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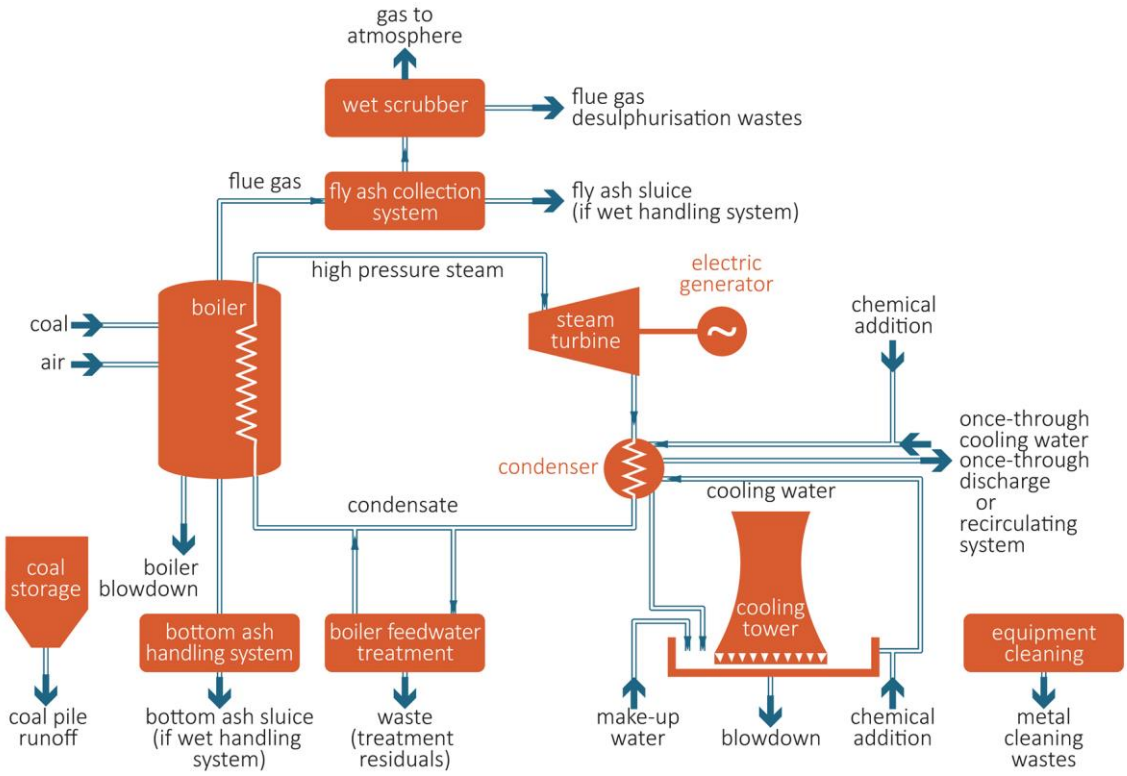
WASTEWATER REGULATIONS AND ISSUES FOR COAL-FIRED POWER PLANTS

The global demand for energy and water is increasing as a consequence of population and economic growth, and higher living standards. But water is becoming a scarcer commodity in many parts of the world due to over-exploitation, droughts, heat waves and other factors. An estimated 20% of the world's aquifers are already over-exploited. Consequently, meeting the growing energy demand through thermal power generation is going to place increasing stress on limited fresh water resources with repercussions for other users in the agricultural, industrial and domestic sectors. Countries, such as India and China, which are building new coal-fired power plants, are already facing water availability issues. Several power plants across India have had to shut down temporarily each year due to water shortages, thus losing potential revenue. Loss of power can also have serious economic consequences. The increase in water withdrawals to meet future energy demand and for other uses will deepen scarcity and stress, and lead to an increasingly water-constrained future in more regions around the world. Climate change is likely to exacerbate the situation. Moreover, water pollution is increasing the pressure on water resources.

