CLEANING THE OUTSIDE OF EVAPORATOR TUBES

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During the past ten years several attempts have been made at Felixton to remove the carbon-like deposit which forms on the outside of the evaporator tubes of the first vessels. The results were in all cases disappointing. The use of toxic or inflammable detergents was undesirable so the choice was somewhat limited.

At the end of the 1965/66 Crushing season, tubes were removed from the Juice heaters, evaporators and pans. Tubes from the vapour cells and the second vessel—which had for many years operated as a first vessel—were heavily coated with a carbon deposit. The Juice heater and pan tubes were also dirty, but to a lesser degree and the scale on them appeared to be softer and flakey. Light syrup during the 1965/66 season put an extra load on the pan station and imbibition had to be reduced at times when the evaporator could not cope. As a higher throughput was decided upon for the 1966/67 season it was imperative that the evaporator should function properly.

Gamlen Treatment

After several enquiries had been made, a so-called carbon solvent by the name of Gamlen at R1.90c. per gallon was recommended and despite the high cost, arrangements were made to attempt to clean the evaporator tubes with this chemical. A representative of the firm which supplied the Gamlen visited Felixton to discuss methods of application. After various laboratory tests on the tubes had been carried out a mixture of two parts paraffin and one part Gamlen was agreed upon.

Procedure

The steam inlets to the evaporator calandrias were blanked off, also the steam traps from these vessels. An old boiler shell was used as a storage tank for the mixture, from where it was circulated through the calandrias by means of a pump. The juice space of the vessels was filled with water to 2″ above the tube and two 1″ steam pipes placed in the downtake to maintain a temperature of 80°-85°C. After twenty-four hours the Gamlen mixture was drained back to the storage tank and the calandria immediately flushed several times with cold water.

Result

Four tubes were removed from different points of the tube plate; on some the deposit had been completely removed, whilst on others a thin film remained. After all the vapour cells had been cleaned the remaining four vessels of the evaporator were treated, then all the Juice heaters and pans. The effectiveness of the solution lessened towards the end of the exercise but all treated tubes were fairly well cleaned.

Conclusion

The syrup Brix for the 1965/66 season was 55.9, and 61.5 for the 1966/67 season, and in addition evaporation per square foot of heating surface increased from 5.10 to 5.90 lbs. At a cost of approximately R2,500 the results obtained can be considered as highly satisfactory.

Caution

It is claimed that Gamlen is non-poisonous but the paraffin Gamlen mixture fumes cause nausea so the vents should be extended well above floor working level. Contact with the skin must also be avoided. At a temperature above 85°C, the mixture may become explosive.

Discussion

Mr. Bentley (in the chair): This cleaning operation cost R2,500 for the season. It seems to me that this money might have been better spent in eliminating the contamination in the steam supplied to the evaporators so that no scaling occurred. It is possible to prevent oil from getting into exhaust steam and this may be the best way to approach the problem.

Mr. Robinson: We used Gamlen with some success at Darnall. A fairly hard carbon scale was still left on our vapour tubes but the loose carbon in an oily film came off easily. We have recently installed an oil separator and have not yet gauged its effectiveness, but we shall still use Gamlen.

Mr. Davies: After the treatment we installed an oil separator on each of our two tandems but the vessels close to the two engines are still getting oil in them.

Mr. Dick: Many years ago, in India and elsewhere, there was a process for cleaning the inside of tubes whereby a solution was made by diluting molasses with water; a few tubes in the calandria were removed and both sides of the calandria were filled with the solution to about six inches above the tube plate. A yeast was put into the solution to start fermentation and over a period of a month or more the solution was allowed to drip down slowly and the tubes were cleaned very effectively.

Mr. Davies: It was tried out on pans at Felixton but was not effective. The insides of the tubes were cleaned but not the outsides.

Mr. van Duyker: There is a paper in the 1940 proceedings of S.A.S.T.A. on the molasses fermentation cleaning method.

Mr. van Hengel: The Gamlen representative stressed that the liquid must not be allowed to stand in the calandria—it must circulate. We used two one inch open steam pipes in the calandria in an attempt to create 'water hammer'.

Mr. Davies: The steam pipes worked until the temperatures were balanced and then they became ineffective.

Mr. Rabe: Some time ago at Illovo we used a product called Mercol in a similar way to Mr.

Davies. To reduce quantities we floated it up on water, in a fairly high paraffin concentration, and then the level of the water was slowly raised and lowered.

Mr. Davies: Gamlen is soluble in water.

Mr. Dick: Mr. Davies says the tubes were heavily coated with a carbon deposit. From my experience I don't remember getting a carbon deposit; it was more a soft oily deposit. Our steam then had a moisture content of up to 5%. Could Mr. Davies tell us the steam temperature entering these vessels because I have known cases of steam at 100°F superheat entering juice heaters?

Mr. Davies: High temperatures might cause it, but our temperatures aren't excessively high—about 13 p.s.i., which is approximately 245°F. But even when low pressure steam at 226°F is present, if it has been there some time the deposit is a carbon and not a sludge.

Mr. Dick: I am referring to high pressure boilers with reducing valves where sometimes engineers are not certain of the degree of superheat entering the vessels.

Mr. Hulett: We have possibly had superheat in the calandrias at Felixton and Darnall but nowadays not much live steam is going into exhaust.

Mr. Hurter: When we installed a new turbo-alternator at Umfolozi a year ago we investigated this and found we had in excess of 100°F superheat and we had to install a de-superheater in the exhaust steam line.

Mr. Buchanan: It is a pity the author has not given overall heat transfer figures for the surface concerned.

I have seen in literature an example from Australia where there was a 60% loss in overall heat transfer coefficient due to scaling on the steam side of the tube. What has been the effect of this chemical on the steam surfaces of the 2nd, 3rd and 4th effects of evaporators which are influenced by entrainment, compared with the first effect where there is an oil type scale.

Mr. Davies: There was very little scale on the 2nd, 3rd and 4th effects despite any entrainment.

Mr. Renton: At Darnall the Gamlen cleaned our 2nd and 3rd effect vessels very well.

There are savings when using this treatment because we have found that for about a week after using it we have been able to use $1\frac{1}{2}$ to 2 lbs. less exhaust steam pressure.

Mr. Fourmond: I think that an increase in rate of evaporation per square foot from 5.10 to 5.90 lbs., combined with an increased throughput rate, indicates a highly successful result.