Challenges in the new norm for water consumption in thermal power stations in India – a review of strategies for adoption

Introduction

India's energy needs of about 60% are met with fossil fuels i.e., coal/lignite. Thermal power stations (TPS) largely contribute the above energy needs. There are concerns about water availability in the globe and only 3% of surface water is available for human consumption. Also, thermal power stations are one of the significant consumers of groundwater in India. In the light of the growing needs of power, MoEF had issued revised guidelines on 08.12.15, with the restriction of existing thermal power stations (TPS) to consume not more than 3.5 cubic metre per megawatt hour and new plants to be installed after 1st January 2017 shall achieve consumption of 2.5 cubic meter per megawatt hour and also achieve zero waste water discharge. As on 1st January 2016, in India about 1.27 gigawatt installed thermal power stations and about 48000 MW were under construction. Though no public data are available in India for consumption of water in thermal power stations, CEA has guesstimate that the figures shall be hovering about 4 to 7 cubic meters per megawatt hour. Hence to achieve the latest limits prescribed for the existing thermal power stations the norm of 3.5 cubic metre per megawatt hour is a relaxed one, as many of the units can run around 3 cubic meters per megawatt hour. However, for new plants to be installed the norm of 2.5 cubic meter per megawatt hours is mainly based on the supercritical technology. This shows that the existing technologies for conservation/recycling of water at thermal power stations have limited scope for further improvement with cost benefits. Hence new untapped avenues/ technologies have to be thought of with cutting edge technology with multiple objectives of water conservation, pollution reduction etc. This paper traces the current scenario of water consumption, limitation in analytics, major areas of conservation and strategies for tapping the untapped areas.

Present scenario

The old thermal power stations have one through cycles, the middle-aged plants have cooling towers of varying efficiency and new plants with supercritical technology. Though the State/Central statutory agencies stipulate cess for water consumption in thermal power stations, it is noted that there is no proper available guideline.

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Robust system to check the actual consumption of water and the cess may not reflect the actual consumption. Also, the consumption varies from plant to plant and CEA estimates that the figure will be hovering around 4 cubic meters per megawatt hour. However, a CEA 2012 report noted that the older thermal power stations have water consumption over 5 and 7 cubic metre per megawatt hour. The CEA also stipulates bar on a study in 2012 that the actual major heads of specific consumption as indicated in Table 1:

TABLE 1: MAJOR HEADS OF WATER CONSUMPTION

	Item	Water (Cum./MWhr)
1	Evaporation needs	2.040
	Blowdown water	0.450
	Drift loss	0.06
2	Bottom Ash handling system (0.09 Cum/MWhr) from blowdown	0.00
3	Misc. needslike DM Plant, Service water, evaporation	0.487
	Total	3.037

CEA study also confirms that the existing system/ designs in circulation eater systems operate at about 80-90 % of their efficiency and not much improvement can be achieved without significant investments which in turn would increase the power generation cost. There are reports in the recent past that some of the thermal power stationswere asked to shutdown for want of water or for conservation of water in the public interest.

Present technology/processes

To conserve water at present, significant efforts are made for use/treatment of blowdown water by means of use of chemicals to increase the CoC/adding makeup water which is about 16% of the water consumed. Efforts are also being made to improve the drift loss in CT. With the available technology it is doubtful whether the latest limits could be achieved for the existing thermal power stations or even the new ones with supercritical technology. The evaporation losses in cooling tower cannot be limited/reduced as it may adversely affect the plant performance.

Avenues on untapped/new areas

The blowdown water is let out with high concentration of minerals with around 300-350 PPM of temporary hardness. Also in most of the thermal power stations, flue gas is let out at around 150-180 degree centigrade, with moisture of about 10-15% by weight. The waste heat in flue gas can be used to remove a portion of water in the blowdown bearing high mineral residues. An integrated system can be designed not only to remove moisture in flue gas, but also to remove other pollutants like an NO_x, SO_x and SPM.

The SPM can be removed for scrapping of flue gas and NO_x, SO_x can be partially removed with suitable beds to convertthem as useful products like HNO_3, $NaSO_4$ etc. After scrubbing and removal of NO_x, SO_x components from the flue gas, a portion of water in blow down water can be operated with suitable condensers. Appropriate engineering schemes/ system have to be designed and developed. A basic scheme is depictedin Fig.1. Few patents are also filed in India and abroad. Engineering and designs schemes are to be made to develop suitable technology for such large-scale water recovery/conservation systems and also to be integrated as a package in the power plant. Some pilot plant studies have reported that there will be a recovery up to 80% of blow down water and about 20% of such recovery shall be

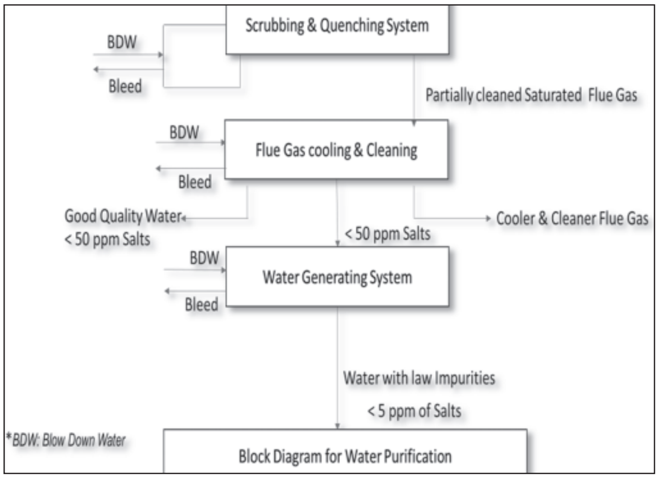

Fig.1: Scheme for water conservation and purification

equivalent to the DM water. Such schemes also mitigate the problems of pollution that may avoid De-sulphurisation plants also.

3.0 Strategies towards new norms

It is noted that no system road map is available for the implementation and monitoring of the new water conservation norms. Hence the following road map is proposed.

1. First and foremost thing is that there shall be a system for quantification of water consumed in a more reliable manner. For this ad libitum, on line monitoring of pumping sources as done for air monitoring shall be done.
2. Appropriate incentives may be given for water conservation and investment concessions in the form of lower capital interest may also be tried.
3. The TPS can be encouraged to take up the local R&D projects in association with the local premier institutes
4. Major TPS can invest in the R&D programmes of cutting edge technologies with much high-end resources.
5. Independent research programmes with participation by the TPS and NGO/private institutes with specific goals and time frames can be arranged.

4.0 Conclusion

Though the intention of the new norms is noble, the problem of implementation lies mostly in the quantification and also the availability of new technology at lower cost for adoption. It is essential that a strategic framework have to be evolved with significant involvement of TPS for development of cutting edge technologies to conserve the water for TPS effectively

References

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