IMPROVED USE OF LIMESTONE RESERVES

Context

Our customer runs a Parallel Flow Regenerative Kiln (PFRK) of 300 tons per day fed with 40-80 mm limestone. In order to maximise the use of the limestone reserves of the quarry, the customer wanted to study the possibility to feed the kiln with various stone size distributions, either coarser of smaller stones. EESAC then proposed to study the influence of the kiln feed size on the kiln process.

Proposed solution

EESAC has developed a PFRK model based on a combination of four elements:

- A global heat and mass balance of the kiln.
- Heat and mass balances of each zone of the kiln (preheating zone, burning zone, cooling zone, connecting channel).
- A heat transfer model including conduction, convection and radiation transfers, for the preheating and the cooling zones of the kiln.
- A pressure drop model, based on a packed bed model, using the Ergun empirical equation.

This model has been validated by measurements, and successfully used to anticipate consequences of kiln process changes.

A baseline case was then established. The calculated temperatures of the preheating zone and the cooling zones were validated by a kiln temperature profile measurement.

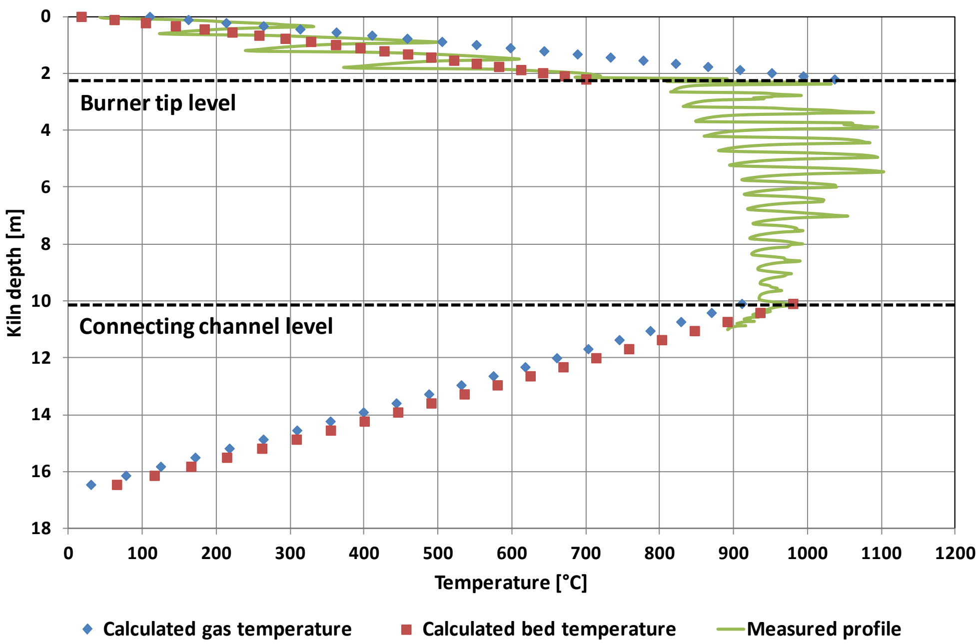

Figure 1 : Measured and calculated temperature profiles of the kiln

Results

Once the baseline case validated, the model was used to assess the influence of the kiln feed size on the kiln process parameters. Figure 2 displays the gas phase temperature profile in the preheating zone necessary to achieve the preheating of the stone bed.

