

TRACE ELEMENT EMISSION IN THE RACEWAY REGION

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Introduction

In the globally steelmaking industry, the blast furnace is the most heavily used method of reducing iron ore to iron. Blast furnaces are responsible for around two thirds of hot metal produced globally from iron ores. [2] [3] Within the blast furnace, trace impurities are introduced from the iron bearing materials, coke, and from the coal used in pulverized coal injection (PCI). High impurity levels can: increase hot metal impurity content, which affects the mechanical properties of the produced steel; and increase the slag volume, which will require an increase in the blast furnace fuel rate. [3] The aim of this work is to study the mechanisms of trace element release from PCI and investigate techniques to mitigate its affect on the blast furnace process.

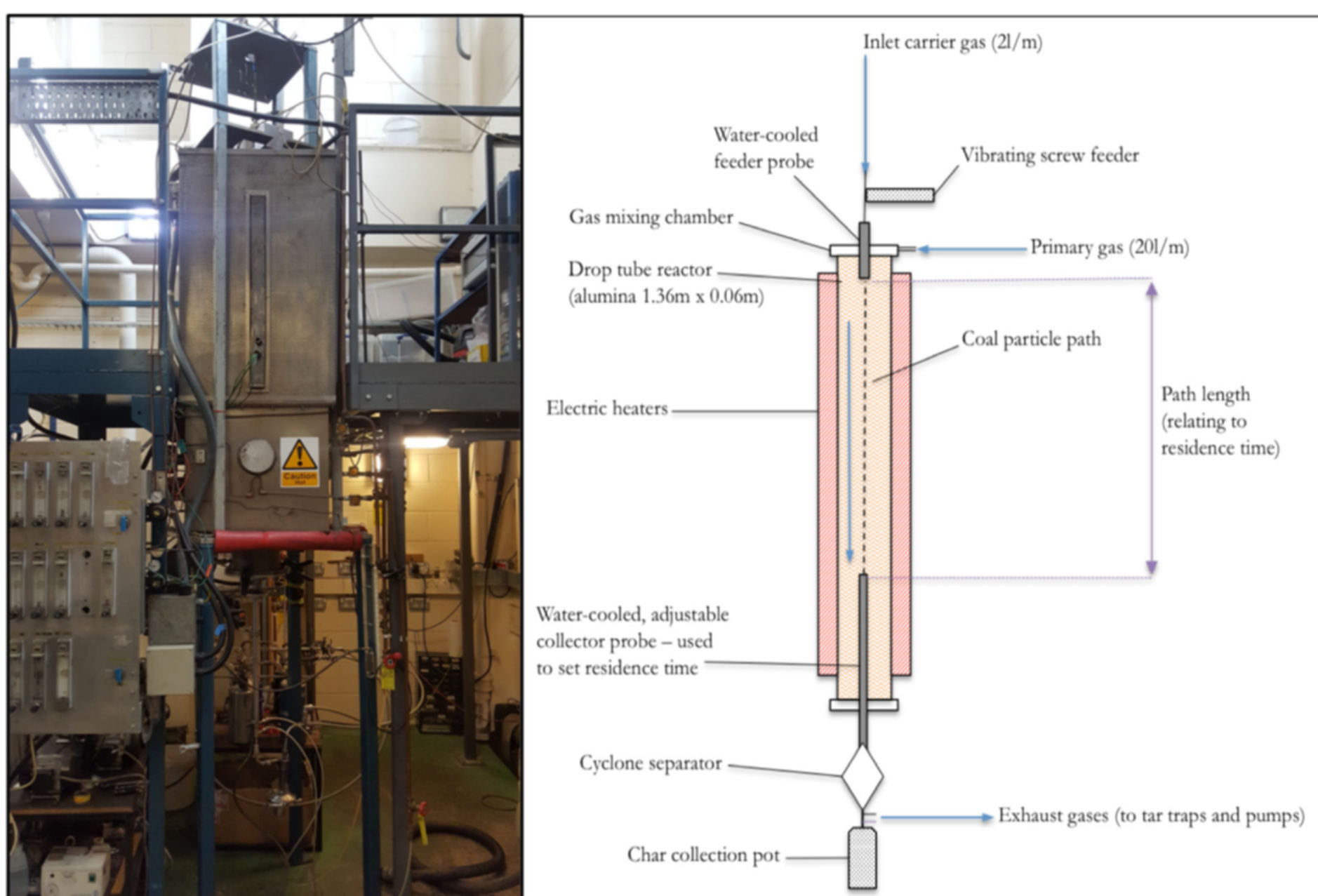


Figure 1: The drop tube furnace, picture and diagram. [4]

Conclusions

Initial testing has been conducted with a high volatile bituminous coal. The effect of an additive on the release of sulphur into a volatile state has been investigated.

- In an oxidising environment, the additive generally reduced the release of sulphur into a gaseous state.
- The additive decreased the burnout of the produced chars, the decrease wasn't proportional to the increase of additive doping.
- Further work will investigate the emission of sodium, potassium, and phosphorus impurities from the coal under raceway-like conditions.

