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SPECIFIC GRAVITY POTATO SEPARATOR

By I. J. PFLUG, M. W. BRANDT and D. R. ISLEIB

DEPARTMENTS OF AGRICULTURAL ENGINEERING AND FARM CROPS

THE ADVANTAGES of separating potatoes into high and low specific gravity fractions has been summarized by Heinze Kirkpatrick and Dochterman (1955) who state that high specific gravity in culinary potatoes is closely associated with a lack of sloughing, dryness, and mealiness, and to a lesser extent with flavor and color.

In potatoes for the chipping industry, it is possible to produce more uniform chips by specific gravity grading prior to chipping. High specific gravity potatoes according to Kunkel, Gifford, Edgar and Binkley (1952) and Smith (1954) give higher yields of chips with lower fat absorption. To date the potato industry has not made extensive use of this grading tool.

A project co-operative with industry was set up to study the problems of specific gravity separation of potatoes. Points to be investigated in this study were: (1) Effect of separation on potato chip quality, (2) behavior of separated potatoes in storage and (3) the reaction of Michigan consumers to separated potatoes. The construction of a machine that would accurately separate potatoes in quantity was essential for these studies.

DESCRIPTION OF MACHINE

The specific gravity separator designed for this project consisted of a separating tank, a reservoir tank, two conveyors and a circulating pump (Fig. 1). The unit was designed to use sodium chloride brine as the separating medium. The separating tank was 12 feet long, 2 feet wide and 2 feet deep, and was divided into three sections by steel plates located 8 inches from the ends to make a stilling brine entry section, a separating section and a discharge section.

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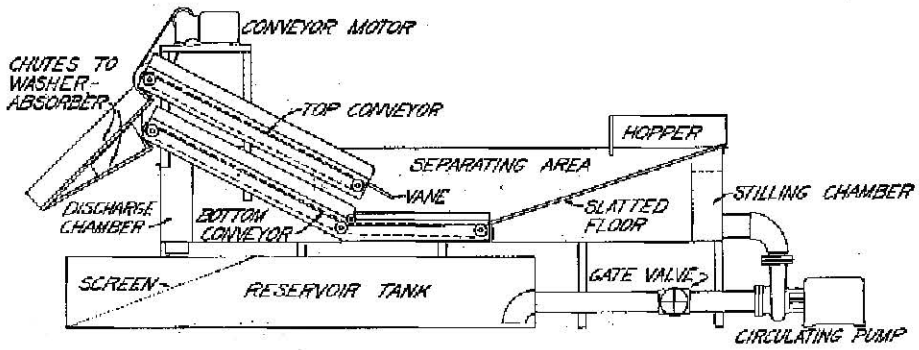

Fig. 1. Cross-section of specific gravity separator showing important parts.

The tank was constructed of 10 gauge steel and mounted on legs so the top was 46 inches above the floor. The plate at the discharge end of the separating section functions as a rectangular weir without end contractions. The plate at the inlet end of the separator, in addition to forming a stilling chamber for reducing the turbulence of the incoming brine, also serves to retain the brine depth in the tank when the pump is not operating. Two 6-inch pipe nipples were welded to the bottom of the outlet section to eliminate excessive splashing as the brine flowed into the reservoir tank.

The reservoir tank was 10 feet long, 23 inches wide and 18 inches deep, and was also constructed of 10 gauge steel. The reservoir tank was located below but was not an integral part of the separating tank. The reservoir tank was extended 2 feet beyond the separating tank, so the screen that restrains sprouts, dirt and other foreign material from recirculating with the brine can be easily cleaned.

Potato elevator chains five-sixteenths of an inch in diameter and 21 inches wide were used for the conveyors which have a slope of 2 to 1. Flights consisting of five-sixteenths of an inch, U-shaped steel bars 18 inches wide were welded to the conveyor links at about 1 foot intervals (Fig. 2). This size and type of flight was necessary to elevate the potatoes in a positive manner without creating an excessive amount of turbulence.

