

## Optimization of Boiler Blowdown and Blowdown Heat Recovery in Textile Sector

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### ABSTRACT

Boilers are widely used in most of the processing industries like textile, for the heating applications. Surat is the one of the largest textile processing area in India. In textile industries coal is mainly used for the steam generation. In a textile industry normally a 4% of heat energy is wasted through blowdown. In the study conducted in steam boilers in textile industries in surat location, 1.5% of coal of total coal consumption is wasted in an industry by improper blowdown. This thesis work aims to prevent the wastage in the coal use by optimizing the blowdown in the boiler and maximizing the recovery of heat wasting through blowdown.

**Keywords-** Blowdown, Boilers, Enthalpy, Flash steam, Flash vessel, Heat exchangers, Steam.

### I. INTRODUCTION

Indian textile industry is one of the leading textile industries in the world. The Textile Industry in India is one of the largest process industry and one of the oldest in terms of number of plants. Among them Surat is the main textile processing area. Nearly 56 textile processing units are present at GIDC Sachin, Surat. Steam is used as energy carrier for processing applications like washing and dyeing in all textile industry. Hence boilers are the main coal consumers in a textile industry. Cost of fuel for generating Steam in the meantime continued to grow steeply, nearly offsetting the benefits of reductions achieved in other areas. This brought focus to this utility and brought in the limelight the limited knowledge and bench marks available for the industry to take concrete actions to curtail the growing costs. This gives more concentration of industries for the reduction heat energy losses [1]. Blowdown is the main energy loss at the place which the steam is generated. Hence the amount of water to be blowdown is to be optimized to reduce the heat energy waste.

As steam is generated, water is evaporated in its pure form leaving practically all of the dissolved minerals behind. Steam is essentially distilled water. Thus the remaining boiler water contains the minerals which are left behind by the evaporating. The feed water that is added to maintain the water level in the boiler has a lower concentration of chemicals and dilutes the chemical concentrations that develop during steam generation. Even with careful boiler water treatment management, water or a water/steam mixture must be periodically released from the boiler to remove particulates and sludge and to control boiler water chemical treatment concentrations. This process is referred to as a boiler blowdown.

Even with significant water treatment, a small amount of dissolved solids (TDS) are contained in the

feed water. These TDSs can accumulate within boiler when water is evaporated to generate steam. To reduce the TDS of feed water the boiler blowdown is performed regularly in boilers. The rate of water blowdown can range from less than 1% when extremely high-quality feed water is available to greater than 20% in a system with poor-quality feed water. The quantity of water to be blow down will depend on the dissolved solids entering the boiler through the feed water [3]. Thus parameters that are most often monitored to ensure this quality of steam are TDS and conductivity, pH, silicates and phosphates concentration. The boiler is blow down to reduce these levels and keep controlled to a point where the steam quality is not likely to be affected. A substantial amount of heat energy is lost in this process.

The main type of blowdown procedure following in most industries is bottom blowdown.

#### 1.1 Bottom Blowdown

Bottom blowdowns discharge approximately 10% of the total volume of water in the boiler. For a bottom blowdown, the water level in the boiler is increased 6", the bottom blowdown valve is opened and then closed when the boiler empties to the normal water level.

### II. BLOWDOWN OPTIMIZATION

The quantity of boiler blowdown to be properly optimized for the efficient operation of a boiler. If the required blowdown is not performed on the boiler, it will lead to raise the amount of dissolved solids in the boiler water. The presence of hardness salts in boiler water leads to formation of deposits, technically known as scale, which has a very low thermal conductivity and impacts the evaporation rates. Scale causes fuel wastage typically up to 2% for

water-tube boilers and up to 5% in fire-tube boilers. As a rule of thumb, one millimeter of scale build-up can increase fuel consumption by 2%. Since the blowdown water is at boiler working pressure and temperature, the blowdown quantity is higher than the required one it may also result in the loss of fuel [4]. Blowdown losses also include the losses through the additional cost for makeup water supplied and its softening costs.

For the optimization of boiler blowdown the very best way is automatic blowdown system. Installation of an automatic blowdown system can optimize the blowdown quantity either reduction from present value or increase.

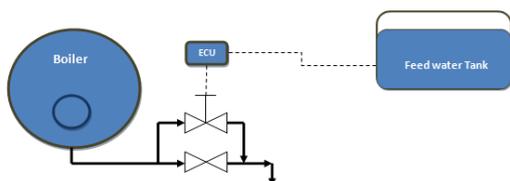


Figure 2.1 Automatic blowdown system

In this system, a control valve which controls the blowdown from the boiler. The position of valve opening is controlled by an ECU connected to the valve positioned. The ECU generate signals for the positioned from a conductivity sensor installed in the inlet line of the pump, by which water is pumped to boiler from feed water tank. The main advantage of this kind of positioning the sensor is that the scaling in the sensor is much less. As per the TDS value from the sensor the ECU generates signals for the positioner which opens the valve for respective rate of blowdown.

On experimental analysis conducted in 19 textile industries located in Surat Apparel Park the following results obtained.

