in the Spreckels Sugar Manteca factory during the Winter of 1989. A brief background of the factory will provide some insight into the decision to use thin juice softening. The evaporator station uses a 5-effect system that consists of 8 separate bodies. Historically, one body was boiled out every day. A treatment program was started in 1983 utilizing antiscalents which extended the boilout frequency to every third day. However, with an average thin juice limesalts of .250% CaO on solids, antiscalents could not economically eliminate the need for evaporator boilouts. In 1986 we began investigating the application of ion exchange technology as a solution to this dilemma.

Evaluating thin juice softening for this factory in California required recognition of two factors: high lime salts and sensitivity for environmental issues. The Gryllus Process is ideally suited to these conditions for the following reasons:

1. There are no regenerant chemicals to be purchased. This can be a significant expense for high limesalt conditions.

2. There are no waste streams to be disposed of.

3. Current chemical usage is reduced by eliminating the purchase of antiscalents and greatly reducing boilout chemical requirements.

4. Reducing boilouts will reduce acid corrosion of the evaporator body, tubes and valves. This will lead to savings in repair and maintenance.

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THIN JUICE SOFTENING/GRYLLUS PROCESS (cont.):

5. No water is used to sweeten off for regeneration, so no additional steam demands are added to the factory.

6. Regeneration with intermediate machine syrup returns the syrup to the same calcium concentration of unsoftened syrup so there is no increase in melassigenic potential for the molasses produced.

7. Softening provides improved evaporator efficiency reported by Applexion to save 44 pounds of steam per ton of beets sliced.

These benefits calculated an 87% return on investment as justification for the project.

In order to ensure the successful integration of this process into the factory, we contracted with Applexion to provide the engineering and technical support. Applexion is an ion exchange company with Gryllus installations in service in Europe.

The Gryllus Process sounds a lot like a perpetual motion machine: using the syrup from the softened juice to regenerate the resin. The driving force that makes this possible is concentration. At low concentration the resin selectivity favors calcium, but as concentration increases this selectivity is reduced. In other words, the attraction for sodium and potassium increases with increasing concentration. Evaporation and crystallization effectively concentrate the sodium and potassium to eight times its original concentration, allowing regeneration with machine syrup to take advantage of this change in selectivity.

Integration of this system into the process is simple. Two three-way valves, one on thin juice and one on machine syrup are all that is required to bypass the softening system for start-up, shutdown, or maintenance **(Attachment 1)**.

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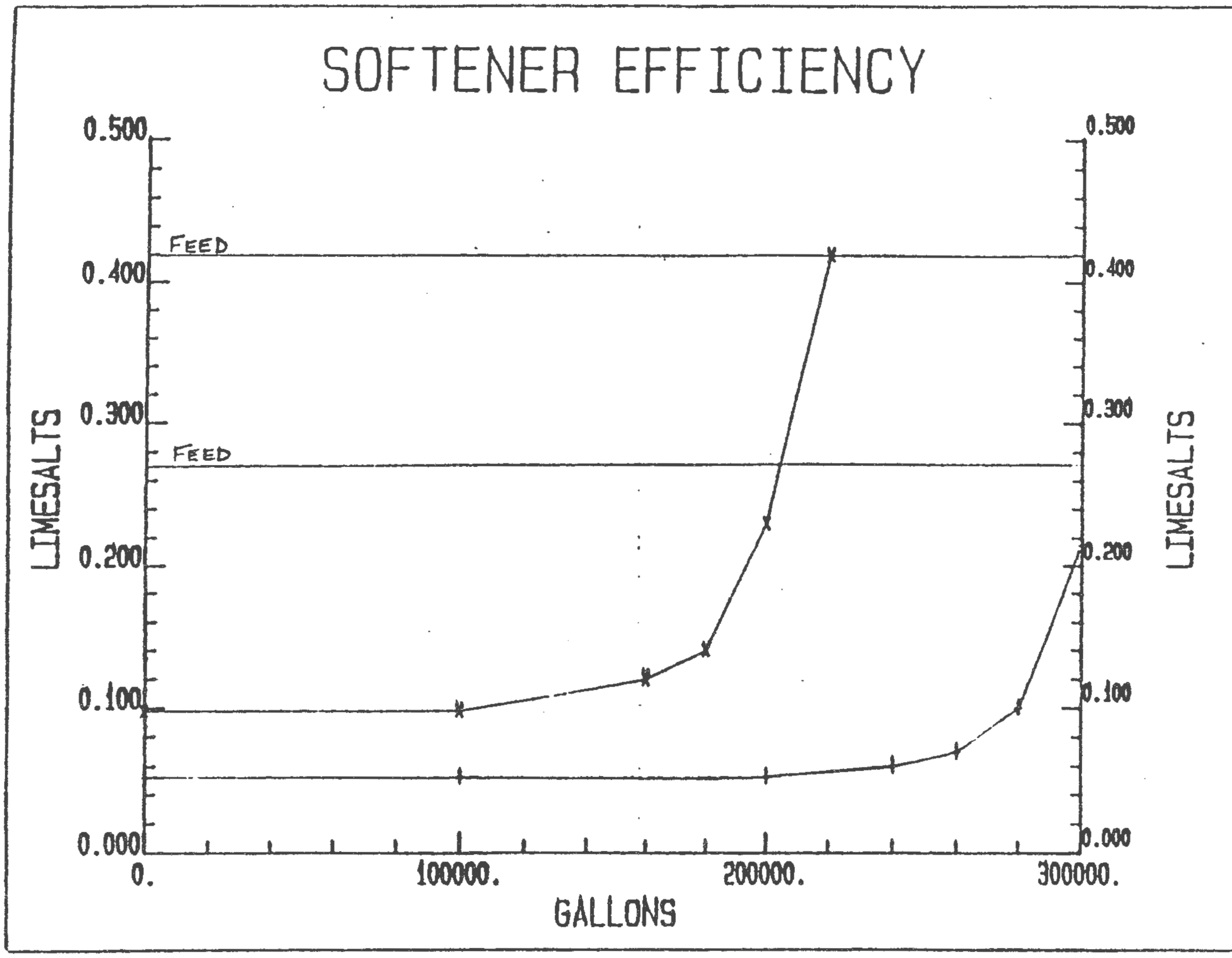
THIN JUICE SOFTENING/GRYLLUS PROCESS (cont.):

