LOW NOx technology for thermal solar power plants

Aitor Jausoro
Technical Manager,
founding partner of E&M Combustión
ajausoro@emcombustion.es

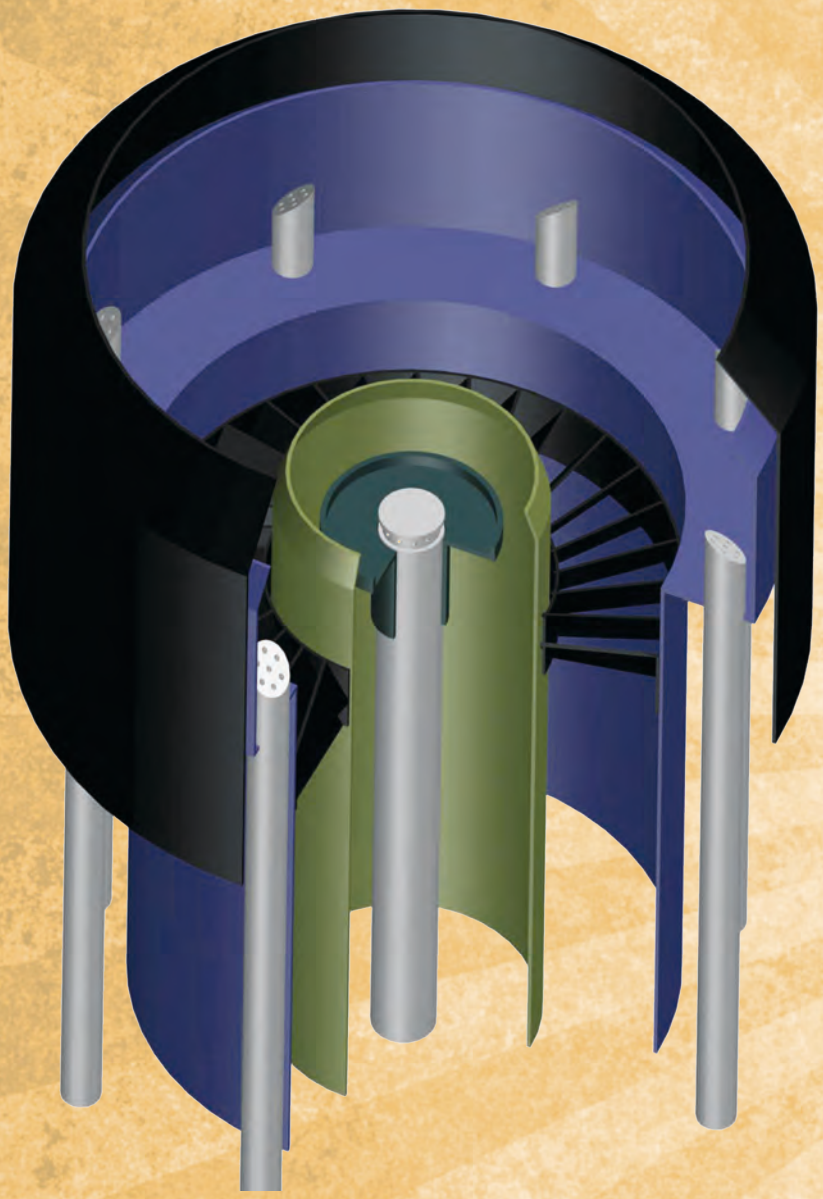
25-Mw thermal oil boilers at the Solacor I plant, Córdoba (Spain).

Since its early days, E&M Combustión has been committed to the development of burners with the lowest possible pollutant emissions, while at the same time also committing itself to participation in R&D projects, above all in the field of renewable energy sources as an alternative means of producing electricity.

> Spain is one of the pioneer countries in thermal solar power plant technology

Within this field of renewable energy, E&M Combustión has a significant presence in the thermal solar power plant sector, where Spain is one of the pioneer countries in this technology.

Hence, E&M Combustión has been involved both in the development of plants combining tower and heliostat field technology, such as the PS20 solar plant in Sanlúcar la Mayor (the second power plant in the world with this kind of technology) and in the development of plants with HTF technology.



Our new JBD-40.000 G burner design is in the equipment for the Solacor I and II, Helios I and II and Solaben III and IV plants

E&M Combustión's participation in the PS20 solar plant project has led it to develop a 50 MW burner to work with LNG and with NOx emissions of less than 100 mg/Nm3 and a wide modulation range of 1:25, which provides it with great accuracy in controlling the steam pressure in the facility.

At E&M, we are involved in power plants with tower and heliostat field technology and plants with HTF technology

On the other hand, the challenge facing E&M Combustión in developing thermal solar plants with HTF technology, consisted of designing LNG burners for 25 MW Sugimat vertical thermal oil boilers at a working temperature of 390ºC. Said burner had to work with combustion air at a temperature nearing 200ºC and have NOx emissions of less than 150 mg/Nm3 at 3% O2 and a modulation range of no less than 1:10.

E&M Combustión intended from the very beginning to simplify the installation works of said burner, as well as the safety of the people who worked in the boiler area. When working in combustion air at approx. 200º C and it being a burner located in an easily accessible area, it was thought that it was a hot spot that could cause burns to the staff in the area. To avoid this, there was one of two possible solutions: One, the traditional approach of insulating the burner by lagging it externally, once fitted in the boiler, or a more novel approach, which is to design the burner with 50mm internal insulation comprising calcium silicate fibreglass, all covered inside by a 1mm-thick stainless steel sheet. It was eventually decided to go for the second option because it offered several advantages in the financial aspect, facilities for accessing the inside of the burner for maintenance work, greater simplicity in assembly, faster installation, fewer staff having to handle the burner, amongst other qualities.

Another of the challenges which they faced was that of lowering the NOx emissions from 150

mg/Nm3 at 3% O2 working with combustion air at approximately 200ºC. To achieve this, the simplest but the most expensive solution was to resort to external recirculation of part of the combustion gases which implied installing additional pipelines for conducting said recirculation gases and regulation and control systems. E&M preferred to work on the variant of modifying the design of the combustion header in order to try achieve this because this made the installation a simpler process. Lastly, and after several tests, it was opted for introducing tertiary air into the combustion to thus perform combustion in three stages, reducing the NOx emissions to below 150 mg/Nm3. This tertiary air enabled the flame, moreover, to have a very long and compact shape, which is necessary in this type of vertical boiler in order to achieve uniform heat distribution throughout the chamber. The burners designed also achieve a great combustion performance when working at maximum points of 1-1.5% excess O2 with CO levels below 100 mg/Nm3.

This new design of JBD-40.000 G burners has been used for the equipment in the Solacor I and II, Helios I and II and Solaben III and IV solar power plants.

Left. Section in 3D. Triple register burner head of LOW NOx air for vertical boilers.
Top. Outside of the installation.
Right. Details of the inside of the installation.
Bottom. JBD 40.000 G details of the burner.