Most countries have legislation for controlling water pollution to protect the quality of their water resources. The regulations limit the amount of pollutants that can be discharged into a water body from any source. Some countries have set limits on the amount of pollutants that can be discharged in effluents from industry, which will include power plants. Only a few countries have set limits explicitly for coal-fired power plants. But even these may not cover all the wastewater streams generated at a power plant; the discharge limits set by the US Environmental Protection Agency are the most comprehensive. However, power plants must obtain a permit or license before they can operate. These can contain restrictions on liquid discharges that may be stricter than the national or state regulations for power plants or industrial effluents; they may also include additional pollutants. Discharge limits could become stricter in the future with the growing concern over environmental effects of pollutants on ecosystems and public health. But regulations are not always observed. Strict monitoring and enforcement is essential in order to achieve cleaner rivers, lakes and other water bodies; this is not always the case.

The type and amount of wastewater treatment required is influenced by the legislation and the plant's permit requirements. Power plant discharges are made up of many streams, some of which are shown in the figure below for a wet-cooled coal-fired power plant. These streams vary in quantity, characteristics and flow rate, and can be intermittent or continuous. Furthermore, the composition of wastewater can alter when power plants change coal suppliers. Additional streams can be introduced when power plants retrofit air pollution control equipment to meet new or stricter emissions legislation. This is happening in India where new limits on the emission of sulphur dioxide have been introduced. The treatment system must be flexible enough to handle all the varying inputs yet consistently produce a treated stream that meets the regulatory discharge limits. Each plant has its own unique needs, and hence the choice of wastewater treatment system is site-specific. Wastewater streams with a similar composition are commonly combined before treatment, whereas others, such as flue gas desulphurisation wastewater, may be treated separately.



Principal wastewater streams generated within a power plant (US Environmental Protection Agency, Steam electric power generating point source category: final detailed study report, EPA 821-R-09-008, Oct 2009)

Many technologies are available that can enable a plant to meet the permitted discharge limits. Each technology will have its advantages and limitations. Treatment commonly involves several sequential steps, which can include physical, chemical, physiochemical and biological processes. Physical technologies are used to remove suspended solids by screening, sedimentation and/or filtration. Chemical treatments can include pH control, and precipitation to remove dissolved solids. Biological processes use bacteria to degrade dissolved organic substances. The discharge limits are often set on what can be achieved with best available techniques (BAT). For example, the flue gas desulphurisation (FGD) wastewater limits in the 2015 US Effluent Limitations Guidelines (currently under review) are based on chemical precipitation followed by biological treatment for existing power plants, and evaporation for new coal-fired power plants. However, even though a technology may be a BAT, it may not always enable a power plant to meet the discharge limits. For example, a pilot test at a US power plant burning subbituminous coal could not consistently meet the selenium discharge limit for FGD wastewater when using a physical/chemical and biological treatment system. There are still a number of unknowns in treating FGD wastewater due to its complexity and variability that require more research.

Water policies in some countries are beginning to force power plants to treat all their wastewater streams and become zero liquid discharge (ZLD). This will help conserve their water resources. China now requires new coal-fired power plants to be ZLD; it has also implemented a policy which promotes the recycling and reuse of water. Reusing and recycling wastewater can also offer significant savings due to the high cost of discharging wastewater. Furthermore, ZLD will eliminate the need to meet regulated discharge limits, and the associated expensive monitoring and measurement requirements. It also reduces the plant's fresh water consumption. However, ZLD can result in complex systems that are difficult to operate. Some water treatment technologies for meeting ZLD, such as brine concentrators, can have a relatively high energy consumption, and high capital and operating costs. The use of membrane-based systems that reduce the amount of wastewater treated by brine concentrators and other thermal evaporation techniques can help lower energy consumption and reduce operating costs. Selling the resultant salt solids, if possible, can

further decrease operating costs, as the ZLD Changxing power plant in China is doing. ZLD provides an opportunity for power plant operators to manage water in a more sustainable way.

IEA Clean Coal Centre is a collaborative project of member countries of the International Energy Agency (IEA) to provide information about and analysis of coal technology, supply and use. IEA Clean Coal Centre has contracting parties and sponsors from: Australia, China, the European Commission, Germany, India, Italy, Japan, Poland, Russia, South Africa, Thailand, the UAE, the UK and the USA.

Each executive summary is based on a detailed study undertaken by IEA Clean Coal Centre, the full report of which is available separately. This particular executive summary is based on the report:

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This report is free to organisations in member countries, £100 to organisations in non-member countries for six months after publication, and free thereafter.