

WATER CONSERVATION IN SUGAR MILLS

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The year 1970 has been declared water year. What is "water year"? It is an attempt by the Government to make both industry and the public more conscious of the part they must play in the conservation of water.

The country's economic growth and prosperity depends on an adequate supply of water—but this supply is dwindling at an alarming rate.

At present, the Government is attempting to conserve our natural water resources by building dams and by passing legislation through parliament making it a criminal offence to misuse water.

This means that in the very near future industry will be forced to take measures to halt unnecessary waste and pollution.

Contrary to Press reports—I refer in particular to an article in the *Natal Mercury* dated 13th March which was headlined "Rubbish . . . by Industry". We all know that industry does cause pollution and we in the sugar industry should make every effort to eliminate this problem and prevent unnecessary waste.

With this in mind I would now like to discuss:

Sugar Mill Effluent Elimination

If one considers the overall water balance of a sugar mill (see Fig. 1) one can see that the amount of water coming in with the cane is almost enough to maintain the operation of the factory and it is this criterion which led engineers to have the courage to build mills such as Empangeni and Jaagbaan, remote from rivers, which have to rely only on water obtained from boreholes for the operation of the mills.

Mills where an abundant supply of water has existed have not, however, bothered to conserve water and so the usage has become greater as the mill gradually expanded. What is happening now to these mills is the materialisation of a twofold problem. One is that the supply of water is running low due to the demand on the river and the other is that restrictions are being placed on the disposal of effluent.

What can be done about this situation?

There are two solutions—

- (a) to build dams and store large quantities of water and install effluent treatment plants and effluent disposal schemes to cope with the water; and/or
- (b) to close up the system and make maximum use of the water by careful selection and recirculation.

It is this latter choice that I wish to discuss in this paper.

Imbibition Water

Consider the water balance sketch (Fig. 1) of a typical sugar mill. The first large water requirement is the imbibition water required for washing the sugar out of the crushed cane.

Most mills require that this water be applied cold for various reasons. The two main reasons are to prevent roller slip when large quantities of imbibition water are used on mills operating at high fibre throughputs and to obviate the mill house becoming wet and clouded with steam on cold evenings.

The hot condensate collected from the evaporator tail ends, pans and heaters is generally sufficient to supply this water and it is simply a matter of cooling this water to a suitable temperature for application to the mills. This is best achieved by first flashing the condensate down the evaporator to 71° C corresponding to the 335 mbar vacuum prevailing in the calandria of the last effect and then cooling with cold mixed juice down to about 32° C in a counter current liquid-liquid heat exchanger. Should really cool imbibition water be required it may be necessary to by-pass the hot return juice from the Oliver filters around this liquid-liquid heater in factories where this filtrate is returned to the mixed juice tank.

Boiler Feed Water

From a steam economy point of view and from the safety angle with regard to sugar contamination, all the low pressure steam should be fed to a pre-evaporator in which the clear juice is boiled to produce vapour at about 1.4 bar for the supply of pans and heaters and other general use. In this way it is possible to collect most of the steam generated in the boilers as condensate and return it to the boilers as feed. This condensate is withdrawn from the pre-evaporator calandria at about 2.03 bar and is flashed to below atmospheric pressure, the flash heat being utilised for juice heating or boiling the tail vessels of the evaporator.

A certain amount of make up, however, is inevitable due to the loss of the flash and the inevitable leaks. This make up for the boilers should be obtained from the second effect of the evaporator calandria condensate. Multiple layer wiremesh entrainment preventers can achieve a very high efficiency in the scrubbing of sugar entrainment from the vapour produced in the pre-evaporator provided, of course, that it has been correctly designed and properly maintained.

Boiler Feed Water Storage

At this point it seems pertinent to mention that accidents do happen even in the best organised and controlled systems and in order to obviate the use of untreated water for boiler feed, it is therefore very wise to have at least four hours' storage of condensate or treated water. Preferably most of this water can be stored out of circuit, i.e. allowed to get cold but must be readily available to the main boiler feed water pumps either by gravity or a reliable independent pumping system.

Bearing Cooling Water

Considerable quantities of water are used for cooling purposes other than in the pan and evaporator barometric condenser system. This water should be arranged to circulate in a closed system, including a cooling tower and a sand filter. This water requires to be looked after and cared for in the same way as that of a swimming pool. Neglect of this system can cause corrosion of the various internals or the build up of algae with consequent blockage of the various small cooling passages. Water loss from this system is usually very small as the amount of heat dissipated is not very great.

The Main Condenser Circulating System

This water is circulated in large quantities but, provided there is no leak in the system, this water level should gradually increase until a slight overflow occurs.

This excess occurs from the fact that water is condensing from the pans and evaporator tails into the system and evaporating again in the cooling tower. However, for each kg of steam condensed, less than

1 kg of water need be evaporated in the cooling tower as some of the cooling (possible 20% in this climate) is achieved by conduction to the air drawn through the tower and not by the transfer of latent heat through evaporation.

