The Improvement in First Carbonation Station Operations at Moorhead, Minnesota

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At the Moorhead factory, which has now operated four campaigns, we have the conventional continuous first carbonation station as furnished under the Dorr patents at the time the plant was built.

Ever since the termination of the first campaign in 1948 we have felt that there was a large field for improvements of the juice as it was leaving the Dorr thickener, in regard to color and non-sugars, and for the bettering of the results at the first carbonation filtration station.

We have at Moorhead a continuous Silver diffuser of the chain and basket type in which the retention time for cossettes is relatively high. This long retention time may have been a contributory cause for the rather dark juices resulting from the first carbonation when it was carried out in the usual manner.

In order to improve the juice color and the settling rate, we considered a change in the recirculation ratio. We found, however, that when making a change in either way from the usual 750 to 900 percent recirculation a poorer settling of the sludge resulted and the filtration of the juices became difficult, so any thought of changing the ratio was abandoned. It is generally agreed that a recirculation ratio of 7.5 to 10.0 should be maintained and that more harm will result from lowering the ratio than from increasing it.

Another possibility for improving the color of the juices was in lowering the retention time in first carbonation. It is generally conceded that the optimum retention time is about 20 minutes, with about 11 minutes in the primary tank and 9 minutes in the secondary tank, whereas at Moorhead we had a total retention time of approximately 31 minutes. The most feasible way to cut the retention time was to lower the circulating line between the tanks, thereby cutting down the volume capacity of the tanks. Due to physical obstructions, however, it was impossible to lower the mentioned circulating line appreciably.

Consideration was next given to certain changes within the carbonation tanks. In the secondary tank there is a vent pipe leading from the center of the deflector over the juice outlet to above the circular baffle plates in this tank. It would seem possible that the newly limed juice from the overflow from the primary tank could short circuit through the vent pipe to the juice outlet, thus causing some under-carbonated juice to be discharged to the Dorr tank. In order to check on this possibility, we closed the vent line on one of the secondary tanks, while the other secondary tank remained unchanged with the vent open. We have operated with and without the vent pipe open for two campaigns, alternating between the secondary tanks as it became necessary to change them and no special difference has shown up.

In order to prevent channeling of the juice between the inlet in the bottom of the primary tank and the circulating line to the secondary tank, we installed a perforated baffle plate of approximately 5 feet diameter

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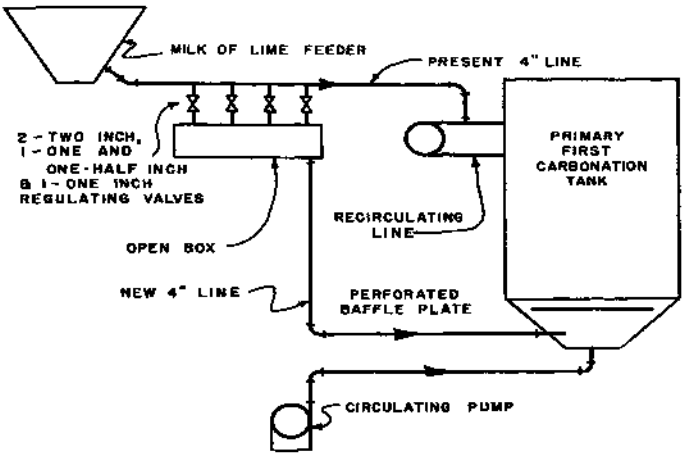

MILK OF LIME TO FIRST CARBONATION- MOORHEAD

horizontally in the center of the tank at about the height where the bottom cone joins the walls of the tank. This disperses the juice and gives a much more evenly distributed flow of the juice through the primary tank.

During the first two campaigns of operation the alkalinity of the primary tank proved to be substantially lower than the alkalinity of the secondary tank, which is in agreement with the fact that all the raw juice enters carbonation at the bottom of the primary tank together with the recirculating juice from the secondary tank. It was our thought, however, that the difference in the alkalinity between the two tanks was too great and for that reason we decided to add a small amount of lime to the primary tank.

As we did not know just how much lime was needed, we arranged a manifold take-off from the regular lime feed line with 3/4 inch, 1 inch, $1^{1/2}$ inch and 2 inch valves. These valves all discharge into a funnel attached to a 4 inch line leading to the bottom of the primary tank. With this arrangement of multiple valves it was possible to obtain a considerable range and a fairly close control in the lime addition.

We proceeded cautiously with the lime addition and observed that with fresh beets and with the 3/4 inch valve open we would obtain an alkalinity in the primary tank slightly under the alkalinity in the secondary tank and that at this point we would get the fastest settling rate, the clearest juice, and the best filtration on the first carbonation filters. After some experimentation, we arrived at a figure of .005 alkalinity below the secondary tank as the proper place to maintain the alkalinity in the primary tank.

The following table gives our operating results for the first four years,

Table 1.

	Alkalinities		Soda Ash		Lime Salts	
	1st press	**2nd** press	**Addition per ton beets**	**Second Press Juice**	**Evap. Thin Juice**	**First Liquor**
1948	.089	.022	**.72**	.095	.084	
1949	.104	.022	**.98**	.103	.066	.035
1950	.102	.027	**.60**	**.060**	.046	.029
1951	.077	022	**.22**	**.060**	.036	**.018**

the first two without split lime addition, and the last two with split lime addition. The results would show an improvement in the lime salts, which have decreased considerably in spite of a decrease in the soda addition. Improvement in the filtering and washing qualities of the lime sludge was indicated by the decrease in requirement of wash water—percent on cake while maintaining substantially the same losses.

Table 2.

	Press Wash Water on Cake	Press losses % Sugar on Beets
1948	128	.10
1949	96	.04
1950	90	.05
1951	80	.04

In the reviewing of the tabular date above, we realize that there can be many other contributing factors which may have improved our operating conditions, but it is felt that the split lime addition has been a contributing factor in improving our local operating conditions.

Table 3.

First Carbonation Station Equipment

1—Primary tank 11'—0" diameter x 13'—9" above gas distributor—overall height 29'—7" total capacity 11,750 gal.

2—Primary tanks 11'—0" diameter x 29'—7" overall height. Juice level 20'—6" total capacity gallons 13,000.

Note: (Only one secondary tank is used at a time) 3'—6" difference in head between the two tanks.

1—Byron Jackson pump 5,000 GPM at 11 ft. head

700 GPM juice flow gives recirculation ratio of 7.5 to 8.