The Oliver Morton Battery

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The early background of the Oliver Morton battery began in 1935 at our Manteca factory.

During the 1935 campaign we began an investigation of continuous diffusion. Our Mr. Winslow was in charge of the work and one of his helpers was Mr. Morton. This formal investigation was more or less discontinued after one year, but the principles developed in this work continued to fascinate Morton, and on his own time he continued to work on the idea of a continuous battery. In 1947 he convinced the Oliver Filter Company that he had a practical solution, and they entered into an agreement to develop it. During the 1948 campaign a small pilot size continuous battery, consisting of 12 cells, was installed for test purposes at our Woodland factory.

In description, the Morton battery is a series of "U"-shaped tanks set on a slope. Each cell is equipped with a scroll to convey the cossettes through the tank. On the discharge end of the scroll is a lifting device for transferring the cossettes to the next higher cell. The transfer mechanism consists of banks of fingers, attached to the rotating shaft, which pass through stationary grid bars. In the end of each cell, adjacent to the transfer mechanism, is a screen for separating the juice from the cossettes. Thus, the cossettes go from cell to cell up the slope and the water flows from cell to cell down the slope. In principle, the Morton battery is a series of tanks connected to allow a flow of juice and in which the cossettes are immersed, drained, and moved up to the next cell counter-current to the flow of juice.

The cells of the pilot unit were 4 ft. in diameter ("U" section) and 8 ft. long. The unit of 12 cells was operated throughout the 1948 campaign, and many series of tests with rates as high as 700 tons per day were made.

From the results of these tests it was our opinion that the Morton battery was a practical continuous battery. Mechanically it was simple and the rate of diffusion appeared to be satisfactory.

On the strength of the pilot plant test, Spreckels Sugar Company contracted for two commercial-sized batteries, which were installed for the 1949 campaign. One was a 24-cell unit installed at the Woodland factory and the other a 28-cell unit installed at the Salinas factory.

The cells in each unit were the same, except that the number of cells was different. They were 7 ft. in diameter ("U" section) and $12^1/_2$ *ft long-* Each cell contains approximately 400 cu. ft. at the working level. Except for the screens in the first 6 cells, which were Everdur, the construction was all steel. Twelve of the cells in the Woodland battery (Nos. 1, 2, 3, 4, 5, 6, 10, 14, 18, 22, 23, 24) and thirteen of the cells in the Salinas battery (Nos. 1, 2, 3, 4, 5, 6, 10, 14, 18, 22, 26, 27, 28) were equipped with steam jackets to supply the heat. Both batteries were fed by means of a weightometer belt. The rate of cossette feed was controlled by varying the rotating speed of the cutters.

[1] Spreckels Sugar Company.

Two cell units were driven by one motor. The speed of the motors was varied by varying the cycle frequency.

By means of ratio controllers it was possible to have the weight of beets on the belt control the speed of rotation of the cells and the rate of water addition.

In the design of the factory-sized installations we planned about a

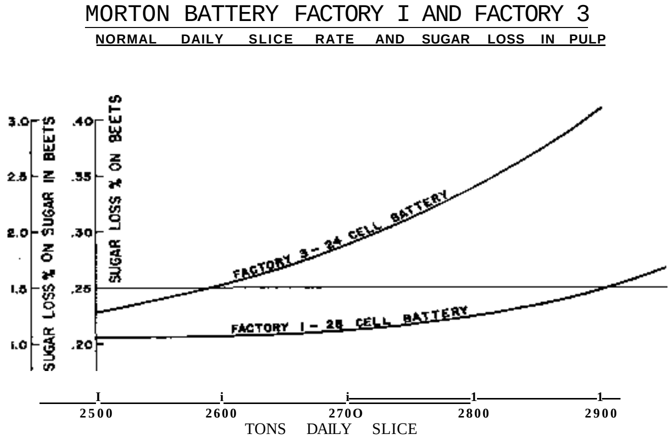

Figure 1.

2,700-ton-per-day capacity at Woodland and about 3,000 tons per day at Salinas.

It takes good estimates and also some good luck to go from the design of a pilot plant size to commercial size and although we had good pilot plant testing, we miscalculated a few points in the factory size. Consequently we had some growing pains during the first year's operation.

At a rate of 2,000 tons per day or perhaps slightly more, and with a draft up to 130, operation was quite good.

However, this was below the capacity needed and we tried continually to operate to the capacity of the house, which was about 2,700 tons for Woodland and 3,000 tons for Salinas, and when we tried to operate at these capacities we began to have trouble.

First, the connections between the cells for juice flow were not large enough to allow sufficient draft. At the desired slice rates a draft of from 115 to 117 was as much as the juice lines would carry.

Second, when we crowded the slicing rate the screens began to blind, and this was our most difficult problem. The blinding was apparently not due to obstruction in the screen perforations, but rather a layer of cossettes held flat against the screen.

We made several minor mechanical changes which improved the operation appreciably and there were more that we would have liked to have made, but the pressure of the campaign would not permit a shutdown for such alterations.

While during this first operating season we cannot say that we solved the problem of screen blinding at slicing rates in the neighborhood of 2,700 tons, we do think this difficulty can be corrected. After another campaign we shall know the possibilities better.

Total beets processed through the Woodland battery were 295,172 tons at an average daily rate of 2,419 tons.

Total beets processed through the Salinas battery were 268,823 tons at a daily average of 2,512 tons.

In Figure 1 two curves are shown, which are plotted from operating data as sugar loss against rate of slice. The draft was for practical purposes constant, varying only from approximately 120 at the lower rates to 117 at the higher rates. These curves do not show slicing rates below 2,500 tons. For the limited number of days that we operated at about 2,000 tons (this was at the Woodland plant) the pulp loss averaged .14 with 125 draft.

During the first 75 days of the campaign, or up until the first rains, there was no noticeable dip in the pH curve through the battery. Normally the water cell was about 8.9 pH and the raw juice was about 6.0 pH. After the rains, however, there appeared at times a dip to about 5.5 pH, running from as high as No. 20 cell to as low as No. 8 cell. At such times we used formaldehyde. Such use was not excessive, however, as we used a total of only 235 gallons at the Woodland factory and about 90 gallons at the Salinas factory.

All cells which operated normally at a pH under 7 showed some corrosion. The cells with the lower pH showed the greater amount and for the most part it was in the areas which were scrubbed by the travel of the cossettes. Apparently any protective oxide was abraded off by the continual wiping action of the cossettes and this gave a clean bright surface upon which the low pH juice acted. The only exception to this was the area covered by the steam chest on the first few cells. Here the heat caused a coagulation and a typical raw juice scale formed on the heating surface. It was quite thin and never built up enough to be noticeable to the heat transfer.

The Everdur screens in the first six cells were not attacked nor were the stainless steel cap screws used in the construction of the transfer mechanism.

Generally speaking, even with the troublesome growing pains experienced this first year, we are enthusiastic about the possibilities of the Oliver-Morton battery.