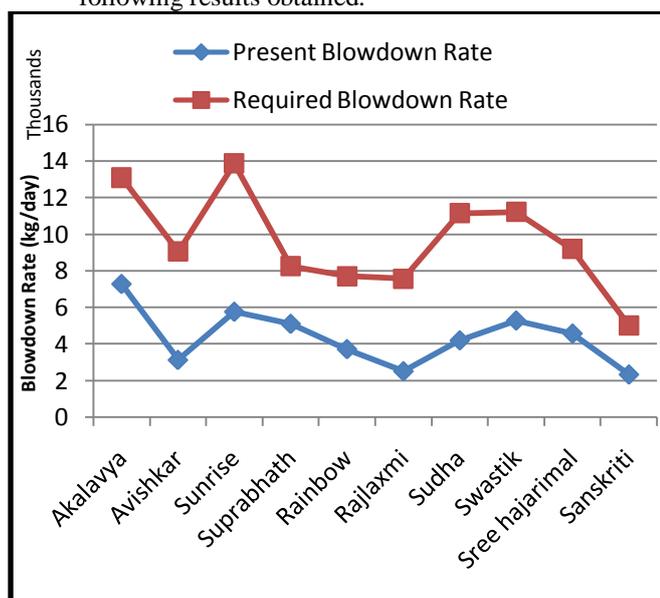


Figure 2.2 Blowdown rates at various industries

In all the industries, the required blowdown rate is either less or more than the required one. If the blowdown is less than the required means, high rate of scaling which results in reduced boiler efficiency. If blowdown is higher than the required means, wastage of fuel to raise that much amount of water to boiler temperature.

On comparison with an automatic blowdown and manual system on Sudha dyeing, the following plot of TDS variation is observed. In an automated system since the TDS is observed continuously, the TDS inside the boiler is maintained at a constant value. But in manual blowdown, the blowdown is performed only when the maximum TDS is reached in the boiler. This may lead to inefficient operation of boiler by increased rate of scaling on boiler tube walls.

### III. BLOWDOWN HEAT RECOVERY

The blowdown performed on a boiler when it's under working; hence the blowdown water is at boiler temperature and pressure. It contains large quantity of energy. For a particular amount of blowdown water to reach that temperature boiler has to supply certain amount of fuel. Hence in all respect the blowdown is fuel wastage [5]. But for efficient operation of boiler it's necessary.

Table 3.1 Fuel wastage in Industries

Industry	Blowdown rate from automatic blowdown system(kg/day)	Amount of fuel wasted(kg/day)
Akalavya	5818.18	294.82
Avishkar	5932.20	200.98
Sunrise	8108.10	172.87
Suprabhath	3157.09	105.126
Rainbow	3989.63	147.12
Rajlaxmi	5062.89	186.69
Sudha	6951.21	237.07
Swastik	5932.20	316.19
Sree hajarimal	4630.70	161.44
Sanskriti	2692.30	117.59

From the audit conducted in 10 textile processing unit it is observed that nearly 1.3% of total fuel consumption is wasted through blowdown. ie, nearly a 1.9T of coal is wasted as blowdown. If this is the case of 10 industries, considering whole industry in the apparel park Surat, nearly 11T of coal is wasted per day, which is equivalent to a price value of 5 lac rupees. In actual blowdown losses may includes the makeup water cost and the it's treatment cost.

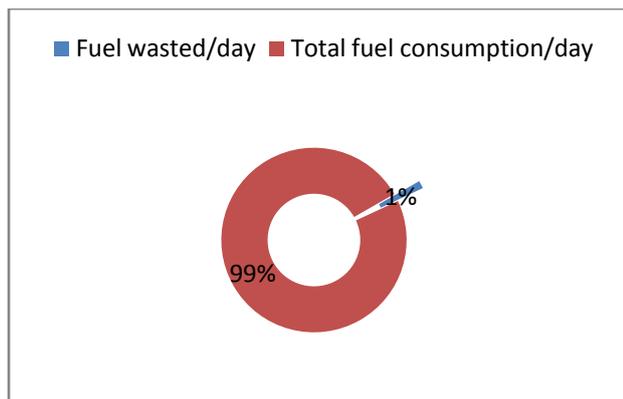


Figure3.1 Percentage fuel wastage

Heat recovery is used frequently to reduce energy losses that result from boiler water blow down. Installation of heat recovery equipment is valuable only when energy from the flash tank or the blow down water can be recovered and utilized.

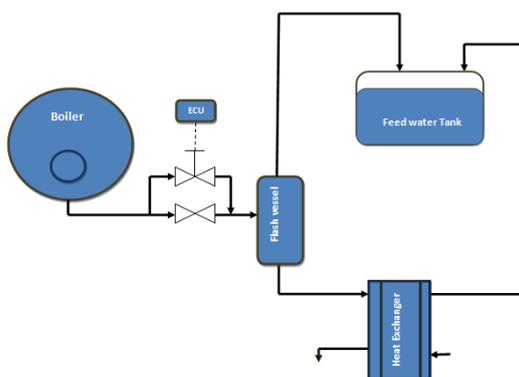


Figure3.2 Automatic blowdown systems with heat recovery

The heat recovery is done by two mechanisms, one by recovering energy in flash steam and the second one by latent heat in the waste water by heat exchanger. In flash recovery system, the blowdown water is directly supplied to a flash vessel which is at atmospheric pressure. Due to the change in enthalpies of water at boiler pressure and atmospheric pressure nearly 13% of blowdown water is converted into flash steam. This steam is directly supplied to the feed water tank hence the temperature of feed water is raised due to high enthalpy value of steam. The flash steam contains nearly 49% of energy contained in the blowdown water. The latter one is using the latent heat in the water coming out of the flash vessel. Using this latent heat the temperature of makeup water coming to the deaerator is rose which will reduce the amount of coal required to produce that amount of steam [6].

