

## SUMMARY

A study was undertaken to evaluate sintering as a potential cause of duct blockage for a submerged arc furnace applied in silicomanganese production. Within the broader aim of the study, four research questions were of principal interest. The research questions were as follows:

- Is there a potential for dust to sinter in the off-gas duct?
- If so, what mechanism of sintering is applicable, under the given conditions?
- Does the firing temperature have an effect on sinter formation and the compressive strength of the dust, given a fixed PSD?
- Does PSD have an effect on sinter formation and the compressive strength of the dust, given a fixed firing temperature?

In order to address the aforementioned research questions, several plant-based, laboratory-based, and desktop-based activities were undertaken. The activities were divided into five chronological stages as follows:

- Stage 1: Smelter based activities – entailed the collection of dust samples from the three streams in the baghouse and the measurement of the furnace duct temperatures. From this exercise, a total of 505 kg of dust across the three streams was collected. The duct temperature was found to vary between 600–1300°C.
- Stage 2: Laboratory dust samples preparations – entailed sample preparation, and PSD and chemical characterisation of each dust stream.
- Stage 3: Laboratory pellet-pressing and firing tests – entailed the pressing of pellets at a pressure of 5 MPa pressure, followed by oven drying, and then firing in a muffle furnace at 600–1300°C (the measured duct temperature) in an air atmosphere. For each temperature and dust stream, forty one pellets were fired.
- Stage 4: Fired dust examination: the fired pellets were examined for sintering using observations of their: physical appearance, compressive strength, bulk chemistry, bulk phase chemical composition.
- Stage 5: Chemical thermodynamic evaluation: thermodynamic calculations were performed using FactSage™, to determine the amount of liquid formed from bulk mixtures, as well phases that were observed to have sintered together.

Following the testwork, the following research outcomes were found:

- There was sound evidence of sintering in the off-gas duct of the smelter in question.
- Both solid- and liquid-state sintering were observed. The former was more localised–observed only in some areas in the sample–and most prominent at firing temperatures of 600–900°C. The latter was observed between 600–1100°C; it was prevalent at 1100°C–where long networks of sintered materials were observed.
- The firing temperature was found to have an effect on sinter formation and the compressive strength.
- The PSD was also found to have an effect on sinter formation and the compressive strength of the formed sinters.