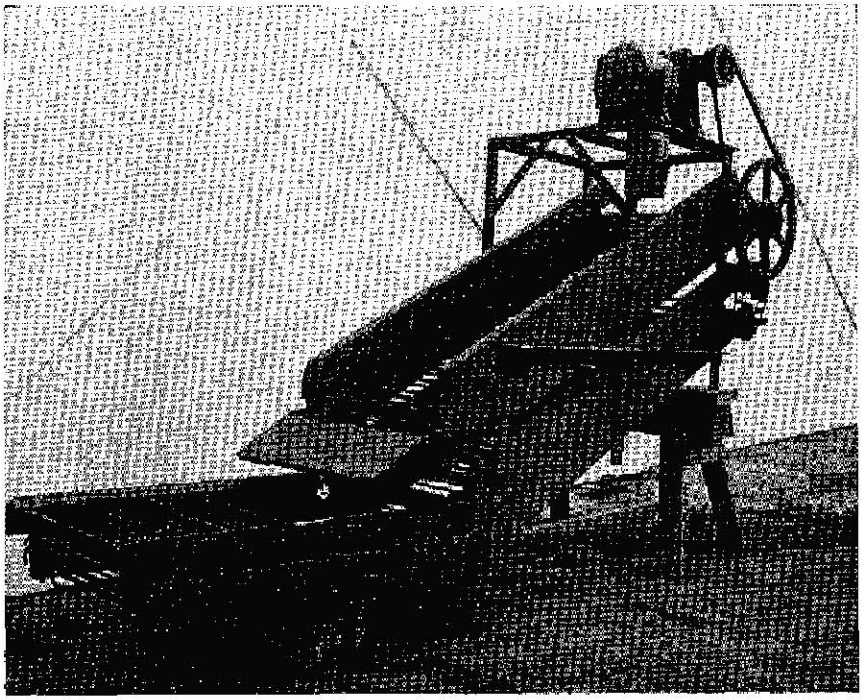

Fig. 2. Conveyor unit of specific gravity separator. The construction of this part of the machine as a removable unit makes it easy to clean the separating tank. The flights on the conveyors are spaced about one foot apart.

The lower conveyor has a 3-foot horizontal extension that rests on the bottom of the tank to assist the sinkers in moving through the machine. The conveyors are driven at the rate of 40 feet per minute by a single one-half horsepower electric motor with integral gear reducer. An inclined slatted wood floor consisting of 1-inch by 2½-inch-wide slats spaced a quarter of an inch apart extends from the lower end of the bottom conveyor to the top of the inlet end of the separating tank; this slatted floor further reduces turbulence in the brine as well as serving as a support on which to dump the potatoes (Fig. 1).

The flow through the slots is sufficient to move the sinkers or high specific gravity potatoes down the sloped floor to the end of the horizontal section of the bottom conveyor. A rectangular box, attached to the upper end of the slatted floor and resting on the top edge of the separator, guides the potatoes as they enter the separating tank and helps to eliminate most of the splash as the potatoes enter the brine (Fig. 1). A 1-inch by 8-inch vane mounted at the lower

end of the top conveyor permits the flow to the upper and lower conveyor to be adjusted so sinking potatoes are not carried up to the top conveyor nor floaters carried down to the lower conveyor.

The centrifugal pump that circulates the brine has a maximum capacity of 500 g.p.m. A gate valve was installed in the suction line of the pump to regulate the rate of flow through the machine. A rate of flow of 200 g.p.m. was found to be optimum in respect to capacity and degree of separation.

DISCUSSION OF OPERATION

The final design of the specific gravity separator performed in an excellent manner. Potatoes were continuously fed into the machine from a preliminary grader which removed dirt and "B" grade potatoes (Fig. 3). The potatoes were moved from the receiving box of the separator into the machine by the brine current.

The floating potatoes were carried through the machine by the brine until they reached the upper conveyor which lifted them out and delivered them to a chute which directed them to the right side of the 30-inch Bean Model 30-18LR washer-absorber that was fitted with a dividing board to keep the high and low specific gravity potatoes separated.

