Further Experiences with Algins

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Introduction

A paper, "Chemical Aids to Carbonation Mud Settling and Filtration," by Somers Moore $(1)^3$, was presented at the seventh general meeting of this Society

The paper dealt chiefly with the use of sodium alginate, commercially known as Kelgun and manufactured by the Kelco Company, as a settling aid for first carbonation juices. It was found that the addition of Kelgun solution to first carbonation was beneficial, with maximum results under certain specific conditions:

a. When added as a 0.1 percent solution in water.

b. When quantity added is near 2 ppm in juice.

c. When the condition it is designed to remedy is not the result of irregularities at the carbonation station.

Two generalizations about the use of algin as a settling aid were made:

a. Algin almost always helps the settling of the thin juice slurry, but as the susceptibility of the juice decreases, trouble develops with

the thicker slurry. b. Juices which are naturally the best settling are the most sus

ceptible to the action of algin.

Recent work has verified these observations and has increased our knowledge of the action of Kelgum. The present paper will only deal with findings which have not been covered previously.

Factory Experiences

During the 1953 campaign two algin preparations, manufactured by the Kelco Company: Kelgum (78 percent algin) and Kelgin (90 percent algin) were used by the Spreckels factories as settling aids for first carbonation juices. In laboratory tests the efficiencies of the two have been found to be practically equal when based on equal algin content. In actual factory use on difficult settling juices Kelgin may be slightly more efficient than Kelgum.

At two of the factories, one Steffen and one straight house, where Kelgum had been used during the three previous campaigns, the Kelgum solution was added to the whole first carbonation juice entering the Dorr thickener. At the third, a Steffen house, where the use of algin had been found to be ineffective in previous campaigns, both in actual use in the factory and by laboratory settling tests (described later), the first carbonation alkalinities were lowered during the 1953 campaign from the previous normal value of around .080 to the vicinity of .065–.070, to increase factory capacity by improving the rate of settling in the thickener. In this lower alkalinity region, laboratory tests indicated that improvements in settling

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could be expected through the use of aigin. These tests also showed that slightly better results could be obtained from Kelgin rather than Kelgum.

At first the Kelgin solution was added to the juice feed prior to entering the Dorr At first the Reight solution was added to the face feed pilot to thermal the Dort thickener. An improvement was noted. Later, and for the remaining portion of the campaign, the Kelgin solution was added in such a way that the conditioning compartment of the thickener, in this case including about one-third the volume of the thickener, was bypassed. This method of addition was adopted under the assumption that the Kelgin was losing its effect with time of contact with the juice. A much more pro-nounced favorable effect resulted, both on settling and sludge filtration rates, when the Kelgin was added in this manner. Whether this bypassing of the conditioning compartment would have enabled the Kelgin to show a beneficial effect when operating first carbonation at the normal alkalinity of approximately .080 has not been determined.

General Considerations

The effects of Kelgin addition to the juices of this factory were determined in a laboratory settling test apparatus (2), in which such data were obtained as: the thickener area required to clarify a given material for a given amount of solids and a fixed underflow discharge ratio; and comparisons of settling characteristics of different materials. The capacity of a thickener is dependent on the slowest settling curve, depending upon physical and chemical circumstances. The curves obtained by plotting the sludge concentration against the values of C (pounds solids which can be settled per square foot of thickener area per hour) have been classified into three types: the A curve, in which the settling rates of sludge as thin as or thinner than feed materials determine the thickener capacity; the C curve in which settling of the nearly completely thickened material determines the capacity, and the B, or transition type, curve.

In most cases the A curve is obtained at lower alkalinities in the region .065-.070, In most cases the A curve is obtained at lower alkalinities in the region .050-...070, with transition curves in between .070 and .080, and marked C curves first appearing from there up to .090. There are many exceptions. The alkalinity point of change from A to B curve varies with the types of nonsugars, depending on the beets, and is lowered by increase in the amount of lime used and by decrease in the Brix of the raw juice. In general an A curve is associated with a higher overall settling capacity, but also a poorer thin juice quality. A C curve is associated with higher quality thin juices. If a turbid quality the set of the transmission of the set of the transmission of the transmission of the set of the transmission of the set of the transmission. overflow is experienced with a C curve, and sufficient filtration capacity is at hand, relief may be experienced by drawing, off more underflow.

