Interview by Peter Edwards, Global Cement Magazine

WASTE HEAT RECOVERY TRENDS

TOBIAS PANSE
SIEMENS ENERGY

What can be done to encourage greater uptake of waste heat recovery in the global cement sector?

***GC:* How important is Waste Heat Recovery (WHR) in the cement sector's race to net-zero?**

Tobias Panse (TP): WHR is one key lever to reduce CO_2 emissions by utilising waste heat to produce electrical power, which can then be used for the internal power consumption of the cement plant. WHR systems are thus important in the race to reach net-zero by 2050, particularly as they are an established technology that can be used to achieve incremental emissions reductions in a cost-effective way. Using WHR, alongside other technologies like carbon capture and green hydrogen will be a powerful path to decarbonisation. While progress is certainly being made, more aggressive action is needed to meet intermediate emissions targets.

***GC:* What is the typical amount of electrical energy that WHR systems can generate?**

TP: Several factors determine the amount of steam and power that can be produced from the waste heat, including the waste gas temperature and composition, kiln design, kiln capacity and raw material moisture content. Typically, a WHR system can generate around one third of the entire cement factory power consumption. The installation of a WHR system will improve the CO_2 footprint significantly, particularly when the electrical power comes from fossil fuels.

***GC:* Which WHR technology offers the biggest potential to the sector?**

Tobias Panse joined Siemens AG in 2006 and, for 10 years, held various positions within Supply Management for Industrial and Utility Steam and Gas Turbines. After serving four years in Hungary as the Managing Director for the factory and country CEO, he now leads Siemens Energy's worldwide service and new unit manufacturing for industrial steam turbines and generators and is driving the transformation of industry to help decarbonise the world for future generations.

TP: This depends on the individual project and the site boundaries. Currently two main technologies are in competition: Steam Rankine Cycle (SRC), also known as Water-Steam-Cycle, and Organic Rankine Cycle (ORC). Most of the WHR systems installed are based on SRC but there is a growing number of ORC installations as well. At Siemens Energy we have significant experience in applying the technology best fitting to the specific customer application.

GC: **Which parts of the plant are most ripe for use of WHR?**

TP: The most widely accepted WHR method in cement plants is to capture and combust flue and waste gas streams from the pre-heater tower and the clinker cooler.

GC: **How are new technologies changing the answer to the previous three questions?**

TP: In addition to the currently available technologies (ORC, SRC) alternative cycles that use super critical CO_2 (sCO_2) as a medium to further increase efficiency beyond the current limits have been investigated.

Studies conducted alongside cement producers by Siemens Energy in recent years to determine the most efficient way of generating power from WHR show that, for the most part, a traditional steam cycle outperforms alternative technologies, i.e.: net electrical output for both air-cooled and water-cooled applications. (Table 1 & Figure 1).

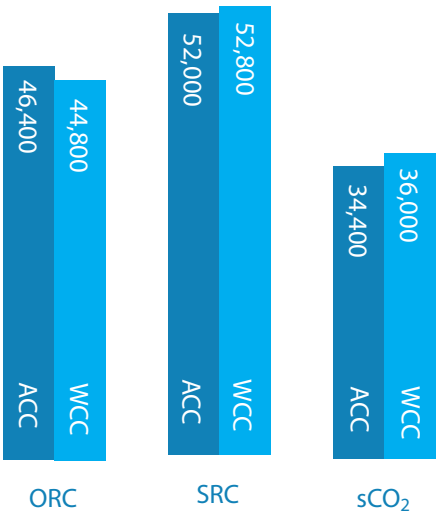

Figure 1: Annual net power production (MWh) based on 8000 operating hours.

Ambient Design Conditions
Temperature = 20°C
Pressure = 1018mBar
Relative Humidity = 74%

WHR Unit Preheater Design Conditions
Mass flow = 73.4kg/s
WHR inlet temp. = 330°C
WHR outlet temp. = 195°C

WHR Unit Clinker Cooler Design Conditions
Mass flow = 70.4kg/s
WHR inlet temp. = 350°C
WHR outlet temp. = Down to min

Table 1	Unit	ORC WHR		Steam WHR		sCO_2 WHR	
Performance @ Design Conditions							
Type of Cooling		ACC	WCC	ACC	WCC	ACC	WCC
Heat recovered (PH & CC)	MWth	25.7	25.6	28.8	29.0	28.6	28.6
Gross Power Output	MWe	6.4	6.3	7.0	7.3	8.2	8.3
Efficiency (Gross)	%	**24.8**	**24.5**	**24.2**	**25.0**	**28.7**	**29.0**
Auxiliary Power Consumption	MWe	0.6	0.7	0.5	0.7	3.9	3.8
Net Power Output	MWe	5.8	5.6	6.5	6.6	4.3	4.5
Efficiency (Net)	%	**22.5**	**21.8**	**22.4**	**22.7**	**15.0**	**15.7**

Markets and drivers

***GC:* Which countries lead the way in WHR use for cement production?**

TP: The biggest markets for WHR in cement production we see currently are in China and India. In both countries government legislation and cost competitiveness have driven our customers to install WHR systems in their plants.

***GC:* Where are the most exciting regions or countries for WHR right now?**

TP: We must take action now in Europe to meet our decarbonisation targets. Here, we see industry leaders in cement communicating their roadmaps to fully decarbonise cement production. In addition, energy prices in the region have been increasing substantially. This drives the interest of our customers to invest into WHR systems for new and existing assets.

***GC:* What can be done to help areas that are further behind?**

TP: Power and emissions pricing, as well as regulation, are major factors that can be used by governments in order to motivate the installation of environmentally friendly technologies such as WHR. While this is the situation in Europe, as mentioned above, the roll-out of WHR in the global cement sector is currently constricted by the lack of government initiatives and regulation. The main focus in the cement sector is in increasing production capacity, which leaves limited investment available for improving process efficiency. 'Green' cement is technically possible and needs to become economically attractive. China and India prove this is possible.

***GC:* What can be done to overcome these limitations?**

TP: Increasing social awareness of 'green cement' products amongst the general public would create additional value for the cement sector to implement environmentally-friendly technologies such as WHR.

***GC:* What are producers like Siemens Energy doing to help the adoption of WHR in high-intensity industries like cement?**

TP: We are ready, but we can't do this alone. As a solution and technology provider, we prefer to co-create the optimum solutions together with our customers. We are continuously investing in future-oriented technologies and portfolio elements to provide the highest value for our customers and the environment.

***GC:* Tobias Panse, thank you for your time today.**

TP: You are very welcome indeed!

A cement plant on the banks of the Yangtze River in China, one of the countries with the largest uptakes of WHR units in the world.