

Minimizing Heat and Water Losses due to Continuous Blowdown Control

The subject of heat recovery from boiler blowdown is treated in our leaflets "Continuous and Intermittent Blowdown Valves" and "Heat Recovery from Steam Systems". Here we want to discuss the possibilities of minimizing heat and water losses by an automatic continuous blowdown process.

Blowdown of steam boilers is an absolute necessity to keep the boiler water TDS (total dissolved solids) at the optimum level. The most effective blowdown is obtained by a continuous process. Continuous blowdown can be carried out manually with the GESTRA continuous blowdown valves (Reactomats) which are adjusted to the estimated blowdown rate. The heat content and a proportion of the water content can be recovered in a GESTRA boiler blowdown heat-recovery system.

However, to minimize heat and water losses the blowdown rate has to be kept as low as possible. How can this be obtained?

The permissible boiler water density (TDS), which exceeds on the boiler design, must not be exceeded.

A reduction in the dissolved-solids content of the feedwater is only possible by improving the feedwater treatment which is not always feasible. What can be done, is a better regulation of the blowdown rate with respect to the actual boiler steam output.

The average steam demand in a plant is generally known. In practice, for reasons of safety, the continuous blowdown valve, is, however, adjusted in accordance with the maximum steam flowrate.

The boiler pressure is normally kept constant within certain limits, but the steam flowrate varies. For long operating periods the steam demand might be very low, and during these periods the manually set blowdown rate is of course too high. To account for a low steam demand the adjustment of the continuous blowdown valve should be correspondingly re-

duced. This is, however, hardly ever effected, and in any case the boiler attendant does not know the actual steam flowrate. Frequently boiler-water monitoring is restricted to determining the TDS to ensure that the permissible level is not exceeded. To be on the safe side, the Reactomat may even be opened further. All this causes unnecessary heat losses and costs.

The more economic solution is therefore to replace manual blowdown by automatic blowdown control. For boilers operating without constant supervision automatic blowdown is in any case required.

It is not recommended to carry out automatic continuous blowdown as a function of the steam flowrate or the feedwater rate, as in this case the dissolved-solids content of the feedwater would not be considered. The best method to determine the actual TDS level of the boiler water is by measuring the boiler water conductivity which is directly related to the TDS level, and to automatically discharge a corresponding blowdown quantity. By this means not only the dissolved-solids content of the feedwater is being considered, but also the steam flowrate. The correct TDS level in the boiler is maintained, and the risk of too high a concentration caused by a wrong adjustment of manually operated continuous blowdown valves is excluded. With the automatic blowdown control the TDS level in the boiler can be raised to the maximum, the automatic control will ensure that this maximum permissible value is not exceeded.

As already said, the TDS level is determined by measuring the conductivity of the boiler water. The boiler-water conductivity is measured in $\mu\text{S}/\text{cm}$ or ppm ($1000 \mu\text{S}/\text{cm} \approx 500 \text{ ppm}$). Absolutely pure water is electrically neutral. Solids dissolved in the water produce electrical conductivity. The higher the TDS in the boiler water, the better the conductivity. As boiler water always contains different dissolved solids an ex-

act deduction of the concentration is not possible. The conductivity is therefore related to a reference salt (e.g. sodium chloride (NaCl)), and for the sum of the actually existing dissolved solids the NaCl content calculated from the conductivity is used as reference quality.

The continuous blowdown control (TDS control) system consists of a continuous blowdown valve with electric actuator type BAE, a conductivity sensing electrode type ER or LRG and a continuous blowdown controller type LRR.

Fig. 1 gives a schematic diagram of the system and shows several possibilities of installing the conductivity electrode.

The electrode should preferably be installed inside the boiler. If this is not possible, it can also be fitted in an outside pot. As soon as the conductivity value adjusted on the continuous blowdown controller is exceeded, the valve is motored by the actuator to its high flowrate position. Once the conductivity (TDS) is back to normal, the valve is motored to its low flowrate position ensuring continuous and economic blowdown. On boiler shutdown the valve is motored to its closed position. For further details on the continuous blowdown control systems, please ask for our data sheets.

There are two different systems available: one with manually adjusted temperature compensation (ER(LRG)/LRR 1-...) and one with automatic temperature compensation (LRG 16-5/LRR 1-9).

The continuous blowdown controllers supply an output signal of 0 to 20 or 4 to 20 mA representing the conductivity. The current output can be used to connect a recorder or indicator, or a max.-min. limit switch.

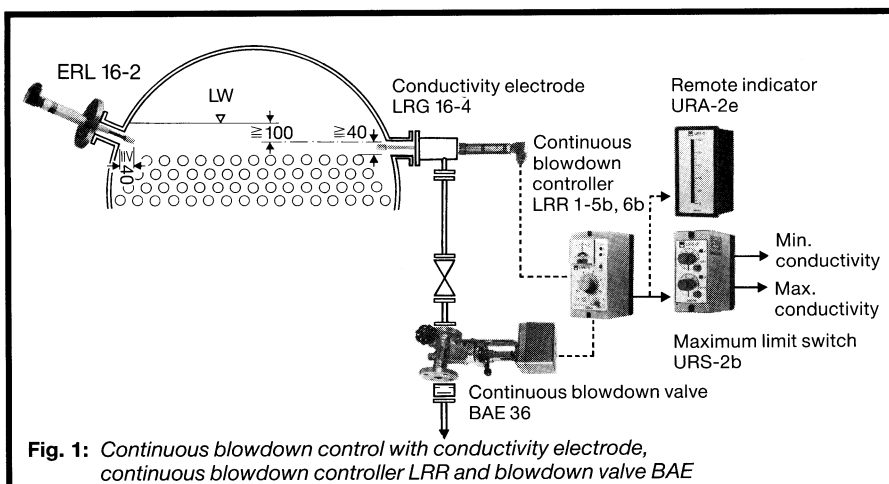


Fig. 1: Continuous blowdown control with conductivity electrode, continuous blowdown controller LRR and blowdown valve BAE