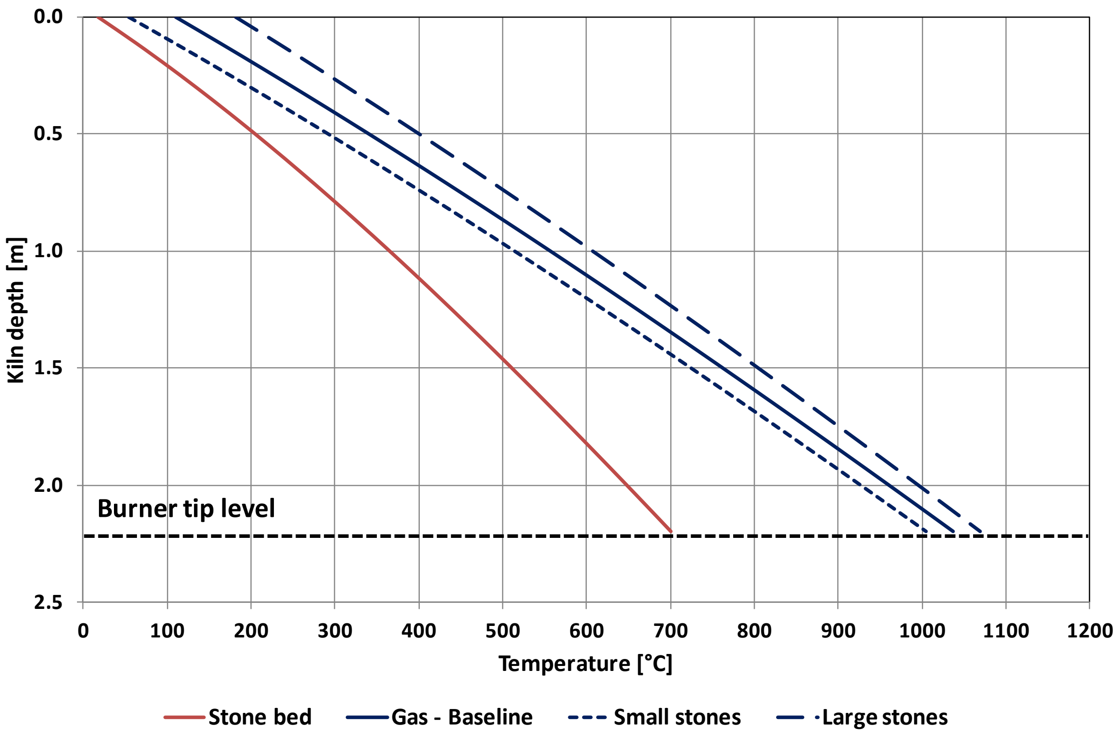

Figure 2: Influence of the stone size on the gas temperature profile in the preheating zone

As indicated in Figure 2, the use of small stones increases the heat exchange rate between the gas and the stone, resulting in lower flue gas temperatures.

Figure 3 displays the variation of the kiln pressure drop along the kiln for different stone sizes.

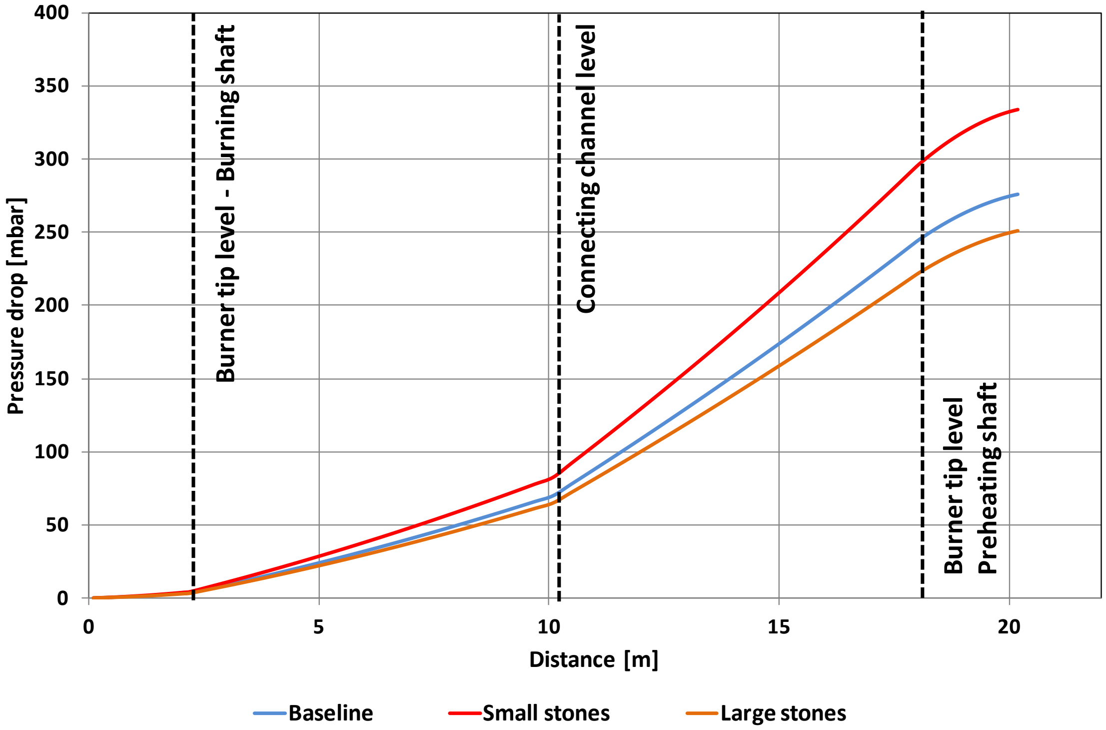

Figure 3: Influence of the stone size on the kiln pressure drop

As shown in Figure 3, the stone size has a significant influence on the pressure drop in the kiln.