Table 3.2 Fuel savings by heat recovery

Industry	Fuel savings through Flash vessel	Fuel savings through Heat Exchanger	Total fuel savings
Akalavya	152.21	99.68	251.90
Avishkar	97.34	72.38	169.73
Sunrise	87.57	59.62	147.19
Suprabhath	49.70	38.75	88.46
Rainbow	79.69	47.12	126.81
Rajlaxmi	101.13	59.80	160.93
Sudha	116.37	84.56	200.94
Swastik	173.61	99.62	273.23
Sree hajarimal	81.49	55.90	137.39
Sanskriti	48.12	48.57	96.696

From the analysis of installed heat recovery system in 10 industries, it is found that around an 85% of total wasted fuel is recovered. The percentage of fuel recovered in each industry is plotted below.

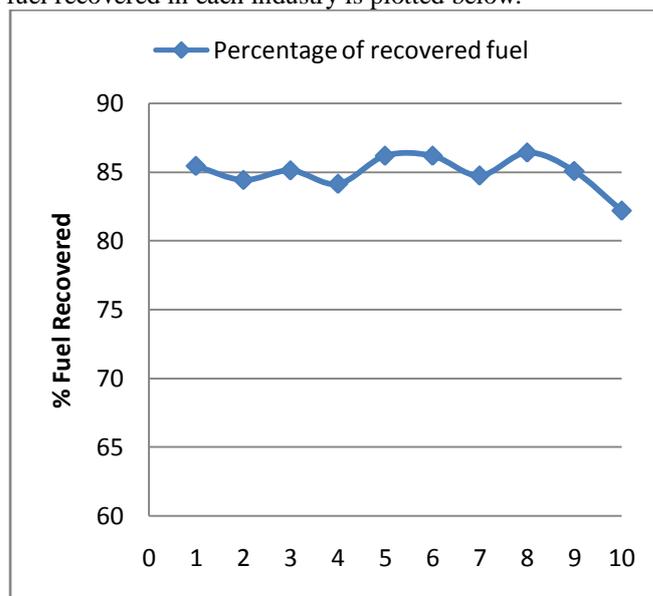


Figure 3.3 Percentage fuel savings

With every 6% rise in the temperature of feed water it is observed that a 1% reduction in the coal consumption. Reduction in coal consumption means that the increased efficiency of boiler. From the analytical comparison between the system with heat recovery and without heat recovery, it is observed that the efficiency of boiler if nearly 1% rose.

There are many mechanical factors that can affect the blow down control limits, including boiler design, rating, water level, load characteristics, and type of fuel. Here in all processing units, boiler blow down limits are lower than necessary due to the shortage in the availability of water from SMC.

#### IV. CONCLUSION

Blowdown is essential for the efficient operation of a boiler. To regulate the amount of TDS in the boiler water optimum amount of blowdown is performed at regular intervals. With increase in the TDS value the scaling occurs on boiler tubes and it reduces the boiler efficiency and increases the boiler operating cost. From the experimental studies it is shown that nearly 1.3% of fuel is wasted through blowdown. by installing the heat recovery system, recover nearly an 85% of total wasted fuel. This recovered energy is supplied to feed water to raise the water temperature. It will also increases the boiler efficiency. An average of 6°C rise in feed water temperature reduces the 1% of fuel consumption.

#### REFERENCES

- [1] Sonntag, Borgnakke, Van Wylen (1998). *Fundamentals of Thermodynamics* (5<sup>th</sup> edition). New York, NY: John Wiley and Sons Inc.
- [2] Franklin Kreith, Mark S. Bohn (1996). *Principles of Heat Transfer* (5<sup>th</sup> edition). Boston, MA: PWS Publishing Company.
- [3] Dukelow, S.G. 1991. *The Control of Boilers*, pp. 74–85 Research Triangle Park: Instrument Society of America
- [4] Stultz, S.C. and J.B. Kitto. 1992. *Steam. Its Generation and Use*, 40th Edition, pp. 9 –22 to 9 – 27. Lynchburg, Va.: The Babcock & Wilcox Company.
- [5] Greg Harrell , Boiler Blowdown Energy Recovery, *Energy Engineering, Volume 101, Issue 5, 2004, pages 32-42*, DOI:10.1080/01998590409509277
- [6] Everett B. Woodruff, Herbert B. Lammers, Thomas F. Lammers (1998). *Steam Plant Operation* (7<sup>th</sup> edition). New York, NY: McGraw Hill.