

# STEAM TRAPPING AND CONDENSATE CONSERVATION

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## Savings

For efficient heat economy it is important not to forget the value of steam after it has done its work, in other words, look after the condensate. Its heat value alone is important.

Consider a factory producing 200,000 lbs. of steam per hour. If the boilerfeed make-up is 40 per cent due to loss of condensate then 80,000 lbs. of cold water at 65° F. must be added to the hot well, and heated to the normal temperature of return condensate which may be 200° F.

Heat to be supplied = 80,000 (200 — 65) Btus.  
11,370 lbs. steam per hour.

If coal is being used in the factory this is equivalent to 1,420 lbs. per hour of coal at R5.00 per ton for 144 hours per week = R511.

In a 40 week season this amounts to R20,440 per season, so it behoves us to look carefully at our condensate collection systems. With care the make-up can be cut to 10 per cent and under, saving R15,330 per annum in fuel bills alone, plus the saving in not having to treat the equivalent amount of make-up water which in the above example would be a further saving of R6,880 if we assess the cost of pumping, clarifying, softening and conditioning feed water make-up at 20 cents per 1,000 gallons.

So, in our hypothetical factory producing 200,000 lbs. of steam per hour and using supplementary coal, there is a potential saving of R22,210 per season if we cut make-up from 40 per cent to 10 per cent.

For any factory using coal this works out at R85 per week for every 1,000 gals. per hour of make-up water saved; worth putting one member of the staff full time on condensate collection.

## Steam Traps

For the efficient removal of condensate from steam users and distribution we have firstly to choose the right trap for the job. There is a bewildering selection of traps to choose from as the following list shows.

### Group 1. Mechanical Traps

Examples of these are:

1. Plain float traps.
2. Trip action float traps.
3. Open bucket traps.
4. Inverted bucket traps.
5. Relay operated, or steam assisted traps.

### Group 2. Thermostatic Traps

Examples of these are:

1. Metallic expansion traps.
2. Liquid expansion traps.
3. Balanced pressure traps.

### Group 3. Thermo-Dynamic Trap

Examples of these are:

1. Impulse traps.
2. Thermo-dynamic disc type traps.
3. Multi-stage nozzle type traps.

No consideration will be given to "U" tubes as steam and water separators as its use is confined to very low pressures. It cannot vent vapours without losing its seal, and its use is fraught with inconsistency. If one imagines hot condensate rising in the outlet leg of a "U" tube one can readily see the danger of flashing occurring and the probable loss of the "U" seal due to the lack of head exerted by the outlet leg. It can sometimes be used with success but its use should be confined to cases where venting is no problem, and the loss of seal is of little consequence. Generally speaking, its use should be avoided.

There is no room in this paper to go into the pros and cons of each type of trap; the technicalities of trapping have been covered in standard books of reference, Oliver Lyle's "Efficient Use of Steam" being one of the best.

## Condensate Collection

It may not always be economic to collect all condensates from steam traps. We should only consider doing so if:

- (a) There is enough of it to bother about — a highly superheated steam main will give very little condensate under normal operation yet still require trapping.
- (b) We want the water for further use, such as boiler feed, mill maceration, process water, and/or
- (c) We want the sensible heat out of the condensate.

Generally speaking, in sugar mills it is hardly worthwhile collecting water from the steam traps of steam mains scattered all over the factory. Goodness knows we have enough pipes, a goodly number of them extraneous as it is, around the place without

cluttering it worse with a host of small bore condensate returns. The money would be better spent on a bit of lagging here and there.

### Boiler Feed

Let us consider first of all the use of condensate as boiler feed. If it is "first generation" condensate, i.e. direct from H.P. steam and not a condensed juice vapour, it will normally be very good boiler feed. A bit of deaeration, some chemical conditioning and it is ready to go back to the boiler. "Second and third generation" condensates are not so easy. They are normally contaminated from the process. They do not make as good a boiler feed, or at the least, they are more risky, and do not lend themselves to condensate contamination control by simple conductivity controllers. So, from a boiler feed point of view we should concentrate on the "first generation" condensates.

The sources available are many, depending on the plant arrangement. The obvious ones are condensing turbines, first effects of evaporators, vapour cells, juice heaters, pans — the latter process equipment is often fed by direct exhaust steam.