Storage of Water for Week-end Washdown

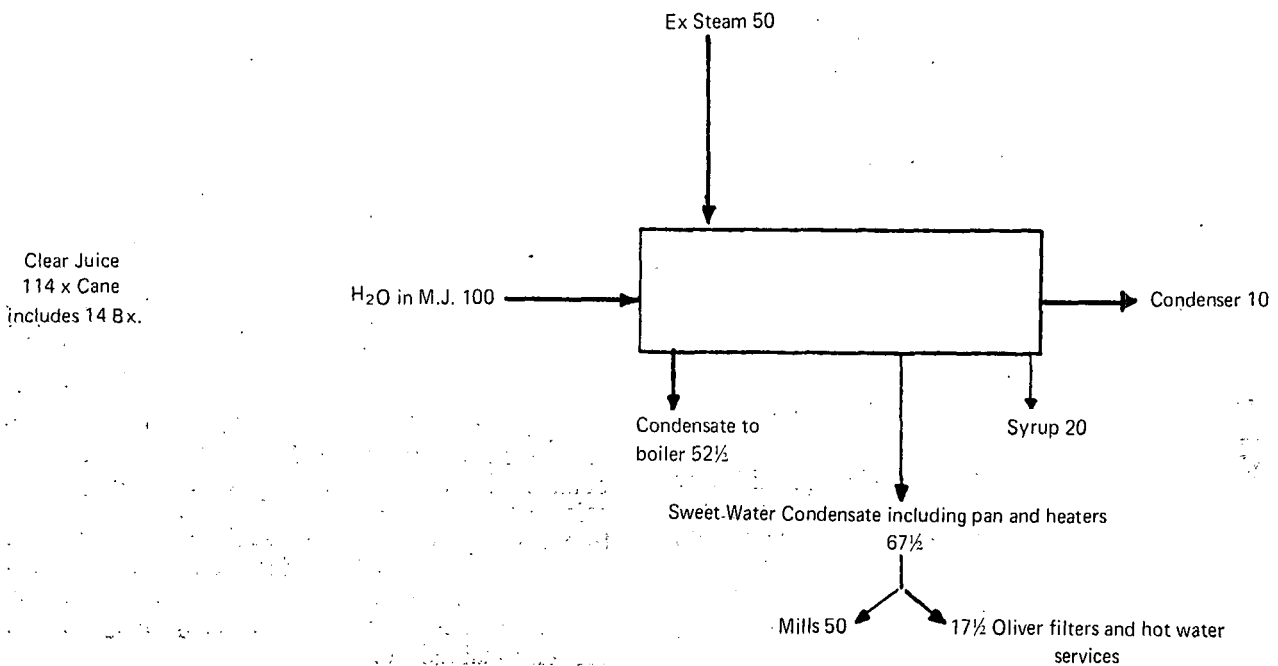
The overflow from the condenser cooling system should be stored in a reservoir of suitable dimensions to allow sufficient water to be stored for the week-end washdown requirements. A sufficiently large pumping station must be connected to this reservoir so that pans and evaporator vessels, which require quick filling for cooling down for maintenance purposes, can be filled in a relatively short time. The dam for a 300 metric tons per hour mill could contain, say, 1 500 m³ and a 150 mm system capable of delivering 38 l/s would be sufficient. Water used for washing out the pans and evaporators must be returned to this dam. An aeration paddle operating on the surface of the water will easily allow the collected sugar to be digested and the water to be purified sufficiently by the following week-end for re-use.

Dunder Water (The Mill Water Effluent)

Dunder water is the term given to the general effluent from a sugar mill and it is made up generally of floor washing, water leaking from bearings or running off hot bearings on the mill, the overflow from the cooling pond, odd condensate leaks or that which is being deliberately dumped, wash water from the pans and evaporators and innumerable other sources, even possibly from the drain of a hand-basin at the centrifugal station.

The elimination of this dunder water is obviously

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possible but, of course, it requires careful planning and attention to detail in order to achieve this.

The week-end washout water has been dealt with in a previous paragraph. Mill bearing water leaks can be routed into the juice or imbibition systems provided that the bagasse is weighed for mill balance calculations. The floor washing can be minimised or possibly even eliminated if the floors are suitably laid and paved so that they can be cleaned with a brush or a mop. Of course, attention will have to be paid to the elimination of molasses leaks from crystallizers and pump glands and the sugar dust problem, but monies spent toward this end do bring a return in the saving of undetermined losses and at the same time greatly improve the appearance of the plant. It is after all a food factory and should, as such, be kept spotlessly clean.

Domestic Supply and Sewage Effluent

No sugar factory can operate without personnel and with personnel comes the problem of domestic water supply and sewage disposal. The factory waters discussed so far are not suitable for domestic purposes and apart from that are not sufficient in quantity. This water supply has to be obtained from a stream, river, boreholes, or piped from a suitable dam site or regional supply and the sewage effluent resulting therefrom will need to be treated in a suitable sewage works.

I have attempted to indicate to you how one should be able to operate a sugar mill with as little water as possible. The systems I have described I know are feasible. It is the responsibility of all of us who are involved in the operating of the sugar mills to see that we play our part in the crusade to save our water supplies.

Discussion

Dr. Mansfield: There is a problem of lack of water in a factory at the end of the season when the cane supply ceases but the boil-off continues for some days.

This should be kept in mind when contemplating siting a factory away from a river. It is for the same reason necessary to have a storage dam.

Mr. Kramer: Mr. Hulett mentions returning condensate to the cooling tower. Did it go back into the top of the tower?

Dr. Mansfield: Yes, because the amount of heat to be removed from the condensate was comparatively negligible.

Mr. Phipson: It was mentioned that when condenser water was used for imbibition it caused trouble in the factory.

Mr. Hulett: The condensate from the latter vessels of the evaporators and the pans is clean and at Darnall it is put through a heat exchanger to cool it before applying it to the mill. It does no harm at all.

Initially, however, the hot water was directed straight into the cooling pond and water drawn from there for imbibition caused trouble.

Mr. Phipson: Is it therefore acceptable to use, for imbibition, water from condenser outlets?

Mr. Hulett: Yes, provided that the system is of small volume and is clean as at Jaagbaan. Dirty cooling pond water will cause trouble in the factory.

Mr. Rennie: I think that any dam for storage of water for weekend wash down would have to be very carefully designed to avoid creating smells, even though aeration would assist purification.

Mr. Hulett: Ponds can be designed with proper aeration facilities to accelerate the period of stabilisation.

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