In theory, the Gryllus Process can remove 90% of the calcium from thin juice. Our operational experience has shown about 80% deliming.



Operational resin capacity is about 0.7 equivalents/liter. Proper sizing of the softening system is very important. We chose a two vessel system, to operate with one unit in service while the other regenerates. Other possible configurations that may be considered in sizing a system use three vessels with two in service in either parallel or series configuration. With two vessels, the minimum service life must equal the time it takes to complete a regeneration **(Attachment 2)**. Sizing needs to allow for the highest level of limesalts that could be expected. When processing degraded beets that produce higher than anticipated limesalts, cycles must be shortened and it can become necessary to bypass juice around the softeners while waiting for a regeneration to finish. Our factory has faced this condition the last couple

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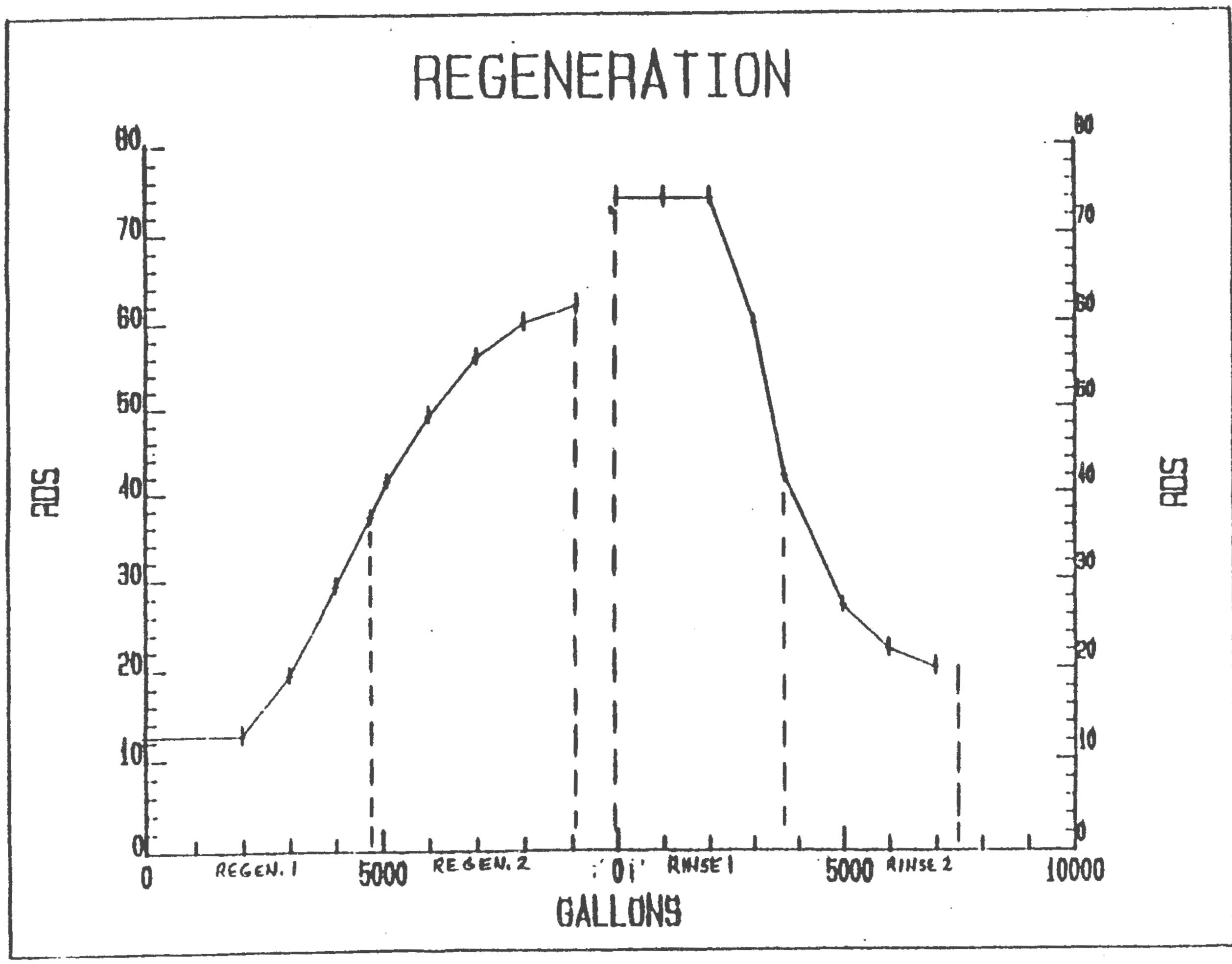
of campaigns, yet in spite of times with incomplete softening, significant gains have been shown in chemical savings and in process energy utilization.