References

- [1] A. M. Carpenter and N. M. Skorupska. *Coal Combustion - Analysis and Testing*. IEA Coal Research, London, 1993.
- [2] M. Geerdes, H. Toxopeus, and C. van der Viet. *Modern Blast Furnace Ironmaking an Introduction*. IOS Press BV, 2nd edition, 2009.
- [3] D. Osborne, editor. *The Coal Handbook Towards Cleaner Production Volume 2: Coal Utilisation*. Number 51 in Woodhead Publishing Series in Energy. Woodhead Publishing Limited, Cambridge, 2013.
- [4] D. C. Sexton, J. M. Steer, R. Marsh, and M. Greenslade. Investigating char agglomeration in blast furnace coal injection. *Fuel Processing Technology*, 178:24–34, Sept. 2018.

Experimental Procedure

A drop tube furnace (DTF) is used to mimic some of the conditions found in the blast furnace raceway region. The DTF can produce:

- high heating rates ($10^4 - 10^5 K/s$);
- high temperatures (up to $1500^\circ C$ in this instance);
- a dynamic, dilute particle phase;
- an atmosphere simulating combustion. [1]

A LECO SC144DR carbon and sulphur analyser was used to measure coal and char compositions.

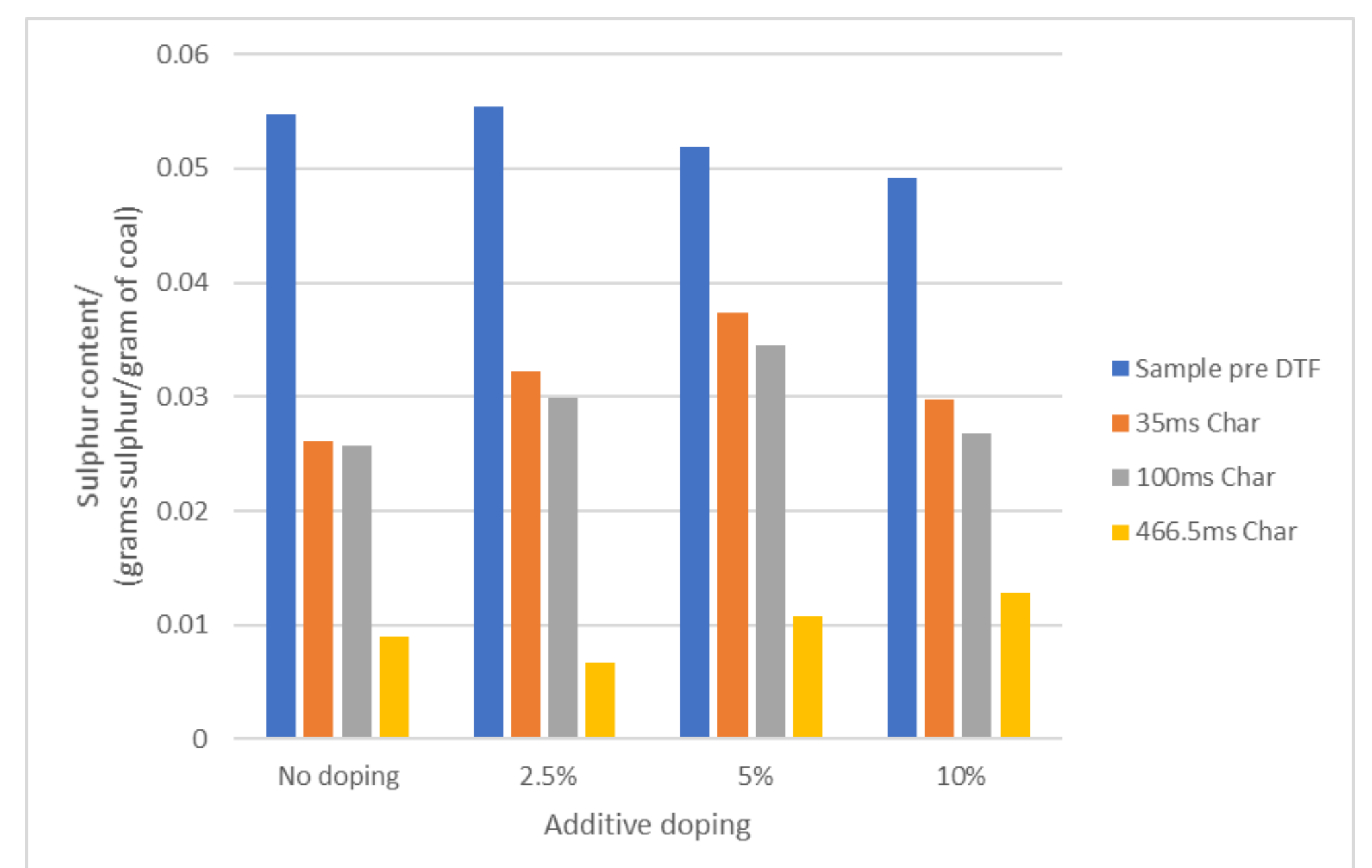


Figure 2: Sulphur retention of coal blends in the DTF.