Ignoring turbine condensate as its use is so obvious, the ideal set-up is to condense all exhaust steam as it is generated in one step. The advantage of the use of one large, or a series of parallel vapour cells, or pre-evaporators, to fulfil this function is outstanding. This matter will be, or has been, discussed at this symposium and will not be gone into detail here.

If it is necessary to use second and third generation condensates for boiler feed, choose the units where the vapour pressure is greater than the juice pressure, such as the vessels of a quad rather than a juice heater. The risk of contamination from a burst tube is less in a quad than in a juice heater.

The essential point is to collect sufficient hot condensate to satisfy the boiler requirements, and to reduce the risk of contamination to a minimum.

### Process Use and Heat Recovery

Any surplus to boiler feed condensate should now be channelled to process. The biggest user is mill imbibition. But we must remove the heat from the condensate by the use of a heat exchanger with mixed juice as the coolant. This cools the condensate for use as imbibition and imparts the surplus heat to the mixed juice on its way to the primary heaters. If there is a surplus of cooled condensate after imbibition it could be cooled further and used as make-up water for bearing and crystallizer cooling water.

The other uses are centrifugal and filter cake washing, lime dilution, and pump gland sealing some of which recycle in juice or syrup evaporation. Tank washing and floor hosing account for a relatively small amount, and are usually run to waste.

Basically, once the factory is running, it can be made self sufficient as far as water is concerned by judicious

collection of condensates, and recirculation of cooling water. It is essential to critically examine the collection and use of condensate throughout the plant if the ideal heat balance is to be found.

**Mr. Bentley** (in the chair): I would like Mr. Cargill to give us further information about the condensate used for maceration and whether hot water was used.

**Mr. Cargill**: The condensate is cooled and sent to maceration via a liquid/liquid heat exchanger. The total maceration is condensate. The condensate inlet temperature to the liquid/liquid heater is approximately 150° F. and it is cooled by mixed juice to approximately 100° F. At this temperature it is applied to the mill as maceration. Surplus condensate is available for process use.

**Mr. Gunn**: How did you solve the problem of high conductivity readings which do not contain sucrose?

**Mr. Cargill**: We tried fitting an ion exchange column in the sample line to the meter to remove ammonia from the sample (the cause of high conductivity). The resins used were specially imported from America and were such that ash due to sugar contamination would not be removed. This was not successful as the sample column ran for only a few hours before regeneration was required, and attempts to regenerate were not good. The resin would not return to its original condition. We have not solved the problem of high conductivity.

**Mr. Angus**: There is apparatus available that will prepare condensate prior to conductivity measurements by removing ammonia and carbon dioxide. Dr. F. Straub of the University of Illinois developed the "Straub degasser" which condenses the steam and then reboils it, removing ammonia and carbon dioxide so that what passes to the conductivity cell is the condensate plus non-volatile material contained in the "carry-over".

The Powell-McChesney scheme for condensate testing has a long tube which is calculated so that you get pressure reduction and a controlled amount of cooling. Ammonia and carbon dioxide are removed to a low constant value before the condensate is passed to the conductivity cell.

There is also the Larsen-Lane analyser which passes the condensate through an acid regenerated cation resin and gets rid of ammonia by ion exchange. We are left with carbon dioxide which is removed by reboiling. Acids which are very much more sensitive to conductivity measurements than salts are formed from the inorganic material in the "carry-over".

**Mr. Cargill**: We tried unsuccessfully to boil the sample to drive off the ammonia present. To condense the steam from this boiled sample and check its conductivity would not be a check for contamination of the original sample.

**Mr. Phipson**: For detecting ammonia we have obtained electrodes with ten times the conductivity of the usual electrodes. Lower-powered electrodes are used to detect sugar.

**Mr. Cargill:** Sugar contamination is normally detected at 9 micro-mhos. The ammonia contamination raised this to 20 micro-mhos thus rendering the instrument useless as a sugar detector.

**Mr. Chiazzari:** Why do you object to the use of "U" legs instead of Gestra traps on pans?

**Mr. Cargill:** We have found "U" legs very erratic. They cannot vent incondensable gases and gas or air locks are a source of trouble. Perhaps if the upflow

leg was large enough they would work better but the cost of all this large bore piping nullifies its use—better to fit a trap.

**Mr. Young:** What is your feeling about injecting cold water into the upward leg of the "U" leg to avoid flashing.

**Mr. Cargill:** I hate the thought of wasting good heat and water by doing this.