Unnecessarily high blowdown rates – i.e. energy losses – are prevented by the continuous blowdown control system. A dropping of the conductivity (TDS) will be signalled by the min. contact, so that the TDS level is kept within the preselected conductivity range.

Excessive blowdown rates will lead to

- increased make-up water consumption, and consequently higher charge on water-treatment plant,
- increased fuel consumption for raising the make-up water temperature to the boiler temperature,
- increased cooling-water consumption to reduce the blowdown temperature to the discharge temperature required by legislation.

Any possible defect of the conductivity electrode and the supply cable is signalled by the continuous blowdown controller.

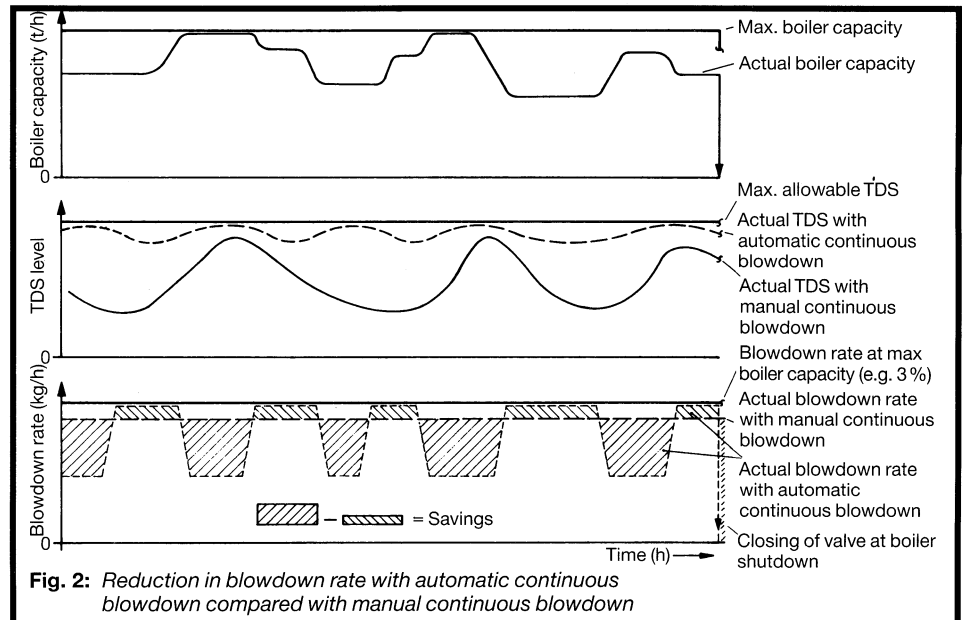
The first graph in Fig. 2 shows the actual output of a boiler compared with its maximum capacity. The second graph indicates the maximum possible TDS that must not be exceeded at any operating phase. As can be seen from the graph the actual TDS level, which depends on the actual boiler capacity, fluctuates considerably if blowdown is effected manually. With automatic continuous blowdown the variations are limited and the curve is much closer to the permissible TDS level. The third graph indicates clearly the savings that can be obtained by an automatic continuous blowdown process.

The table (Fig. 3) indicates the heat and energy savings that are possible by automatic blowdown (without considering waste-heat recovery) if the blowdown rate is reduced by, for example, 20, 50 or 100 kg/h. It also indicates the approximate time required for the continuous blowdown system to pay for itself. The reduced feedwater demand and water treatment costs have not been considered. The table is based on the following values:

Temperature of cold feedwater 10 °C

Lower calorific value 39770 kJ/kg

Boiler efficiency 85 %



Boiler pressure		barg	8	16	32
Heat savings per hour, if blowdown rate is reduced by 20, 50 or 100 kg/h	20 kg/h	W	3846	4520	5331
		kJ/h	13847	16272	19192
	50 kg/h	W	9616	11299	13327
		kJ/h	34618	40679	47979
	100 kg/h	W	19232	22599	26655
		kJ/h	69236	81358	95958
Annual savings of fuel oil, if blowdown rate is reduced by 20, 50 or 100 kg/h (boiler operation 24 h/250 days = 6800 h/a)	20 kg/h	kg	2457	2888	3406
	50 kg/h	kg	6144	7220	8516
	100 kg/h	kg	12289	14440	17032
Cost for equipment					
Equipment to pay for itself, if blowdown rate is reduced by 20, 50 or 100 kg/h	20 kg/h	months	~49	~41	~42
	50 kg/h	months	~19	~17	~17
	100 kg/h	months	~ 9	~ 8	~ 8

Fig. 3



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