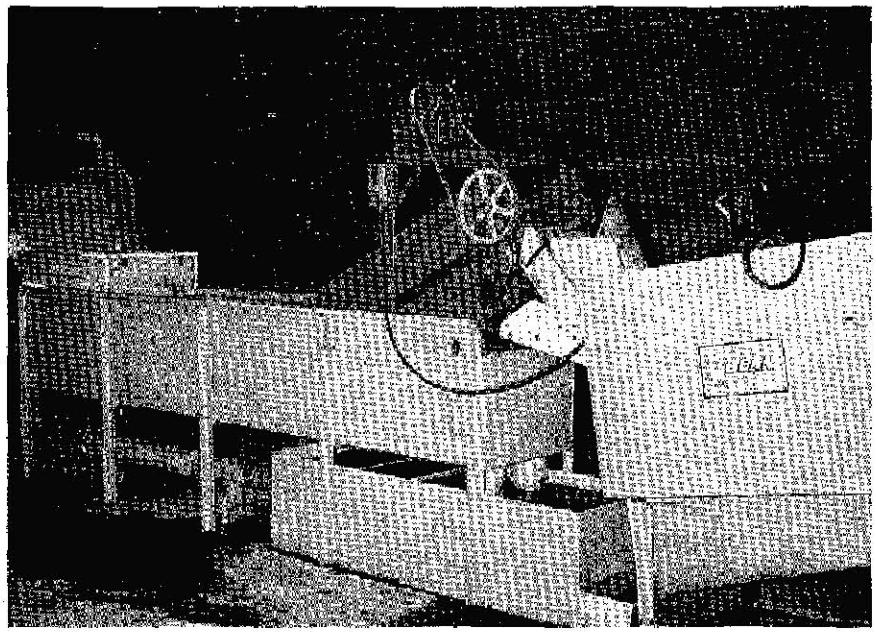

Fig. 3. Specific gravity separator in potato grading line.

The high density potatoes or sinkers tended to roll down the inclined slatted floor of the separator until they reached the lower conveyor which carried them out of the brine and into a chute leading to the left side of the Bean washer-absorber. The potatoes were washed, the excess water was removed by the absorption rolls and then the potatoes were bagged for market.

During the 1954-1955 storage season, approximately 100 tons of potatoes were separated by this machine. The maximum rate at which potatoes could be handled by the grading line in which this machine was installed was about 6 tons per hour which was approaching the capacity of the separator. The quality of the potatoes being separated and the presence of sprouts or excessive foreign material all effected the operation.

It was found in this operation, as suggested by Kunkel *et al.*, that the brine density did not change appreciably as long as dry potatoes were used. Brine was carried out by the potatoes and periodic additions of brine had to be made. Brine additions were not needed until after several hours of operation since this machine had a large reservoir tank.

The brine in the specific gravity separator leaches carbohydrate material from unsound potatoes and sprouts. The mechanical circulation of the brine containing saponins induces a certain amount of foaming. Whereas the foaming was not troublesome during the early part of the season, a large amount of brine was carried out with the foam when potatoes with substantial sprouts were separated. An anti-foaming agent should be successful in overcoming this problem.

ACCURACY OF SEPARATION

Considerable time was spent in testing and adjusting the machine for accuracy of separation. Several modifications were made in the machine to improve separation, and the vane at the lower end of the upper conveyor was finally set at an angle of 30° with the horizontal (Fig. 1) for best results.

For testing purposes, the specific gravity of the brine in the separator was adjusted to 1.080 and potatoes with an average density of about 1.080 were used. Potatoes were separated by the machine and then checked for degree of separation by using crocks filled with brine at 1.075, 1.080, and 1.085 specific gravity. Under these conditions it was found that all potatoes separated as high density (1.080) or sinkers had a specific gravity that was equal to or exceeded 1.080.

In the fraction separated as floaters, 15 to 20 percent were in the specific gravity range 1.080 to 1.085, with the remainder below 1.080. This performance was considered adequate since the fraction of potatoes separated as floaters, but with a specific gravity above 1.080, had a mean specific gravity near 1.080.

SUMMARY

The construction and operation of a machine for separating potatoes into two specific gravity groups has been described. This machine uses sodium chloride brine as the separating medium; the potatoes are moved through the separator by mechanically circulated brine. The potatoes are lifted from the brine as they reach the end of the machine by two conveyors, one for floaters and one for sinkers. In practice, the potatoes go from the separator to a washer-absorber where adhering salt brine is rinsed from the tubers.

Advantages of this machine include: (1) movement of the potatoes through the machine is positive; (2) the capacity in relation to machine width is high.

Acknowledgement

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