Abstract

Recovery Boiler Technology trends in past and in future

New developments in technology have made it possible to take advantage of the economy of scale when building new big pulping lines. Therefore, the recovery boilers had to grow in size in order to meet the production capacity in the large new single line pulp mills. Excellent process and availability experiences from XL and XXL size recovery boilers have been experienced during last decades and “huge” boilers seem to be “standard” in many market areas when new pulp mills are planned.

High power recovery boilers have become more and more common in pulp mill industry as electricity price has increased. Electricity produced by recovery boilers is seen as green energy in many countries meaning incentives to electricity price which make high power feature investments more profitable.

One important item in development of recovery boilers is safety. This means personnel safety, environmental safety and equipment safety. What are ways to improve safety? The following procedures are common in nowadays engineering of recovery boilers: hazard analysis, hazardous area classification, safety engineering, material selection, personnel training, instructions and safety procedures and continuous learning curve meaning feedback and improvement from previous projects. Also technical solutions, such as smelt spout robots, improve safety and are becoming more common.

Todays’ recovery boilers have the latest design from environmental point of view; all NCG and vent gases are burnt in recovery boiler compared mills decades ago when all odorous gases went to atmosphere. DNCG (diluted non-condensable gas), dissolving tank and mixing tank vent gases and concentrated non-condensable gases (CNCG) are incinerated in recovery boiler furnace. Mills have also back-up system for those gases meaning separate incinerators with scrubbers, flares and burning as a back-up in power boilers.

Gas emissions from recovery boilers have changed drastically during years. When black liquor dry solids content was at the level of 65% then especially SO2 emissions were high. This also caused acidic sulfates formation meaning sticky ash which then increased fouling and corrosion in recovery boilers. When black liquor dry solids content has reach the level of 80% then SO2 emissions started to be insignificant. Also TRS emissions have been minimized due to new air systems and good combustion processes. Nowadays, most challenging emission is NOx which is requiring in modern recovery boilers air staging meaning many air levels in the furnace. Trend seems to be even tougher limits and therefore new secondary methods have been developed. Presently already NOx scrubbers are in operation and also SNCR systems have been developed to recovery boilers.

Automation has been developed very rapidly since Valmet introduced first Distributed Control System (DCS) 1979. Computing power was quite limited on early years for complex flue gas calculations etc., but when next generation Valmet XD DCS was released in 1987 it enabled whole new world for advanced process control development. Our first Recovery Boiler Optimizer was developed and delivered for Kemi Oy in 1991. Original targets which where; less human errors, maximum steaming rate, better cleanability, increased safety in all conditions are still valid today.
Nowadays Valmet Recovery Boiler Optimizer is the most comprehensive advanced process control for Recovery Boilers including different modules for controlling sootblowing, furnace combustion and steam production. New innovations have brought up for measuring and controlling for example reduction rate which is one of the most important process parameters in recovery boilers. Leak detection system is one new innovation for even safer boiler operation.

Today industrial internet and big data are hot topics in the industry. There's a trend towards analyzing huge amount of data and utilizing that to improve asset reliability. Some examples are predictive maintenance and process key performance indicator follow-up applications which include advanced analytics. There is also a demand for performance centers where global and local network of service professionals are ready to back up boiler operation and can even predict on coming challenges before anything critical occurs and give consulting services.

Existing and Future measurement, modelling and control technologies allow us to see all the time deeper and deeper to recovery boiler process during the operation. This open up new opportunities to see critical operational limitations better and enable on time recommendations or decisions for related operation targets. This increasingly sharper window to the process enable continuously safer, cleaner and more efficient operation of Chemical Recovery Boiler