In the case of the particular Steffen factory referred to above, since filtration was a bottleneck, the type A curve was obviously most desirable.

Results of Laboratory Tests

Figure 1 illustrates the effect of 2.5 ppm. Kelgin on a juice of .087 alkalinity as compared to that on the same juice at .067 alkalinity. At the higher alkalinity the top settling rates are only slightly improved by the addition of Kelgin, and the bottom rates are slightly retarded. The curves



Figure 2,---The effect of time on settling of first carbonation juices with and without algin, .067 alkalinity.

in both cases are definitely of type C. At .067 alkalinity there is a very decided improvement, roughly two times, in the settling rates from the use of algin. In both cases lowering the alkalinity has produced a curvve of the B type.

Figure 2 illustrates the effect of time on the settling curves, with and without the use of Kelgin. The juices for the delayed tests were kept in a water bath for 1.5 hours at 80° C. The alkalinity was .065.

The effect of time on the settling rates of untreated first carbonation juice is slight. With 3 ppm. of Kelgin, the settling curves obtained from this particular juice permit some significant deductions.

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The laboratory settling tests show that on the addition of Kelgin the immediate effect is that the curve appears to pivot around a point at a fluid to solids ratio of about 10, so that the top settling rate is increased and the bottom rate is slowed down. After 1.5 hours' contact with the Kelgin, the curve pivots back around the same point, reverting toward the curve of the original untreated juice, but with an increase of overall thickener capacity.

Discussion

In the laboratory tests, each series of determinations on different concentrations of sludge is made within a relatively short interval of time, and the curves shown on Figure 2 are of more or less "instantaneous" nature. In a factory thickener with a total detention time of 1.5 hours, the actual time of contact with the algin is very short for the top concentrations. Considering this, the actual settling curve in the factory would probably be somewhat of the nature of the dotted line shown.

It is clear that algin improves the settling rates of the less concentrated mixtures of sludge and juice, and that it retards the settling rates of the more concentrated mixtures. It is likewise apparent that the effect of algin decreases with time. It is thus somewhat fortuitous that when inserted into Dorr feed material its initial effect is an advantageous one, and the effect on the thickened mixtures, which is reduced due to time of contact, is an undesired one.

Thus, from this work, it appears that the proper place to add algin is at the commencement of thickening, bypassing the conditioning compartment, and that it is not desirable to add it directly to the nearly thickened materials.

Factory experiences at the two other Spreckels factories continue to verify the efficiency of Kelgum addition to first carbonation juices under controlled conditions. The reason that algin works well at alkalinities of near .080 at two factories, and only at lower alkalinities in the third, appears to be related to the fact that A curves are obtained only at lower alkalinities in the third factory, and it has been shown that A curves are essential for algin to be useful. Why this difference in the alkalinity-curve type relation exists at the third factory is not determined, but may be involved in carbonation equipment characteristics, or in the presence of reburned lime in the liming reagent.

Conclusions

Since the paper given at the seventh general meeting, it has been found that:

 Algin when added to first carbonation juices in amounts of about 2-3 ppm. has an accelerating effect on sludge settling rates in the more dilute mixtures of sludge and juice, and a retarding effect in the more concentrated mixtures.

2. The effectiveness of algin decreases very slowly with time of contact with the juices.

3. In practical usage, the result of points 1 and 2 is fortuitously advantageous, since the algin reaches the nearly thickened mixtures after the longest detention time.

4. Algin may be used to advantage with sludges and under conditions giving type A settling curves. Since type A curves are obtained under somewhat different conditions at different factories, due probably to differences in reagent materials, this possibly explains why algin appears to be of value at some factories and not at others.

5. For maximum beneficial effect, algin should be introduced into the thickener feed, shortly before it enters the settling compartments, and never to nearly thickened materials.

Literature Cited

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