

I. INTRODUCTION

In the early days of the sugar industry when the juice was concentrated in open vessels, scaling mattered very little. When a vessel became coated with scale it was simply emptied and the scale chipped out. It did not matter if the vessel had to be withdrawn from use as there were a number of these units. If, as might have happened in extreme cases, the boiling house had to be shut down to remove the scale from the vessels the loss of time did not matter much, and there was plenty of cheap labour available.

Today the sugar industry is faced with a very different situation. The juice is boiled in closed vessels under reduced pressure. The amount of water evaporated in unit time per unit area of heating surface is many times as great. Thus the rate at which scale is deposited on the heating surfaces is much greater. Coupled to this is the fact that in a modern factory all the units are operating at more or less full capacity. This means that any slowing down in the rate of heat transfer due to scale insulation, and consequent slowing down of throughput, will mean a reduced grinding rate and consequent increase in overhead costs. To this may be added the loss of sugar due to having to grind overripe cane.

As no completely satisfactory process has yet been devised for preventing scale from forming on the evaporator tubes, it remains to devise a means of removing the scale in the shortest possible time. At present factories have to shut down every weekend for periods ranging from 12 to 24 hours in order to clean the evaporators, and some of the older factories have to clean boilers and juice heaters as well. Improvements in furnace design have overcome the necessity for shutting down the factory for boiler cleaning, and most modern factories have a spare juice heater, so that the heaters can be isolated and cleaned one at a time. This means that the only units which cause the factory to shut down while they are being cleaned are the evaporators. At present the cane supply is regulated on the basis of a factory grinding for

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only six days a week. If, however, the factory was able to operate seven days a week without stopping it should be possible to organise the cane supply so that the factory could carry on over the weekend.

If the time taken to clean the evaporators could be halved, it would mean the saving of a whole day every four weeks. The money saved in reduced overhead costs would pay for a fairly expensive cleaning process. Mechanical cleaning is handicapped by the fact that the vessels, immediately after they have finished boiling, are far too hot to permit the cleaning gangs to enter. A long time has to elapse before cleaning can begin. Chemical cleaning seems to offer the quickest means of cleaning the evaporators, as it can be started immediately the juice is emptied out. Unfortunately the scale has so many different constituents that no one chemical has, up to the present time, been found which will dissolve the scale without, at the same time, attacking the metal of which the evaporator is constructed. In this respect the tetra sodium salt of ethylene diamine tetraacetic acid (EDTA) seems promising, as it is non-corrosive and it is not necessary to follow the treatment by boiling with acid as has to be done when sodium hydroxide is used. Work on this method of descaling evaporators has been going on in this department for some time, and the present thesis forms part of this programme of work.

fact that sucrose and reducing sugars are not present in scale, and that alkali and magnesium salts, which are present in clarified juice to about the same extent as calcium salts, occur only to a very small extent in evaporator scales.

King (1950) advances the theory that many of the scaling constituents, with the exception of calcium sulphate and perhaps calcium phosphate, are present as negatively charged colloidal complexes. These complexes are attracted to the heating surfaces.

Swinger (1957) goes a stage further in stating that it is possible that even calcium sulphate may be present as a colloidal complex. There is no evidence to support these assertions however.