In one year of operation a direct savings of $107,000 was made in operating chemicals. Energy savings are not easy to quantitate because of process dynamics. Optimization generally means running at capacity, so improved evaporator performance will translate to increased slice or better utilization of downstream vapors. Manteca now produces stable vapor pressures, allowing third vapor pan boiling. Reduced scaling has extended past evaporation to allow heating of melters with 2nd vapors rather than exhaust steam and diffuser heating to be shifted from 2nd vapor to 3rd vapor.

One feature of the Gryllus Process requires careful tuning to avoid process complications: Use of intermediate machine syrup for regeneration results in a mixed phase with thin juice during sweetening-off and sweetening-on.



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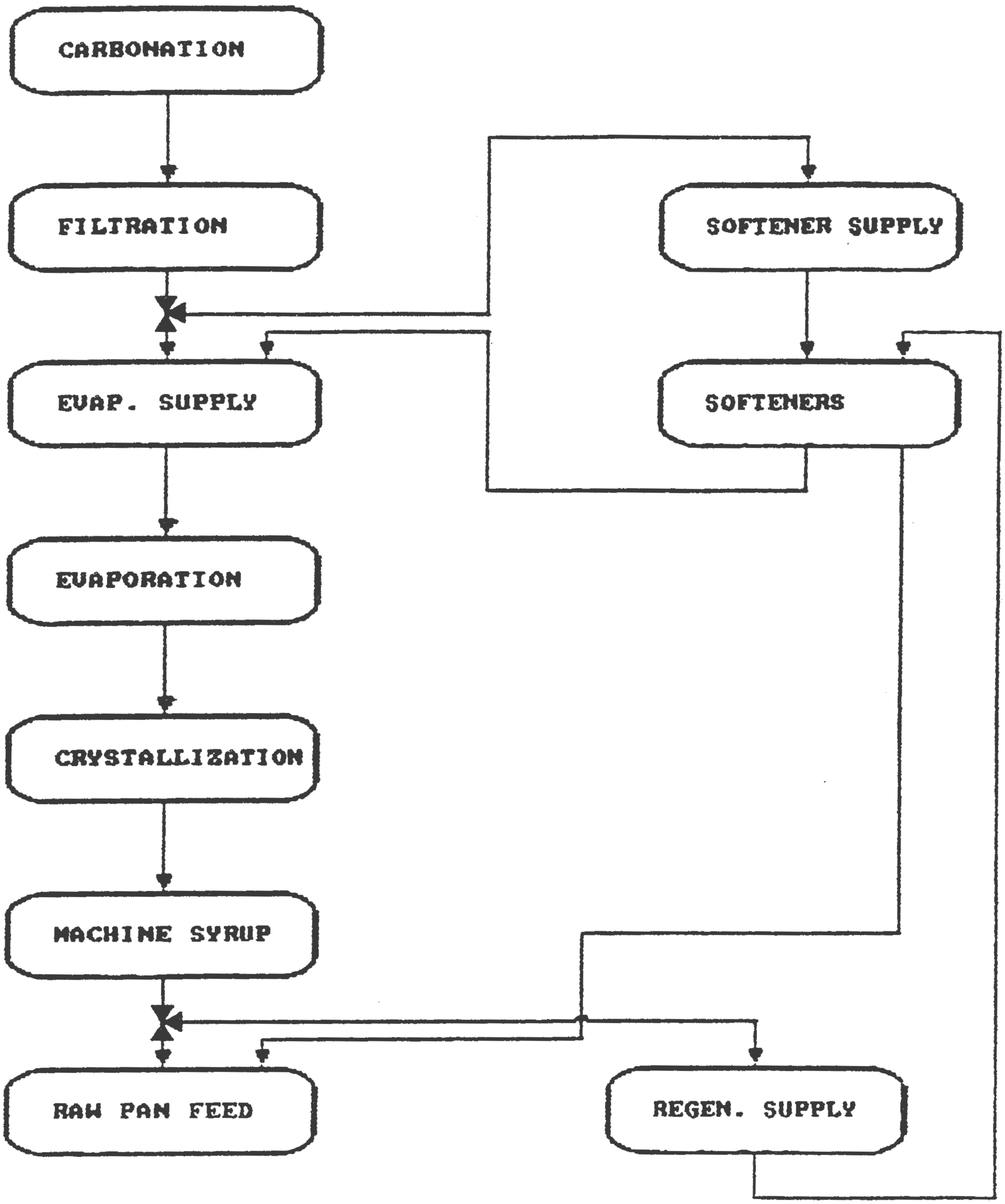
THIN JUICE SOFTENING/GRYLLUS PROCESS (cont.):

Tuning requires adjusting what proportion of this high color, intermediate brix material should be recycled to carbonation and what proportion can be returned to the raw boiling. Adjustments can be made to the regeneration profile to support process concerns such as color, purity and raw side capacity.

In summary, thin juice softening using the Gryllus Process was chosen as the most cost effective solution to the evaporator scaling problem at the Manteca factory. During its two years in service, the softening system has proven its ability to provide chemical savings and has supported energy-saving changes in steam utilization. An automated control system and the simplicity of its operating principle allowed it to be readily received by the factory personnel. Continued benefits in maintenance of factory equipment are expected as intercampaign crews are observing significantly less scaling in process equipment.

GRYLLUS JUICE SOFTENING



SPRECKELS SUGAR
SEQUENTIAL

Resin volume : 12 m3
Diameter : 3 178 mm

13.09.1988

N°	SEQUENCE	PRODUCT IN	PRODUCT OUT	VOLUME IN Gal.	VOLUME IN m3	VOLUME OUT Gal	VOLUME OUT m3	FLOW Gal/mn	FLOW m3/h	TIME (mn)
1	RUN	Hard thin juice	Soft thin juice	348 700	1 320	348 700	1 320	900	204	307
2	PARTIAL EMPTYING	Air 65 psi (4.5 b)	Soft thin juice					900	204	3
3	TO ATMOSPHERE		Air (vent)							1
4	AIR SCOURING A	Air 12 psi (0.8 b)	Air (vent)					1 700	400	5
5	REGENERATION A	Low green 75 brix 65 °C	To second carbo.	4 750	18	3 430	13	125	28.5	30
6	REGENERATION B	Low green 75 brix 65 °C	Low green to cristallization	4 650	17.5	3 720	14	125	28.5	37
7	PARTIAL EMPTYING	Air 65 psi (4.5 b)	Low green to cristallization			2 250	8.5	125	28.5	18
8	RINSING A	Hard thin juice	Low green to cristallization	3 700	14	2 380	9	125	28.5	29
9	RINSING B	Hard thin juice	To second carbo.	3 700	14	3 300	12.5	125	28.5	30
10	PARTIAL EMPTYING	Air 65 psi (4.5 b)	To second carbo.			1 720	6.5	125	28.5	14
11	TO ATMOSPHERE		Air (vent)							
12	AIR SCOURING B	Air 12 psi (0.8 b)	Air (vent)					1 700	400	5
13	BACKWASHING A	Hard thin juice	To second filtration	5 830	21	2 900	11	530	120	11
14	WAITING									
15	BACKWASHING B	Hard thin juice	To second filtration	1 590	5.5	1 590	5.5	530	120	3

ATTACHMENT 2